Case 16368

Eurorad

Myocardial ischaemia in unstable angina: A myocardial perfusion CT diagnosis

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Section: Cardiovascular
Area of Interest: Cardiac
Technique: CT-Angiography
Special Focus: Arteriosclerosis Haemodynamics / Flow dynamics Ischaemia / Infarction Case Type: Clinical Cases
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Workplace:

Patient: 64 years, female

Clinical History:

A 64-year-old woman was referred to the emergency department (ED) with symptoms of slowly progressive chest pain. The pain started one week before while performing daily chores but worsened to a level of pain at rest. There were no other cardiac symptoms. ECG showed no specific changes. Serum-markers were determined multiple times but remained normal. The on-call cardiologist evaluated the patient as low to intermediate-risk but with a possible high pretest probability.

Imaging Findings:

Because of the low to intermediate risk and repeated normal cardiac enzymes, a coronary CT angiography was requested by the cardiologist to rule out significant coronary artery stenosis. This scan revealed a calcium score of 1220 with multiple probably high-grade stenosing lesions on the proximal right coronary artery as well as some less extensive lesions on the left anterior descending artery and the left circumflex artery.
After obtaining informed consent, the patient was admitted in a clinical study which adds dynamic CT perfusion to the examination to increase sensitivity in patients who are diagnosed with significant stenosing lesions.The myocardial stress perfusion CT was performed after IV administration of 140 µg/kg/min ml of dipyridamole during 6 minutes. This scan showed a significant decrease in MBF in the inferior segments of the heart (basal: 69 ml/100ml/min, mid-ventricular: 73 ml/100ml/min, apical: 77 ml/100ml/min) when compared to the other myocardial segments. The monophasic CT angiography cannot reliably evaluate for myocardial hypokinesia. No late enhancement CT was performed to test for viability of the left ventricle myocardium.
Later, the therapeutic percutaneous coronary artery angiography, upon stenting of the right coronary artery, confirmed these findings.

Discussion:

Cardiac function depends on aerobic metabolism. Progressive arteriosclerosis may lead to critical coronary artery stenosis which causes myocardial ischaemia and possibly infarction [1].

When patients present with acute chest pain they are considered high risk for cardiac ischaemia when they have ST-segment changes on ECG, ischaemic pain, serum-markers elevation (CK-MB, HS-troponin I, ...) and left ventricular dysfunction. These patients will eventually be admitted for PTCA. While PTCA remains the gold standard in the diagnosis of stenosing coronary artery disease, this technique remains invasive and results in a significant radiation dose. Low or medium risk patients will be referred to rule out cardiac causes of chest pain with less invasive techniques [2, 3].
CT angiography can easily rule out coronary artery disease but the degree of stenosis is often overestimated because of beam hardening artefacts from the calcified plaques [4]. Adding dynamic CT perfusion, when significant lesions are suspected, can increase specificity and illustrate the repercussion on tissue vascularisation. This type of examination allows us to measure the early portion of first-pass circulation of iodinated contrast through the myocardium. Using the table's shuttle mode in dual-source CT (or stationary in MDCT) the entire heart is covered while sampling the myocardial attenuation multiple times during systole. Systolic scanning provides the advantage of a smaller apicobasal length, a thicker and contracted myocardium and a relatively constant length of this phase when compared to diastole [5, 6].

The administration of a vasodilator agent is used to cause pharmacological stress (since an exercise test is difficult to obtain), which induces myocardial hypaeremia. Myocardial perfusion at rest is normal until the luminal diameter is narrowed for more than 85-90%. However, during hypaeremia caused by pharmacological stress, the impairment of hyperaemic flow already starts at a luminal reduction of 45% [7].
Semi-quantitative and quantitative analysis can be performed using colour mapping and mean blood flow (MBF) calculations. With this analysis, we can calculate and compare the MBF in every myocardial segment and also compare the subepicardium and subendocardium in the same segment, since the latter is more susceptible to ischaemia. Generally, a cutoff value of 78 ml/100 ml/min is accepted to be diagnostic of a haemodynamically significant coronary artery stenosis [5, 7].

Coronary CT angiography is a good examination to rule out significant coronary artery disease because of its high sensitivity. However, the reliability to quantify the degree of stenosis is limited, resulting in a lower specificity. Adding dynamic CT perfusion imaging can increase specificity by demonstrating reduced blood flow in the concerned myocardium.

Written informed patient consent for publication has been obtained.

Differential Diagnosis List: Inferior wall myocardial ischaemia caused by significant right coronary artery stenosis, Stable angina, Myocardial infarction, Pericarditis

Final Diagnosis: Inferior wall myocardial ischaemia caused by significant right coronary artery stenosis

References:

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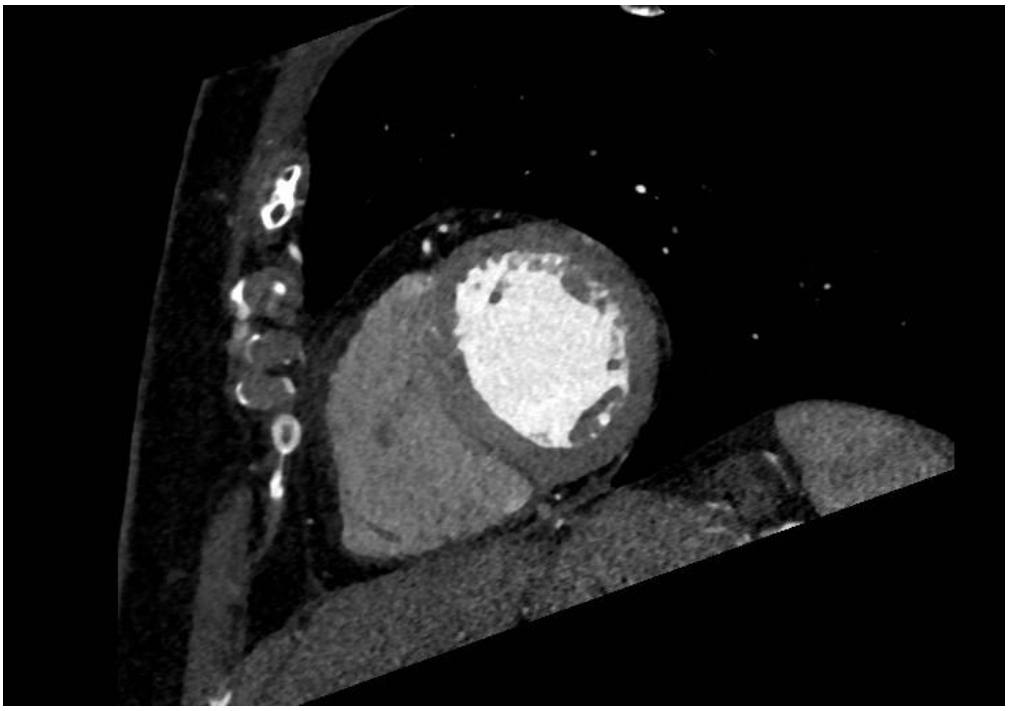
Figure 1

a



Description: Short axis view from the left ventricle (A) and curved multiplanar reformat of the right coronary artery (RCA) (B) from CT coronary angiography shows extensive, partially calcified plaques, with a high-grade stenosing lesion on the proximal RCA. **Origin:** © Department of Radiology, University Hospitals Leuven/Belgium 2018

b

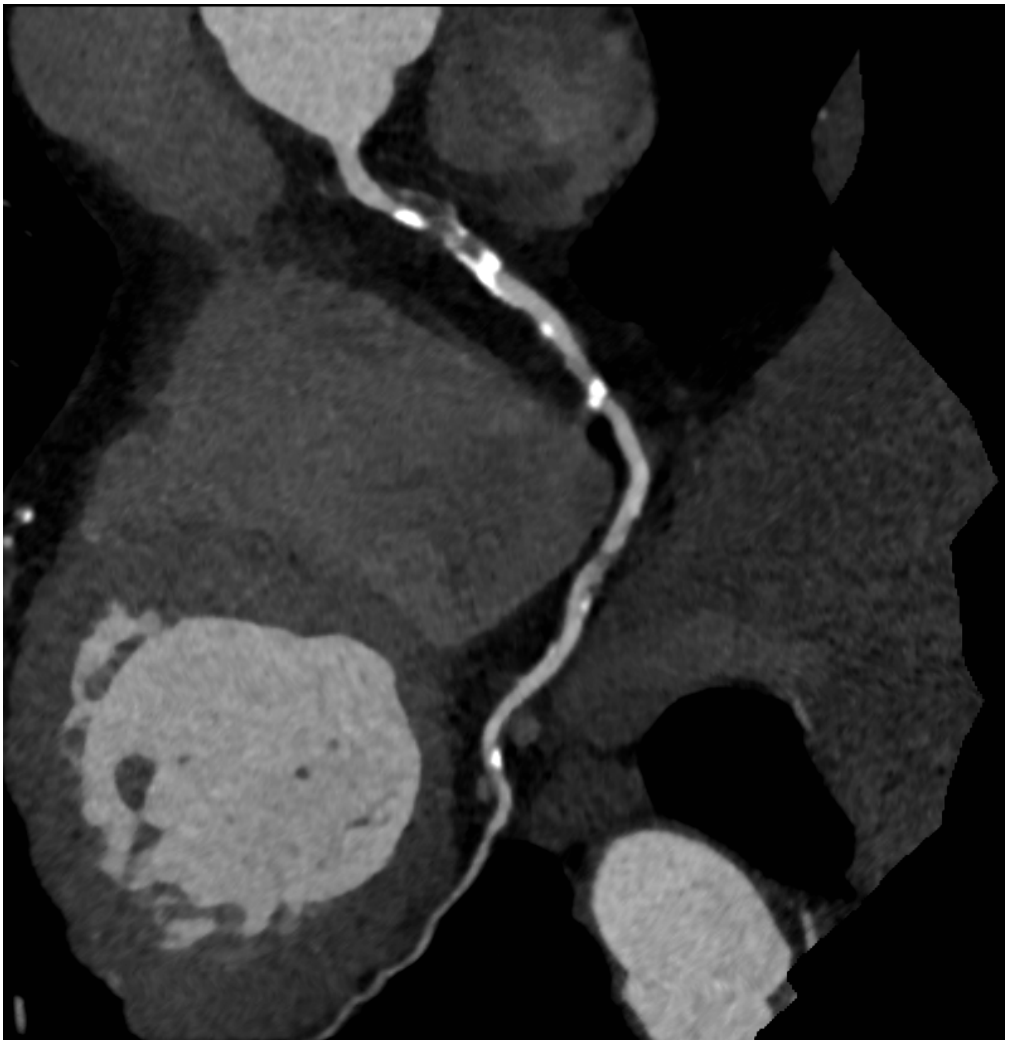


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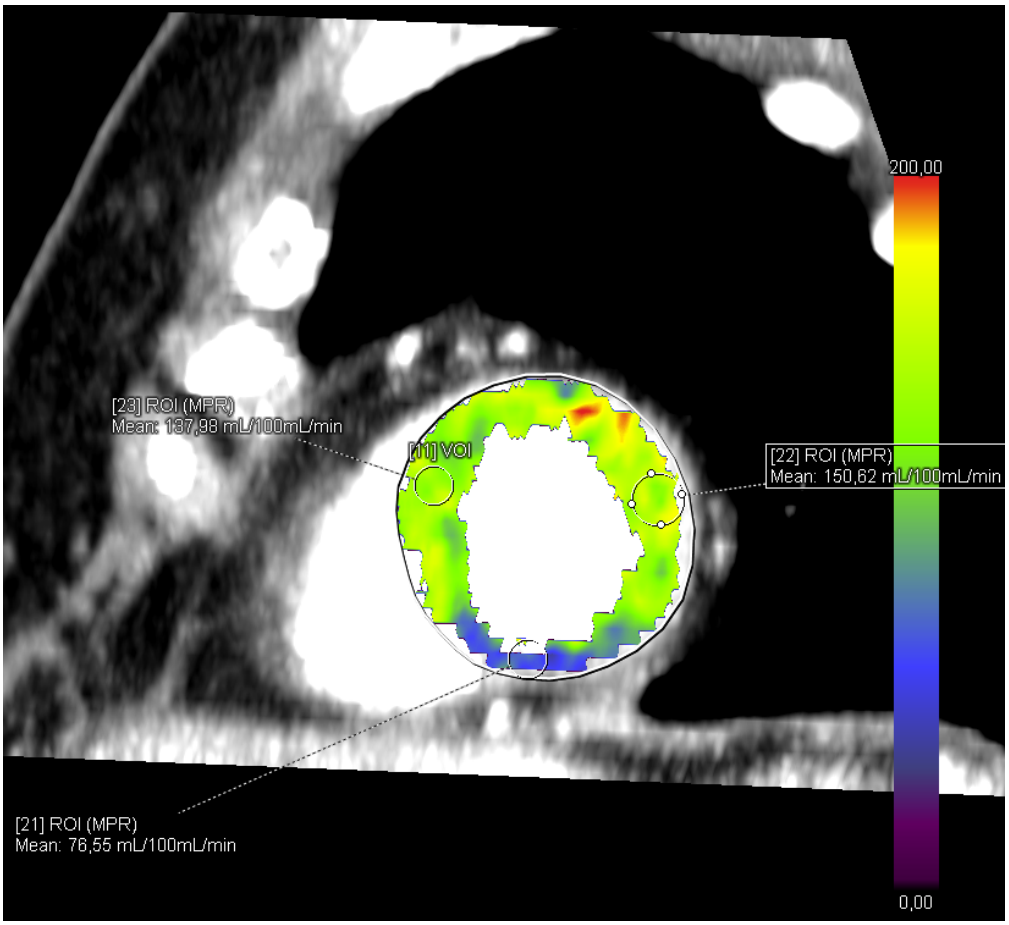
Figure 2

a



Description: Stress dynamic CT perfusion colour code map demonstrates a substantially reduced myocardial perfusion in the inferior wall with an MBF of 76,55 ml/100 ml/min at the apex (A) and an MBF of 68,52 ml/100 ml/min at the base of the left ventricle (B). **Origin:** © Department of Radiology, University Hospitals Leuven/Belgium 2018

b

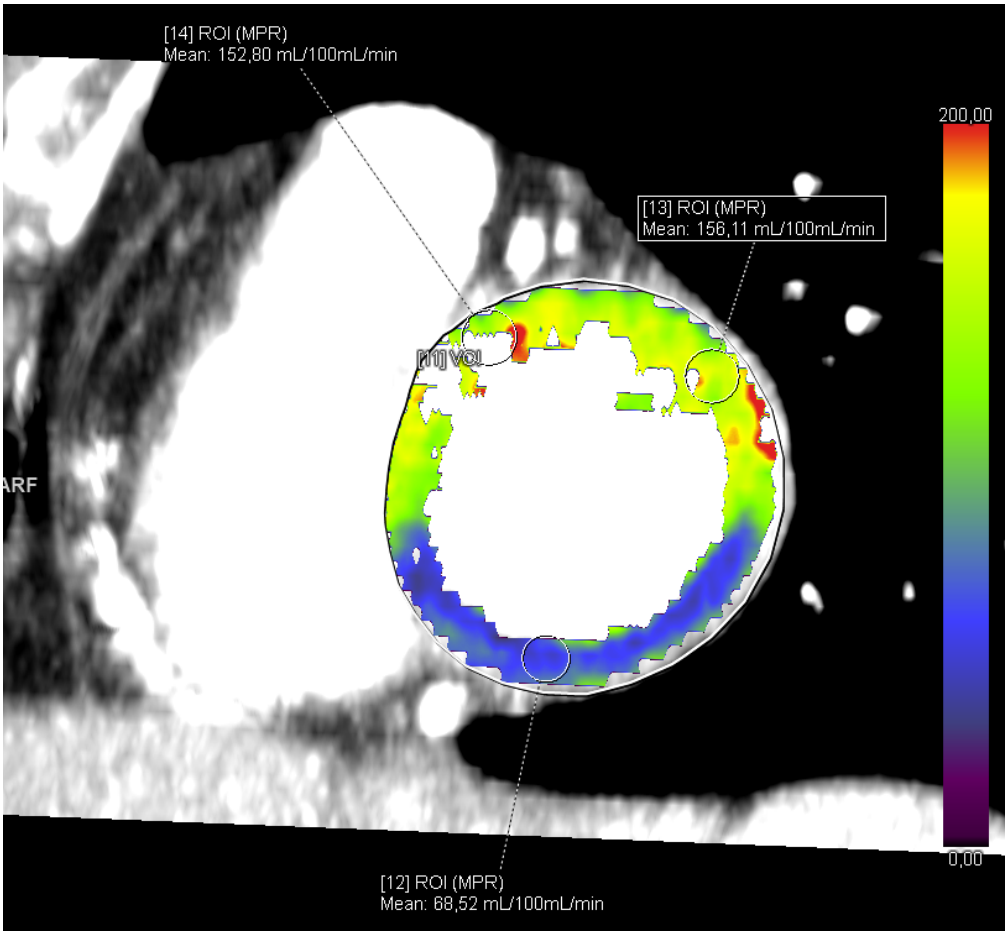


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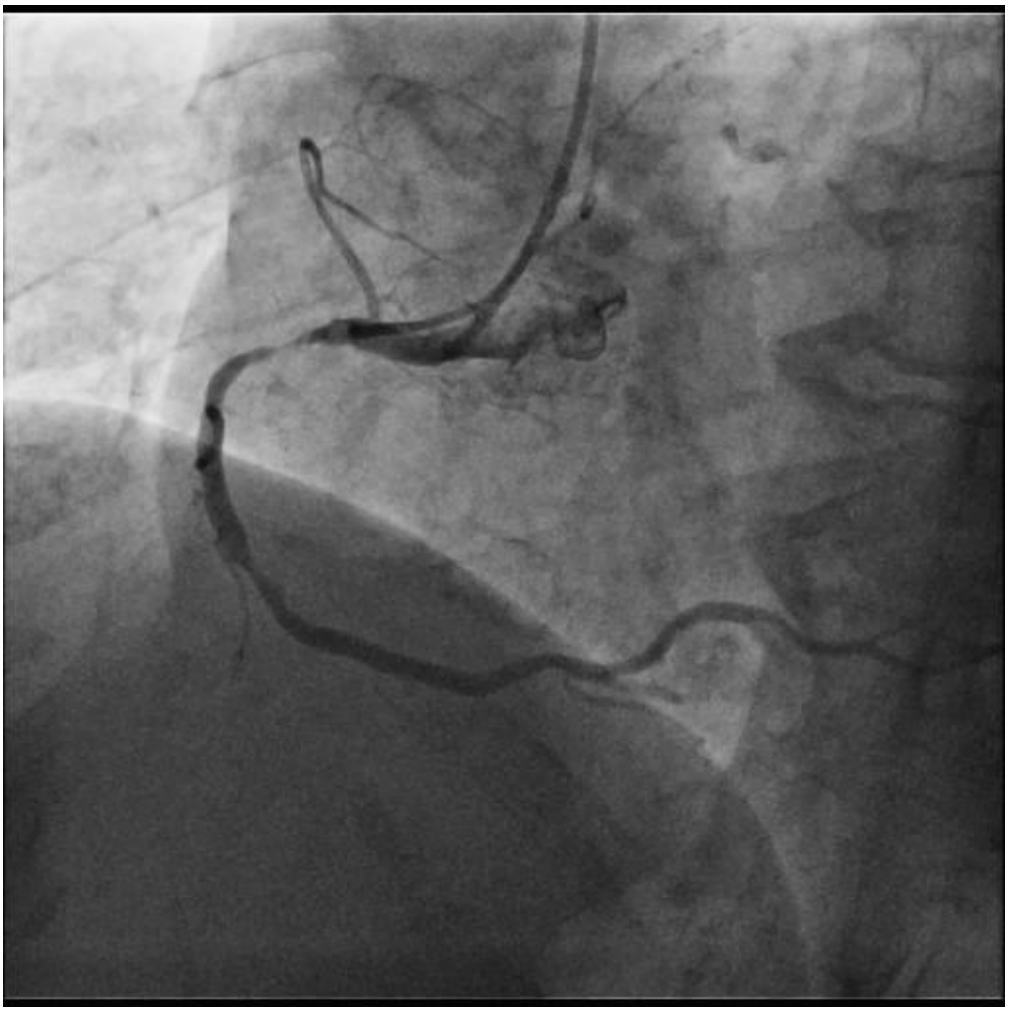
Figure 3

a



Description: Conventional coronary angiography during stenting confirms a high-grade stenosing lesion in the proximal right coronary artery. **Origin:** © Department of Cardiology, University Hospitals Leuven/Belgium 2018