Reminder of important clinical lesson

Significance of exercise induced U wave inversion as a marker for coronary artery disease

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Exercise stress testing for detecting inducible ischaemia was first introduced in the 1950s and remained one of the only methods of stressing the heart for years to come. The presence of inducible ischaemia was assessed by ECG changes during exercise apart from other factors, namely, duration of exercise, blood pressure and heart rate response, metabolic equivalents achieved, etc. With the emergence of other tests to look for inducible ischaemia, for example, dobutamine stress echocardiography and myocardial perfusion scanning and also as the threshold for invasive evaluation has decreased, unusual and infrequently encountered ECG changes are not looked for during exercise stressing with the same degree of diligence. The authors describe below the case of a 49-year-old male whose left anterior descending artery stenosis was diagnosed on exercise stress test on the basis of a negative U wave.

BACKGROUND

It is important that apart from usual parameters in exercise test we look for, that is, ST segment changes and T wave changes or change in axis, subtle changes like U wave inversion are not overlooked as we may miss significant coronary artery disease.¹⁻⁴

CASE PRESENTATION

A 49-year-old male was referred to the local open access Rapid Access Chest Pain Clinic (RACPC) after presenting to his general practitioner with exertional chest pain of a few weeks duration. He was hypercholesterolaemic (total serum cholesterol 6.9) and was a current heavy smoker (30

Figure 1 Baseline ECG recorded in sitting position.

Figure 2 ECG at peak exercise.

Figure 3 ECG at 00:50 min into recovery phase with inverted U waves in precordial leads V2–V4.

cigarettes per day for 30 years). He was non-diabetic, non-hypertensive with no family history of ischaemic heart disease. Clinical examination was unremarkable.

INVESTIGATIONS

His resting 12-lead ECG was normal (figure 1).

As part of the RACPC protocol, he was subjected to a treadmill exercise tolerance test (ETT) using the Bruce

protocol. He could exercise for 03:59 min, achieving 74% of target predicted heart rate before the test was stopped because of reproduction of chest pain and ECG changes.

The patient first reported symptoms of left arm pain at 03:05 min into the exercise test which increased as the exercise progressed. At peak exercise, the ECG showed a change in QRS axis to -45 degrees with associated intra-ventricular conduction delay (figure 2).

Figure 4 Images from myocardial perfusion scan.

Figure 5 (A) Minimal left main stem disease,significant ostial LAD disease. (B) Minimal Circumflex atheromatous disease. (C) Minor atheromatous disease of RCA.

The changes of an intraventricular conduction delay resolved quickly (00:50 min into recovery) with normalisation of QRS axis to +45 degrees. Inverted U waves were noted in leads V2–V4 with ST sagging in inferior limb leads

(II, III and aVF) and V5–V6 (figure 3). The inversion of U waves persisted until 04:50 min into recovery phase (figure 3). The ECG returned to baseline at 07:50 min post exercise.

In view of the unusual ECG changes, he was subjected to a myocardial perfusion scan that confirmed a large area of reversible perfusion defect involving the apex and anterior/antero-septal myocardium (figure 4). Perfusion to the rest of the myocardium was normal. The left ventricular function post stress was mildly reduced and was calculated to be 49% as a result of septal hypokinesia.

Subsequent coronary angiography (figure 5A,B) revealed distal left main disease with subtotal occlusion of the left anterior descending artery (LAD) at the ostium. Moderate mid vessel disease was seen in the circumflex and there was mild proximal disease of right coronary artery territory (figure 5C).

TREATMENT

The patient subsequently underwent 2-vessel bypass surgery.

OUTCOME AND FOLLOW-UP

The patient was subsequently followed up in clinic with complete resolution of symptoms. He quit smoking completely.

DISCUSSION

U wave inversion is defined as a discrete negative deflection between the T and P waves relative to the 'isoelectric' PR segment.^{5 6} U waves represent prolonged repolarisation of myocardial M cells. Under normal conditions the M cells are electrically coupled to adjacent cell layers. However, in conditions that produce electrical uncoupling, these M cells have significant effects on repolarisation producing prolonged rounded ST-T waves or U waves. The finding of U wave inversion on an ECG at rest or baseline is a non-specific finding. It is significant when observed post exercise, being originally described in early 1940s. Subsequent studies in the late 1970s, demonstrated a significant correlation of U wave inversion with either left main or LAD disease.^{2 3 7} It is best observed during recovery from exercise as the heart rate slows, becoming upright after several

minutes, which helps to verify the finding.⁴ Negative U waves can also be induced by dobutamine stress echocardiography with up to 96% specificity for coronary artery disease.

PATIENT'S PERSPECTIVE

Patient was happy that a simple investigation, that is, exercise test led to further investigations and surgery with complete resolution of symptoms.

Learning points

- ▶ U wave inversion in exercise test is a marker of left anterior descending disease and should be looked for diligently.
- ▶ If U wave inversion is found, on exercise test, it should be investigated with further investigations to rule out significant ischaemia.

Competing interests None.

Patient consent Obtained.

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