Noise Texture Deviation: A Measure for Quantifying Artifacts in Computed Tomography Images With Iterative Reconstructions

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OBJECTIVES
The aims of this study were to introduce the measure noise texture deviation as quantitative parameter for evaluating iterative reconstruction (IR)-specific artifacts in computed tomography (CT) images and to test whether IR-specific artifacts, quantified through this measure, are reduced in advanced modeled IR (ADMIRE) as compared with sinogram-affirmed IR (SAFIRE) images of the liver ex vivo and in patients with hypodense liver lesions.

MATERIALS AND METHODS
In the ex vivo study part, an abdominal phantom was used. In the institutional review board-approved in vivo study part, 40 consecutive patients (mean age, 63 years) with hypodense liver lesions undergoing abdominal CT in the portal-venous phase were included. Images were reconstructed with filtered back projection, with the second-generation IR algorithm SAFIRE and with the third-generation IR algorithm ADMIRE. Noise power spectra and noise texture deviation were calculated in the phantom; image noise was measured in the phantom and in patients. Two blinded readers evaluated all image data regarding IR-specific artifacts (plastic-like, blotchy appearance); patient data were evaluated regarding conspicuity and confidence for detecting hypodense liver lesions.

RESULTS
Image noise was significantly reduced at increasing IR levels (P < 0.001) with both algorithms, with no significant differences between corresponding strength levels of SAFIRE and ADMIRE (all, P > 0.05). Noise power spectra were similar at corresponding strength levels of SAFIRE and ADMIRE (all, P > 0.05). Noise texture deviation in ADMIRE was reduced compared with corresponding strength levels of SAFIRE (all, P < 0.001) and strongly correlated with subjective IR-specific artifacts (r = 0.88, P < 0.001). Iterative reconstruction-specific artifacts were significantly reduced in ADMIRE compared with that in SAFIRE images at strength levels 3 or greater, both ex vivo and in vivo (all, P < 0.001). There were no significant differences in the readers' ratings of lesion conspicuity and lesion confidence in detecting hypodense liver
lesions between SAFIRE and ADMIRE (P > 0.05). Only lesion conspicuity was superior with SAFIRE and ADMIRE compared with filtered back projection (all, P < 0.001).

CONCLUSIONS
Noise texture deviation is a quantitative measure reflecting IR-specific artifacts and is reduced in CT images with ADMIRE compared with SAFIRE.