Minimizing patient-to-patient liver enhancement variability while personalizing iodine load delivery: a multicenter multivendor study

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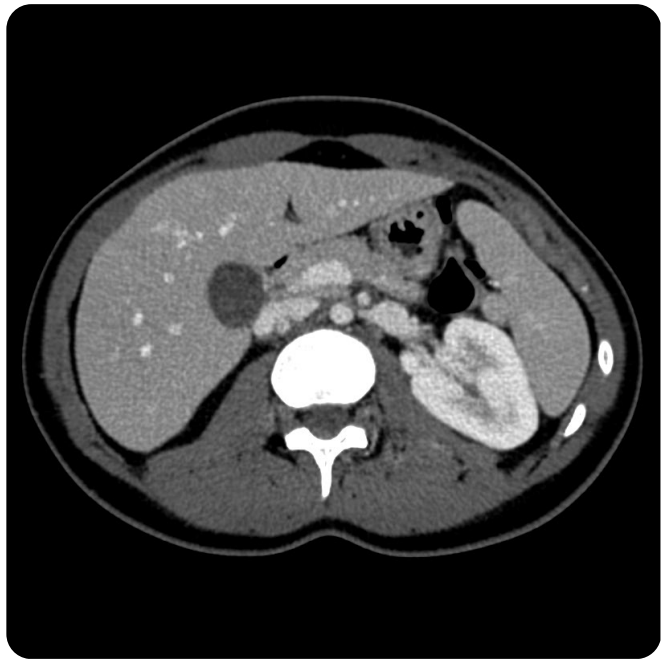


Introduction

- Contrast-enhanced MDCT is used for detection, characterization and follow-up of liver lesions
- Liver enhancement across patients is often highly variable (under- to over-enhancement)
- Patient-to-patient uniformity of liver enhancement is essential for lesion assessment and reporting accuracy in baseline and follow-up CT examinations

Purposes

- To reduce patient-to-patient liver parenchyma enhancement variability
- To reach a clinical Target enhancement, i.e. a diagnostically appropriate level of 50 HU for all patients

METHODS AND MATERIAL

668 patients

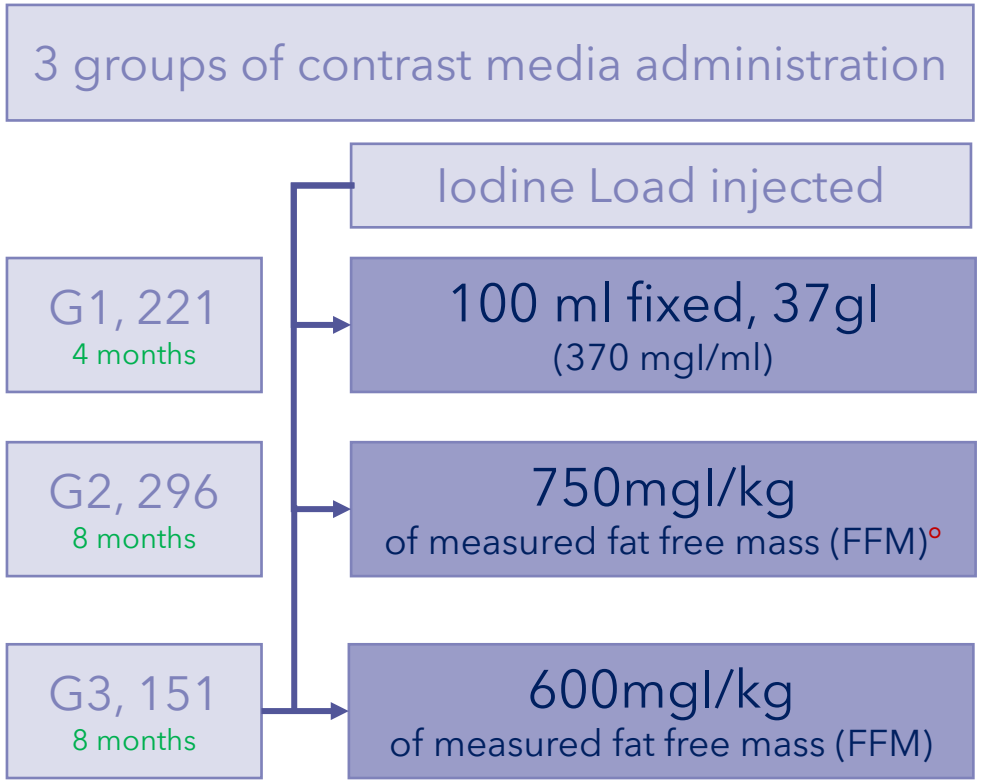
Clinical indication

Suspicion

Characterization

Follow-up

of liver lesion

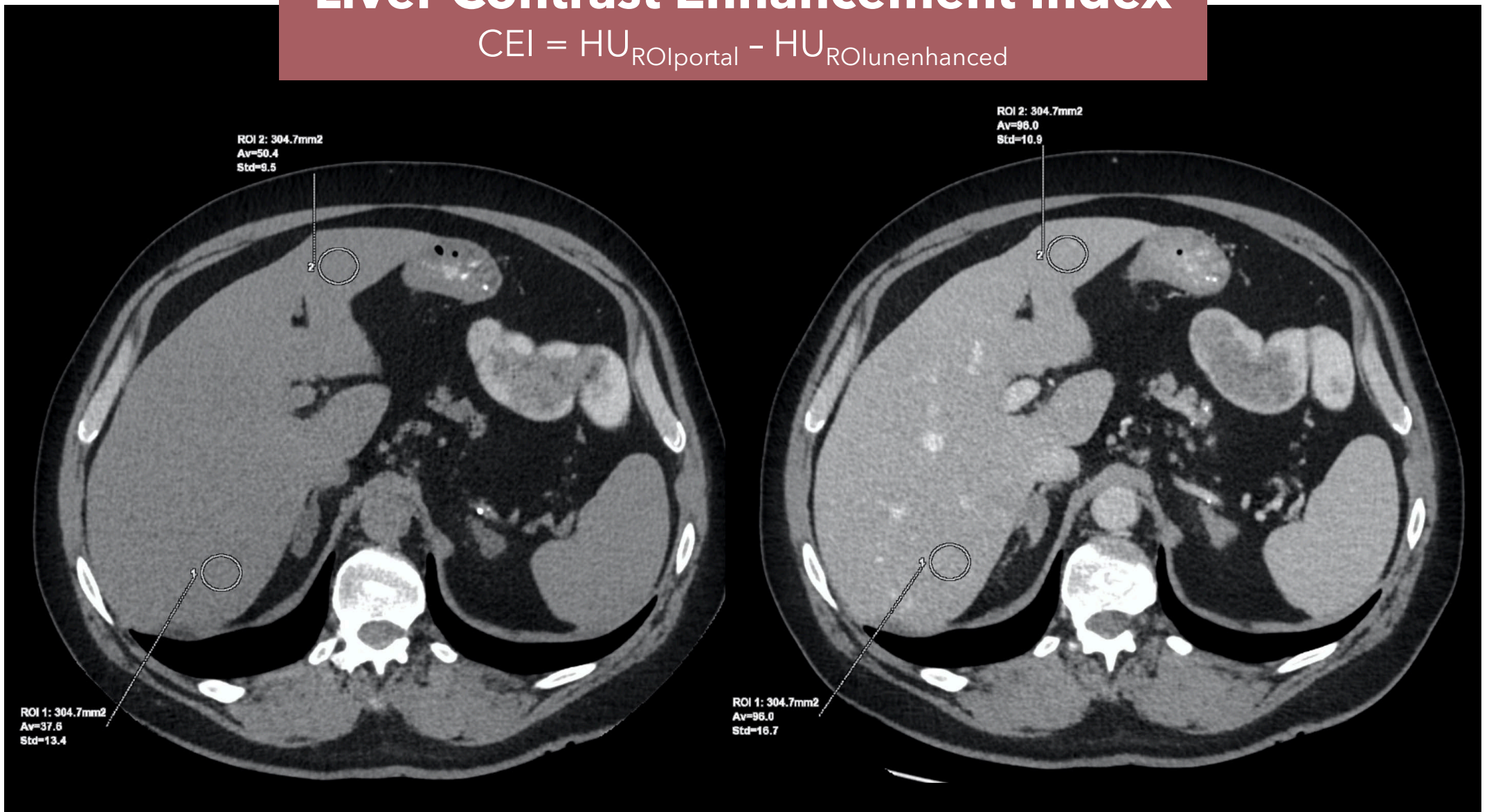


°The Optimal Body Size Index with Which to Determine Iodine Dose for Hepatic Dynamic CT: A Prospective Multicenter Study. Awai K et al. Radiology 2016 Mar;278(3):773-81. doi: 10.1148/radiol.2015142941. Epub 2015 Sep 10.

METHODS AND MATERIAL

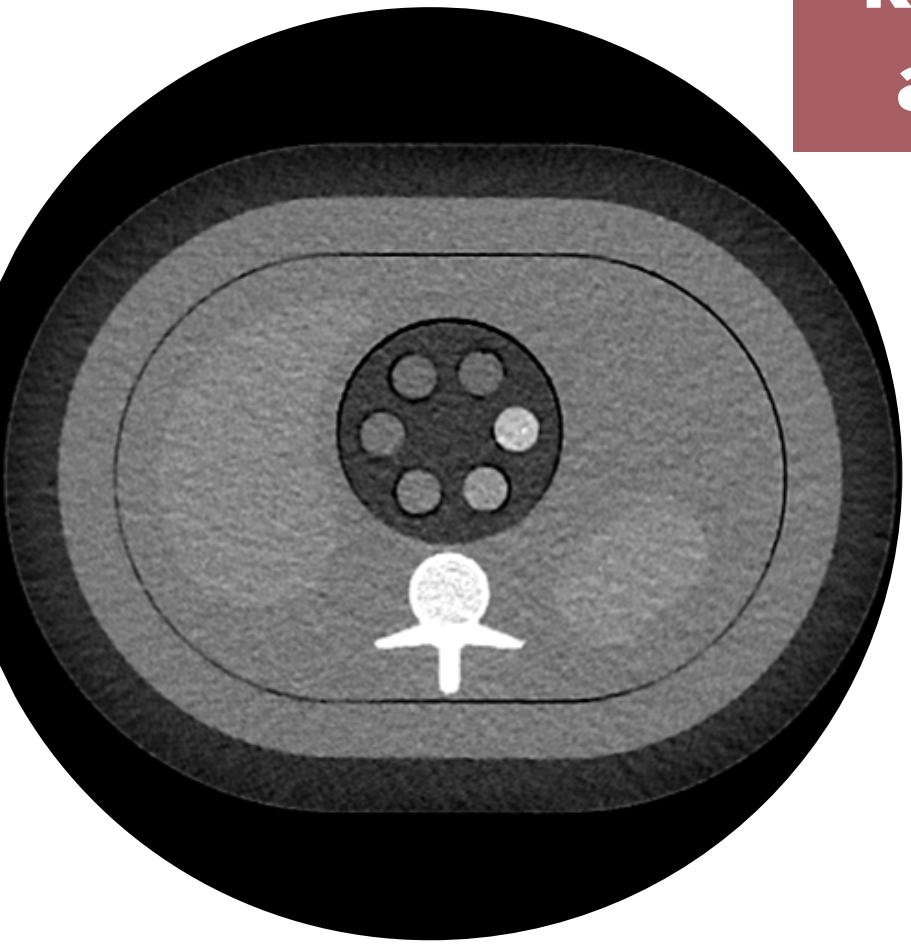
Liver Contrast Enhancement Index

$$CEI = HU_{ROIportal} - HU_{ROIunenhanced}$$



METHODS AND MATERIAL

kV scaling factors measurements using an anthropomorphic phantom (QRM)



QRM abdomen phantom

(Medium and Large)

5 contrast syringes

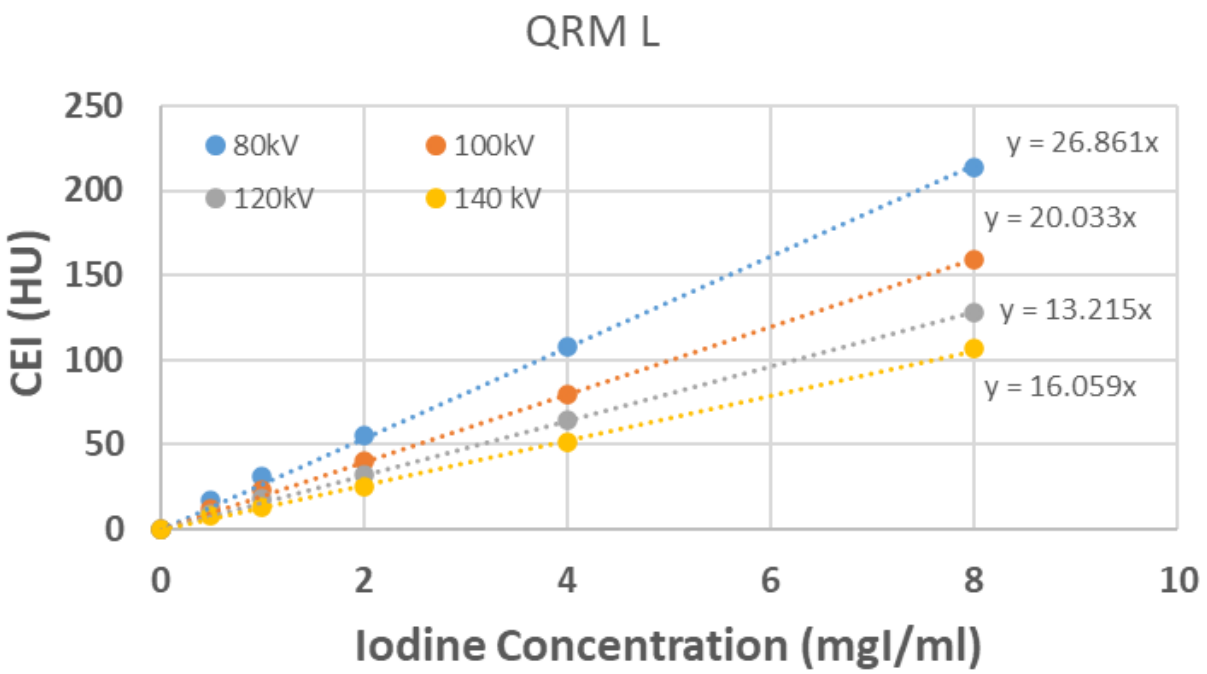
[0.5, 1, 2, 4, 8] mg/ml I_2

1 NaCl syringe

CEI at 80,100, 120, 140kVp

RESULTS

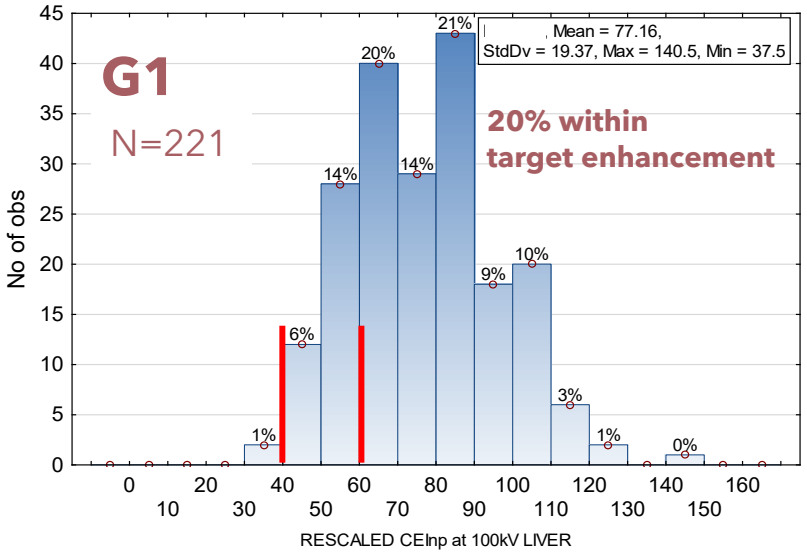
kVp scaling factors

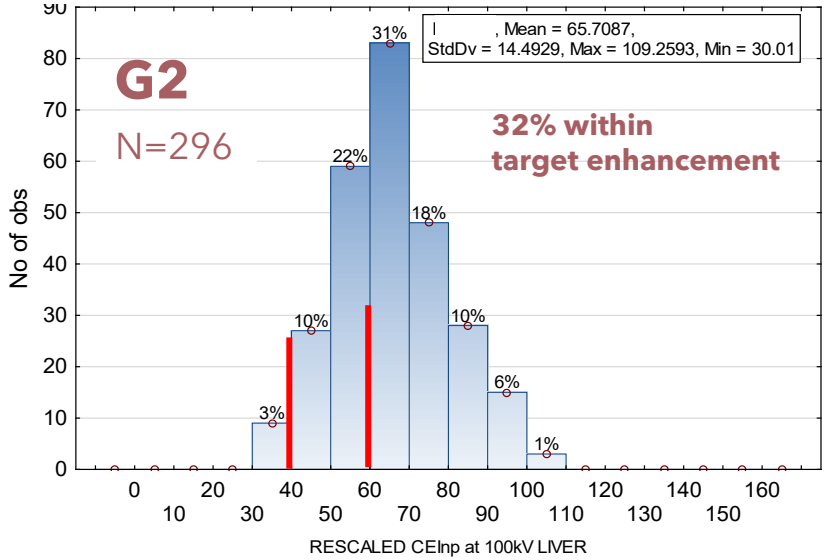


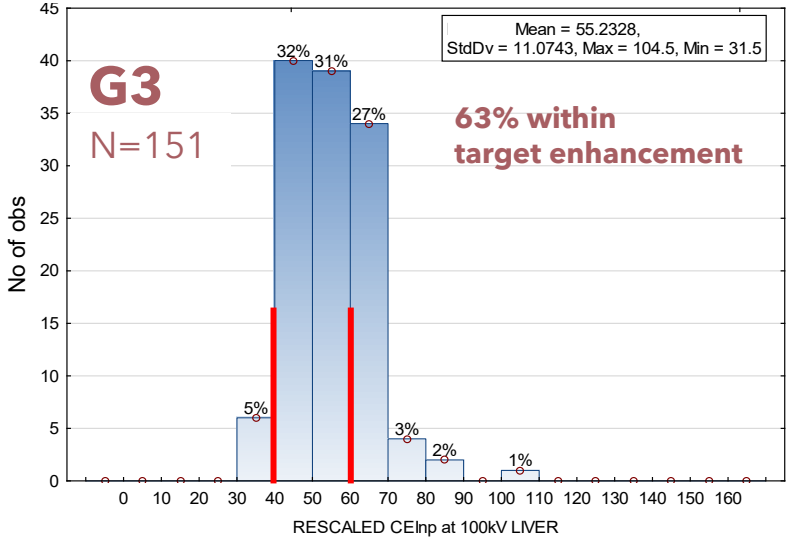
Tube potential (kVp)	Scaling factor	
	Mean	SD
80	0.737	0.030
100	**1.000**	0.000
120	1.267	0.018
140	1.535	0.016

RESULTS

CEI histograms and SD







Target enhancement was reached in 63% of G3 (G1:20%; G2:32%)
SD was reduced to 11.1% in G3 (19.4%; 14.5%)

WORKFLOW DIAGRAM

10 sites – multivendor CT

Standardized protocols → 80 - 140kV → 5ml/s injection rate → 80 sec portal phase delay → 350, 370 , 400mgI/ml

Dose management Software (Dosewatch™)

impedancemetre (BIA-ACC, Biotekna)

2 senior radiologists

Medical Physics Expert

3 groups of contrast media administration

G1, 221 4 months	Iodine Load injected	100 ml fixed, 37 gI (370 mgI/ml)
G2, 296 8 months		750mgI/kg of measured fat free mass (FFM)
G3, 151 8 months		600/kg of measured fat free mass (FFM)

Liver Contrast enhancement CEI measured

kV scaling factors measurements using an anthropomorphic phantom (QRM)

Comparison among 3 groups (one-way ANOVA or Kruskall-Wallis) for:

- **Mean iodine dose (gI)**
- Median CEI@100kV
- Variance of the CEI distributions and comparison to a target CEI of 50 HU

CONCLUSION

- We improved patient-to-patient liver parenchyma enhancement uniformity with a three-steps strategy to optimize and personalize our contrast media injection protocol according to kV, patient habitus and Iodine concentration
- We reached the target enhancement for 63% of the patients