**FLAT-PANEL VERSUS 64-CHANNEL COMPUTED TOMOGRAPHY FOR IN VIVO QUANTITATIVE CHARACTERIZATION OF AORTIC ATHEROSCLEROTIC PLAQUES**

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**BACKGROUND**

- Multidetector computed tomography (MDCT) imaging of atherosclerotic plaque components within lesions requires additional improvement to the instrument in order to accurately predict their vulnerability.
- Noninvasive quantification of plaque components by CT is critical to early identification of these life-threatening lesions.
- Currently, cardiac CT is commonly used to determine the degree of coronary calcification, which has been shown to be an independent predictor of atherosclerotic coronary artery disease. Cardiac CT is also used to estimate degree of coronary artery stenosis and to detect non-calcified plaque and vessel wall thickening. However, the ability of this imaging modality to provide useful information about plaque composition is severely limited by the current spatial resolution of clinical computed tomography scanners.
- Computed tomography with flat-panel X-ray imagers (FpCT) provides much higher spatial resolution and isotropic image volume when compared to MDCT.

**METHODS**

**Clinical 64-Channel Computed Tomography (64-CT)**

- The LightSpeed Volume Computed Tomography scanner (GE Healthcare, Milwaukee, WI) is a clinical scanner with 64 data channels and a maximum X-ray beam width of 40 mm. Gain acquisition was not possible because of the rabbits’ high heart rate (~300 beats/min).
- The following scan variables were used: 80 kVp, 675 mA, 0.4 second/rotation, pitch 0.536, 64 × 0.625-mm detector configuration, small body scan field-of-view (FOV), 33-cm display field-of-view (DOV).
- A second scan protocol was also used: 120 kVp, 200 mA, 0.4-second/rotation, pitch 0.526, 64 × 0.625-mm detector configuration, small body FOV, 33-cm DOV.
- Both protocols were first executed without intravenous contrast enhancement. The images were not processed for dual-energy information.
- This part of the study was done to confirm that use of one kV setting over the other was justified. Post-contrast scanning was performed 30, 60, and 90 seconds after injection by using 500 views per rotation, and each rotation covered 4.3 cm in the z-axis (table direction). The standard reconstruction algorithm was used to generate all images. Pre-contrast: 120 kV, 40 mA, 4 sec and 80 kV, 150 mA, 4 sec.

**Image Generation and Analysis**

- With an automated tool (Voxel Analysis, JW Workstation, GE Healthcare), multiplanar reformatted images were created perpendicular to the center line of the aorta along its entire imaging length. Voxel sizes were 0.20 × 0.20 × 0.625 mm for 64-CT and 0.20 × 0.20 × 0.20 mm for FpCT.
- Because Hounsfield unit (HU) values produced by the FpCT scanner are not very reliable and differ substantially from those produced by clinical CT scanners, HU parameters were not used for image segmentation. This was done visually, using a consistent window width of 800 and window level of 100 selection.

**RESULTS**

- Only FpCT images provided the spatial resolution necessary to distinguish lipid from fibrous wall-thickening and to identify normal thickness wall.
- The histopathologic data for plaque eccentricity and circumference, number, lipid pools and minimal distance from the vascular lumen correlated better with the FpCT data than with the 64-CT data. Both FpCT and histologic examination could detect lipid pools (low-attenuation foci) as small as 0.3 mm in diameter; 64-CT allowed us to detect only lipid pools ≥1.5 mm in diameter.
- In both FpCT and histologic images, but not 64-CT images, we identified lesions containing >5% lipid and calcific deposits ≥1 mm in diameter.
- According to the Lin concordance coefficient, the Bland-Altman plot, and the Pitman test, neither 64-CT nor FpCT measurements of wall thickness (minimum and maximum) correlated well with histologic measurements.
- In measuring minimal wall thickness, 64-CT was better correlated with pathology than was FpCT, and the Bradley-Blackwood F ratio showed that the Lin coefficient parameters were not used for image segmentation. This was done visually, using a consistent window width of 800 and window level of 100 selection.

**CONCLUSIONS**

- Flat-panel CT seemed to have more potential for quantitative screening low risk small atherosclerotic lesions, whereas 64-CT was apparently more useful when imaging established, well-characterized lesions particularly when measuring the vascular wall thickness in a rabbit model of atherosclerosis.
- Further longitudinal studies are needed to explore the maximal capabilities of this new imaging modality for early and accurate assessment of different models of atherosclerotic lesions.

**DISCLOSURES**

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