Case 4

Comprehensive Cardiac CT Study for Simultaneous Evaluation of the Coronary Arteries and the Myocardium

By Kakuya Kitagawa, MD, PhD, Tatsuro Ito, MD, Hajime Sakuma, MD, PhD, Naoki Nagasawa, PhD, Akio Yamazaki*, Shiro Nakamori, MD, Hiroshi Nakajima, MD, PhD**

  * Department of Radiology, Mie University School of Medicine, Mie, Japan
** Department of Cardiology, Mie University School of Medicine, Mie, Japan

History

A 67-year-old male patient, with a history of peripheral arteriosclerosis obliterans and inferior wall myocardium infarction, had been treated with an interventional stenting placed in the left circumflex artery (LCx) #13–14. A comprehensive cardiac CT study, including coronary CT angiography (cCTA), stress myocardial dynamic perfusion, and delayed enhancement, was ordered to simultaneously evaluate both the coronary artery and the myocardium.

Diagnosis

Coronary CTA images showed a left coronary artery (LCA) dominant system (Figs. 1A and 1B). Mixed plaques could be seen in the proximal left anterior descending artery (LAD).

These plaques caused a moderate stenosis in segment #6 (Fig. 2A) and a mild stenosis in segment #7 (Fig. 2B). No significant in-stent stenosis was seen in the LCx #13–14, with the exception of a mild stenosis distal to the stent (Fig. 2C).

Adenosine-induced stress myocardial dynamic perfusion CT images showed no significant ischemic area. Reduced myocardial blood flow could be seen in the basal septal inferior wall area, which corresponds with the old infarction (Fig. 3).

Delayed enhancement CT images showed sub-endocardial infarction from the basal septum inferior wall to the apical inferior wall. This became partially transmural at the apex (Fig. 4). Myocardium viability was retained.
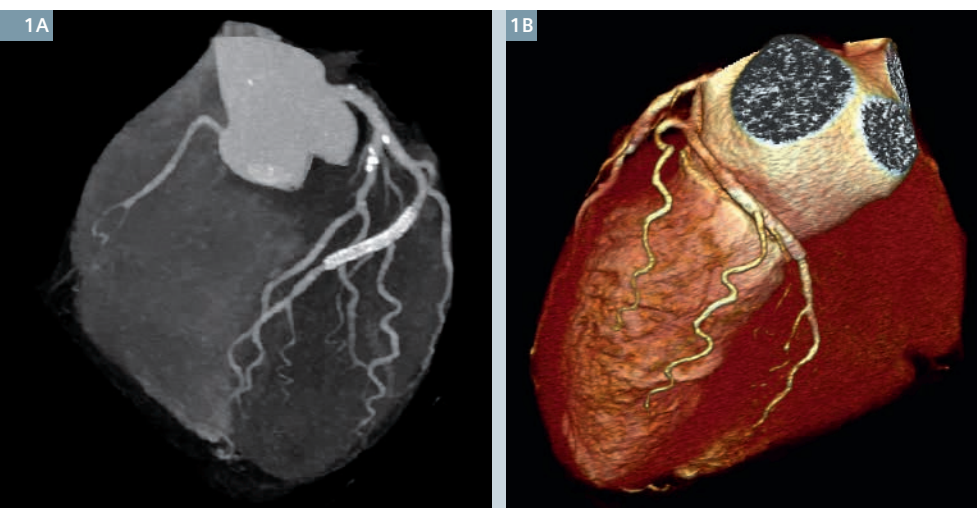
Comments

In this case, a comprehensive study with excellent results was achieved with a total effective dose of only 5.9 mSv. In myocardial perfusion evaluation, not only a high temporal resolution but also accurate myocardial CT values extremely important. Half-reconstruction methods offer a high temporal resolution but, at the same time, result in myocardial CT value fluctuation related to X-ray source position, impacting the evaluation of myocardial perfusion.

SOMATOM Definition Flash offers a Heart Perfusion mode (Systolic ECG-triggered Sequential Shuttle mode) which is equipped with an advanced algorithm that offers both 75 ms high temporal resolution and stabilized myocardial CT values with 360° full reconstruction at the same time. This works very well in the evaluation of myocardial perfusion together with a perfusion analysis application that enables a fast calculation of the myocardial blood flow with a color map. Furthermore, we also apply this Heart Perfusion mode for delayed enhancement CT which also requires accurate myocardial CT values.[1]

Scanning four time-points and averaging them using the motion correction algorithm of the perfusion application, this excellent scan mode can offer clear delayed enhancement images with reduced artifact and noise. This study exemplifies the feasibility of one-stop-shop cardiac CT examination including assessment of coronary artery stenosis, ischemia, and myocardial viability with reasonably low radiation dose. ■

1   Coronary CTA images show a LCA dominant system (Fig. 1A – MIP, Fig. 1B – VRT).

References
[1] Kurobe Y, Kitagawa K, J Cardiovasc Comput Tomogr. 2014 Jul-Aug;8(4):289-98.
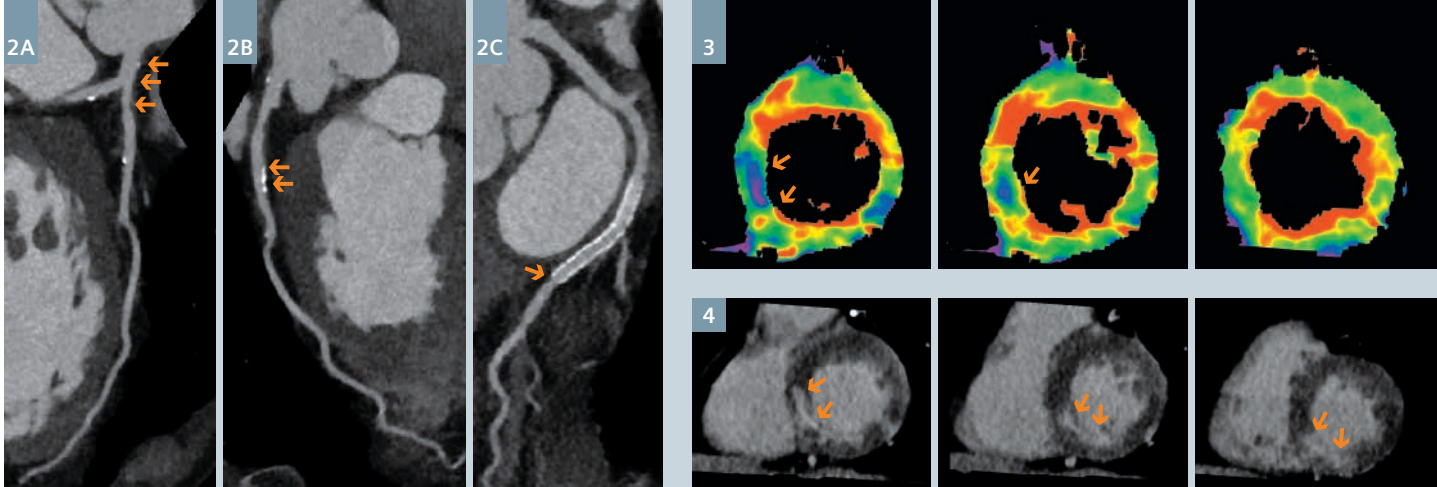
2 Coronary CTA images show mixed plaques (arrows) in the proximal LAD causing a moderate stenosis in segment #6 (Fig. 2A) and a mild stenosis in segment #7 (Fig. 2B). No significant in-stent stenosis was seen at LCx #13–14 with the exception of a mild stenosis (Fig. 2C, arrow) distal to the stent.

3 Stress myocardial dynamic perfusion CT images show no significant ischemic area, but reduced myocardial blood flow in the basal septal inferior wall area (arrows) which corresponds with the old infarction.

4 Delayed enhancement CT images show sub-endocardial infarction from the basal septum inferior wall to the apical inferior wall. This became partially transmural at the apex.

Table 1: Scheme of a comprehensive cardiac CT study
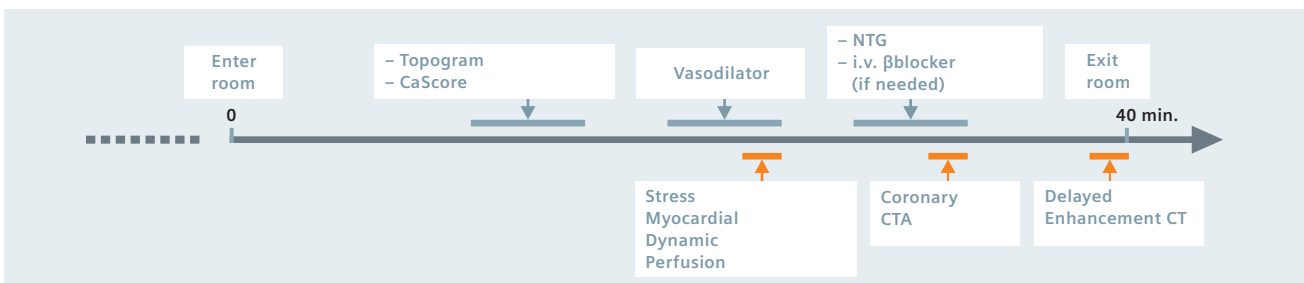
Examination Protocol

Scanner	SOMATOM Definition Flash	SOMATOM Definition Flash	SOMATOM Definition Flash
Scan mode	Stress Myocardial Perfusion	Coronary CTA (Sequence)	Delayed Enhancement CT
Scan area	Left Ventricle	Heart	Left Ventricle
Scan length	67 mm	102.8 mm	69 mm
Scan direction	Shuttle	Cranio-caudal	Shuttle
Scan time	32 s	5 s	9 s
Tube voltage	80 kV	80 kV	80 kV
Tube current	127 mAs/rot.	197 mAs/rot.	370 mAs/rot.
Dose modulation	CARE Dose4D	CARE Dose4D	–
CTDI$_{vol}$	28.9 mGy	8 mGy	17.9 mGy
DLP	208 mGy cm	82 mGy cm	128 mGy cm
Effective dose	2.9 mSv	1.2 mSv	1.8 mSv
Contrast			
Volume	40 mL	41 mL	–
Flow rate	5 mL / s	3.4 mL / s	–
Start delay	4 s	17 s	–
Scan timing	Adenosine infusion start ↓ 2 min scan	Adenosine infusion release ↓ 3 min Nitro ↓ 5 min scan	Coronary CTA ↓ 5 min scan