Role of image-based iterative reconstruction technique for low radiation dose chest CT

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Summary
A 50-year-old male, weighing 80 kg (body mass index: 22 kg/m²), underwent a follow-up chest computed tomography (CT) exam for further evaluation of indeterminate focal ground-glass opacity in the right lower lobe. The patient had symptoms of shortness of breath, fatigue, chest pain, and pressure with exertion, which were unrelated to coronary artery disease. In addition, the patient had a history of progressive muscular weakness and difficulty in walking, for which a skeletal muscle biopsy was performed and revealed chronic neuropathic myopathy. The patient was suspected of having paraneoplastic syndrome, for which he underwent the initial chest and abdominal CT.

Imaging Findings
At the time of follow-up chest CT, written informed consent was obtained from the patient for acquiring a low-dose CT image series in addition to the standard-of-care chest CT. Standard-of-care chest CT was acquired on a 64-section multidetector-row CT scanner (Discovery 750HD, GE Healthcare).

FIGURE 1. A follow-up chest CT examination was performed at the standard 400 mA (A and C) and with a low dose of 80 mA (B and D). The low-dose images were processed with an image-based iterative reconstruction technique. The lung window shows ground-glass opacity in the right lower lobe in transverse chest-CT images at both dose levels as well as the pericardium in the mediastinal window settings.
care) at 400 mA. Immediately after the standard, we acquired low-dose CT images over a 10-cm scan length in the mid chest and reduced tube current of 80 mA. Other scan parameters were held identical to the standard-of-care CT at 120 kV, pitch of 0.984:1, table speed 40 mm per rotation, 64*0.625-mm detector configuration, and a 0.5-second gantry rotation time. All standard-of-care and research images were reconstructed at a 2.5-mm section thickness and a 2.5-mm section increment applying a detail reconstruction algorithm using conventional filtered back projection technique. The volume CT dose index (CTDIvol) for the standard-of-care and research low-dose CT series was 15 mGy and 3.4 mGy, respectively, resulting in a 75% radiation dose reduction. The research images were then processed with SafeCT algorithm (MedicVision Inc., Israel) in order to improve the image quality.

SafeCT processed low-dose CT images (Figure 1) at 75% lower radiation dose, which were then compared with the standard-of-care CT images. Both the processed low dose and unprocessed standard-of-care CT images demonstrated patchy ground-glass opacity in the superior segment of the right lower lobe. No significant mediastinal or hilar lymphadenopathy was noted on either set of images. Diagnostic confidence and image quality on both sets of images were identical. A subsequent follow-up chest CT showed interval resolution of the ground-glass opacity in the right lower lobe.

**Diagnosis**

Pneumonia or aspiration.

Given resolution of the focal opacity in the right lower lobe, the finding likely represented a small focus of pneumonia or aspiration.

**Discussion**

Several studies have evaluated strategies to reduce radiation dose from CT with the reduction of tube potential and tube current, and with improvements in image quality of low-radiation dose images with image noise reduction filters and iterative reconstruction techniques. Iterative reconstruction algorithms reduce image noise while maintaining or improving other image attributes (such as sharpness and contrast) in the low-dose CT images. The Food and Drug Administration (FDA) approved the 3-dimensional (3D) image-based iterative reconstruction algorithm, SafeCT (MedicVision, Israel), used in our study segments’ CT images represented as 3D patches to estimate the noise statistics and signal. Then, images are processed in an iterative loop to reach an acceptable quality. Since this process takes place entirely in a DICOM image domain, it can process images from any CT vendor and takes a few seconds to process a routine CT examination. Generally, the SafeCT image processing server lies between the CT scanner and the PACS so that images are processed with SafeCT when they arrive at the interpretation workstations in an automatic manner.

The example presented in this article demonstrates the significant potential of image-based iterative reconstruction techniques, such as SafeCT, for dose reduction while retaining the image quality and diagnostic information.

**Conclusion**

Radiation dose reduction for chest CT is important and feasible with the use of iterative reconstruction techniques, which help improve image quality in low-dose CT images.

**References**

10. Pourjabbar S, Singh S, Singh AK, et al. Prospective clinical study to assess image based iterative reconstruction for abdominal CT acquired at two radiation dose levels. [Accepted J Comput Assist Tomogr on June 3rd 2013.]