CODE ANGIO: A LEAN MULTIDISCIPLINARY PROTOCOL TO DECREASE INTERVENTIONAL RADIOLOGIST RESPONSE TIMES FOR TRAUMA PATIENTS WITH ACUTE VASCULAR INJURY

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PURPOSE

- To review the need for CODE ANGIO - a lean multidisciplinary workflow to decrease Interventional Radiologist (IR) response times for patients with acute vascular injury
- To present an overview of the CODE ANGIO system at a Level 1 Trauma Center to improve access to IR for trauma patients with acute vascular injury

INTRODUCTION

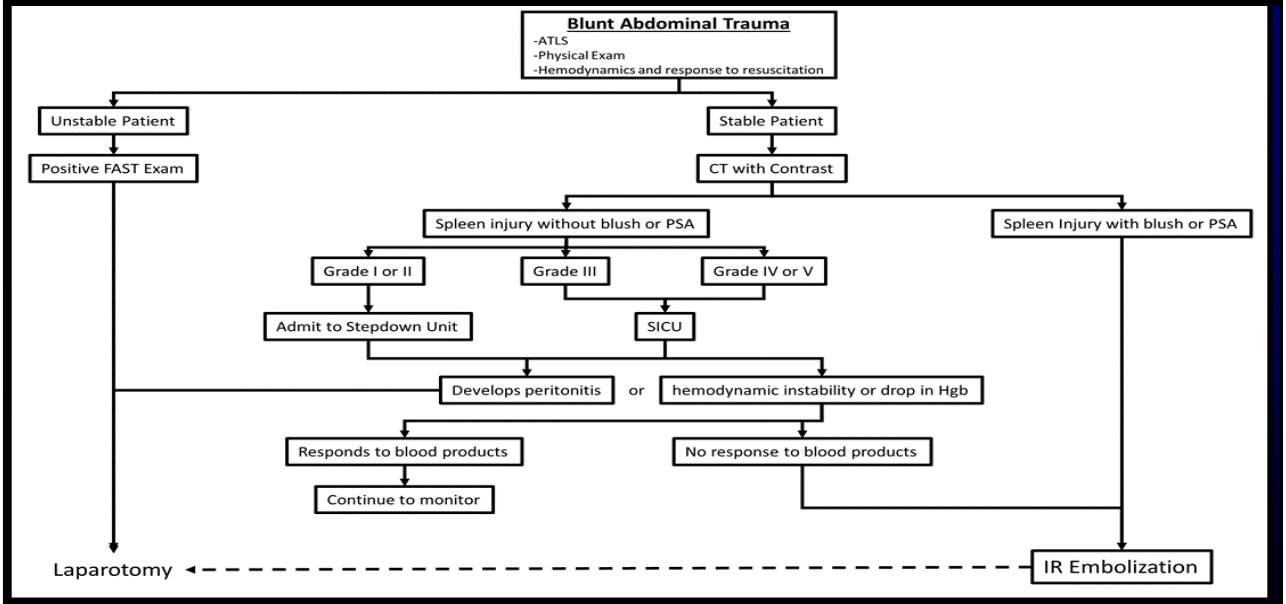
- Paradigm shift towards IR management of acute vascular injury in trauma
  - with decreasing need for blood transfusion and similar to better survival c/w surgery
- Need for qualified radiologists to be available within 30 minutes
  - *American College of Surgeons Clarification Document, under Resources for Optimal Care of the Injured Patient, Chapter 11 Collaborative Clinical Services,* quotes "In Level I and Level II trauma centers, qualified radiologists must be available within 30 minutes to perform complex imaging studies or interventional procedures (page 23) [1]
  - *Royal College of Radiology – Standards of Practice and Guidance for Trauma Radiology in severely injured patients (Standard 17)* assert that qualified IR should be available within 30 minutes after the need for an intervention is established [2]
- To achieve this 30 minute turnaround time (TAT), a multidisciplinary workflow (involving Trauma ED, IR & Anesthesia) called CODE ANGIO was created at our institution in 2014 to decrease IR response times for acute vascular injury.

1. *https://www.facs.org/~/media/files/quality%20programs/trauma/vrc%20resources/clarification_document.ashx*
2. *https://www.rcr.ac.uk/system/files/publication/field_publication_files/bfcr155_traumaradiol.pdf*

METHODS – COMPONENTS OF CODE ANGIO

- INDICATIONS FOR CODE ANGIO
  - Definite active extravasation on CT in hemodynamically stable stable patient; or hemodynamically unstable patient with suspect vascular injury where non-surgical management is deemed necessary (Refer to Table 1 for Institutional Protocol for Trauma)
- ACTIVATION OF CODE ANGIO
  - by Trauma Surgery, Emergency Radiology, or Interventional Radiology, following direct communication between these services, based on pre-established guidelines
  - Activation process: Simultaneous activation of multiple teams – IR (faculty/ fellow, IR technologist), OR (transport, technician, nurses), Anesthesia and Trauma surgery
- RESUSCITATION AND PROCEDURE
  - Hybrid OR/IR suite with Massive transfusion protocol and resuscitation as needed.
  - Patient prepped for IR access and if need be operative intervention (on stand by)
- IR ROLE:
  - Interventional Radiologist and Technologist coming in while patient being resuscitated
  - Aim to start IR procedure within 30 minutes of CODE ANGIO activation

METHODS - INSTITUTIONAL PROTOCOL FOR TRAUMA TRIAGE



Adapted from: Western Trauma Association: Management of Adult Blunt Splenic Trauma. J Trauma (2008) 65(5): 1007.
EAST Practice Management Guidelines: Blunt Injury to Liver and Spleen. (2003)

METHODS - CODE ANGIO MULTIDISCIPLINARY PROTOCOL

TRIGGERS - CT with extravasation; patient hemodynamic status

Trauma faculty decides emergent angio indicated

PROTOCOL BEFORE CODE ANGIO IMPLEMENTATION (BEFORE 2014)

- In-house radiologist pages IR faculty
- IR reviews case/calls ED
- Decision to proceed with IR
- Tech/RN/IR team paged
- Patient called when team reaches IR suite
- Patient prepped; start case

90-120 minutes

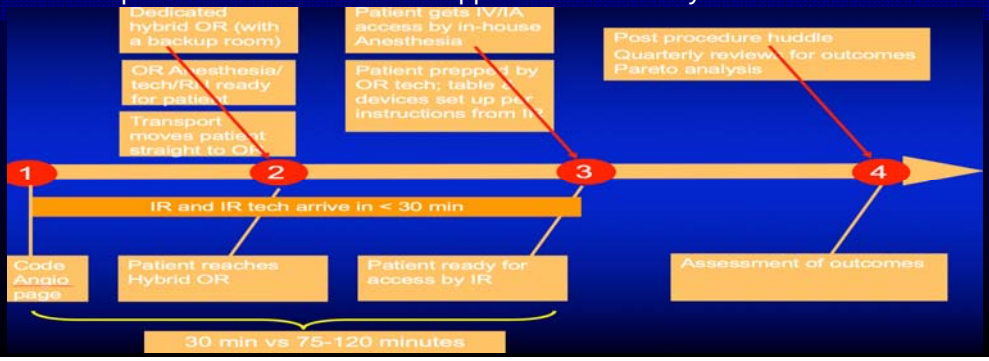
- Concurrent pages to IR/Tech/Anesthesia/ dedicated hybrid OR scrub techs/OR PCC – Code Angio
- Patient transfer to OR, resuscitated and prepped
- IR equipment, catheter/devices set up by OR tech
- IR team enroute – aim to access groin in < 30
- Patient prepped; start case

30 minutes

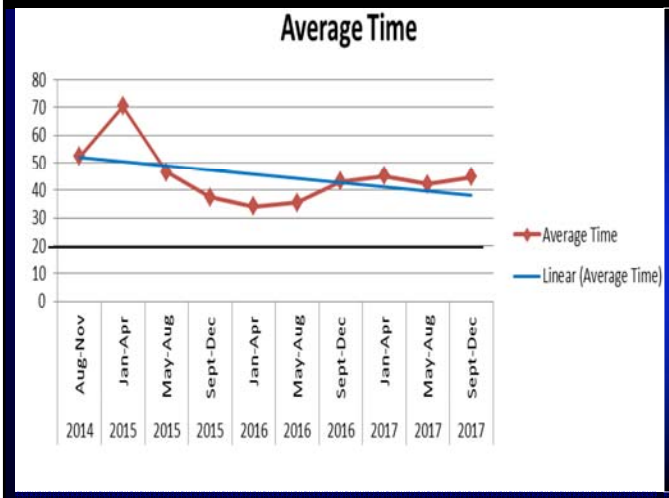
PROTOCOL AFTER CODE ANGIO IMPLEMENTATION

RESULTS - CODE ANGIO

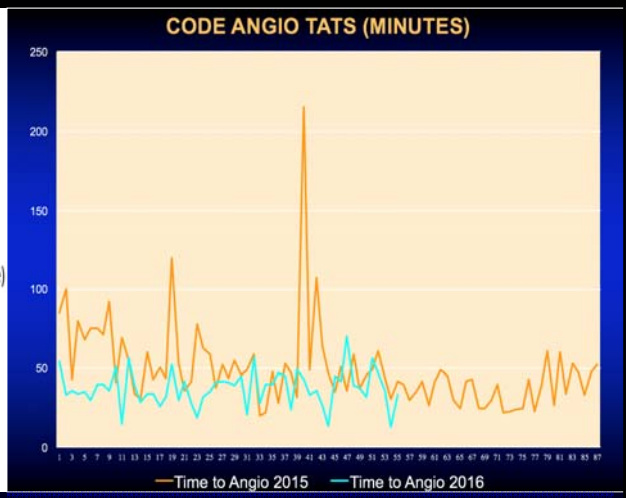
- Before 2014 the Trauma Response protocol's components occurred in series:
  - Trauma team directly called IR team members, discussing pros/cons of intervention
  - Transport of the patient to IR suite occurred only after the IR team arrived in-house
  - Several inefficiencies caused turnaround times (TAT) of 2 hours (or longer)
- Since 2014 the new CODE ANGIO protocol's components occur in parallel:
  - Simultaneous activation of Radiology ED team, IR team (faculty/fellow/tech), OR Anesthesia, OR tech support, OR/ED transport
  - All components of CODE ANGIO happen simultaneously rather than one after another



RESULTS - CODE ANGIO OUTCOMES



Decrease in mean IR TAT (time from Code Angio Initiation to IR procedure start) from 70+ minutes to 30-40 minutes in 2017… and in 2018 to 30 minutes



Decrease in variations in response time in 2015 (wide variations– 30 to 220 min) to 2016 (25 – 70 minutes) to now (25-35 minutes)

Monthly review of all cases to assure appropriate utilization and assess outcomes

RESULTS - CODE ANGIO OUTCOMES

TQIP REPORT FALL 2017: IX. Processes of Care: Hemorrhagic Shock with in the First 24 hours
Table 29: Hemorrhagic Shock Management

	PATIENTS	ANGIOGRAPHY		TIME TO ANGIOGRAPHY (HOURS)			MISSING TIME TO ANGIOGRAPHY	
Group	N	N	%	Median	25th Percentile	75th Percentile	N	N
All Hospitals	6,321	1,088	17.4	3.0	1.6	5.2	32	2.9
Your Hospital	38	7	18.4	**0.7**	**0.4**	**0.8**	0	0.0

Comparing outcomes for Fall 2017 (our institution vs American College of Surgery TQIP data) shows similar Angiographic Intervention rates, with significant difference between our times to angiopgraphy

Retrospective analysis of our splenic injury outcomes (2011-2014 and 2014-2017):

01/01/11-3/31/14 before CODE ANGIO (PRE); 04/01/14-12/31/17 post CODE ANGIO (POST).

- 924 patients with spleen injury (423 PRE and 501 POST)
- 159 patients had angiography (81 PRE and 78 POST):
  - 33 (41%) PRE and 37 (47%) POST had Grade IV/V splenic injuries
- Median time (activation to IR intervention decreased) - 118 min. PRE to 42 min. POST ($P<0.05$)
- Median systolic BP was lower in POST group (112 mmHg) compared to PRE (120 mmHg).

CONCLUSIONS

- CODE ANGIO is a resource intensive lean multidisciplinary response to acutely bleeding patients with trauma
  - Interventional Radiologists, Trauma teams and OR Anesthesia are the core elements in reducing response times to interventions and buy-in from all is needed
  - Aimed target TAT 30 of minutes is achievable
  - Continued success depends on regular outcomes analysis to include huddles and pareto analysis of outliers
- Further research needed to assess outcomes in specific categories:
  - Assess patient outcomes in specific trauma categories (solid organ vs pelvic trauma); assess need for decreased operative interventions/re-bleeds and hospitalization
  - Assess challenges/outcomes in other practices nationwide when this is implemented