CASE REPORT

Chest pain in a patient with a tall R wave in V1

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SUMMARY

An 83-year-old man 2 days postoperative from L3 to L5 laminectomy developed sudden onset of chest pain. Initial ECGs demonstrated a tall R wave in V1 and ST-segment depression in leads V2–V5. A posterior ECG was performed, but failed to demonstrate ST elevations. The patient was initially treated as a non-ST-segment elevation myocardial infarction with weight-based enoxaparin. On further review, the patient's ECG was identified as a STEMI equivalent, and he underwent cardiac catheterisation. He was noted to have a near complete occlusion of the posterior descending branch of the right coronary artery (RCA). Bare-metal stents were placed in the proximal and distal RCA, with restored flow distal to the lesions. The patient was transferred to the intensive care unit for observation, and was noted to develop atrial fibrillation. Rate control was achieved with diltiazem, and the patient was started on dabigatran. Medical therapy including aspirin and clopidogrel was initiated, and the patient was discharged home.

BACKGROUND

Posterior wall myocardial infarction (PWMI) represents an easily missed lesion due to the lack of leads lying directly over the posterior wall of the left ventricle on the standard 12-lead ECG. It is encountered in the setting of inferior and lateral wall MIs, where it worsens prognosis due to the involvement of a larger area of the myocardium, or as an isolated finding. In either situation, the key to identifying the PWMI is recognising the reciprocal changes in the anterior leads that represent an ST-segment elevation myocardial infarction (STEMI) equivalent. This case illustrates the importance of recognising that the differential for a tall R wave in V1 includes PWMI. The tall R wave in V1 is rarely a normal variant, and several important diagnoses must be considered in the evaluation of a patient with this finding.¹ This case also illustrates that caution must be used when relying on the expanded posterior ECG, as the increased distance between the myocardium and the ECG leads will result in more subtle elevations of the ST segment. A tall R wave in the right clinical setting suggestive of PWMI represents a STEMI equivalent and should prompt early intervention with early percutaneous coronary intervention.

CASE PRESENTATION

An 83-year-old Caucasian man with a medical history of hypertension, Alzheimer's dementia and neurogenic claudication was admitted for laminectomy of L3–L5. The patient tolerated the procedure well and had been transferred to a general medical floor following surgery, but on

postoperative day 2 the patient was noted to be less responsive with decreased respirations. He was transferred to the intensive care unit (ICU) and treated with a naloxone infusion and CT scans of the chest and head were performed to assess for pulmonary embolism and ischaemic or haemorrhagic stroke, respectively. Both studies were negative, and the patient was noted to improve with naloxone and supportive care.

On postoperative day 3, the patient was transferred back to a general medical floor, but was noted to develop tachycardia and chest pain. An ECG (figure 1) performed at that time demonstrated ST-segment depressions in leads V2–V5. The patient received sublingual nitroglycerine with improvement in his chest pain. He was initially started on weight-based enoxaparin for presumed non-ST-segment elevation myocardial infarction. The patient was monitored with serial ECGs and cardiac enzymes were sent, as these ECG changes represented an acute change from his baseline ECG.

Six hours later the patient noted a return of his chest pain and his ECG at that time showed a tall R wave in V1 with a deep 2 mm ST depression (figure 2). A posterior ECG was performed using leads V4R–V6R, which failed to show significant ST-segment elevation (figure 3). The family consented on behalf of the patient and he was taken to undergo cardiac catheterisation.

INVESTIGATIONS

Initial cardiac enzymes revealed a troponin I of 3.33 ng/mL and a peak troponin I of 16.7 ng/mL (reference range less than 0.034 ng/mL). A transthoracic echocardiogram was obtained demonstrating borderline normal ejection fraction of 50–55%. The interventricular septum was noted to be akinetic from the base to the apex. The patient underwent left heart catheterisation by right radial approach, and was noted to have 80–90% occlusion of the distal right coronary artery (RCA) with significant proximal occlusion of 60% (figure 4). The left main trunk showed 40% distal occlusion and the left anterior descending showed diffuse mild disease with 60% occlusion of the middle segment. The left circumflex showed 60% occlusion of the distal obtuse marginal (figure 5).

DIFFERENTIAL DIAGNOSIS

- ▶ Posterior myocardial infarction
- ▶ Right bundle branch block
- ▶ Type A Wolff-Parkinson-White syndrome
- ▶ Right ventricular hypertrophy
- ▶ Misplaced precordial leads
- ▶ Normal variant

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Figure 1 Initial ECG demonstrating ST-segment depressions in leads V2–V5.

TREATMENT

On further review of the ECGs, the tall R wave with ST depression in V1 was identified as a STEMI equivalent representing infarction of the posterior wall. Consent was obtained from the patient's family. The patient was transferred to the cardiac catheterisation lab in stable condition and bare-metal stents were placed in the distal RCA initially with restoration of flow distal to the stent. The proximal RCA was noted to have been dissected during passage of the guide wire, so an additional bare-metal stent was placed during the procedure. No intervention was undertaken for the left circumflex or left anterior descending. Given his recent orthopaedic surgery and possible issues with medication non-compliance secondary to his dementia, the decision was made to use bare-metal stents.

OUTCOME AND FOLLOW-UP

The patient was transferred to the ICU where he was monitored for 24 h, during which time he was noted to have developed atrial fibrillation with a rapid rate. Owing to his age and

comorbidities, rate control was deemed preferable to attempts to convert to a sinus rhythm. Rate control was achieved with diltiazem, and a decision was made to place him on dabigatran for embolic stroke prevention after careful consideration of bleeding risks and discussion with the family. The patient was also started on daily aspirin and clopidogrel with plans to continue the latter for a minimum of 2 months. The patient experienced complete resolution of his pain and was discharged home. On follow-up he was noted to be doing well.

DISCUSSION

PWMI is common, occurring in 15–20% of acute MIs,^{2 3} and due to the dual blood supply of the posterior wall of the left ventricle from the RCA and left circumflex arteries, it is often found in conjunction with inferior and lateral wall infarction. Evidence of PWMI on the standard 12-lead ECG is subtle, since none of the limb or precordial leads are positioned directly over the posterior wall. The clinician must recognise mirror image changes in leads facing the uninjured anterior wall.^{4–6} PWMI as

Figure 2 Repeat ECG demonstrating a tall R wave in V1 with 2 mm ST depression.

Figure 3 Posterior ECG notable for a lack of ST-segment elevations in the posterior leads.

evidenced by a tall R wave in V1 represents an easily missed STEMI equivalent, especially as an isolated finding. A tall R wave in V1, defined as an R/S ratio of equal to or greater than one, can result from other common conditions, such as right bundle branch block, ventricular tachycardia, acute right heart strain or right ventricular hypertrophy, type A Wolff-Parkinson-White syndrome, or less common conditions, including dextrocardia or muscular dystrophy.¹ It is important to recognise that it is estimated to be a normal variant in only 1% of patients without underlying cardiac pathology.⁷

The presence of ST depressions in leads V1 through V3 serves as further evidence for acute infarction of the posterior wall. These changes represent the inverted reflection of ST-segment elevations in the posterior leads. Patients suffering PWMI have been shown to have a worse prognosis when occurring in

conjunction with other ST-segment elevations.² Furthermore, it has been demonstrated that patients suffering PWMI benefit from acute reperfusion therapy.²⁻³ As a result, the addition of posterior chest leads has been advocated as an inexpensive and relatively simple strategy to increase detection and early intervention in these patients. This strategy is sometimes referred to as the 15-lead ECG, since it adds three additional leads: V4R parallel to V4 on the right chest, and V7 through V9 on the posterior chest.⁸ In two subsequent studies looking at the use of the 15 lead ECG, Zalenski *et al*⁹⁻¹⁰ demonstrated an increased sensitivity in detecting ST elevation; and in approximately 2% of patients with an initial 12-lead ECG without ST elevation, the expanded ECG detected unique elevation greater than 1 mm.

Owing to the increased distance and tissue between the myocardium and the posterior chest leads, ST-segment elevations

Figure 4 Right coronary artery angiography demonstrating 80–90% stenosis in the distal segment.

Figure 5 Left coronary circulation with 50% stenosis of the left anterior descending artery.

may be more subtle than those noted in the anterior leads. Wung *et al*¹¹ demonstrated ST-segment elevations of 0.5–1 mm in 45% of patients with balloon occlusion of the left circumflex artery, which supports the recommendation of many authors to lower the diagnostic criteria from 1 to 0.5 mm for diagnosing STEMI in the posterior leads. This may explain the unimpressive findings of the posterior leads applied in this patient.

Learning points

- ▶ A tall R wave in V1 is an abnormal finding that may indicate acute posterior wall myocardial infarction in the right clinical setting.
- ▶ Use of posterior and right-sided chest leads (the 15-lead ECG) can increase the sensitivity of detecting acute myocardial infarction.
- ▶ ECG evidence of posterior wall myocardial infarction should be considered a STEMI equivalent, with a goal for rapid recognition and initiation of reperfusion therapy.

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Competing interests None.

Patient consent Obtained.

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