Reminder of important clinical lesson

The importance of an ECG: back to basics

Golaleh Haidari,¹ Kirsty Gray,² Senthil Kirubakaran³¹Department of Genitourinary Medicine, St Thomas' Hospital, London, UK²Department of Acute Medicine, St Thomas' Hospital, London, UK³Department of Cardiology, St Thomas' Hospital, London, UK

Correspondence to Dr Golaleh Haidari, ghaidari@doctors.net.uk

Summary

A 48-year-old man presented to accident and emergency with syncope on a background history of 3 weeks of increasing shortness of breath. He collapsed at home prompting admission. He was a smoker with a 30-pack-year history. On examination, he was found to be tachypnoeic and hypoxic, with a raised JVP and quiet heard sounds. He was haemodynamically stable and a chest x-ray showed right upper-lobe collapse.

His resting ECG demonstrated electrical alternans prompting urgent referral to the cardiologist for echocardiography. This revealed a large pericardial effusion with evidence of right ventricular diastolic collapse. In view of this, he underwent urgent pericardiocentesis.

A subsequent CT scan showed bilateral pleural effusions and multiple lung nodules. Both pericardial and pleural fluid cytology were reported as metastatic non-small cell adenocarcinoma. The pericardial fluid continued to reaccumulate requiring a pericardial window. He was referred to the oncology team for palliative chemotherapy.

BACKGROUND

In our patient, the finding of electrical alternans on the ECG, along with the clinical examination findings led to a strong suspicion of pericardial effusion and tamponade and urgent referral to the cardiologist. This case demonstrates the importance of careful interpretation of the ECG together with the clinical context. In this case, a delay in the diagnosis may have resulted in significant haemodynamic compromise and cardiac arrest despite a stable blood pressure on presentation, as there was evidence of right ventricular collapse on echocardiography.

CASE PRESENTATION

A 48-year-old Portuguese gentleman presented to accident and emergency with syncope. He reported a 3-week history of increasing shortness of breath on exertion, leading to collapse with loss of consciousness at home. He had been well prior to this with no medical history and had been an active cyclist until 3 weeks prior to admission.

On examination, he was found to be tachypnoeic with a respiratory rate of 30, hypoxic on air (P02 9.2), had a raised JVP and quiet heart sounds. His blood pressure was 115/70 mm Hg. A chest x-ray showed a right-sided upper-lobe collapse of unclear aetiology and an enlarged cardiothoracic ratio. His Glasgow coma scale was 15/15.

He had no relevant family history. He was a smoker with a 30-pack-year history, and was unemployed with no recent foreign travel.

INVESTIGATIONS

His resting ECG showed electrical alternans (figure 1) which prompted urgent referral to the cardiologist for an echocardiogram. Echocardiography revealed a large pericardial effusion with evidence of right ventricular diastolic collapse (figure 1). In view of this, he underwent an urgent pericardiocentesis which drained 2.3 l in total of

blood-stained fluid. This was sent for microscopy and cytology. The electrical alternans promptly resolved with drainage of pericardial fluid (figure 1). A formal echocardiogram on the following day revealed biventricular dysfunction with severe tricuspid regurgitation which did not improve on subsequent scans.

He underwent a CT scan which showed bilateral pleural effusions, a right upper-lobe collapse and multiple lung nodules (figure 2). His sputum was negative for acid-fast bacilli on three occasions and his HIV status was also negative. Approximately, 1 l of pleural fluid was subsequently drained, and bronchoscopy showed a large obstructing tumour. Pericardial and pleural fluid cytology were reported as metastatic non-small cell adenocarcinoma, with bronchial biopsy confirming an acinar adenocarcinoma.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis for syncope is extensive. Our patient had a clear history of increasing shortness of breath on exertion, therefore massive pulmonary embolus, a cerebrovascular event, and cardiac pathologies including acute myocardial infarction, myocarditis and arrhythmias need to be considered and excluded.

In the absence of trauma, the causes of pericardial effusion include bacteria (pneumonia and tuberculosis), viruses (Coxsackie, HIV and influenza), postmyocardial infarction and cardiac surgery (Dressler's syndrome), post-radiotherapy and complications of systemic diseases (sarcoid, rheumatoid arthritis and systemic lupus erythematosus).

OUTCOME AND FOLLOW-UP

The pericardial fluid continued to reaccumulate, requiring a pericardial window. He was taken over by the oncology team for further management.

Figure 1 ECG showing electrical alternans in our patient in conjunction with echocardiogram findings.

DISCUSSION

Cardiac tamponade is caused by the accumulation of fluid in the pericardial space resulting in raised venous pressures. When the pericardium is stretched, there is an exaggeration of normal inspiratory decrease in systolic blood pressure. The current formal definition of pulsus paradoxus is an inspiratory fall in systolic blood pressure of over 10 mm Hg. Kussmaul's sign can be defined as a paradoxical increase in venous pressure with inspiration.¹

Cardiac tamponade commonly presents with dyspnoea, chest pain, orthopnoea, dizziness, general fatigue and syncope. Although tamponade can be diagnosed clinically, echocardiography remains one of the most important tools in aiding with diagnosis.² Neoplastic pericardial effusion is a serious and relatively common clinical disorder, which may arise from direct extension of the malignancy, metastatic spread or side effects from chemotherapy and

radiotherapy.^{3 4} Cardiac involvement is often a late clinical presentation of malignancy.

Electrical alternans is a rare manifestation of pericardial effusion and represents changes in the direction, wave-form and amplitude in the ECG. It can broadly be classified into three types depending on which part of the ECG is affected.^{5 6} Repolarisation alternans involves T or ST segments. When the T segment is involved there may be a rapid increase in heart rate or prolongation of the QT segment, resulting in a possible predisposition to polymorphic ventricular tachycardia.⁷

Conduction alternans can be triggered by changes in heart rate or other physiological factors resulting in impedance of electrical conduction. It can involve the P wave, PR interval, R–R interval or QRS complex and is often seen in the context of atrial fibrillation, ischaemia and left ventricular dysfunction.⁸

Finally, electrical alternans can be caused by the 'pendulum' motion of the heart within the enlarged fluid filled pericardial cavity as in this case, and in the context of pericardial disease changes in the P, QRS and T waves which can be an indicator of tamponade.

Figure 2 CT chest of our patient demonstrating right upper quadrant collapse, pleural effusion and large obstructing tumour.

Learning points

- ▶ This case demonstrates the importance of careful interpretation of the ECG together with the clinical context.
- ▶ The recognition of electrical alternans on the ECG, along with the clinical examination findings led to a strong suspicion of pericardial effusion and urgent referral to the cardiologist.
- ▶ In this case, a delay in the diagnosis might have resulted in significant haemodynamic compromise and cardiac arrest.
- ▶ Malignancy should be included in the differential of pericardial effusion.

Competing interests None.

Patient consent Obtained.

REFERENCES

1. **Bilchick KC**, Wise RA. Paradoxical physical findings described by Kussmaul: pulsus paradoxus and Kussmaul's sign. *Lancet* 2002;**359**:1940–2.
2. **Veress G**, Feng D, Oh JK. Echocardiography in pericardial diseases: new developments. *Heart Fail Rev* 1 July 2012. (Epub ahead of print).
3. **Sagristà-Sauleda J**, Sarrias Mercé A, *et al*. Diagnosis and management of pericardial effusion. *World J Cardiol* 2011;**3**:135–43.
4. **Refaat MM**, Katz WE. Neoplastic pericardial effusion. *Clin Cardiol* 2011;**34**:593–8.
5. **Surawicz B**, Fisch C. Cardiac alternans: diverse mechanisms and clinical manifestations. *J Am Coll Cardiol* 1992;**20**:483–99.
6. **Niarchos A**. Electrical alternans in cardiac tamponade. *Thorax* 1975;**30**:228.
7. **Laurita KR**, Rosenbaum DS. Cellular mechanisms of arrhythmogenic cardiac alternans. *Prog Biophys Mol Biol* 2008;**97**:332–47.
8. **Rinkenberger RL**, Polumbo RA, Bolton MR, *et al*. Mechanism of electrical alternans in patients with pericardial effusion. *Cathet Cardiovasc Diagn* 1978;**4**:63–70.

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