

Presenter: Ajit Goenka, MD

Title of Multi-reader detectability and contrast-to-noise (CNR) ratio of low contrast, low attenuation

Abstract: (LCLA) liver lesions using an integrated circuit CT detector: Effect of radiation dose, subject size and reconstruction method

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Modality: CT

Organ System: GI

Intro: N/A

Purpose: To assess changes in contrast-to-noise (CNR) ratio and low-contrast, low-attenuation (LCLA) liver lesion detection with reduced dose and with iterative reconstruction (SAFIRE) when using a detector with integrated photodiode and ADC components (Stellar).

Methods Used: A semi-anthropomorphic phantom containing liver inserts with 4 unique spherical lesions (15mm at 18HU; 10mm at 12 and 18HU; and 5mm at 24HU below 90HU simulated liver) without and with a 5-cm thick fat ring (30-cm and 40-cm diameters) was scanned on two 128-slice MDCT scanners (Somatom Definition AS+); one without and one with Stellar detector; at 120kVp, 0.6-mm collimation and 200 (CTDIvol 13.5 mGy), 150, 100, 50 and 25 mAs [30-cm phantom] or 400 (CTDIvol 26.9 mGy), 300, 200, 100, 50 mAs [40-cm phantom]. 3-mm images were reconstructed with FBP and with SAFIRE on Stellar scanner. Lesion CNR was calculated on each scanned series using MATLAB (MathWorks) and values for all lesions were averaged at each mAs level. Four radiologists blinded to study design independently reported lesion presence/absence on a 5-point confidence scale on randomized datasets (600 images/reader). Cumulative logit models were constructed to assess effect of variables on reader confidence. ROC area was considered accuracy.

Results of Stellar-SAFIRE combination significantly increased CNR (27.7-51.7%). Stellar alone resulted in modest

Abstract: increments in CNR (2.3-19.8%) with the effect being more pronounced at lower doses and for larger phantom size. Accuracy trended higher with Stellar-FBP and with Stellar-SAFIRE till 50% dose reduction (200mAs) for 40-cm phantom and 25% dose reduction (50mAs) for 30-cm phantom. Confidence for lesion detection was significantly affected by dose, phantom size (both $p < 0.001$), and by Stellar-SAFIRE combination ($p = 0.029$) but not by Stellar or SAFIRE alone.

Discussion: Stellar detector with SAFIRE improved CNR and confidence in lesion detection independent of phantom size and dose; the increase in CNR was greater at lower doses.

Scientific and/or Clinical Significance? Estimates loss of LCLA liver lesion detectability at reduced doses and assesses any incremental advantages of using iterative reconstruction (IR) and integrated circuit-detector hardware, in order to enable clinical dose optimization. Clinical benefits of IR- and integrated circuit-detector-mediated electronic noise-reduction may be limited at ultra-low doses.

Relationship to existing work Lowest CT dose needed to accurately detect LCLA liver lesions is currently not known; IR has been shown to improve or maintain diagnostic accuracy on low-dose images for some tasks but not for LCLA liver lesions