Coronary Artery Fistula and Coronary Aneurysm – A Rare Incidental Coincidence

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History

A 58-year-old male patient, complaining of recurrent paroxysmal thoracalgia for the past year, presented himself for a check-up. After resting, his symptoms were less pronounced. Physical examinations, electrocardiogram and chest radiograph were unremarkable. A coronary CT angiography (cCTA) was requested for further evaluation.

Diagnosis

cCTA images revealed an anomalous fistula, connecting the proximal left anterior descending artery (LAD) to the main pulmonary artery (MPA). The fistula was tortuous and dilated towards the MPA which inserted directly above the valve on the left side. A saccular aneurysm, measuring 4.6 × 2.5 mm in size, was also shown in the mid segment of the 2nd diagonal branch of the LAD. The origins and the courses of the right coronary artery (RCA), the LAD and the circumflex (Cx) were normal.

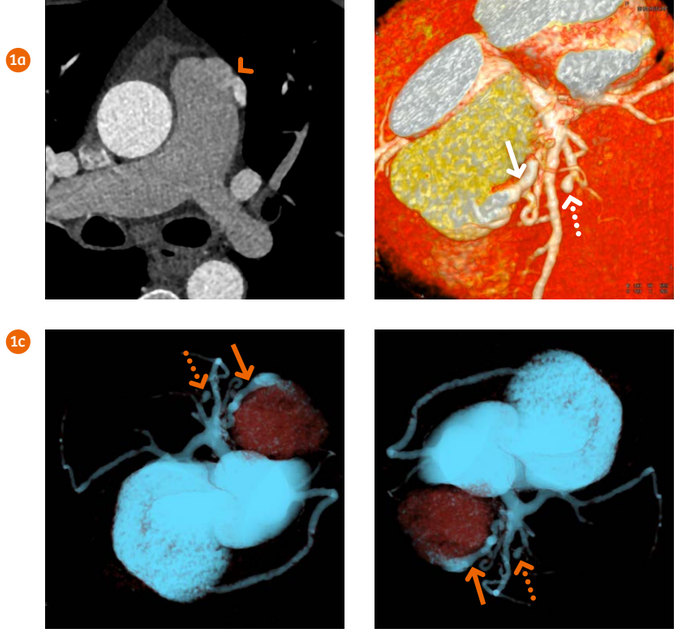
Comments

A coronary artery fistula (CAF) is classified as an abnormality in the termination of a coronary artery and defined as an anomalous connection between a coronary artery and a major vessel or cardiac chamber.[1] A coronary artery aneurysm (CAA) is described as a localized dilatation of a coronary artery segment more than 1.5-fold compared with adjacent normal segments.[2] Both CAF and CAA are rare and usually asymptomatic. Nonetheless, these can have fatal outcomes for the patients.

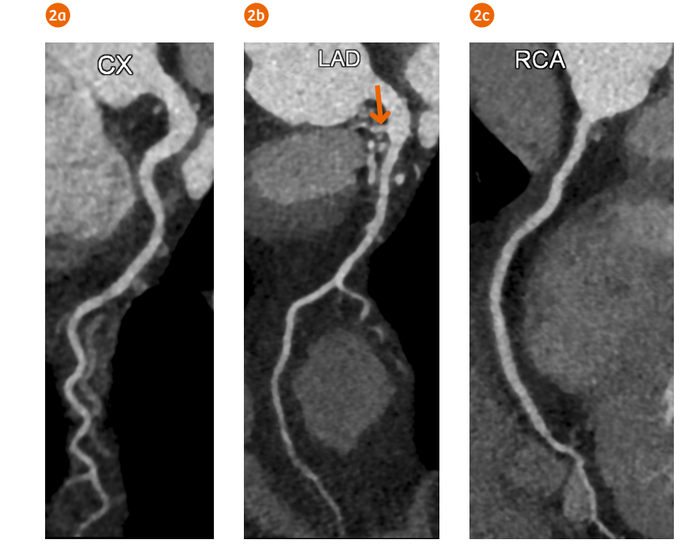
Conventional coronary angiography can reliably demonstrate the proximal part of the CAF. However, the drainage site may not be well seen due to significant dilution of the contrast agent.[1] As the angiography is limited to a "luminogram", it cannot provide adequate information concerning the vessel wall. This could lead to an underestimation of the actual size of an aneurysm or perhaps even to overlook a CAA which may be occluded by a large thrombus or a plaque.[2] Contrary to the invasive approach of the conventional coronary angiography, cCTA is a noninvasive alternative. Potential applications of cCTA include identification of anomalous origin and course of coronary arteries, assessment of the complexity of the fistula, evaluation for aneurysmal dilatation or thrombus formation in the vessel.[2,3]

Excellent three dimensional image data can be acquired by synchronizing image acquisition with cardiac cycle using ECG – either triggered prospectively or gated retrospectively. In each cardiac cycle, the least movement of the coronary arteries is observed in two phases – the end-systole (ES) and the end-diastole (ED). At lower heart rates, the ES phase (approximately 100–150 ms) is much shorter than the ED phase. However as the heart rate increases, the ED phase shortens and can be even shorter than the ES phase while the ES phase remains mostly unchanged.[4]

For comparable signal-to-noise ratio, an ECG-gated spiral acquisition requires a higher patient radiation dose than an ECG-triggered sequential acquisition. This is due to the fact that the ECG-gated acquisition acquires image data with a small spiral pitch and continuous X-ray exposure. Thus patients with a higher and regular heart rate, such as in this case (92 bpm), would benefit from the ECG-triggered sequential scanning in the ES phase – if an appropriate temporal resolution is provided. We performed the cCTA with SOMATOM Force, which provides 66 ms temporal resolution enabling motion-free image acquisition. Additionally, the radiation exposure could be substantially reduced by applying techniques such as CARE Dose4D™ (automatically controlled tube current modulation) and ADMIRE (advanced modeled iterative reconstruction). The 70 kV setting was chosen automatically by CARE kV (automatic tube voltage optimization), which significantly improved contrast enhancement, although only 35 mL contrast agent was administrated. The lower kV setting also contributes to the radiation dose reduction. ●



1 An axial image (Fig. 1a) shows the insertion of the fistula (arrowhead) into the MPA on the left side. VRT images (Figs. 1b–1d) reveal a tortuous fistula (arrows) connecting the proximal LAD to the MPA, and a small aneurysm (dashed arrows) in the mid segment of the 2nd diagonal branch of the LAD.



2 Curved MPR images show normal origins and courses of the RCA, the LAD and the Cx. The fistula coming off the proximal LAD (arrow) is also shown.

Examination Protocol

Scanner	SOMATOM Force
Scan area	Heart
Scan mode	Prospective ECG-triggered sequential scan
Scan length	133 mm
Scan direction	Cranio-caudal
Scan time	4 s
Tube voltage	70 kV
Tube current	389 mAs / rot.
Dose modulation	CARE Dose4D™
$CTDI_{vol}$	7.84 mGy
DLP	105.9 mGy cm
Effective dose	1.48 mSv
Rotation time	0.25 s
Slice collimation	192 × 0.6 mm
Slice width	0.75 mm
Reconstruction increment	0.5 mm
Reconstruction kernel	Bv36 / Bv40 (ADMIRE 3)
Heart rate	92 bpm
Contrast	370 mg/mL
Volume	35 mL + 30 mL saline
Flow rate	4 mL/s
Start delay	Bolus tracking + 5 s

References
[1] Zenooz et al. Coronary Artery Fistulas: CT Findings. RadioGraphics 2009; 29:781–789

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[3] Schmitt R, Froehner S, Brunn J, et al. Congenital anomalies of the coronary arteries: imaging with contrast-enhanced, multi-detector computed tomography. Eur Radiol 2005;15(6):1110–1121.

[4] Achenbach S, Ropers D, Holle J, Muschiol G, Daniel WG, Moshage W (2000a). In-plane coronary arterial motion velocity: measurement with electron-beam CT. Radiology 216:457–463.