Dynamic dual-source computed tomography imaging for myocardial perfusion

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A 54-year-old man who was an ex-smoker was admitted to Pok Oi Hospital in August 2015 with acute chest pain that was subsequently confirmed to be a non-ST elevation myocardial infarction. Echocardiogram revealed anterior wall hypokinesia. Computed tomography (CT) coronary angiography demonstrated chronic total occlusion of the right coronary artery and a 90% stenotic lesion in the proximal to mid left anterior descending artery that was deemed to be the culprit lesion. Percutaneous coronary intervention was subsequently performed with a drug-eluting stent deployed across the proximal to mid left anterior descending artery stenosis. Angiographic results were excellent.

At clinical follow-up, the patient complained of persistent chest discomfort. Repeated echocardiogram was unremarkable showing normal left ventricular function without any regional wall motion abnormality. A CT stress myocardial perfusion and viability study was requested to guide subsequent management. The study protocol included quantitative evaluation of myocardial perfusion with pharmacological stress using a dynamic approach, followed by a delayed scan for the presence or absence of late myocardial enhancement.

Adenosine stress myocardial perfusion study with colour-coded maps demonstrated perfusion defects in the apicoseptal segment, the mid-inferoseptal segment, and to a lesser extent the basal inferoseptal segment (Fig 1). For quantitative evaluation, the normal areas had a myocardial blood flow of approximately 128 mL/100 mL/min, whereas areas with ischaemia had a flow of around 40 mL/100 mL/min. No delayed enhancement of the corresponding segments was evident to suggest scarring due to prior myocardial infarction (Fig 2).

Eventually the patient underwent a percutaneous coronary intervention to the chronic total occlusion of the right coronary artery in 2016 via a combined radial and femoral arterial approach with successful stent deployment across the occluded segment. Final angiography showed excellent results with mild residual stenosis in patent ductus arteriosus ostium (Fig 3). To date, the patient remains symptom-free with improvements in both his exercise tolerance and mood, and psychiatric reports revealing reduced dosage of antidepressants.

Discussion

Various imaging modalities are available for stress myocardial perfusion assessment.[1] The present case demonstrates how a state-of-the-art dynamic and quantitative assessment of myocardial perfusion

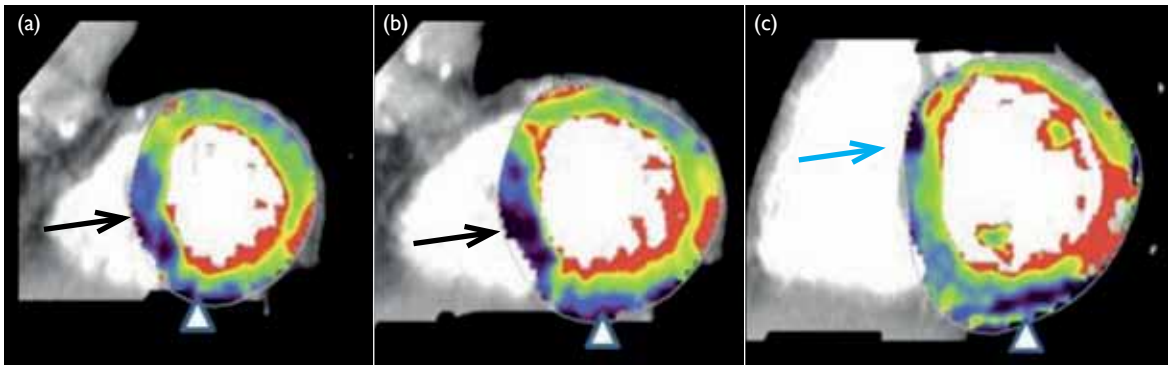

FIG 1. Colour-coded maps of myocardial blood flow derived from stress dynamic computed tomography myocardial perfusion imaging (radiation dose about 8.5 mSv) showed significant perfusion hypoenhancement that involved (a) the apicoseptal segment, (b) the mid-inferoseptal segment, and to a lesser extent (c) the inferior aspect of the mid-basal anteroseptal segment (blue areas as indicated by the black arrows). Of note is the presence of artefacts at the subepicardial region of the mid-basal inferior segments (white arrowheads) and basal anteroseptal segment near the insertion point (blue arrow). Hibernating myocardium with reduced myocardial blood flow in the anterior segments from basal to apical levels

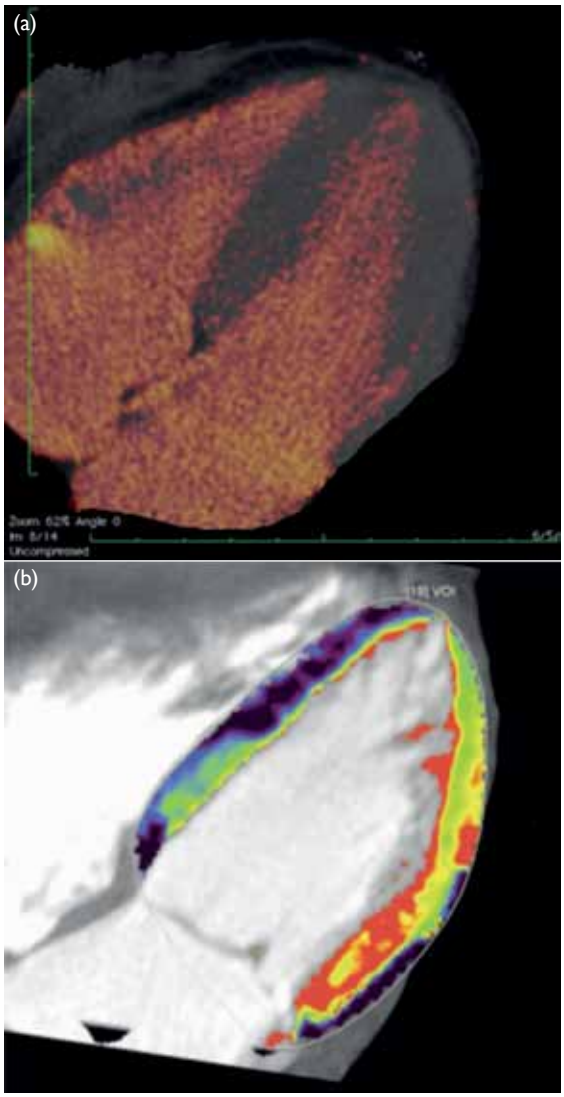

FIG 2. (a) Dual-energy computed tomography delayed enhancement showing no suspicious areas of late enhancement (radiation dose about 0.88 mSv). (b) Computed tomography myocardial perfusion study at the corresponding level demonstrates perfusion hypoenhancement (as indicated by the blue areas) of the inferoseptal segments

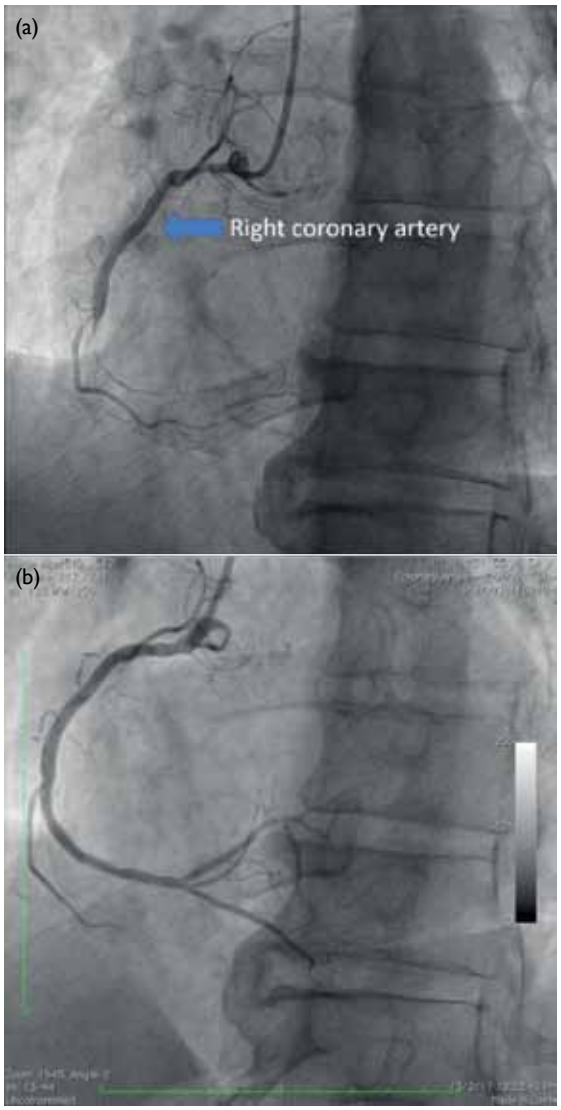

FIG 3. Coronary angiography demonstrating (a) chronic total occlusion of the right coronary artery with retrograde septal collaterals supplied from the left coronary system and (b) successful percutaneous coronary intervention with minimal residual stenosis of the patent ductus arteriosus ostium

using a dual-source CT scanner enables detection of ischaemia along with viability assessment in a rapid and non-invasive fashion within an acceptable radiation dose.[2]

Conventional "static" CT myocardial imaging allows visual qualitative assessment of a single snapshot of myocardial iodine contrast attenuation that requires precise timing of the arrival of contrast to preserve diagnostic integrity. With a dual-source CT, quantitative assessment of myocardial perfusion in multiple cardiac phases with precise anatomic localisation of the ischaemic area becomes possible. To date, many studies have assessed the reliability of dual-source multiple-detector CT in the dynamic and quantitative evaluation of myocardial perfusion.[2-5]

Stress CT myocardial perfusion is emerging as a potentially promising non-invasive technique to detect myocardial ischaemia both qualitatively and quantitatively. With new-generation multiple-detector CT scanners, a one-stop non-invasive comprehensive evaluation of the heart including the coronary artery, ventricular function, myocardial perfusion, and viability is possible. Stress CT myocardial perfusion provides incremental benefit to standard coronary CT angiography, particularly for intermediate coronary lesions.[2]

Author contributions

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Concept or design: All authors.
Acquisition of data: A Li, YH Chan.
Analysis of data: A Li, YH Chan.
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Conflicts of interest

All authors have disclosed no conflicts of interest.

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