A young woman with chest pain and ECG changes

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Articles in this section use cases to illustrate the emergency management of patients presenting in general practice with cardiac problems. They are inspired by, but not based on, real patient situations.

Anna, a 34-year-old teacher, presents to you, her GP, with chest pain and shortness of breath. The week prior to presentation, she had been diagnosed with a salmonella infection, which she acquired while on holiday in Bali. She had been treated with antibiotics, and the diarrhoea had resolved. However, one day later, she developed a pressure-like sensation in the centre of her chest and had difficulty catching her breath.

Her medical history was unremarkable and she had no risk factors for cardiovascular disease. She takes an oral contraceptive pill. Physical examination revealed she was afebrile, with a blood pressure of 130/80 mmHg and pulse rate of 80 beats per minute. Lungs were clear and cardiovascular examination revealed a friction rub heard best at the left lower sternal border. Anna complained that her pain became much worse when she was asked to lie flat on the examination table.

Her ECG showed sinus tachycardia, widespread concave ST elevation, PR depression (I, II, aVF, V4 to 6), reciprocal ST depression and PR elevation in leads V1 and aVR (see Figure 1).

What would be your differential diagnoses?

Answer: More severe differential diagnoses include acute coronary syndrome, pulmonary embolism, aortic dissection and pneumothorax, whereas less severe diagnoses include viral pleurisy and costochondritis. Anna's ECG is consistent with pericarditis.

What clues do you look for on history and examination to suggest a diagnosis of pericarditis?

Answer: Signs to suggest a diagnosis of pericarditis are described below.

- Pain, which is almost always pleuritic, usually aggravated by inspiration, coughing and sometimes swallowing. The pain is

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Table 1. Four stages of ECG changes in acute pericarditis	
Stage 1	Widespread concave ST elevation and PR depression throughout most of the limb leads (I, II, III, aVL, aVF) and precordial leads (V2 to V6). Reciprocal ST depression and PR elevation in lead aVR (± V1)
Stage 2	ST segments return to isoelectric line. T wave amplitude decreases
Stage 3	T-wave inversion (especially leads I, V5 and V6)
Stage 4	Normalisation of the T waves

typically more severe when supine and relieved when sitting up or leaning forward.
- Vital signs such as fever, tachycardia, tachypnoea.
- Pericardial friction rub may be heard on cardiac auscultation. This is the pathognomonic sign of pericarditis. It is nearly 100% specific, but not very sensitive. The classic pericardial friction rub consists of three phases corresponding to the movement of the heart during atrial systole (which is not heard in patients with atrial fibrillation), ventricular systole and the rapid filling phase of early ventricular diastole. However, some rubs are present only during one or two phases of the cardiac cycle. In patients with pericardial friction rub, the rub has been found to be triphasic in 56% of patients in sinus rhythm. Overall, biphasic rubs have been found to be present in 33% of patients and monophasic rubs in 15% of patients. Detecting this sign may be difficult as it can be transient and migratory. Pericardial friction rubs have a superficial scratchy or squeaking quality and are best heard with the diaphragm of the stethoscope over the left lower sternal edge.
- Clinical signs of tamponade (Beck's triad), including raised jugular venous pressure, muffled heart sounds and hypotension.

What are the most common causes of pericarditis?

Answer: Possible causes of pericarditis include:
- idiopathic (25%; most of these are probably viral)
- infectious
  - viral (coxsackie B virus, Epstein-Barr virus, influenza, human immunodeficiency virus)
  - bacterial (staphylococcal infection, streptococcal infection, tuberculosis)
  - fungal (particularly histioplasmosis)
- malignancy (25%; primary or secondary)
- autoimmune/connective tissue disease (systemic lupus erythematosus, rheumatoid arthritis, polyarteritis nodosa)
- trauma (blunt or penetrating, postpericardiotomy, radiation injury)
- associated with acute myocardial infarction
- drugs (e.g. phenytoin, penicillin)
- systemic illness (uraemia, myxoedema).

What are the typical findings on ECG that would suggest pericarditis?

Answer: The ECG in acute pericarditis can evolve through as many as four stages of changes, but these changes are not always significant (see Table 1). Typical ECG evolution has been noted in 60% of cases of pericarditis. Of note is that sinus tachycardia is also common in acute pericarditis due to pain and/or pericardial effusion.

What ECG criteria may help differentiate acute pericarditis from acute myocardial infarction?

Answer: Although chest pain and raised troponin levels are presenting features in both acute pericarditis and acute myocardial infarction, the ECG changes in acute pericarditis differ from

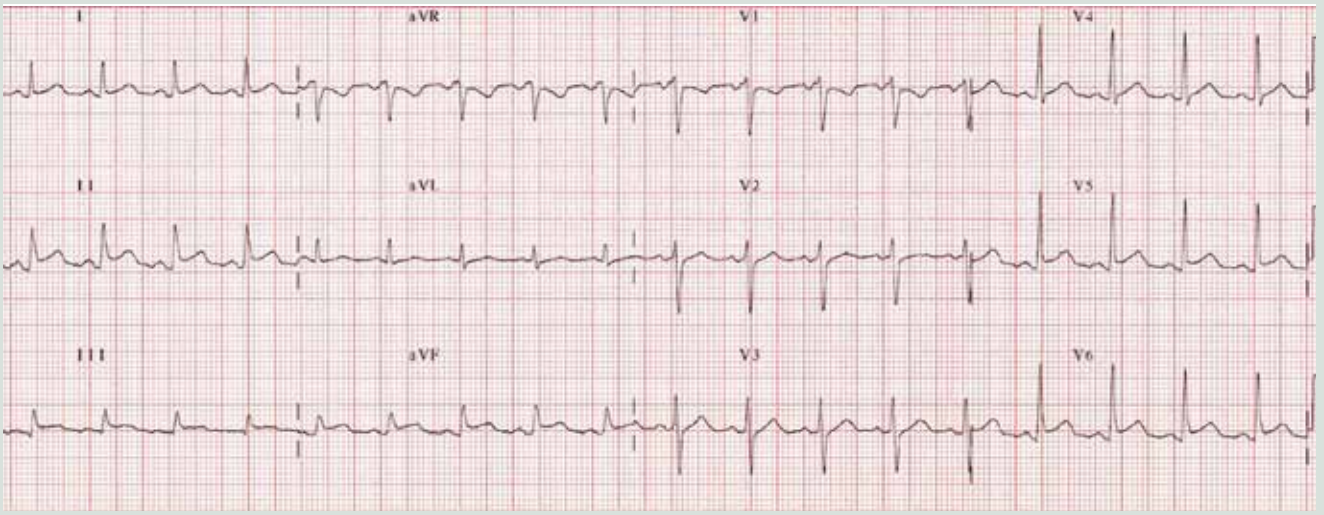

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Figure 1. ECG showing sinus tachycardia, widespread concave ST elevation, PR depression (I, II, aVF, V4 to 6), reciprocal ST depression and PR elevation in leads V1 and aVR.

Table 2. Differences in ECG criteria for acute pericarditis and acute myocardial infarction

Acute pericarditis	Acute myocardial infarction
ST segment elevation occurs in all leads except in aVr and V1	ST segment elevation occurs in leads corresponding to specific coronary artery territories
Reciprocal changes are not seen except in leads aVR and V1 Concave-upward ST segment elevation ST segment elevation rarely more than 5 mm	Acute ST segment elevation myocardial infarction is often associated with reciprocal ST segment changes Convex ST segment elevation ST segment may be more than 5 mm in height
T wave inversion usually occurs after ST elevation returns to baseline	T wave inversion usually occurs spontaneously with ST elevation
ST segment axis ranges from 30 to 60 degrees	ST segment axis ranges from 100 to 120 degrees
PR segment depression (sensitivity 64%)	No PR segment depression
No evolution of Q wave	Q wave may evolve

that of acute myocardial infarction in several ways (see Table 2).

How can you differentiate benign early repolarisation (also called 'high take-off') from pericarditis?

Answer: Benign early repolarisation can be difficult to differentiate from pericarditis because both conditions are associated with concave ST elevation. A useful way to distinguish between each of these conditions is to look at the ST segment/T wave ratio (see Figure 2). The vertical height of the ST segment elevation (from end of PR to J point) is measured and compared with the amplitude of the T wave in lead V6. A ratio of more than 0.25 suggests pericarditis and a ratio of less than 0.25 suggests benign early repolarisation.

How can you further assess for pericarditis?

Answer: Further assessment is outlined below.

- Full blood count, electrolytes, urea and creatinine, troponin (30% elevated, concurrent myocarditis) and blood cultures (if bacterial infection suspected) should all be measured. Anna's results were all normal except for a white cell count of 10.5 x 10^9/L and a C-reactive protein level of 21 mg/L. Her estimated pretest probability for pulmonary embolism using Well's criteria was low risk. The pulmonary embolism rule-out criteria was then used to assess the need for a D-dimer test. Her D-dimer result was negative at 0.29 µg/L (<0.5 µg/L).
- Chest x-ray has limited value and is typically normal in patients with pericarditis. Although patients with a substantial pericardial effusion may have cardiomegaly, this is uncommon in pericarditis because at least 200 mL of fluid must accumulate before the cardiac silhouette enlarges. Chest x-ray can be useful to rule out other causes of chest pain.
- Echocardiography is still the gold-standard test for pericarditis. It helps with diagnosis of pericardial effusion, evaluates possible effect on haemodynamics and allows assessment of myocardial function. The absence of an effusion on echocardiography does not exclude pericarditis. In one series of 300 consecutive patients with acute pericarditis, pericardial effusion was present in 60% of patients. In most cases the effusion was small or moderate in size without haemodynamic consequences. Cardiac tamponade was present in only 5% of patients.
- Patients with suspected pericarditis and/or chest pain should be sent by ambulance to the emergency department to rule out acute coronary syndrome.

Anna wants to know what they will do for her in hospital and if she has to stay overnight. What do you tell her?

Answer: You tell her the following.

- Treatment depends on the underlying cause.
- Severe causes of similar chest pain,

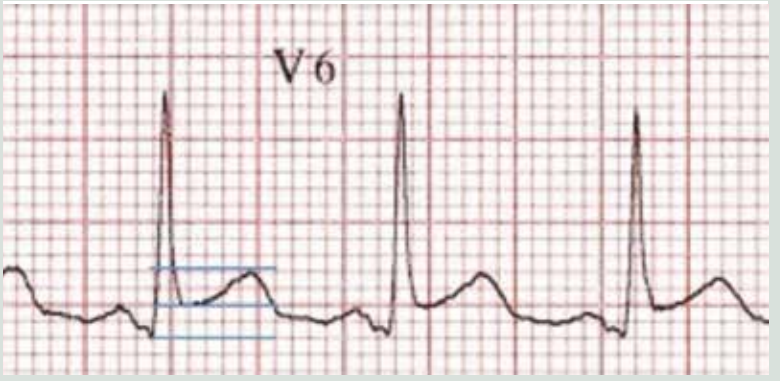

Figure 2. ST-segment/T-wave ratio in lead V6. ST-segment elevation is 2 mm, T-wave amplitude is 4 mm. Ratio = 0.5, which is >0.25. This is suggestive of pericarditis.

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such as acute myocardial infarction or pulmonary embolism, need to be excluded.
- Pericarditis usually has a benign course lasting one to two weeks.
- Good symptom control is usually achieved with use of NSAIDs (e.g. ibuprofen 400 to 600 mg three times daily for seven days to three weeks).
- Corticosteroids may be effective if the pain is severe and does not respond to NSAIDs within 48 hours.
- In the case of recurrent pericarditis or steroid-dependent pericarditis, several studies have shown that colchicine is an effective substitute, prescribed as a loading dose of 0.5 mg twice daily for six months (adjusted for patients with renal impairment). The mechanism of action is its anti-inflammatory effect on neutrophil function.
- Colchicine is also now increasingly used with NSAIDs as first-line therapy for pericarditis.
- Hospital admission is usually not necessary and follow-up echocardiography is not needed unless symptoms fail to resolve.

What are the indicators of a poor prognosis?

Answer: Indicators include:
- temperature above 38°C
- subacute onset over weeks
- immunosuppression
- history of use of anticoagulants
- associated myocarditis
- large pericardial effusion.

After discharge from the emergency department, Anna rings you and asks what she should now look out for?

Answer: After starting treatment and being discharged from hospital, Anna should be aware of possible complications. These may include worsening shortness of breath, worsening chest pain and palpitations. These may be a sign of her condition worsening and should prompt reassessment to look for specific complications, including:
- pericardial effusion
- cardiac tamponade
- constrictive pericarditis
- heart failure (if associated myocarditis)
- arrhythmia (however uncommon).

What are the pearls in diagnosis of acute pericarditis?

Answer:
- Acute pericarditis is diagnosed by the presence of at least two of the following criteria: typical chest pain, pericardial friction rub, suggestive ECG changes, and new or worsening pericardial effusion.
- Acute myocardial infarction should always be considered as a possible diagnosis in patients who present with chest pain because the clinical presentation for this condition may be similar to acute pericarditis.
- Although use of the ECG criteria (see Table 2) has shown to decrease the incidence of acute pericarditis being misdiagnosed as acute myocardial infarction, the ECG is still not a very sensitive diagnostic tool and may lead to misdiagnosis. Some patients with pericarditis but misdiagnosed with acute coronary syndrome have been treated with thrombolysis and have developed complications such as cardiac tamponade requiring urgent pericardiocentesis. In these cases, coronary angiography is a preferable alternative to thrombolysis. **CT**

Key points

- **Acute pericarditis is diagnosed by the presence of at least two of the following criteria: typical chest pain, pericardial friction rub, suggestive ECG changes, and new or worsening pericardial effusion.**
- **Patients with suspected pericarditis and/or chest pain should be sent by ambulance to the emergency department of their local hospital to rule out acute coronary syndrome.**
- **Echocardiography is still the gold-standard test for pericarditis.**
- **The ECG changes in acute pericarditis differ from that of acute myocardial infarction in several ways.**
- **Treatment of pericarditis depends on the underlying cause.**
- **Indicators for poor prognosis in patients with pericarditis include temperature above 38°C, subacute onset over weeks, immunosuppression and large pericardial effusion.**

Further reading

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COMPETING INTERESTS: None.