Coronary CT Angiography using 640 slices CT scanner and Adaptive - Iterative Dose Reduction (AIDR) : dose reduction and image quality

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Purpose

Coronary CT angiography (CTA) is nowadays considered a non-invasive method to evaluate the coronary artery, with high sensitivity and negative predictive value. Increasing concerns have been raised regarding the radiation exposure associated with CTA. The image reconstruction process is a fundamental determinant of image quality and, thus, of the radiation dose that is necessary for generating a diagnostic CT image.

The objective of our study was to evaluate the effect of Adaptive - Iterative Dose Reduction (AIDR) on mean radiation dose and on image quality compared with traditional filtered back projection (FBP) for coronary CT angiography.

Methods and Materials

From september to december 2012, we prospectively evaluated 100 consecutive patients undergoing a coronary CT angiography using a 640 slice CT scanner (Aquilion One, Toshiba Medical Systems). Patients included in the study have suspected coronary heart disease. Were not included patients with previous coronary artery interventions including stenting and/or coronary artery bypass grafts.

In the first 50 patients, we used higher tube current and FBP reconstruction algorithm; in the latter 50 patients, we use lower tube current and AIDR reconstruction algorithm. Anonymised images were transferred to a post-processing workstation (Vitrea fx, Vital Images, Minnetonka, MN, USA) and were evaluated by three independent radiologist, completely blinded to the reconstruction technique. Original transverse images, curved planar reformations and volume rendered images were used; each vessel was analyzed in at least two planes, one parallel and one perpendicular to the course of the vessel. The coronary arteries were categorized into 15 segments according to the American Heart Association classification. For every patient, were assessed mean radiation dose and images quality, either objective (noise, signal to noise ratio, contrast to noise ratio) and subjective. The effective radiation dose (measured in millisieverts, mSv) was calculated by multiplying the DLP (Dose Length Product) by the conversion coefficient for the chest (0.014). Signal and noise were measured in the aortic root and in the proximal portion of the two coronary arterieswithin circular regions of interest (ROIs) on axial images. Signal is defined as mean attenuation value (Hounsfield units, HU) within ROIs; image noise is defined as the standard deviation of the Hounsfield units (HU). Also, they judged the image quality using a 4 scores grading system: score 1 (absence of motion artefacts), score 2 (presence of mild artefacts), score 3 (presence of moderate artefacts), score 4 (presence of severe artefacts). Continuous quantitative variables are expressed as mean and SD and were compared using Student t test. A P value of < 0,05 was deemed to indicate significance.

Images for this section:

Fig. 1: This image show how signal and noise were measured within circular regions of interest (ROIs) on axial images in the aortic root and in the proximal portion of the two coronary arteries. Signal is defined as mean attenuation value (Hounsfield units, HU) within ROIs; image noise is defined as the standard deviation of the Hounsfield units (HU).

Results

Mean radiation dose of AIDR group was 20% lower than that of FBP group (p=0,0012). Signal - to - noise ratio and contrast - to - noise ratio were significantly higher in AIDR group (p < 0,005).

Images for this section:

Fig. 1: This image show how signal and noise were measured within circular regions of interest (ROIs) on axial images in the aortic root and in the proximal portion of the two coronary arteries. Signal is defined as mean attenuation value (Hounsfield units, HU) within ROIs; image noise is defined as the standard deviation of the Hounsfield units (HU).

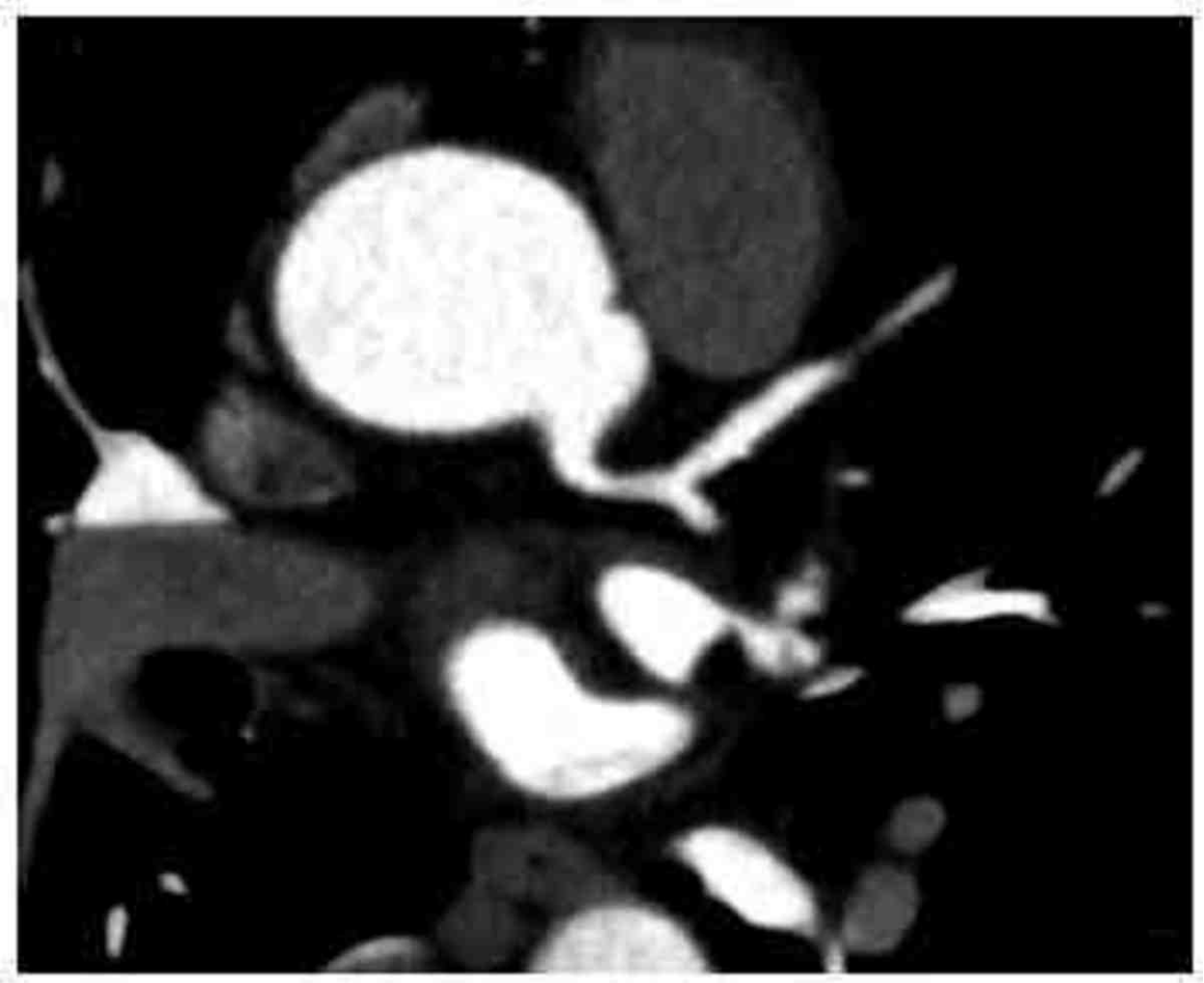

Fig. 2: Axial image of the left coronary artery reconstructed using Adaptive Iterative Dose Reduction.

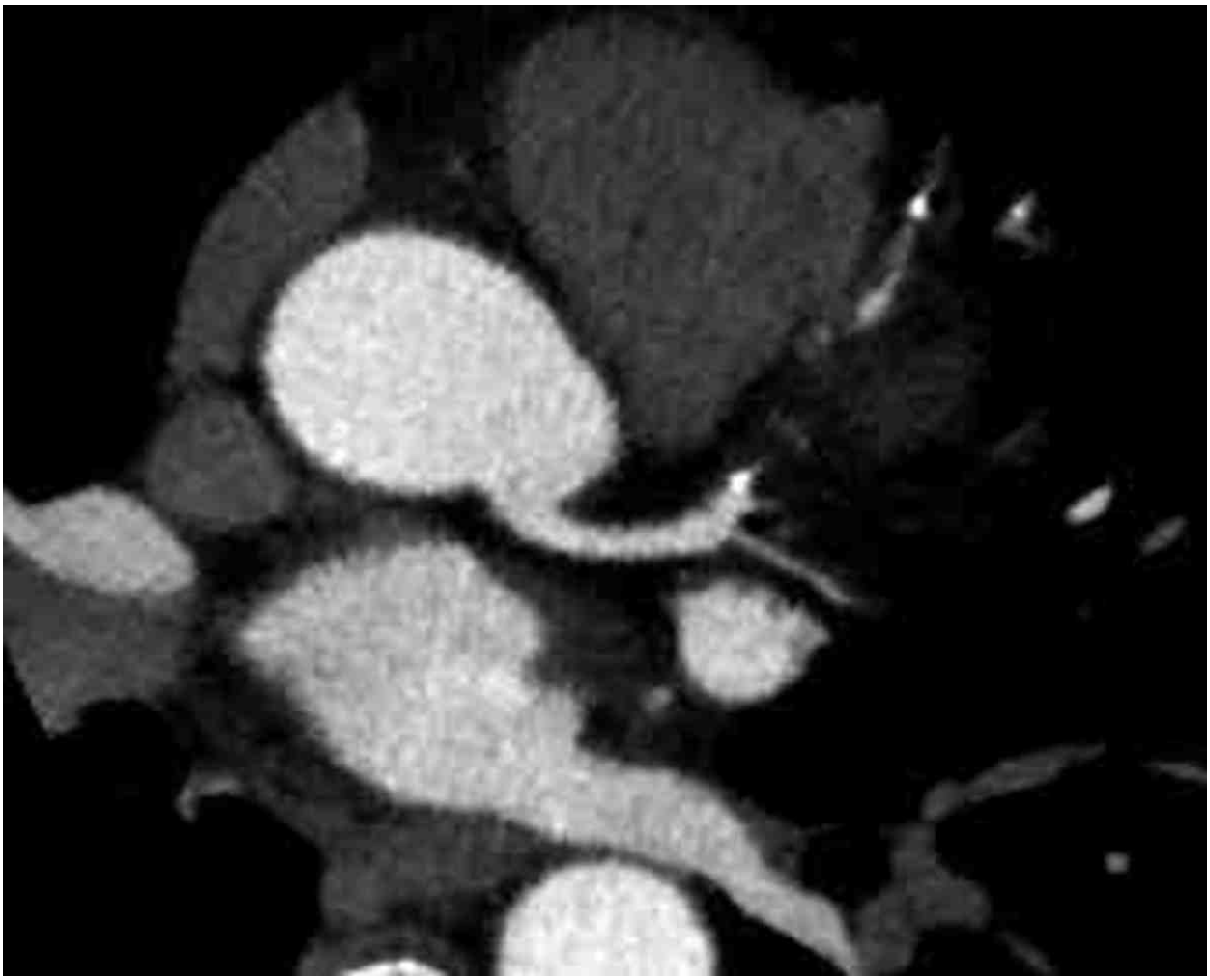

Fig. 3: Axial image of the left coronary artery reconstructed using Filtered Back Projection.

Conclusion

In coronary CT angiography, AIDR, compared with traditional FBP, reduce significantly mean dose improving the image quality.

References

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