

IMAGING VIGNETTE

ADVANCED

CLINICAL VIGNETTE: RHYTHM DISORDERS

An Unusual Cause of Cerebral Embolism

PFO-Straddling, Spontaneously Fractured Pacemaker Lead



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ABSTRACT

We report an exceptionally rare complication of cardiac pacing: a case of spontaneous fracture of a modern bipolar pacing lead that led to migration across a patent foramen ovale into the left atrium and embolic stroke. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2022;4:854–856) © 2022 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

An 86-year-old man was admitted with recurrent embolic stroke manifesting as acute onset of diplopia, dysarthria, and right-sided paresthesia. Computed tomography (CT) of the brain revealed no acute intracranial disease. He received thrombolytic therapy and recovered without a residual neurologic deficit. He had experienced a transient ischemic attack (TIA) 3 years earlier, and a dual-chamber pacemaker was implanted 11 years before that for heart block. Four years after implantation of the pacemaker, electrical noise and loss of capture developed on the right ventricular (RV) lead (Fineline II 4459, Boston Scientific). Lead fracture was suspected, but the chest radiograph was unremarkable. A new RV lead was implanted; the redundant lead was capped and sutured in the pacemaker pocket (**Figure 1A**, arrow). At the time of the TIA, a chest radiograph showed a broken redundant RV lead, with a short proximal fragment remaining in the pacemaker pocket (**Figure 1B**, inset arrow), whereas the rest of the lead had migrated behind the heart (**Figure 1B**, arrowheads); however, this was missed. Following this admission, transesophageal echocardiography and cardiac CT showed the free end of the redundant RV lead crossing through a patent foramen ovale (PFO) into the left atrium (**Figure 1C**, arrowheads) and the left inferior pulmonary vein (**Figure 1D**). Despite refusing lead extraction, the patient remains well on rivaroxaban, 20 mg daily, after 9 months of follow-up.

Spontaneous fracture of modern bipolar pacing leads resulting in migration and systemic embolism is exceptionally rare. We are aware of only 1 other similar report, involving a thin, old-generation unipolar RV lead.¹ In that case, at the time of reintervention for exit block, the proximal end of the RV lead was cut short and left uncapped in the pocket, thus potentially facilitating migration. We were unable to identify any procedural factors causing this unusual complication in our case.

This case should raise awareness of this potentially underreported complication. It also highlights that lead abandonment is not always simple or safe. Indeed, migration of leads into the venous circulation has been reported²; given proper circumstances, these leads might have crossed through a PFO into the systemic circulation. As such, in every case requiring lead revisions, physicians who are performing implantation procedures should carefully assess the risks vs benefits of lead extraction vs lead abandonment, and if the lead is abandoned, they must use careful techniques to prevent migration into the systemic circulation.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the [Author Center](#).

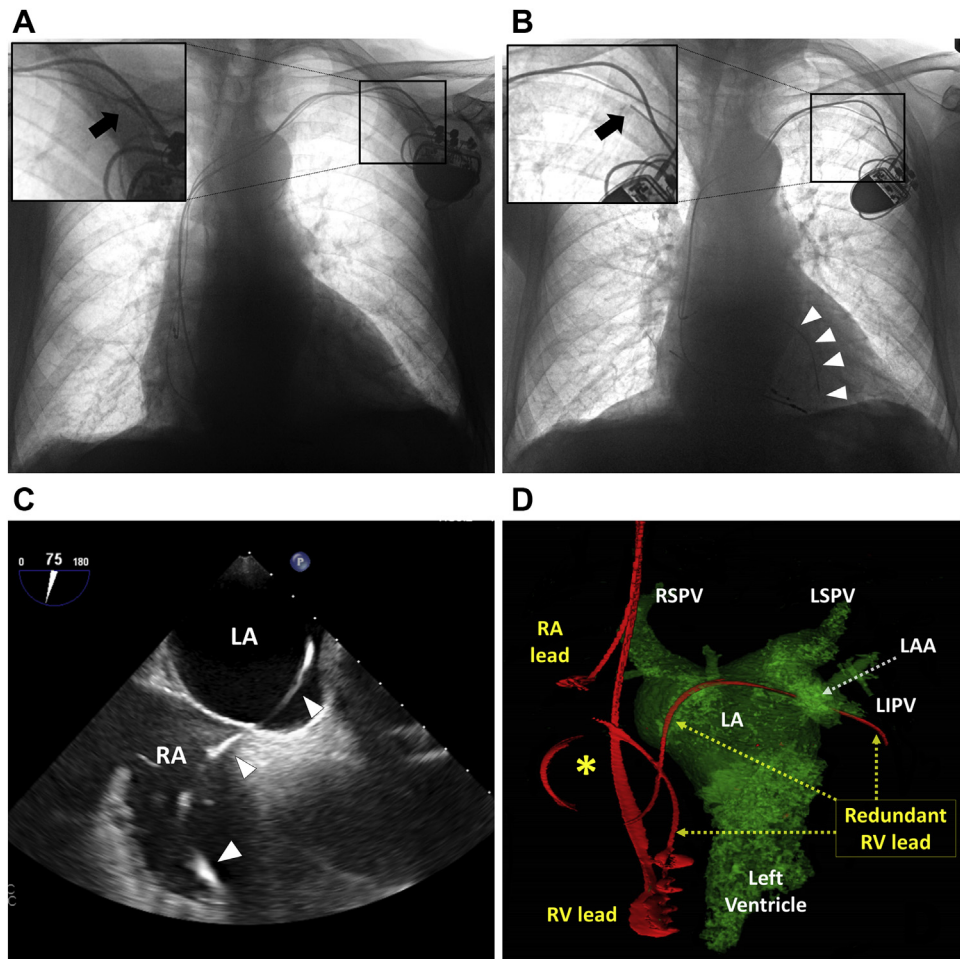
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Extraction of redundant pacing leads is not an absolute indication, and there are no randomized trials to guide the decision.³⁻⁵ Lead extraction performed in experienced centers has a reported major complication rate of 1% to 2% and a periprocedural mortality of 0.3% to 1%.³⁻⁵ An individualized decision is required and should account for the following: 1) the indication for lead extraction (eg, manufacturer recall, need for system upgrade, lead fracture); 2) the age, comorbidities, and functional status of the patient (extractions are favored in younger, healthier patients because these patients they likely face a higher long-term risk of abandoned leads); 3) the type of lead (pacing vs high-voltage defibrillator vs left ventricular leads); 4) active fixation and thicker bipolar leads are easier to extract compared with passive fixation and thinner unipolar leads; 5) the time since implantation (leads implanted for <12 months are less likely to be embedded in dense encapsulating fibrosis and can be

**ABBREVIATIONS
 AND ACRONYMS**

- CT** = computed tomography
- PFO** = patent foramen ovale
- RV** = right ventricular
- TIA** = transient ischemic attack

FIGURE 1 Fractured Pacemaker Lead Migrating Across PFO in Systemic Circulation



(A) Initial pacemaker lead positions after right ventricular (RV) lead revision. **Inset:** pacemaker leads at the pocket level are apparently intact (**arrow**). (B) Fractured redundant right ventricular lead at the time of a transient ischemic attack. The loose end of the broken lead can be seen behind the cardiac silhouette (**arrowheads**), while a short fragment of the fractured lead remained in the pacemaker pocket (**inset: arrow**). (C) Transesophageal echocardiogram demonstrating the lead crossing the patent foramen ovale (PFO) (**arrowheads**). (D) Cardiac computed tomography reconstruction using InVesalius 3.1.1 software showing the course of the pacemaker leads (**red**) superimposed on the 3-dimensional reconstruction of the left ventricle and the left atrial cavity (**green**). The **asterisk** indicates movement artifact. See text for further details. LA = left atrium; LAA = left atrial appendage; LIPV = left inferior pulmonary vein; LSPV = left superior pulmonary vein; RA = right atrium and right atrium; RSPV = right superior pulmonary vein.

explanted by simple traction in about one-fourth of patients); and 6) the number of leads already present in the venous system.³⁻⁵ Algorithms to predict 30-day mortality after lead extractions have been published.⁶

If a decision to abandon a lead is made, the lead should always be capped and fixed with nonabsorbable suture to the pectoral muscle. The lead should never be cut and abandoned because: 1) sufficient length will be needed to grasp the lead if extraction will be indicated at some point in the future; 2) cutting the lead will collapse the inner lumen, thus preventing a locking stylet to be advanced inside the lead at future extractions; and 3) the exposed conductors can erode through the plastic cap into the surrounding structures (including neighboring leads) or can erode through the skin. A preoperative venogram may provide useful information because the lead is unlikely to migrate downstream in cases of extensive lead adhesions (lead seen outside the venous lumen) and/or venous occlusions.

Physicians should be aware that redundant leads can migrate through a PFO into the systemic circulation, thereby resulting in embolic complications.

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