Case 1
Coronary CTA with 80 kV: Improving Image Quality with Reduced Radiation and Contrast Medium Dose

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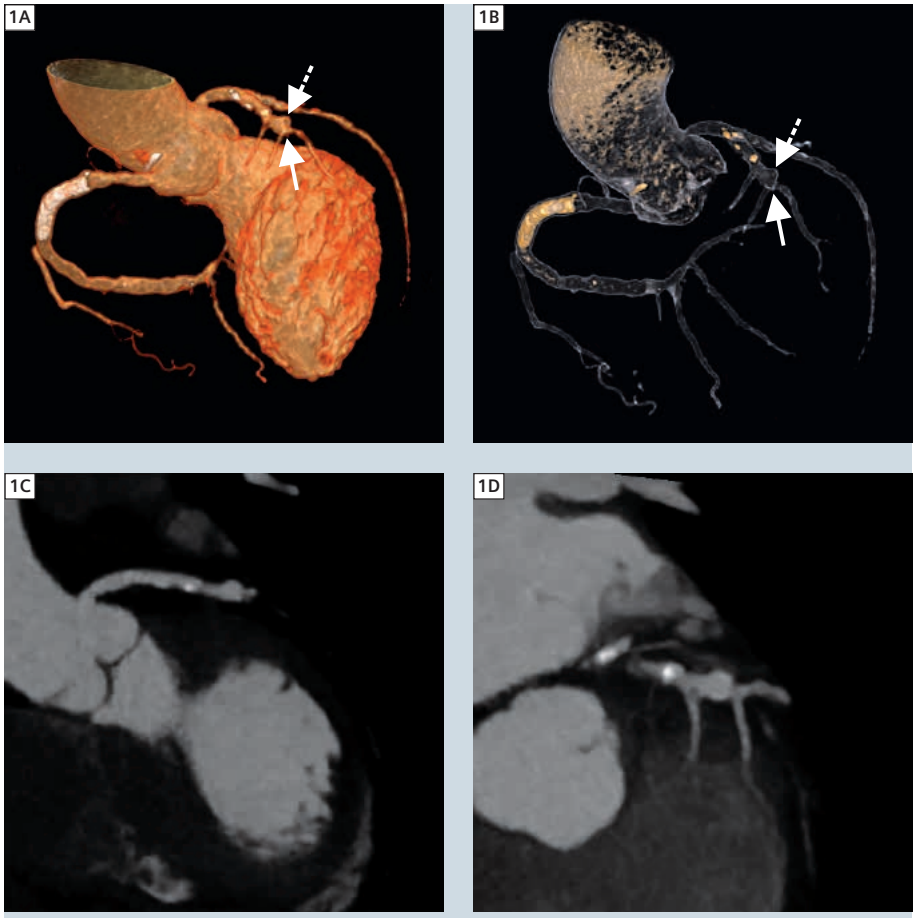
HISTORY

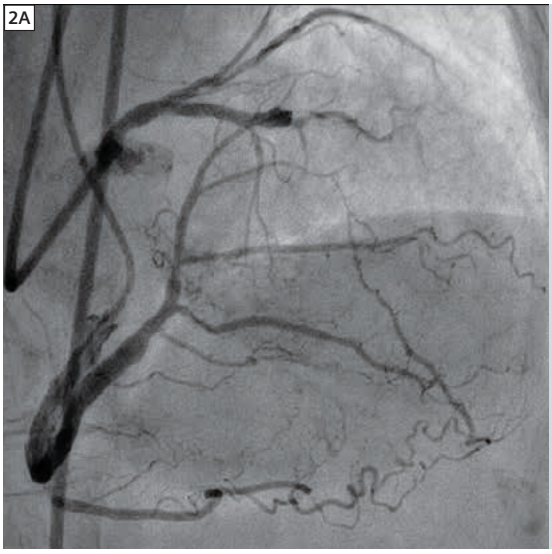
An 84-year-old female patient, with a history of hypertension and dyslipidemia, was hospitalized due to heart failure. Cardiac enzyme tests were normal. After an improvement of her heart failure, the first coronary CTA was performed. This revealed an aneurysm and a chronic total occlusion (CTO) of the left anterior descending artery (LAD) and a 75% stenosis of the right coronary artery (RCA) which was then treated with a stent. A second coronary CTA was performed to evaluate the characteristics of the CTO after the intervention.

DIAGNOSIS

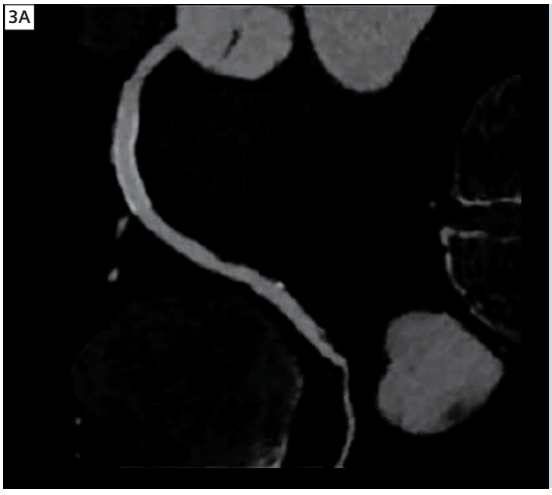
An aneurysm located directly in front of the diagonal and the septal branches, as well as the CTO (Figs. 1A and 1B), could be clearly visualized in the LAD. Neither calcified plaques nor thrombosis were seen in the aneurysm (Figs. 1C and 1D). A stent shown in the proximal RCA was patent (Fig. 3A). The distal branches of the RCA were well developed supposedly to compensate the limited blood supply of the occluded LAD. A few small calcified plaques were present in the proximal circumflex artery (Cx, Fig. 3B).

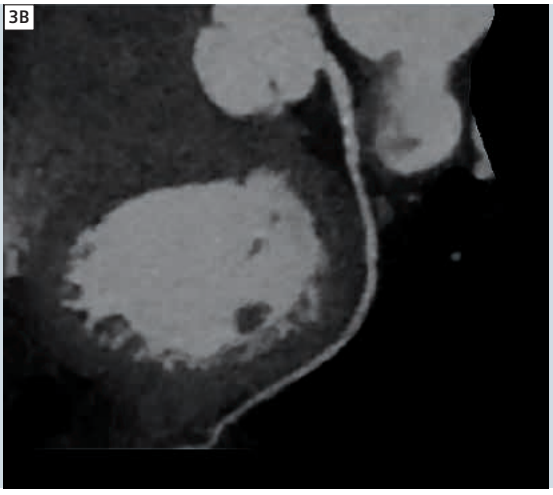


1 VRT images with different presets (Figs.1A and 1B) showed the CTO (arrows) and the aneurysm (dashed arrows) in the LAD. Neither calcified plaques nor thrombosis were seen in the aneurysm (Fig. 1C – MPR and Fig. 1D – MIP).



2 An angiographic image (Fig. 2A) and a VRT image (Fig. 2B) demonstrated both left and right arteries.





3 A patent stent in the RCA (Fig. 3A) and few small calcified plaques could be revealed with curved MPRs (Fig. 3B).

COMMENTS

To achieve the optimal CT image quality with the lowest possible dose, various CT techniques have been established. In the newly developed Stellar Detector, the photodiode and the analog-to-digital converters (ADCs) were combined in single application-specific integrated circuit (ASICs). This therefore reduces the path of the analog signal and decreases the electronic noise which in turn directly enhances the image quality. In this case, SAFIRE as a raw data-based iterative reconstruction technique, Flash Cardio Spiral provided by Dual Source CT, CARE kV, and CARE Dose4D were all additionally applied to minimize the dose to 0.38 mSv while maintaining the image quality. The 80 kV setting selected by CARE kV remarkably enhanced the contrast although only 42 mL (including test bolus injection) contrast medium were used.

EXAMINATION PROTOCOL

Scanner	*SOMATOM Definition Flash*		
Scan area	*Heart*	***Pitch***	*3.4*
Heart rate	*56 bpm*	***Slice collimation***	*128 x 0.6 mm*
Scan length	*111 mm*	***Slice width***	*0.75 mm*
Scan direction	*Cranio-caudal*	***Spatial resolution***	*0.3 mm*
Scan time	*0.2 s*	***Reconstruction increment***	*0.4 mm*
Tube voltage	*80 kV with CARE kV*	***Kernel***	*I36f*
Effective mAs	*316 mAs*	***SAFIRE***	*SAFIRE*
Dose modulation	*CARE Dose4D*	***Contrast***	
$CTDI_{vol}$	*1.46 mGy*	***Volume***	*42 mL (including test bolus)*
DLP	*27.1 mGy cm*	***Flow rate***	*3.5 mL/s*
Effective dose	*0.38 mSv*	***Start delay***	*Test Bolus Tracking*
Rotation time	*0.28 s*		

In clinical practice, the use of SAFIRE may reduce CT patient dose depending on the clinical task, patient size, anatomical location, and clinical practice. A consultation with a radiologist and a physicist should be made to determine the appropriate dose to obtain diagnostic image quality for the particular clinical task.