Optimization of acquisition protocol in multiphasic computed tomography imaging of the liver with high-concentration contrast media

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Purpose

- Optimization of the acquisition protocols of HCC patients undergoing multiphasic CT of the liver by exploiting the intrinsic properties of iodine enhancement at low kVp.

- Compare Exposure indexes (CTDIvol) and abdominal organ dose of standard and optimised scans.

- Compare peak aortic attenuation at the origin of the coeliac trunk as a quantitative index of image quality of standard and optimised scans.

- Compare Likert score as a qualitative assessment of image quality of standard and optimised scans.

Materials and Methods

CT scanner: Brilliance ICT 256 slices Philips

Contrast Agent: Iomeprol 400mgI/ml (HCCM)

Patients

N= 59 HCC patients in follow-up with and without known focal liver lesion were prospectively randomised to be scanned either with the optimised (N=32) or the standard protocol (N=27) for a multiphase CT study of the liver.

Standard Protocol

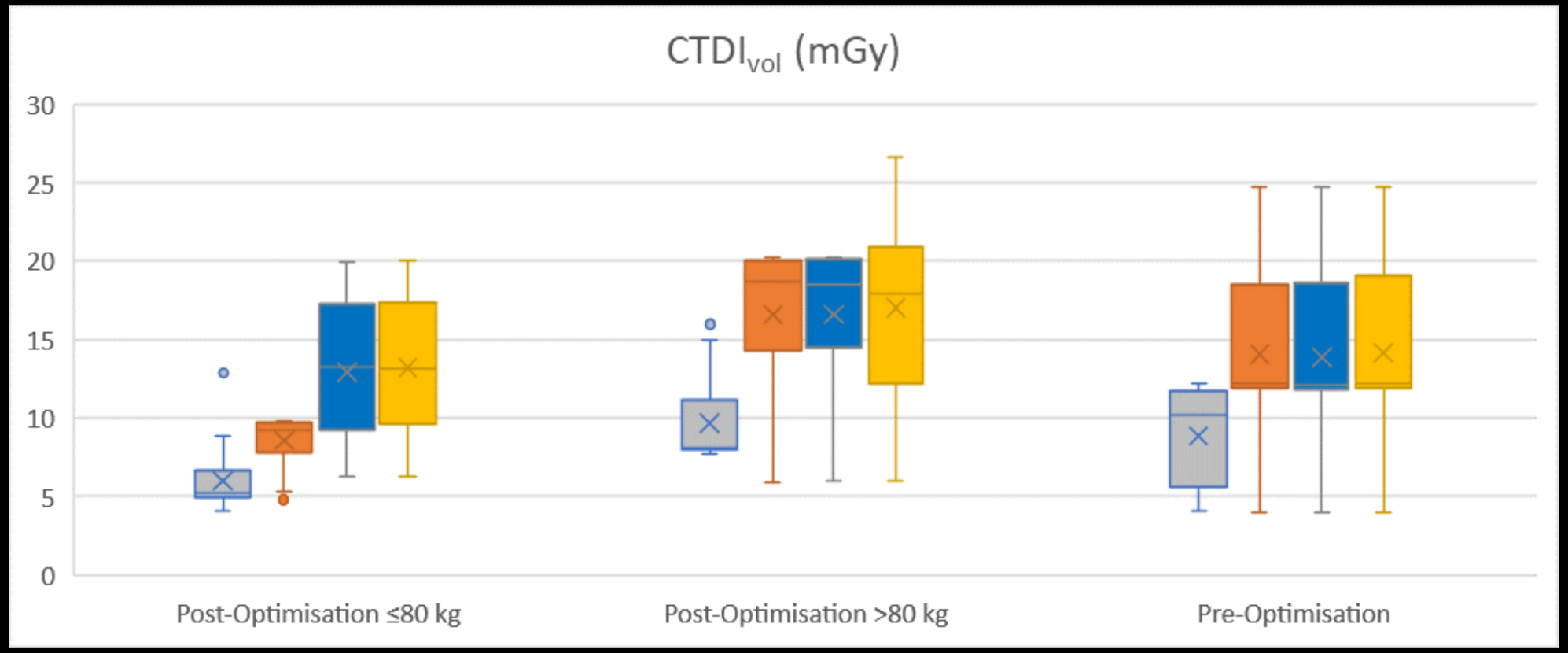
Automatic Tube current modulation (100-500 mAs)

- Dose Right Index = 21
- Tension= 100 kV
- Slice Thickness = 1.25 mm
- Reconstruction: Iterative iDose^4 (L6; 70%/30% blend of IR/FBP)

Optimised Protocols

Patients ≤ 80 kg (N=21; mean BMI=23.3)	Patients >80 kg (N=11; mean BMI=30.1)
Automatic Tube current modulation (100-500 mAs); Dose right Index = 21	Automatic Tube current modulation (100-500 mAs); Dose right Index = 21
1,3 ml/kg flow 3ml/s	**1,3 ml/kg flow 3ml/s**
Tension	**Tension**
• Unenhanced 100 kV; Sl.Thick= 5 mm	• Unenhanced 100 kV; Sl.Thick= 5 mm
• Hepatic Arterial 80 kV	• Hepatic Arterial 100 kV
• Portal Venous 100 kV	• Portal Venous 100 kV
• Equilibrium 100 kV	• Equilibrium 120 kV
• Reconstruction Iterative iDose^4 L6	• Reconstruction Iterative iDose^4 L6

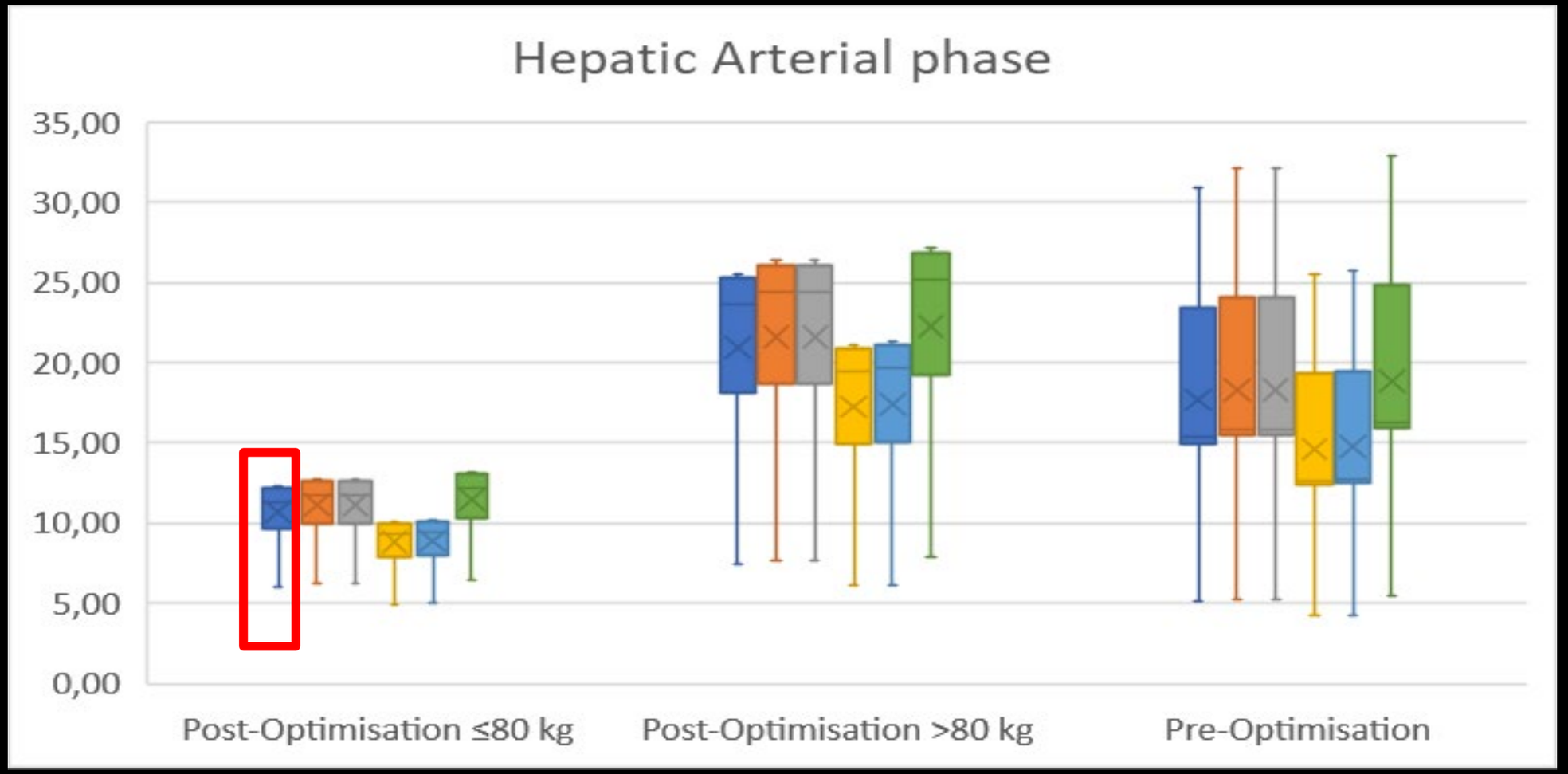
Results: $CTDI_{vol}$ (mGy)



$CTDI_{vol}$ reduction in arterial phase in normal weight pts : -37% P<0.0001

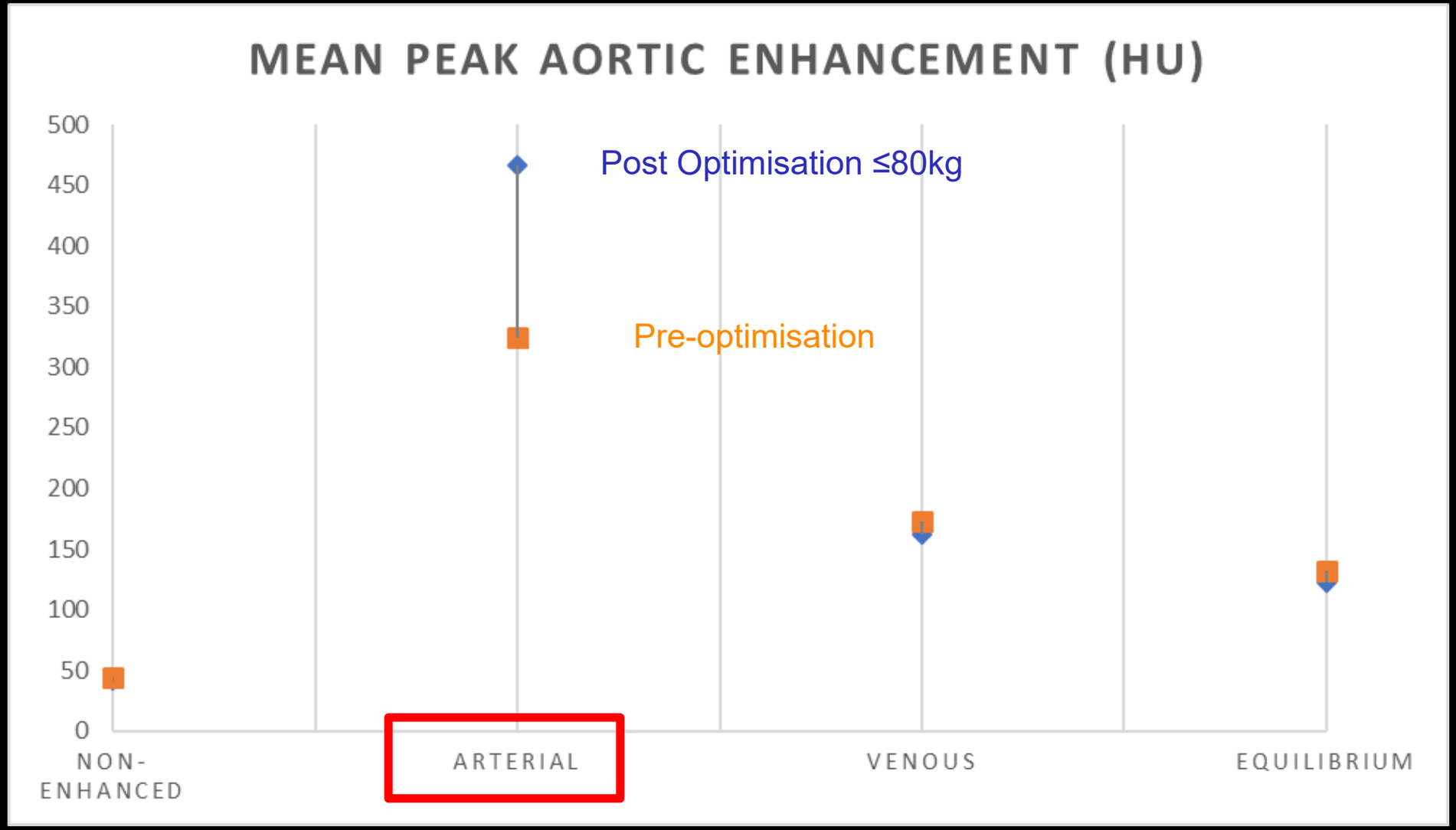
$CTDI_{vol}$ reduction in unenhaced phase in normal weight pts : -35% P<0.0001

Results: equivalent organ dose (mSv)



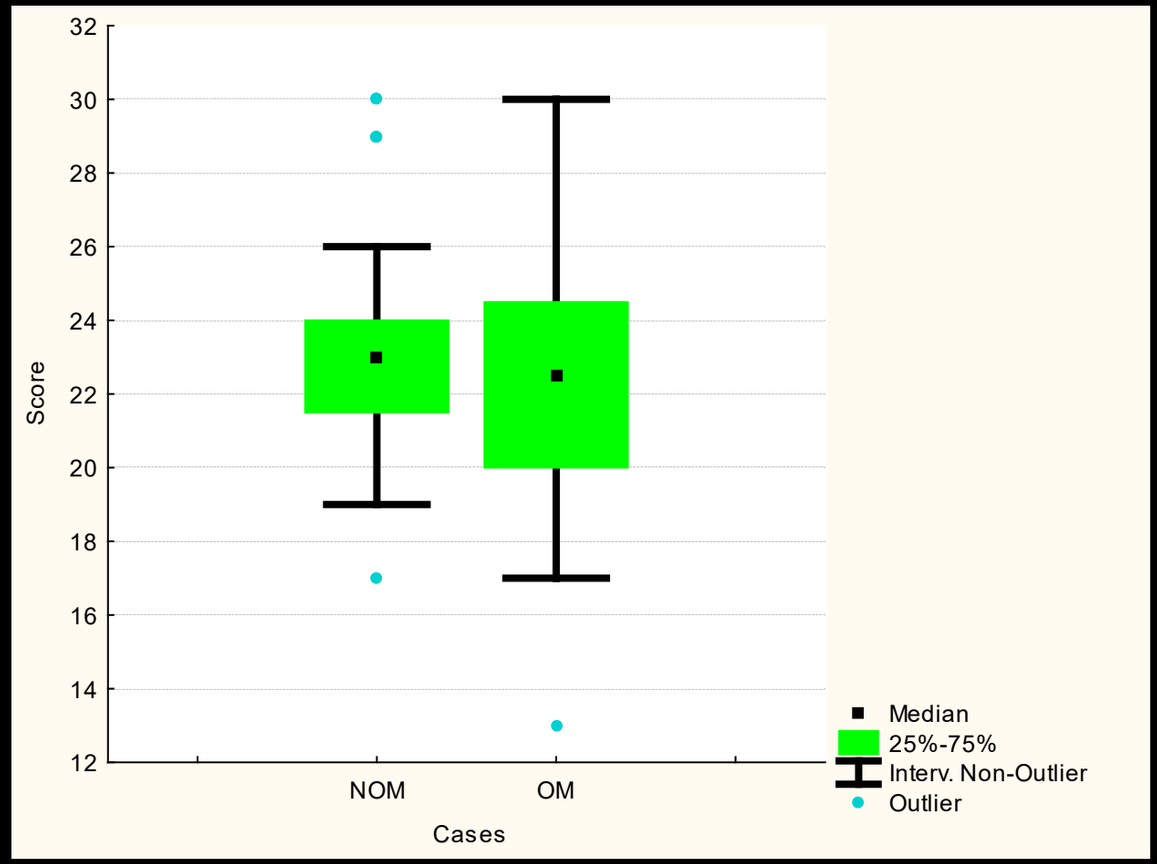
Liver dose reduction in arterial phase: -40% P<0,001

Results: peak aortic enhancement



Peak Aortic Attenuation: +44% P=0,003

Results: Image quality qualitative assessment
Likert score analysis



Pre-optimisation Post Optimisation

Likert score: 23.2±3.3 vs 22.1±3.9 p=0.20 Non significant

Conclusions

- Our optimised protocol with use of 80 kVp and high iodine concentration for arterial phase in normal weight patients resulted in a substantial improvement of aortic attenuation and radiation dose reduction in patients ≤80 kg.

- Image quality assessed through Likert scale evaluation did not show any significant difference between Optimized and standard protocol
- This is a pilot project for the dose team, which is gradually overhauling all CT protocols at our institution.

- A shift towards CT acquisitions which are increasingly tailored on the individual patient is necessary.