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CME ARTICLE

Non-ischaemic causes of ST segment elevation

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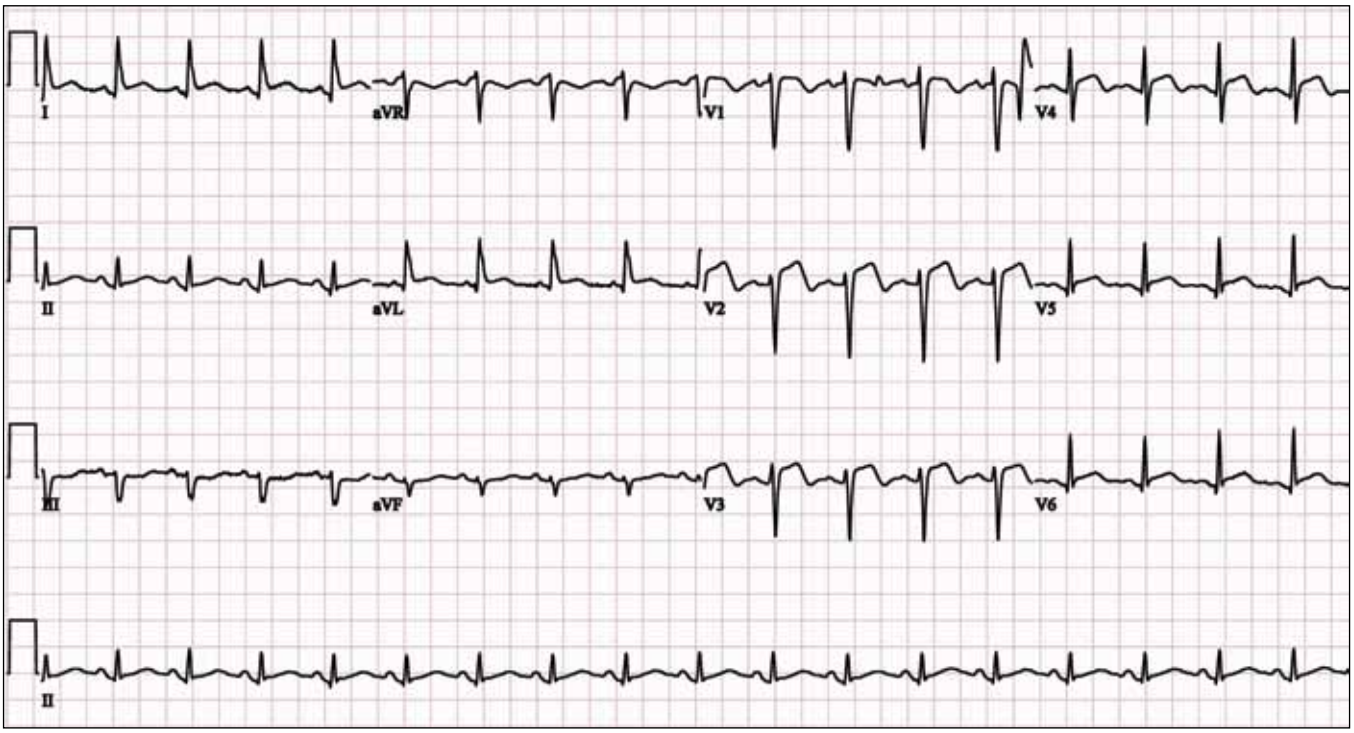

Fig. 1 ECG shows ST elevation in leads V1–V6, I and aVL with biphasic T wave in V1–V4. Mild ST depression can be seen in lead III.

CASE 1
CLINICAL PRESENTATION

A 54-year-old woman with a history of dyslipidaemia was admitted with shortness of breath following an upper respiratory tract infection and a stressful argument with her husband on the morning of her admission. Her symptoms progressively worsened and she was subsequently intubated in the emergency department. She was transferred to our hospital due to an abnormal electrocardiogram (ECG). What are the ECG abnormalities seen in Fig. 1?

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ECG INTERPRETATION

The ECG shows sinus tachycardia with elevated ST elevation (1–3 mm) in the anterior and lateral leads (V1–V6, I and aVL). The T waves in V1–V4 are biphasic. Mild ST depression is seen in lead III.

CLINICAL COURSE

The patient was rushed to the cardiac catheterisation laboratory for emergency coronary angiography, which showed a non-significant 25% stenosis of both the left anterior descending and right coronary arteries. Her left ventriculogram showed apical and mid-left ventricular ballooning (Fig. 2). She was diagnosed as suffering from stress-induced cardiomyopathy. Supportive measurement with intra-aortic balloon pump (IABP) was initiated. Further investigation showed only a mild elevation of the cardiac enzymes, with a peak creatine kinase (CK)-MB fraction of 11.0 ug/L and troponin T of 1.09 ug/L compared to ST segment elevation myocardial infarction (STEMI), where the cardiac enzymes would usually be significantly higher. Echocardiogram showed moderate left ventricular systolic dysfunction. The patient's condition improved and she was weaned off the IABP and extubated within the next 48 hours. She was discharged well from the hospital. Repeat echocardiogram done five months later showed normal left ventricular function with an ejection fraction of 60% and no apical ballooning.

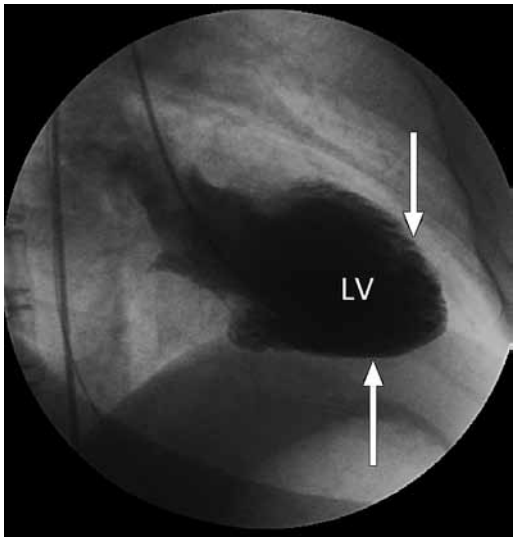

Fig. 2 Left ventriculogram shows apical and mid-left ventricular ballooning (arrows) during systole. LV: left ventricle

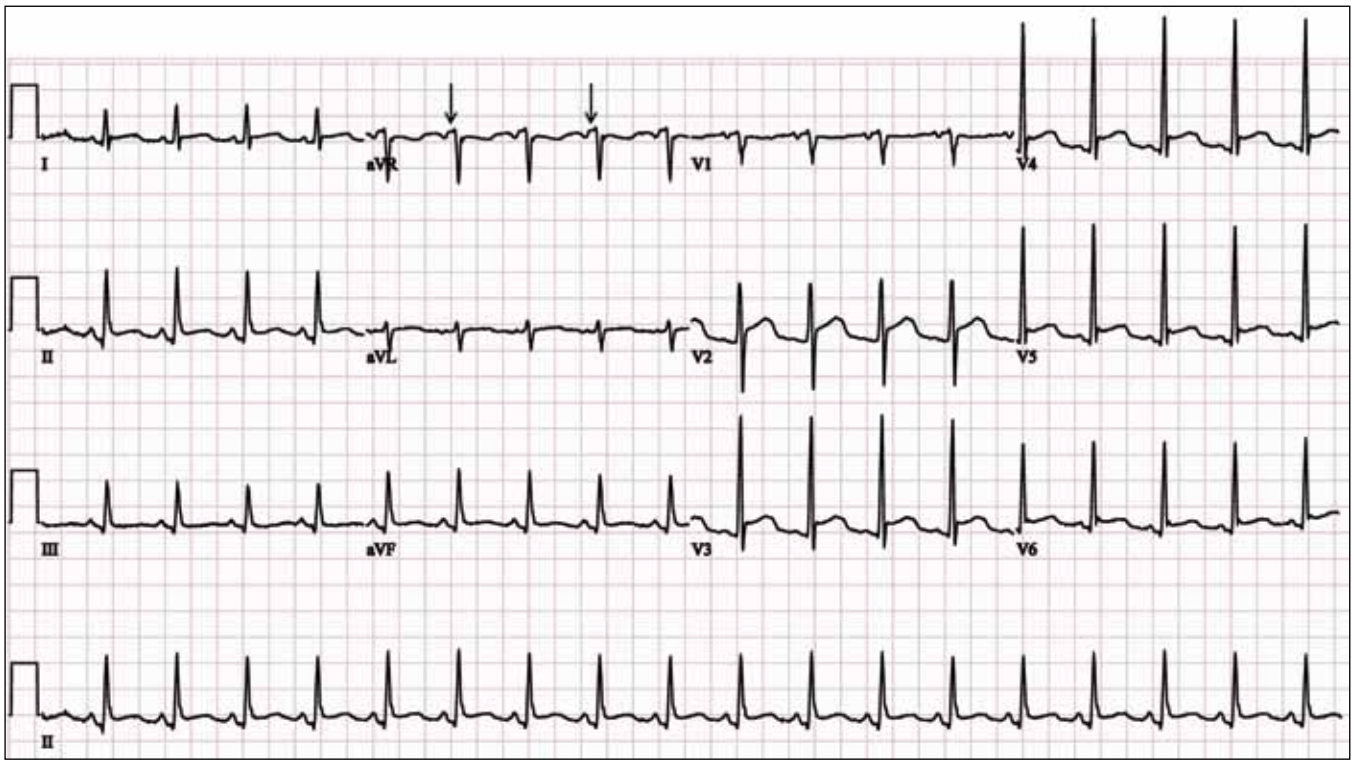

Fig. 3 ECG shows sinus tachycardia with widespread ST elevation. PR elevation (arrows) is seen in lead aVR and reciprocal PR depression in lead II.

CASE 2
CLINICAL PRESENTATION

A 59-year-old man with a history of prostate cancer (status post prostatectomy) and myelodysplastic syndrome, with recent transformation to acute myeloblastic leukaemia (AML), was admitted with chest pain of three days' duration. The chest pain was worse on deep inspiration, and was accompanied by fever, chills and palpitation. He had normal blood pressure and the heart rate was 120 beats per minute. What are the ECG abnormalities seen in Fig. 3?

ECG INTERPRETATION

There is diffuse ST-segment elevation in leads V2–V6, I, II and aVF, and reciprocal ST depression in aVR. The ST elevation is about 2 mm and is mildly concave. There is PR segment elevation in aVR and reciprocal PR segment depression in lead II. These abnormalities are consistent with acute pericarditis.

CLINICAL COURSE

The patient underwent urgent bedside echocardiography, which showed moderate pericardial effusion with no definite features of pericardial tamponade. However, he deteriorated the next day, and repeat echocardiogram showed worsening of the pericardial effusion (Fig. 4). Pericardiocentesis was done and 350 mL of haemoserous fluid was drained. Fluid cytology revealed no malignancy and all cultures sent from the fluid sample were negative. His acute pericarditis and pericardial effusion were most likely exacerbated by the newly diagnosed AML. The patient's condition improved after he was started on chemotherapy for AML. Repeat echocardiogram ten days later revealed no pericardial effusion. He stayed in the hospital for a total of 30 days for chemotherapy and post-chemotherapy care. He was discharged well from the hospital.

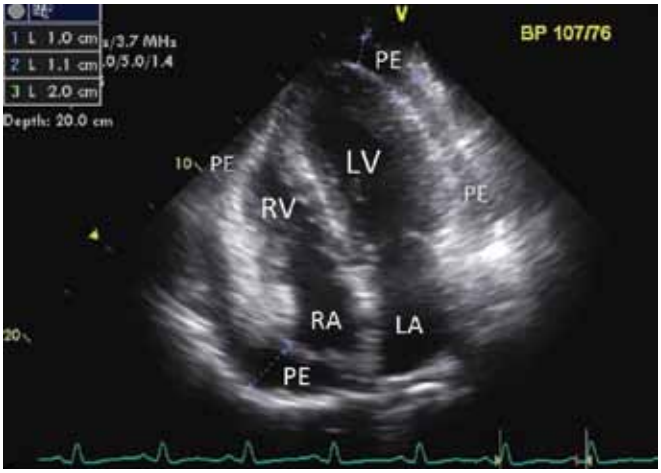

Fig. 4 Echocardiogram in apical 4-chamber window shows circumferential pericardial effusion. PE: pericardial effusion; RA: right atrium; RV: right ventricle; LA: left atrium; LV: left ventricle

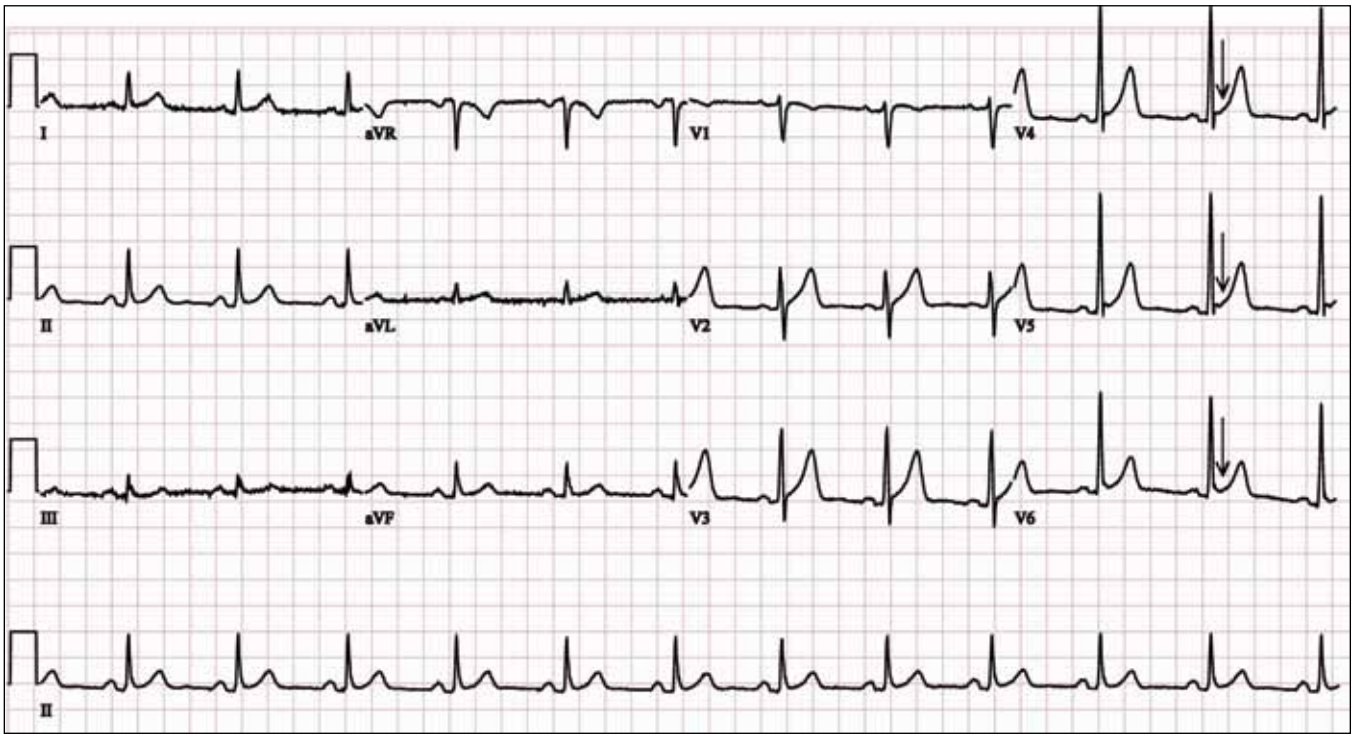

Fig. 5 ECG shows sinus rhythm with concave ST elevation (arrows) in leads V4–V6. There are prominent and asymmetrical upright T waves. No reciprocal ST depression is seen in the inferior leads.

CASE 3
CLINICAL PRESENTATION

A 58-year-old man with hypertension and hyperlipidaemia was electively admitted for transforaminal lumbar inter-body fusion of L4–L5 with bilateral decompression. The cardiology team was consulted postoperatively to review his ECG. What is the ECG diagnosis in Fig. 5?

ECG INTERPRETATION

The ECG shows ST segment elevation (concave upwards) associated with tall T waves in leads V3–V6. There is no reciprocal depression seen in the inferior leads. This is consistent with a normal variant pattern of the ECG known as 'early repolarisation pattern'.

Table I. Causes of non-ischaemic ST segment elevation on ECG.

Acute pericarditis
Normal variants (early repolarisation pattern)
LVH, LBBB (mainly in V1–V2 or V3)
Takotsubo cardiomyopathy
Acute pulmonary embolism
Post cardioversion
Brugada pattern (Coved-like ST segment elevation in V1–V3)
Type IC anti-arrhythmic drugs
Hypercalcaemia, hyperkalaemia

LVH: left ventricular hypertrophy; LBBB: left bundle branch block

CLINICAL COURSE

The patient was in good condition postoperatively without any active cardiac symptoms. Blood tests revealed normal troponin T, with a slight elevation of total CK level, most likely due to muscle injury post surgery. A repeat ECG showed no significant change. The patient was subsequently discharged from the hospital. Further evaluation with a nuclear stress test a few months later showed normal perfusion with normal left ventricular ejection fraction.

DISCUSSION

STEMI remains the most important cause of ST segment elevation in the ECG, and needs be recognised and treated immediately with urgent coronary revascularisation.[1] However, there are several non-ischaemic causes of ST segment elevation on ECG (Table I) that are also important. Stress-induced cardiomyopathy is also known as Takotsubo cardiomyopathy, apical ballooning syndrome or broken-heart syndrome. This condition is more common in females,[2] mostly postmenopausal, and usually triggered by an acute medical illness or sudden and intense emotional[3] or physical stress (such as death of relatives, particularly if unexpected, domestic abuse, arguments, catastrophic medical diagnoses and natural disasters).

Clinical presentation of stress-induced cardiomyopathy has many similarities with acute myocardial infarction. The most common symptoms are acute onset of chest pain, commonly accompanied by ST elevation in the ECG in a majority of the patients.[4] Coronary angiogram, which is frequently performed on such patients, usually shows no significant coronary lesions that can contribute to the significant decrease in left ventricular function and apical ballooning of the left ventricle. The mechanisms for these ECG findings are currently unclear. The possible hypothesis is catecholamine excess or micro-vascular dysfunction. Echocardiogram usually shows ballooning of the apex and the mid-left ventricular cavity with hyperkinesis on the basal wall.[5] Despite the severity and acute presentation of this condition, the abnormality is most often transient. Supportive treatment during the illness and heart failure medication during the recovery phase often result in complete recovery of the symptoms and heart function.

The second case highlights the other frequent cause of ST elevation. In contrast to the first case, the ST elevation in acute pericarditis has some distinct and specific characteristics, especially in the acute phase. The ST segment elevation rarely exceeds 5 mm and usually retains its normal concavity, unlike in STEMI.[6] Reciprocal ST depression is absent except in aVR. Since the pericardium wraps around the heart, the ST changes are more generalised, and thus present in most leads and do not correspond to anatomical grouping based on coronary vascularisation. Another important clue to the diagnosis of acute pericarditis is the frequent presence of PR segment elevation in aVR, with reciprocal PR segment depression in lead II.[7]

The last case highlights the importance of knowledge that normal variant ECG or 'early repolarisation pattern' can mimic the ST elevation seen in myocardial infarction. This variant occurs in 2%–5% of the population, mainly in young adults who are athletically active.[7] The characteristic concave ST elevation and asymmetrical tall upright T wave need to be recognised in order to differentiate this normal variant from STEMI. A few recent studies have suggested the association of this syndrome with an increased risk of sudden death from ventricular tachyarrhythmias. However, in these studies, ST elevation was noted to be present mainly in the inferior (and not the lateral leads), and prominent J waves were seen. There are, at present, important ongoing studies on this issue. However, it is currently accepted that early repolarisation pattern is generally a benign ECG finding with an excellent prognosis, although in a few patients, a very low risk of ventricular tachyarrhythmia and sudden death may be present.

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ABSTRACT ST segment elevation is one of the most important electrocardiographic features that need to be recognised. Although ST segment elevation myocardial infarction is one of the main causes of this abnormality, there are other non-ischaemic causes that are also important. We discuss reversible apical ballooning syndrome or Takotsubo cardiomyopathy, pericarditis and a case of ST segment elevation due to 'early repolarisation pattern'.

Keywords: acute pericarditis, early repolarisation, ECG, ST segment elevation, Takotsubo cardiomyopathy
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SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME

(Code SMJ 201206A)

	True	False
Question 1. The following are causes of stress-induced (Takotsubo) cardiomyopathy:		
(a) Severe emotional stress.	☐	☐
(b) Acute psychosis.	☐	☐
(c) Severe acute illness.	☐	☐
(d) Natural disasters.	☐	☐
Question 2. These statements are true for Takotsubo cardiomyopathy:		
(a) The ECG changes can be easily differentiated from ST segment elevation myocardial infarction.	☐	☐
(b) No treatment is necessary for the acute phase.	☐	☐
(c) Most patients will recover and retain normal left ventricular ejection fraction.	☐	☐
(d) Performing cardiac catheterisation on these patients is considered unnecessary.	☐	☐
Question 3. Causes of non-ischaemic ST elevation on ECG include:		
(a) Hypokalaemia.	☐	☐
(b) Acute pulmonary embolism.	☐	☐
(c) Left bundle branch block pattern.	☐	☐
(d) Brugada ECG pattern.	☐	☐
Question 4. The following ECG changes are characteristic for acute pericarditis:		
(a) The ECG changes are widespread because the pericardium wraps around the heart.	☐	☐
(b) PR elevation can be seen in lead aVR.	☐	☐
(c) PR depression and ST elevation can be seen in lead II, causing PR-ST segment discordance.	☐	☐
(d) ST elevation is usually less than 5 mm.	☐	☐
Question 5. The following are true of 'early repolarisation pattern' on ECG:		
(a) The ST elevation is convex.	☐	☐
(b) T wave can mimic those of hyper-acute T wave changes in acute myocardial infarction.	☐	☐
(c) T wave abnormality is usually asymmetrical.	☐	☐
(d) It is more common in older people.	☐	☐

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(1) Answers will be published in the SMJ August 2012 issue. (2) The MCR numbers of successful candidates will be posted online at www.sma.org.sg/cme/smj by 16 July 2012. (3) All online submissions will receive an automatic email acknowledgement. (4) Passing mark is 60%. No mark will be deducted for incorrect answers. (5) The SMJ editorial office will submit the list of successful candidates to the Singapore Medical Council. (6) One CME point is awarded for successful candidates.

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