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CLINICAL SPOTLIGHT

Paradoxical Cardiac and Cerebral Arterial Gas Embolus During Percutaneous Lead Extraction in a Patient with a Patent Foramen Ovale

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A 42 year-old man presented for elective percutaneous lead extraction for pacemaker redundancy. The procedure was performed supine under general anaesthesia via the right femoral vein and was complicated by acute inferior ST elevation and hypotension. Urgent transoesophageal echocardiogram showed inferior left ventricular hypokinesis, right ventricular impairment, a patent foramen ovale and air in the left ventricle. Coronary angiography demonstrated normal coronary arteries, the ST changes resolved and the leads were subsequently removed intact. Post-operatively the patient displayed nystagmus, was managed with hyperbaric oxygen therapy, and had complete resolution of his symptoms. An MRI brain confirmed an acute left cerebellar infarction, and a diagnosis of paradoxical air embolus to the coronary and cerebral circulations was made. This case illustrates the risks associated with paradoxical embolism in patients with PFOs undertaking percutaneous lead extractions. It also highlights the need for further consideration into techniques to avoid this complication in all high-risk percutaneous procedures.

Keywords Paradoxical embolus • Patent foramen ovale • Lead extraction • Myocardial infarction • Cerebral infarction • Hyperbaric oxygen therapy

Case

A 42 year-old man presented for elective percutaneous pacemaker lead extraction, two years after insertion of a dual chamber pacemaker for asystole during tilt table testing. The active fixation ventricular lead and passive fixation atrial lead were being removed due to pacemaker redundancy.

The lead extraction was performed in supine position under GA with transoesophageal (TOE) guidance, via the right femoral vein. The pre-procedural TOE was unremarkable. During the procedure, prior to extraction of the leads, whilst a 9 French snare catheter was being used, the patient developed acute inferior ST elevation and hypotension. Urgent TOE demonstrated inferior left ventricular hypokinesis, right ventricular impairment, a previously unrecognised patent foramen ovale (PFO) and the transient appearance of air in the left ventricle adjacent to the apex.

Immediate coronary angiography showed normal coronary arteries, with no evidence of a right coronary artery (RCA) lesion. Thus, a working diagnosis of paradoxical air embolus, in the context of a PFO, resulting in air in the RCA and subsequent inferior ST elevation, was made.

The patient stabilised, with resolution of ST segments over 15 minutes, and normalisation of blood pressure. The leads

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were subsequently extracted intact without further complication. Post-operatively he was promptly extubated, sedation was withdrawn and his GCS was 15, with bilateral gaze-evoked nystagmus his only focal neurological sign.

Under the advisement of the neurology team, the patient was acutely managed with hyperbaric oxygen therapy (18 metres for 4.75 hours- RN table 62), during which his symptoms completely resolved. A further hyperbaric oxygen treatment (14 metres for 90 minutes) was performed the following day. Serial high sensitivity Troponin T levels were 34 and 25. Twenty-four hours post-procedure, an MRI brain was performed, which demonstrated signal hyperintensity in the T2/flair sequence consistent with an acute left cerebellar infarction.

Despite paradoxical air emboli to the coronary and cerebral circulations, the patient remained clinically well and was discharged home on day 4.

Discussion

Device lead extraction, especially in the context of active lead infection, is a curative procedure that also confers a significant potential risk of embolic events (especially with vegetations >10 mm in size). In a small case series of 38 patients, of those with vegetations > 10 mm, 55% had evidence of septic pulmonary embolism. [1] Whilst a significant proportion of these cases of septic emboli were subclinical, it does highlight the potential risk to patients if an intracardiac shunt exists.

To the authors' knowledge there have been very few published case reports of paradoxical embolus during device lead extraction. Dieuzaide et al reported a case of paradoxical lead fragment embolism in a 71 year-old man. In that case, a pacemaker lead fragmented and embolised through a PFO into the left peroneotibial trunk artery. [2] Furthermore, there are a modest number of case reports of paradoxical embolus due to infected pacemaker leads *in situ*. Allie et al have reported a case of a septic embolus through a PFO due to an infected pacemaker lead in 2000. [3] Wilson et al also described a case of acute coronary syndrome due to a paradoxical coronary embolus (thrombus) from a ventricular pacing lead. [4] Our case, however, represents the first published case of paradoxical air embolism at the time of percutaneous lead extraction.

In this case, air entered the patient's venous system from the femoral venous sheath during snare use, and in the context of a transient reversal of his left-to-right shunt, air entered the left ventricle, which then embolised to the RCA and cerebral vasculature, causing both acute myocardial ischaemia and cerebral infarction. The RCA is the most common artery affected by air embolism as air is buoyant and the ostium of the RCA is the most anterior and superior in the supine position. [5] What is unusual in this case is that air embolised to the cerebral circulation, given the patient's supine position.

The use of femoral venous access is relevant in this case. Evidence from TOE and bubble studies has shown that there is an increased risk of paradoxical embolism using femoral venous access due to the preferential direction of the inferior vena cava flow towards the inter-atrial septum, as compared to the superior vena cava. [6]

Autopsy reports suggest that PFOs occur in 11-35% of the normal population, and are predominately a silent, innocent

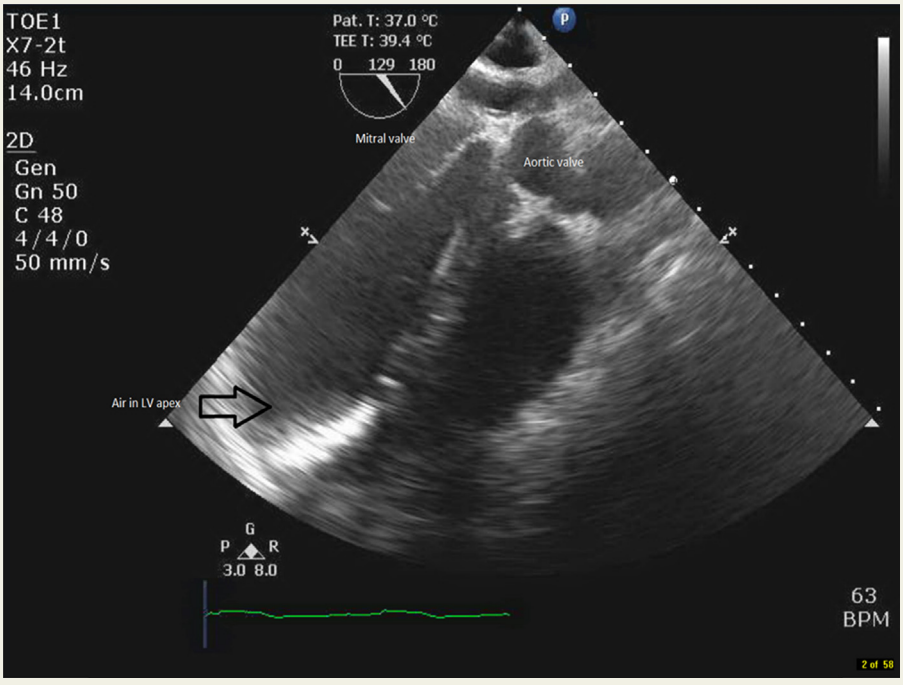

Figure 1 Transoesophageal echocardiogram demonstrating air in left ventricle apex.