CASE REPORT

Lead aVR: beyond 'No man's land'

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SUMMARY

Coronary artery disease (CAD) is one of the leading causes of mortality in the world. Treadmill test is a very useful non-invasive test to diagnose and stratify the risk of CAD. Lead aVR is usually a neglected lead while reading the ECG. We describe a case demonstrating the importance of subtle changes in lead aVR that has got a direct angiographic correlation with left main CAD. Therefore picking up the subtle clues on ECG may help in stratifying the risk and optimal treatment of the patient in a timely fashion.

BACKGROUND

Coronary artery disease (CAD) is one of the leading causes of mortality in the world.¹ Treadmill test (TMT) is a very useful non-invasive test to diagnose and stratify the risk of CAD. TMT may also be used to assess the likelihood of anatomically severe disease that may be of prognostic importance.² High risk TMT features are suggestive of more advanced CAD. Patients with left main coronary artery (LMCA) disease are associated with very poor clinical outcomes, but it is very difficult to identify these patients only on the basis of clinical presentation. Exercise TMT may be useful to give certain clues that point towards LMCA disease.

CASE PRESENTATION

A 50-year-old man who is a chronic smoker presented to the outpatient department with a history of chest pain of 5 days duration. Chest pain was retrosternal, pricking in character, non-radiating, non-exertional and intermittent in type. He had no history of diabetes, hypertension, dyslipidaemia or family history of premature CAD. He had no history of breathlessness, palpitation or syncope. Physical examination was unremarkable.

INVESTIGATIONS

Twelve-lead ECG showed normal sinus rhythm with no significant ST-T wave changes. Resting transthoracic echocardiogram revealed no segmental wall motion abnormalities and preserved left ventricular systolic function. Routine laboratory investigations were normal. Cardiac troponin level was within normal limit. The patient was subjected to TMT as per Bruce protocol. At the end of the first stage of TMT the patient developed mild chest discomfort associated with ST-T wave changes in the form of ST elevation in lead aVR and aVL with ST depression in inferior leads (figure 1A; black arrows). Thereby, the TMT was stopped prematurely. During recovery phase (figure 1B; black arrows), the ST elevations persisted in lead aVR and aVL along with new appearance of

downsloping ST depression in the inferolateral leads and it was followed by complete normalisation of those changes. There was a hypotensive response during recovery. All these features suggested severe CAD.

DIFFERENTIAL DIAGNOSIS

As the patient developed ST segment elevation in lead aVR with diffuse ST depression in inferolateral leads during TMT, the differential diagnosis of LMCA disease, LM equivalent disease, that is, ostioproximal left anterior descending (LAD)/left circumflex artery, or triple vessel disease was considered.

TREATMENT

As the TMT was suggestive of high risk features, the patient was admitted to coronary care unit and started on antiplatelets, statin, β -blocker and nitrates. After informed consent, patient was taken for early coronary angiogram (figure 2A and video 1) which showed 90% stenosis of the ostial LMCA with distal thrombolysis in myocardial infarction (TIMI) II flow which was reconfirmed after giving nitroglycerine injection; rest of the coronary system was normal. During angiogram the patient developed angina associated with gross ST depression along with haemodynamic compromise, thereby, the decision for emergency percutaneous transluminal coronary angioplasty to LMCA was taken, and 4×10 mm drug-eluting stent (figure 2B and video 2) was placed successfully with no complication. After angioplasty, his ECG changes normalised. He was discharged on dual antiplatelets, high-dose statin and β -blocker.

OUTCOME AND FOLLOW-UP

At 1 month of follow-up, patient is asymptomatic and doing well.

DISCUSSION

For many years stress TMT has been used for evaluation of patients suspected of having CAD as well as its severity and urgency of the required intervention.^{3–5} Like ST elevation myocardial infarction (MI), ST elevations in leads with no q-waves during TMT also localise the territory of ischemia in coronary arteries, but lead aVR is infrequently used for this reason.⁶ Many studies have demonstrated correlation of ST elevation in lead aVR and LMCA disease in acute coronary syndrome but their role in patients with chronic stable angina is less well established.⁷ Lead aVR of standard 12-lead ECG depicts changes in electrical activation of the upper right part of the heart, including right ventricular outflow tract and the basal part of the interventricular septum.⁸ In the

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Figure 1 Treadmill test (TMT) at the end of first stage of Bruce protocol (A) showed ST elevation in lead aVR and aVL (thick arrows) along with ST depression in inferior leads (thin black arrows). TMT during recovery phase (B) revealed persistent ST elevation in lead aVR and aVL (thick arrows) along with ST depressions in inferolateral leads.

presence of LMCA or proximal LAD stenosis particularly, the basal part of the left ventricle is subject to ischaemia that results in superior deviation of the net vector in the left ventricle which is reflected in the ECG as elevation of ST segment in the leads aVR and V1, and ST segment depression in leads V5, V6 as well as inferior leads. One study reported that the isolated exercise-induced ST elevation in lead aVR in detecting LMCA disease had sensitivity of 85%, specificity of 50%, positive predictive value of 25.8% and negative predictive value of 94.2%.⁹ Tuna Katircibasi *et al*¹⁰ showed that exercise-induced ST segment elevation in lead aVR accompanied by ST segment elevation in lead V1 had a sensitivity of 85.7% and a specificity of

81.6% in predicting LMCA disease. Iwasaki *et al* found that ST segment elevation in lead aVL was observed in high incidence in LMCA-related acute MI. The ST segment elevation in leads aVL and I in patients with LMCA-related acute MI was caused by ischaemia of myocardium perfused by the diagonal branch associated with acute LMCA obstruction.¹¹ It appears that the reduced exercise tolerance and/or early ST segment depression in the first two stages of exercise with relatively low peak heart rate is a clue to the presence of LMCA disease. Thomson and Keleman¹² found that 33% of their patients with exercise-induced hypotension had at least 75% stenosis of LMCA. Our case demonstrates that the elevation of ST segment

Figure 2 Coronary angiogram in right anterior oblique (RAO)-caudal projection (A) revealed 95% ostial left main coronary artery (LMCA) stenosis (white arrow). Check angiogram (B) after LMCA stenting with 4.0×10 mm drug-eluting stent (DES) (white arrow) showed normally flowing LMCA with distal thrombolysis in myocardial infarction (TIMI) III flow.

Video 1 Coronary angiogram in RAO-caudal projection revealed 95% ostial LMCA stenosis with distal TIMI II flow. LMCA, left main coronary artery; RAO, right anterior oblique; TIMI, thrombolysis in myocardial infarction.

Video 2 Check angiogram in RAO-caudal projection after LMCA stenting with 4.0×10 mm DES showed normally flowing LMCA with distal TIMI III flow. LMCA, left main coronary artery; RAO, right anterior oblique; TIMI, thrombolysis in myocardial infarction.

in lead aVR and aVL along with ST depression in inferolateral leads and hypotension are very useful to predict significant LMCA disease. So one has to be vigilant enough to pick up the subtle changes to take prompt actions.

Learning points

- ▶ Treadmill test (TMT) is a very useful test to identify high-risk patients before invasive tests like conventional coronary angiogram.
- ▶ During exercise stress testing, ST segment changes in lead aVR give an important clue to detect left main coronary artery (LMCA) disease.
- ▶ Generalised ST depressions and hypotension are additional features during TMT which indicate more advanced coronary artery disease, especially LMCA disease.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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