Case 2

Low-Dose Coronary CT Angiography with 0.37 mSv and 35 mL Contrast Agent using Turbo Flash CT Scanning

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2 Axial (Fig. 2A) and VRT (Fig. 2B) images reveal extensive calcified plaque in the proximal LAD which causes a severe stenosis at the ostium of the first diagonal branch (arrows). Multiple calcified plaques are shown in all 3 coronary arteries (Fig. 2B).

History

A 77-year-old male patient, with multiple risk factors including hypertension, hyperlipidemia and history of cigarette smoking, was admitted with a recent onset of chest discomfort and shortness of breath at rest. The physical examination was unremarkable. Patient characteristics, including body mass index (25 kg/m²), blood pressure (130/80 mmHg) as well as ECG and echocardiography, were normal at admission. The chest discomfort and shortness of breath persisted after admission and an initial set of cardiac troponin I showed a level of 0.04 ng/mL. The patient was subsequently referred for coronary CT angiography (cCTA) for further evaluation.

Diagnosis

Calcium scoring revealed multiple calcifications in the left main (LM), left anterior descending (LAD), right (RCA) and circumflex (Cx) coronary arteries, most distinct in the LAD.

The total calcium score was 509, corresponding to the 61st age, race and gender adjusted percentile.

cCTA images demonstrated an approximately 50% stenosis of the mid LAD segment and mid CX without LM stenosis. An extensive calcified plaque caused significant stenosis (>50%) of the ostium of the first diagonal branch off the LAD. The RCA showed only mild luminal irregularities in the mid-vessel segment.
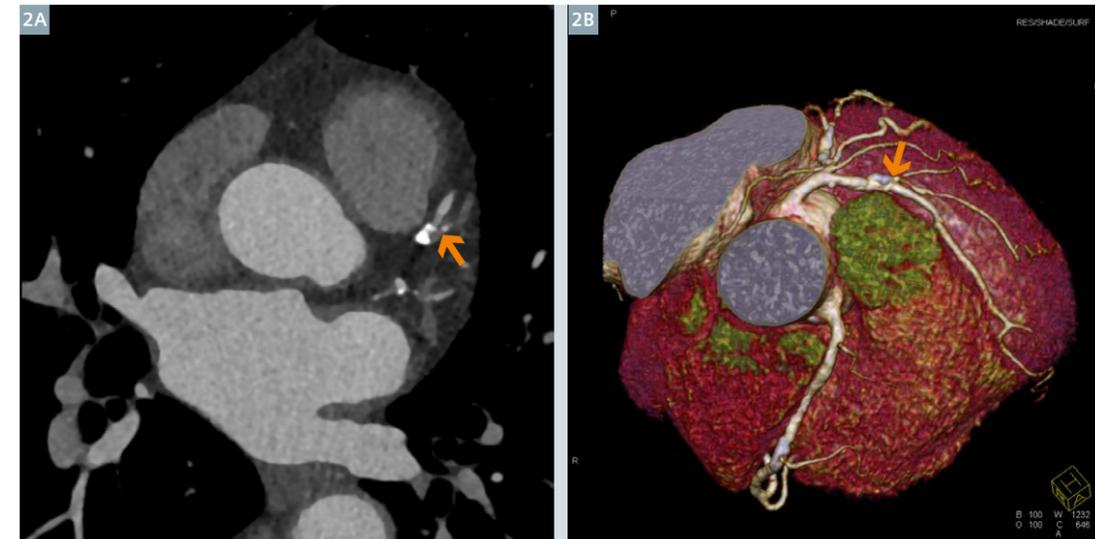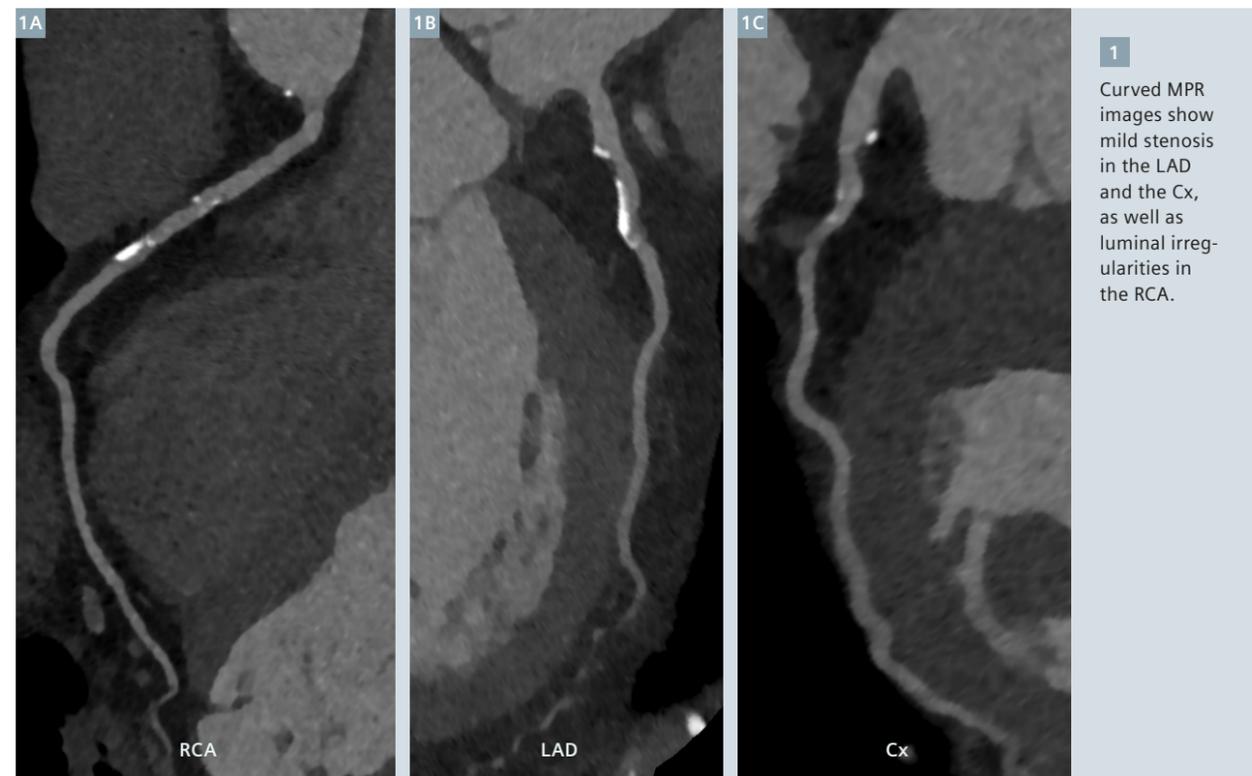
Invasive cardiac catheterization was performed, confirming the stenosis (>70%) of the first diagonal branch. An everolimus-eluting stent was successfully deployed after balloon angioplasty. An excellent angiographic result was achieved. The patient was safely discharged 24 hours after the procedure without recurrence of symptoms during follow-up.

Comments

In this case, cCTA helped obtain a definitive diagnosis and aided immediate treatment in a patient with atypical chest pain and a medium risk for coronary artery disease. Excellent image quality, despite diffuse coronary calcifications, allowed for the detection of hemodynamic-relevant stenosis and facilitated planning of the percutaneous interventional procedure. Timely diagnosis is a decisive factor in the management of unstable angina considering that "time is myocardium".

All available latest Dual Source CT radiation dose-saving techniques were applied in this case. ECG-gated ultra-high-pitch acquisition was performed, automated tube current modulation (CARE Dose4D) was activated, and automated tube voltage modulation (CARE kV) resulted in a 70 kV image acquisition. The estimated effective dose was only 0.37 mSv. Performing the scan at 70 kV allowed restricting the contrast media bolus to only 35 mL due to the increased intravascular attenuation of iodine. To further decrease image noise associated with the low tube voltage, advanced image-based iterative reconstruction (ADMIRE*, level 3, 4, 5) was performed. ∎

RCA — LAD — Cx

1 Curved MPR images show mild stenosis in the LAD and the Cx, as well as luminal irregularities in the RCA.

Examination Protocol

Scanner	SOMATOM Force		
Scan area	Heart	Rotation time	0.25 s
Scan mode	Turbo Flash mode	Pitch	3.2
Scan length	125.7 mm	Slice collimation	192 × 0.6 mm
Scan direction	Cranio-caudal	Slice width	0.5 mm
Scan time	0.17 s	Reconstruction increment	0.3 mm
Tube voltage	70 kV (CARE kV)	Reconstruction kernel	Bv40 (ADMIRE)
Tube current	555 eff. mAs	Contrast	370 mg / mL
Dose modulation	CARE Dose4D	Volume	35 mL + 50 mL saline
CTDI$_{vol}$	1.56 mGy	Flow rate	2.2 mL / s
DLP	26.1 mGy cm	Start delay	Bolus tracking + 4 s
Effective dose	0.37 mSv		

*In clinical practice, the use of ADMIRE 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.