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Case report

# ST-segment elevation in the recovery phase of nuclear exercise stress test with $^{99m}$Tc-sestamibi in a patient with critical RCA stenosis and subtle systolic dysfunction in speckle tracking imaging

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## Abstract

An asymptomatic Caucasian male patient underwent coronary artery disease diagnostics. Standard exercise treadmill test was inconclusive, and Holter ECG study didn't show any significant abnormalities. Considering the high risk of ischemic heart disease nuclear exercise stress test was performed, which revealed ST-segment elevation in the recovery phase of the treadmill exercise test. Single photon emission computed tomography (SPECT/CT) showed myocardial perfusion abnormalities in the inferior and lateral walls of the left ventricle. Furthermore, speckle tracking imaging showed subtle left ventricle dysfunction. Finally critical stenosis in the second segment of right coronary artery was diagnosed in coronary angiography.
**Key words: ST-segment elevation, speckle tracking imaging, nuclear exercise stress test, SPECT/CT imaging, critical RCA stenosis**

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## Case report

68-year old caucasian male was admitted to the Department of Cardiology to perform diagnostics due to suspected coronary artery disease (CAD). Patient has been treated for hypertension and type 2 diabetes (oral medications). The history of chest pain/discomfort and abnormal heart beating was negative, physical effort tolerance was adequate to lifestyle. Physical examination revealed blood pressure (BP) of 140/90 mmHg, heart rate of 80 beats per minute, body mass index 29 kg/m$^2$, no significant negative findings.

Laboratory tests revealed no abnormalities apart from elevated levels of fasting glucose (186 mg/dl) and glycated hemoglobin (7,1%). Resting electrocardiogram (ECG), Holter ECG and Holter blood pressure monitoring showed no significant abnormalities.

Echocardiography (GE VIVID 7) showed left atrium diameter of upper normal limit (40 mm). The thickness and contractility of left ventricle (LV) muscle as well as heart valves morphology and function were normal, pericardium without any pathology.

We also performed longitudinal 2d strain evaluation using the dedicated software AFI (Automated Functional Imagining). The strain 2d values of basal segments of lateral and anterior walls were far below the global longitudinal 2d strain (which is the average of all segments values). This observation suggested subtle regional

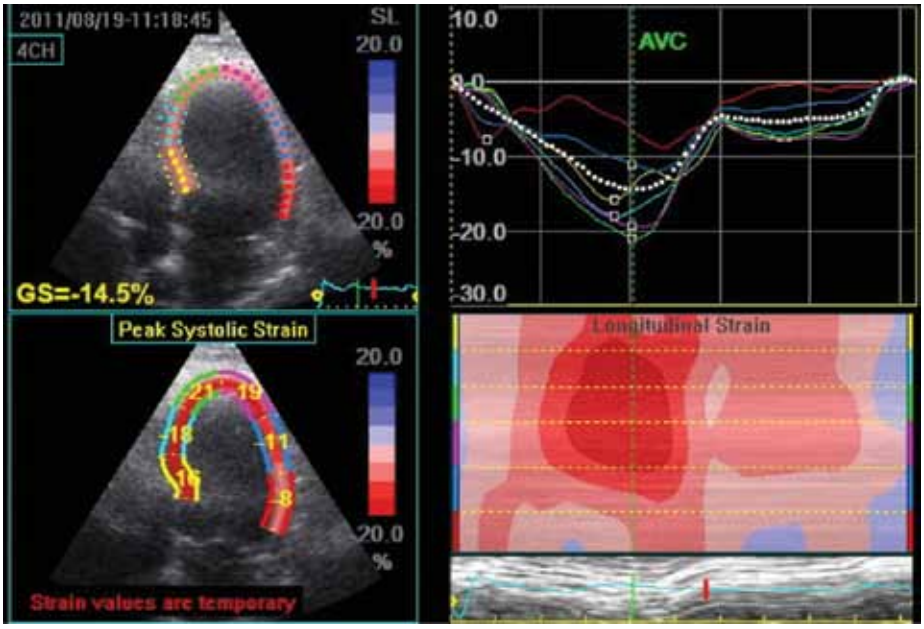


**Figure 1.** Speckle tracking imaging showing subtle regional systolic dysfunction — dedicated software (VIVID 7 — GE Healthcare)

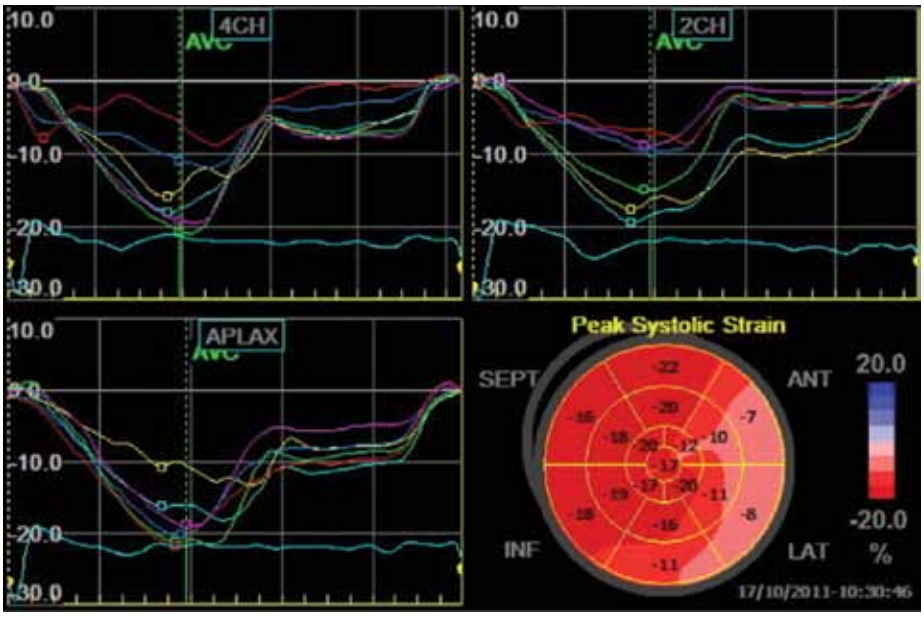


**Figure 2.** Polar map of left ventricle's walls strain estimation using speckle tracking imaging — dedicated software (VIVID 7 — GE Healthcare)

systolic dysfunction in the ischemic area, which is not detectable by standard, visual estimation of contractility [1, 2].

Considering the high risk of probable ischemic heart disease (age, gender, hypertension, type 2 diabetes mellitus, smoking in the past) the exercise ECG stress test was planned. The standard graded treadmill exercise ECG test in accordance with Bruce's protocol was inconclusive, the patient was exercised for 7 minutes until stage three (7,5 METs of exercised effort, 86% of age-predicted maximum heart rate, BP response normal). The treatment was optimised with ramipril, ASA and atorvastatinum.

Myocardial perfusion imaging (MPI) with single photon emission computed tomography (SPECT/CT) was performed with $^{99m}$Tc-sestamibi tracer. Before the nuclear exercise stress test patient was asymptomatic, ECG displayed normal sinus rhythm of 90 per minute, BP of 140/80 mm Hg. Treadmill exercise ECG test in accordance with Bruce's protocol was finished after 6 minutes and 45 seconds because of fatigue, no chest pain was reported (8 METs exercised effort, achieved heart rate of 139 per minute, which was 91% of maximal age-predicted). There was no significant ST-segment changes during exercise period. The blood pressure reaction was correct. During the first minute of recovery phase ST-segment elevated in lead II (1,5 mm), lead III (2 mm) and lead aVF (1,5 mm) with pathological Q wave in lead III and ST-segment depression in leads I, aVL, V2 — patient denied any chest pain/discomfort, no heart rhythm disorders or hypotension were observed. The ST-segment elevation returned

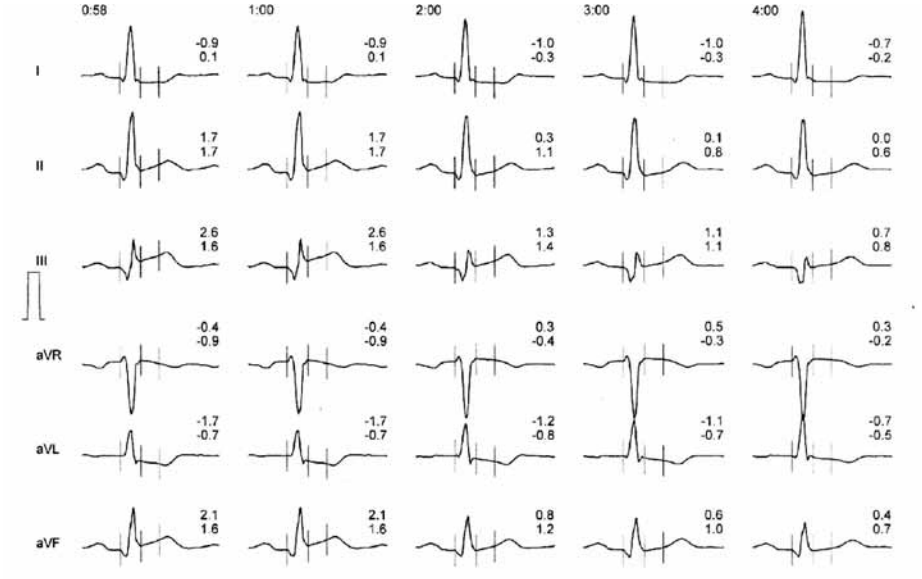


**Figure 3.** ST-segment elevation in the recovery phase of nuclear exercise stress test with $^{99m}$Tc-sestamibi tracer

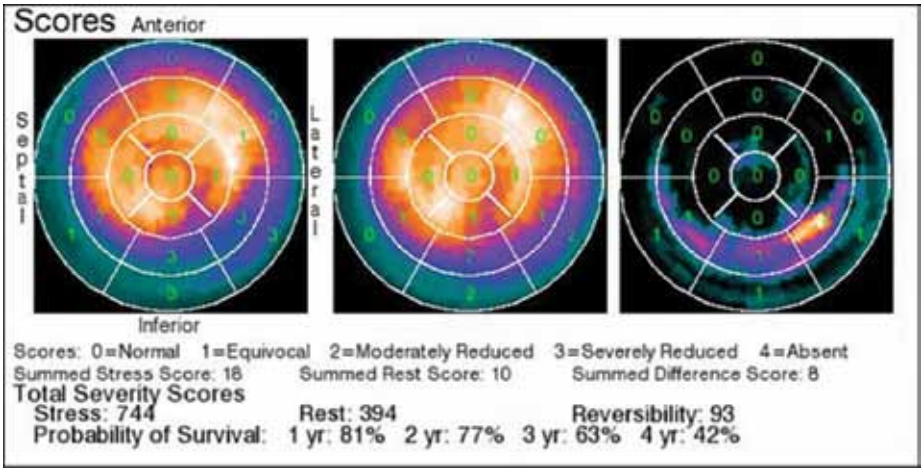


**Figure 4.** Defects and reversibility of perfusion on polar maps of $^{99m}$Tc-sestamibi MPI stress/rest 2-day study — stress MPI (left), rest MPI (middle), perfusion reversibility (right)

to previous position after 3 minutes with persisting pathological Q wave in lead III.

One hour later miocardial perfusion images were acquired with GE Infinia Hawkeye H3000WW gamma camera. The severely diminished perfusion occurred within left ventricle's inferior wall and partially in lateral wall. The next day miocardial perfusion imaging at rest was performed, showing partial improvement of regional perfusion where impaired perfusion was localised previously [3].

The left ventricular ejection fraction with SPECT/CT was evaluated (LVEF), after exercise test LVEF was 50%, LVEF was 60% at rest.

Due to CAD diagnosis the bisoprolol and clopidogrel were added to treatment, atorvastatinum dose was raised to 40 mg. After 2 weeks patient was admitted for coronary angiography and further proceedings.

Coronary angiography from right transradial approach (JR 4.0, JL 3,5 — 6F) revealed atherosclerosis involving all segments of dominant right coronary artery (RCA) with massively calcified critical stenosis in 2 segment (> 90%) and "short" 60% stenosis in 3 segment. Posterior descending artery (PDA) showed diminished flow (TIMI 1). Left Main coronary artery with narrowings below 30%, left anterior descending (LAD) with long 50% lesion involving whole 6 segment and proximal part of 7 segment. First diagonal branch (D1) was significantly narrowed from the ostium. Left circumflex artery occurred as recessive artery. Retrograde flow from LAD via septal arteries to peripherial RCA (mainly to PDA) was shown.

The patient was subjected RCA angioplasty with minimal final effect because of resistant highly calcified lesion. Stent implantation was not attempted because of persistent problem with forcing through the lesion. The 80% RCA residual stenosis in 2 segment was still present. Normal TIMI 3 flow only in the PDA was restored.

Therefore the concept of performing an RCA angioplasty using rotablation was presented and put under patient's consideration. After a month from PCI (percutaneous coronary intervention) first

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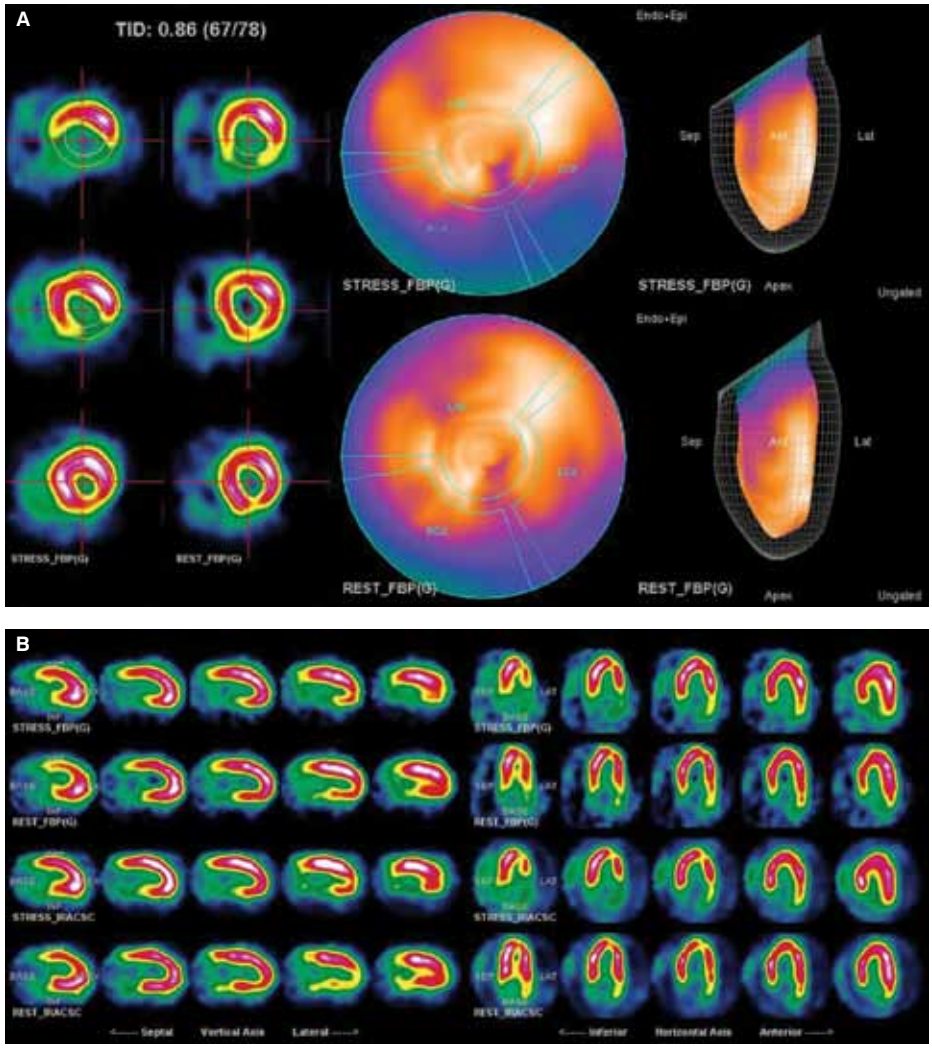


**Figure 5.** Combined image showing slices and polar maps (A) and slices (B) of $^{99m}$Tc-sestamibi MPI stress/rest 2-day study

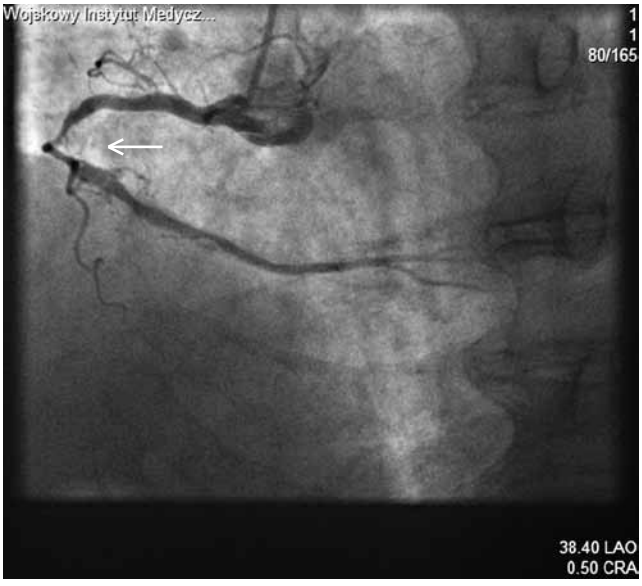


**Figure 6.** Critical stenosis concerning 2 segment of RCA in coronary angiography (arrow)

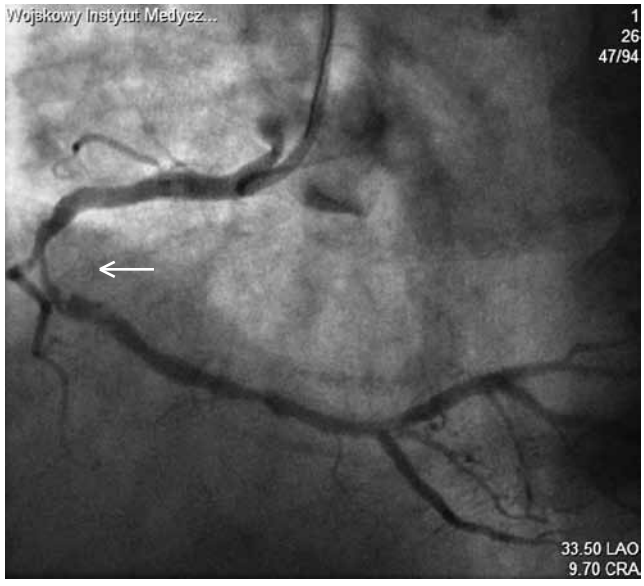


**Figure 7.** Dilatation attempt of critical stenosis in segment 2 of RCA finished with residual stenosis of 80% left (arrow)

attempt the patient was subjected to RCA rotablation with implantation of 2 EES (everolimus eluting stents) in another hospital. Normal TIMI 3 flow in RCA was restored. The short 60% lesion in distal part of 3 segment of RCA was left, as not significant.

## Discussion

ST-segment elevation provoked by exercise test is predictive of coronary artery severe stenosis and corresponds to the diseased vessel [4–8]. However, delayed ST-segment elevation during recovery phase is distinctly uncommon to be observed.

One of the concept of explanation ST-segment elevation can be main coronary arterial spasm — RCA in this case. This occurrence appeared in patients with exercised ST-segment elevation and was evaluated by coronary angiography, with the decreasing coronary blood flow. The coronary arterial spasm was observed in main coronary arteries with and without any lesions, during or immediately after exertion [4–8]. The other attempt to explain is the coronary "steal phenomenon" occurring when part of myocardium supplied by severely narrowed coronary artery is also dependent on collateral vessels from remote vessels. Blood flow depends on perfusion pressure, especially in region where supplying by collaterals seem to be appreciable. The narrowed coronary arteries always have to be maximally dilated to compensate for the decreased blood flow. Considering that, dilating the arterioles provoked by vasodilator stress agent causes decreasing perfusion pressure which leads to blood "stealing". Diminished and insufficient supply provided by artery with severe stenosis can cause acute myocardial ischemia [9, 10].

This case presented above is interesting as the severity of long RCA lesion demonstrated with ST-segment elevation in recovery phase of nuclear exercise test and left ventricle myocardium strain abnormalities evaluated by speckle tracking imaging [1, 2]. It is the first case of such phenomenon described in the literature that combines various imaging modalities, supported by novel echocardiographic strain imaging technique. The unsuccessful attempt of RCA highly calcified critical stenosis angioplasty led to rotablation resulted in RCA TIMI 3 flow.

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