

# An unusual presentation of delayed lead perforation: It's never too late



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## Introduction

Lead perforations are rare, but significant, complications following the implantation of cardiac implantable electronic devices (CIEDs). Literature estimates the incidence is 0.4%–6.4% of leads or 0.1%–0.8% of patients.<sup>1,2</sup> Although perforations can occur acutely (within 24 hours of implantation), both subacute cases (within 30 days of implantation) and delayed cases (>30 days postimplantation) have been described.<sup>1,3</sup> The incidence of perforation is greatest with right atrial leads, followed by right ventricular implantable cardioverter-defibrillator (RV ICD) leads, and then RV pacing leads.<sup>1,4</sup> Among RV ICD leads there is also some data suggesting that smaller-caliber leads are associated with increased incidence of late perforations.<sup>5,6</sup> According to 1 study by Hsu and colleagues,<sup>7</sup> risk factors associated with complications including cardiac perforation during the index hospitalization are female sex, older age, worsening heart failure, multichamber ICD implantations, and left bundle branch block. Other cohort studies have also shown an increased risk of complications associated with use of antiplatelet agents, emergency admission, and hemodialysis.<sup>2</sup> RV ICD leads appear to be more prone to cardiac perforation; however, there was no difference observed between active- and passive-fixation leads. Data regarding delayed lead perforation are sparse, and the true incidence of events is most likely underestimated, as patients are often asymptomatic and go undetected.<sup>4</sup> Here we present a very unusual case of an acute symptomatic presentation of a significantly delayed lead perforation.

**KEYWORDS** Delayed lead perforations; Transvenous lead extraction; Cardiac implantable devices; Laser lead extraction; Pericardial effusion (Heart Rhythm Case Reports 2022;8:106–109)

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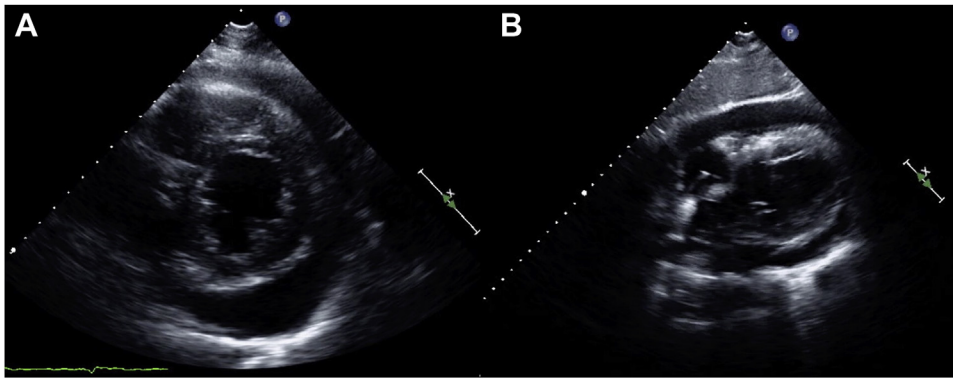
## KEY TEACHING POINTS

- Delayed perforation should always be considered when there is an abrupt change in lead parameters. Perforation can both occur in the acute postimplantation time period and be delayed in time.
- Multimodality imaging and follow-up of device parameters is key in making an accurate diagnosis.
- Transvenous lead extraction should be considered for management of lead perforation at centers with experience.

## Case report

An 80-year-old woman with a history of nonischemic cardiomyopathy, left bundle branch block, past CIED implantation, and persistent atrial fibrillation presented 2 weeks after the acute onset of chest pain and dyspnea in 2020. The CIED implant was done in February 2014, consisting of a bipolar right atrial lead (Medtronic #5568 53 cm), dual-coil RV ICD lead (Medtronic #6947, 62 cm), and a coronary sinus lead (Medtronic #4396, 88 cm); these were used in conjunction with a Medtronic VIVA S generator, Model #DTBB1D4 (Medtronic, Minneapolis, MN). The original implantation of the primary prevention device was without immediate complication. Postimplant, the patient was continually monitored with a combination of remote monitoring and in-office interrogations for 6 years thereafter.

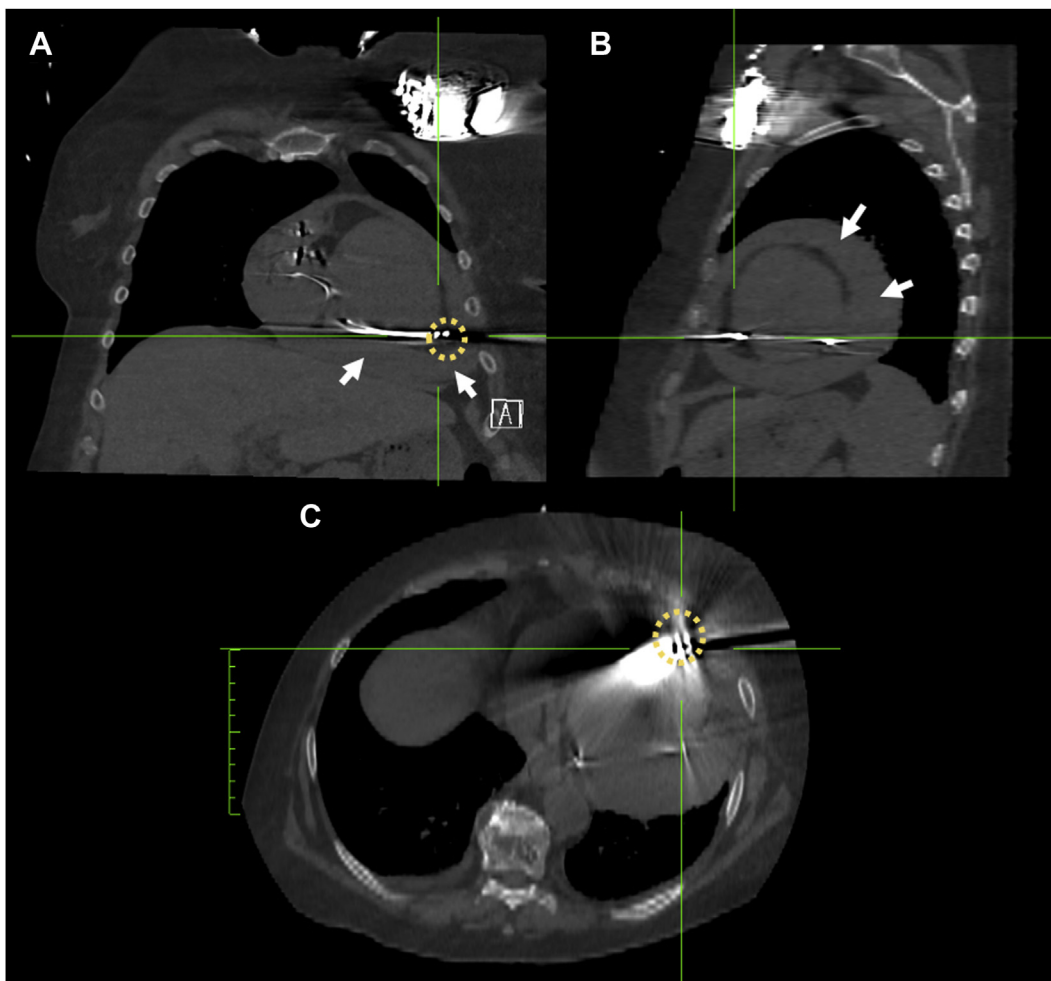
Upon her symptomatic presentation 6 years postimplant, she was noted to have a normal heart rate and blood pressure. Subsequently, she had an episode of hypotension, associated with diaphoresis and dizziness. A chest radiograph showed evidence of pericardial effusion, with no obvious change in lead position compared with prior films (Supplemental Figure 1). Subsequently a transthoracic echocardiogram (TTE) was obtained, which showed a large pericardial effusion, without evidence of tamponade physiology (Figure 1). The RV apex was not seen well in any view;



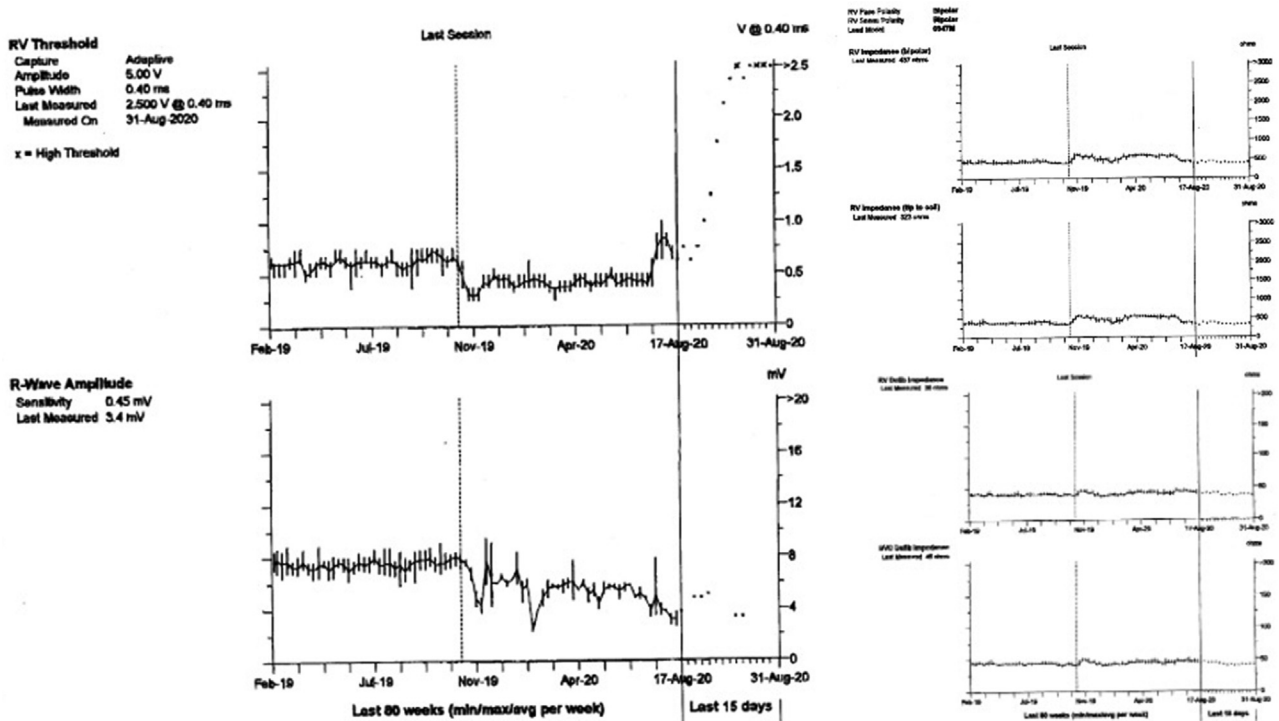
**Figure 1** Transthoracic echocardiogram images. **A:** Parasternal short-axis view at end diastole showing a large circumferential pericardial effusion. **B:** Sub-xiphoid view showing large pericardial effusion.

thus exact lead position could not be assessed on the TTE. Given concerns about the etiology of the pericardial effusion, she underwent computed tomographic imaging of the chest, which demonstrated a moderate-to-large hemopericardium, with evidence of the RV lead tip visualized in the pericardial space (**Figure 2**).

On device interrogation, a sudden change in previously stable lead parameters occurred 14 days prior to her presentation, correlating with the onset of her symptoms. An increase in the RV pacing threshold and a decrease in the sensed R-wave amplitudes (without change in lead impedance) was observed (**Figure 3**). Given the acute changes in



**Figure 2** Computed tomographic imaging of the chest. **A:** Axial images. **B:** Coronal images. **C:** Sagittal images. Images show moderate-to-large hemopericardium (*white arrows*) and perforation of the right ventricular lead (*yellow circle*).



**Figure 3** Device interrogation: stable right ventricular (RV) lead pacing and defibrillator impedances. Acute increase in RV pacing threshold from  $<0.75$  V @ 0.4 ms to  $>2.5$  V @ 0.4 ms. Decrease in the R-wave amplitude from an average of 6 V to  $<4$  V.

the lead parameters, ongoing symptoms, and a pericardial effusion with evidence of perforation, the decision was made to extract the original RV ICD lead and implant a new one. The patient was taken to the operating room on day 3 of hospitalization. Intraoperatively, a pericardiocentesis with drain placement was performed prior to extracting the lead. A total of 800 mL of blood was removed from the pericardial space and transfused back to the patient using a cell saver. The RV lead was prepped for extraction using a lead locking stylet, and with gentle consistent traction the lead was removed. There was no reaccumulation of pericardial effusion assessed with intraoperative transesophageal echocardiogram for a 30-minute period after extraction and a new RV single ICD lead was then implanted. The pericardial drain was removed at the end of the case and repeat TTE was performed the following day, showing no reaccumulation of a pericardial effusion. At the time of discharge the patient had no symptoms and was discharged home on hospital day 7.

## Discussion

To our knowledge, this is the first reported case of delayed lead perforation occurring more than 6 years post device implantation. What is also significant is that the patient presented with the acute onset of symptoms, which correlated precisely with the abrupt changes observed in lead sensing/pacing thresholds. Of specific interest, our patient had stable device parameters until 2 weeks prior to the presentation.

Clinical factors including steroid use, advanced age, female sex, and low body weight have been associated with increased risk of lead perforation.<sup>8,9</sup> In our case, only female sex and advanced age were present. The association of her sex and age alone do not allow for an adequate explanation for such a delayed occurrence of lead perforation.

The mechanism of delayed lead perforation is not well understood. Several previously hypothesized mechanisms include slow lead advancement during cardiac contractions and dissection between cardiac muscle layers,<sup>10</sup> or tension and fixation at the lead tip preventing it from moving in conjunction with heart movements, thereby resulting in erosion and, ultimately, perforation.<sup>9</sup> While these mechanisms may have contributed, they do not explain the sudden change over 2 weeks occurring more than 6 years following initial implant. An acute or subacute asymptomatic perforation following the initial implant would not result in an acute symptomatic presentation 6 years later. Normal engagement of the lead with the endocardium with progressive change in tissue integrity over time, resulting in an acute perforation, would be more consistent with the presentation in this case.

Earlier literature, including the 2009 Heart Rhythm Society consensus statement,<sup>11</sup> preferred an open surgical approach in the management of delayed perforation. However, data from multiple groups have shown that use of transvenous lead extraction is both safe and efficacious in these cases.<sup>8,12,13</sup> The more recent expert consensus statement from the Heart Rhythm Society in 2017 endorses lead extraction for lead perforation cases.<sup>14</sup> Given our patient's ongoing symptoms, large pericardial effusion, and sudden change in

lead parameters, we chose this methodology. For asymptomatic patients without lead parameter changes, although conservative management can be considered, there is some recent data suggesting that there may be some risk to this approach, including recurrence of symptoms, late-onset pericardial effusion, and abnormal lead functioning ultimately requiring revision.<sup>15</sup>

Delayed cardiac perforation is a rare but serious complication of CIED implantation. This case is a useful reminder about the importance of clinical suspicion in a CIED patient presenting with suggestive symptoms, the utility of imaging in making this diagnosis, and the importance of timely management. Although most delayed perforation cases occur 30–45 days from implantation, in the setting of a symptomatic patient whose lead parameters may have acutely changed, the possibility of a more delayed perforation should be considered independent of the age of implant. We safely and successfully used a transvenous approach for lead extraction and replacement as our first-line therapy. We also recognize that not all centers have similar lead extraction experience; thus each case should be evaluated via a collaborative cardiac approach, and if a center has adequate extraction experience cardiac surgery can serve as backup and clinical care can be provided safely and effectively, without the need for open heart surgery. Overall, we recommend considering an early multidisciplinary strategy, if clinically warranted, based on patient characteristics in an institution with the necessary experience with lead management.

## Appendix Supplementary data

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.hrcr.2021.11.012>.

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