

Coronary Stenoses in a Patient with Dyspnea, Arrhythmia and Heart Failure

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History

A 76-year-old male patient was admitted to the hospital with an initial diagnosis of arrhythmia (atrial fibrillation and ventricular extrasystoles) and heart failure. He had been suffering from exertional dyspnea for the past year. This improved after rest but had aggravated over the past 4 days. A coronary CT angiography (cCTA) was requested for further evaluation.

Diagnosis

cCTA images showed a right coronary artery (RCA) dominant system. Multiple calcified and non-calcified plaques were visualized in all coronary arteries (Figs. 1 and 3), causing severe stenoses in the proximal, middle and distal RCA, moderate to severe stenoses in the proximal left

anterior descending artery (LAD), as well as mild stenoses in the left main artery (LM) and the circumflex artery (Cx). Both atria were significantly enlarged (Fig. 2).

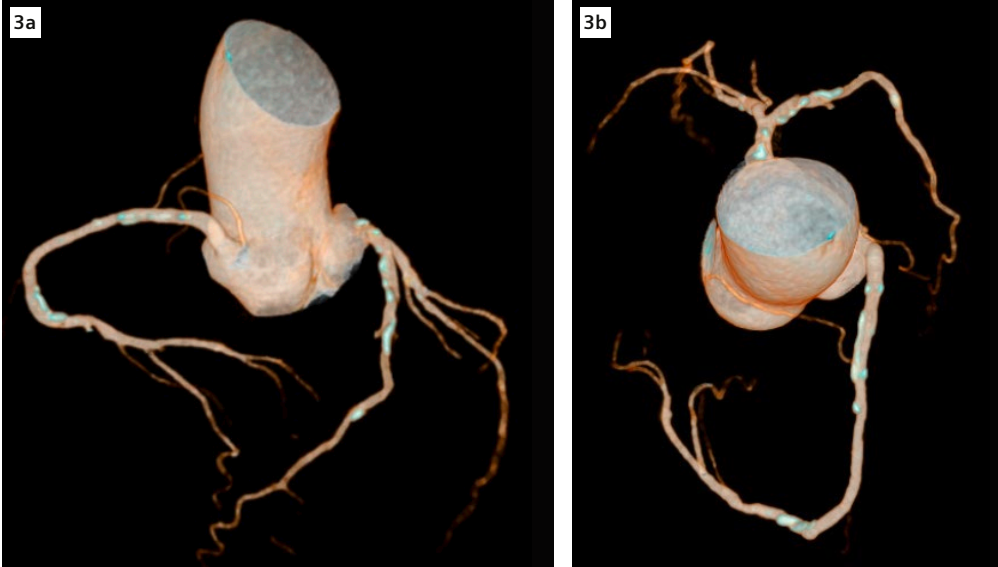
Comments

cCTA is an established non-invasive and robust imaging assessment for coronary arteries. To achieve optimal image quality, appropriate scanning techniques need to be selected dependent upon the patient's situation. In this case, the patient could not maintain a standard breath-hold command due to his dyspnea. The case was further complicated by the diagnosed heart failure and a highly arrhythmic heart rate (atrial fibrillation and ventricular extrasystoles). In such a critical situation, a so-called "Double Turbo Flash Spiral" scan mode – two

consecutive spiral scans, prospectively ECG-triggered, using a high pitch of 3.2 (table movement speed of 736 mm/s) is performed. Each scan acquires images of the entire heart within one cardiac cycle, using a single bolus of intravenous contrast agent, and free breathing technique. Even though both scans are triggered in non-optimal cardiac phases (Fig. 4) due to the arrhythmia – the first was too late (80% to 1%), and the second was too early (23% to 42%) – both acquisitions yielded amazing image quality. It is reasonable to assume that this is due to the combination of a 66 ms high temporal resolution Dual Source imaging and the less-prominent motion of the atria and the ventricles due to heart failure.

Alternatively, a prospectively ECG-triggered sequential scan mode with absolute delay could have been considered, however, artifacts due to the patient's free breathing, would have probably occurred at the sequence stack transition images. It is also noteworthy that the trigger

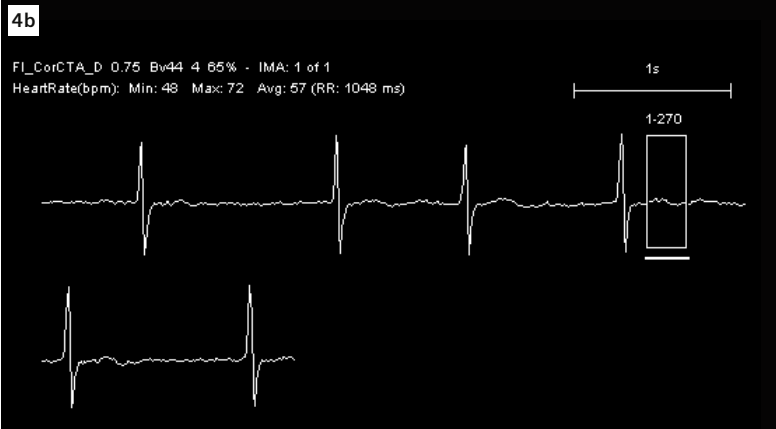
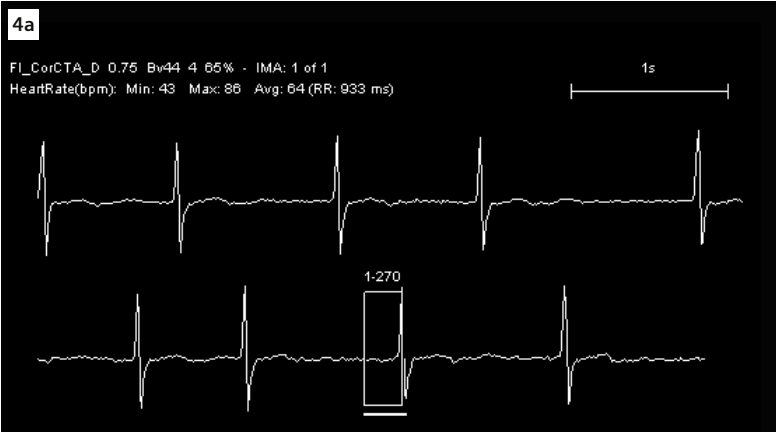
level is changed from 100 HU to 120 HU, since a prolonged time-to-peak due to heart failure is anticipated. The contrast injection rate was also reduced from 4.5 mL/s to 3.6 mL/s to achieve an extended plateau of the time-to-density curve, ensuring an optimal contrast enhancement for the second scan. This case demonstrates that optimal image quality for coronary assessment can be achieved, even under difficult circumstances, when the appropriate scan techniques are selected and applied. ●



3 VRT images of the coronary tree show multiple calcified plaques in all coronary arteries in three dimensions.

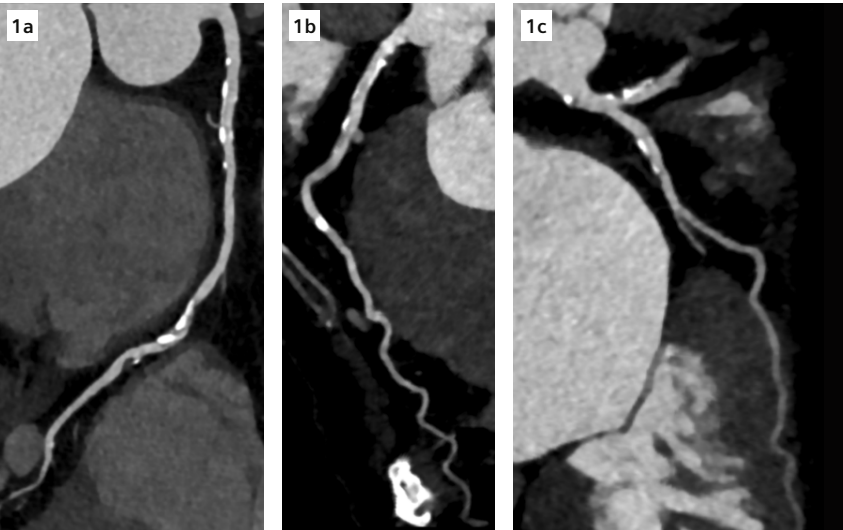
Examination Protocol

Scanner	SOMATOM Force
Scan area	Heart
Scan mode	Double Turbo Flash Spiral
Scan length	134.5 / 134.5 mm
Scan direction	Caudo-cranial / Cranio-caudal
Scan time	0.18 / 0.18 s
Tube voltage	90 / 80 kV
Effective mAs	491 / 484 mAs
Dose modulation	CARE Dose4D
CTDI _{vol}	3.47 / 2.23 mGy
DLP	60.8 / 38.9 mGy cm
Rotation time	0.25 / 0.25 s
Pitch	3.2 / 3.2
Slice collimation	192 × 0.6 / 192 × 0.6 mm
Slice width	0.75 / 0.75 mm
Reconstruction increment	0.5 / 0.5 mm
Reconstruction kernel	Bv40 / Bv40
Heart rate	43–86 / 43–72 bpm
Contrast	400 mg/mL
Volume	45 + 35 mL saline
Flow rate	3.6 mL/s
Start delay	Bolus tracking in the descending aorta at 120 HU with an additional 5 s for the first scan / + 6.2 s after the first scan



4 ECG recorded during the first (Fig. 4a) and second (Fig. 4b) scans show that both acquisitions were triggered in non-optimal cardiac phases.

The outcomes by Siemens Healthineers customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that other customers will achieve the same results.



1 Curved MPR images show multiple calcified and non-calcified plaques in all coronary arteries, causing severe stenoses in the proximal, middle and distal RCA (Fig. 1a), moderate to severe stenoses in the proximal LAD (Fig. 1b) and mild stenoses in the LM and Cx (Fig. 1c).



2 An axial image shows significantly enlarged atria.