For decades, dual-energy imaging has been used for tissue differentiation with several x-ray–based imaging modalities, exploiting the fact that the tissues in the human body show different absorption characteristics when penetrated with different x-ray spectra, spectra that are typically generated by different kV settings of the x-ray tube. Recently, dual-source computed tomography (CT) with 2 x-ray tubes and 2 detector arrays mounted in the same gantry has become available.1 After experience with earlier experimental prototypes, this dual-source CT for the first time enables the clinical acquisition of dual-energy CT studies simultaneously with a single scan.

We used a dual-source CT scanner (Definition, Siemens, Forchheim, Germany) in dual-energy mode for performing coronary CT angiography in a 74-year–old woman with suspected coronary artery disease and prior abnormal nuclear rest/stress single-photon emission CT (SPECT). The CT scan was acquired with retrospective ECG-gating and the following scan parameters: 330-ms gantry rotation, pitch 0.2, and 32×2×0.6-mm collimation. One tube of the dual-source system was operated with 150 mAs/rot at 140 kV and the second tube with 165 mAs/rot at 80 kV. The scan was contrast medium-enhanced (70-mL Ultravist, 370-mg iodine/mL; Bayer, Wayne, NJ), using our routine clinical protocol.

From the dual-energy scan, 3 different image reconstructions with 0.75-mm section width and 0.4-mm increment were performed using the routine dual-energy CT reconstruction algorithm implemented on the scanner platform. The first set of transverse gray-scale images was aimed at optimizing spatial and contrast resolution by merging 70% of the 140-kV spectrum and 30% of the 80-kV spectrum, which was used for 3-dimensional volume rendering (Figure 1A) and morphological diagnosis based on automatically generated curved multiplanar reformations (Figure 1B and 1C) of the coronary artery tree. Another set was based only on the 80-kV x-ray spectrum (Figure 2A and 2D) and yet another only on the 140-kV x-ray spectrum (Figure 2B and 2E). The myocardial blood pool was analyzed by determining the iodine content within the myocardium on the basis of the unique x-ray absorption characteristics of this element at different kV levels. The resulting color-coded “iodine map” representing the myocardial blood pool was then superimposed onto gray-scale multiplanar reformats of the myocardium in short-
axis (Figure 2C) and long-axis (Figure 2F) views, from which the iodine content in the voxels had been digitally subtracted to generate a virtually nonenhanced scan.2

Analysis of coronary CT angiographic images revealed diffuse atherosclerotic disease with subtotal ostial stenosis (Figure 1B and 1C) of the first diagonal branch, caused by extensive calcified and noncalcified plaque. These findings were subsequently confirmed at coronary catheterization (Figure 1F). The dual-energy iodine maps (Figure 2C and 2F) showed a myocardial blood pool deficit in the first diagonal branch territory within the anterolateral wall of the left ventricle. Findings at dual-energy CT blood pool imaging correlated well with the results at prior rest/stress SPECT thallium myocardial perfusion imaging (Figure 3), which showed ischemia in the same myocardial territory.

In this patient, dual-energy CT imaging enabled comprehensive assessment of coronary artery anatomy and myocardial ischemia with a single contrast-enhanced CT scan in good correlation with coronary catheterization and myocardial perfusion imaging. This approach may be an interesting topic for further research to investigate the general validity of this technique.

Disclosures

Dr Flohr is an employee of Siemens. Dr Costello is a medical consultant to Bracco and receives research support from Siemens. Dr Schoepf is a medical consultant to Bayer, Bracco, General Electric, Medrad, Siemens, and TeraRecon and receives research support from Bayer, Bracco, General Electric, Medrad, and Siemens. The remaining authors report no conflicts.

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