

Right ventricular lead perforation through the septum, left ventricle, and pleura, managed by an open surgical approach



Alexander Iribarne, MD, MS,^{*†} Rajbir S. Sangha, MD,[‡] Ian C. Bostock, MD, MS,^{*} Eric S. Rothstein, MD,[‡] Jock N. McCullough, MD^{*}

From the ^{*}Section of Cardiac Surgery, Dartmouth-Hitchcock Medical Center, Lebanon, New Hampshire,

[†]The Dartmouth Institute for Health Policy and Clinical Practice, Lebanon, New Hampshire, and

[‡]Section of Cardiovascular Medicine, Dartmouth-Hitchcock Medical Center, Lebanon, New Hampshire.

Introduction

Cardiac perforation of the right ventricle is an uncommon but potentially serious complication of transvenous pacemaker implantation. When it occurs, right ventricular (RV) perforation is typically seen through the apex. Here, we describe a case of a pacemaker lead that perforated through the RV septum and then the left ventricle, discuss the management of this complication, and provide a brief review of the literature.

Case report

A 69-year-old woman with a history of asthma, hypothyroidism, anxiety, and oral steroid therapy for reactive airways disease was admitted for evaluation of syncope. Upon admission she was found to have recurrent episodes of sinus bradycardia and, subsequently, a 10-second sinus pause that reproduced syncope. Her baseline electrocardiogram was unremarkable. A transthoracic echocardiogram showed a left ventricular ejection fraction of 73% with no segmental wall motion abnormalities. There was mild-to-moderate aortic stenosis with a peak aortic valve gradient of 25 mm Hg. She was diagnosed with symptomatic sick sinus syndrome and a dual-chamber pacemaker was implanted without immediate complication. The active fixation pacemaker leads (Medtronic “CapSurefix” Model #5076, 52 cm and 45 cm) were placed on the RV septum and right atrial appendage, respectively. The following day, a chest radiograph confirmed satisfactory lead position and device interrogation confirmed excellent pacing parameters. She was discharged home.

KEYWORDS Lead perforation; Pacemaker complications; Septal perforation; Ventricular lead complication; Ventricular perforation (Heart Rhythm Case Reports 2018;4:397–400)

Address reprint requests and correspondence: Dr Alexander Iribarne, Section of Cardiac Surgery, Dartmouth-Hitchcock Medical Center, 1 Medical Center Dr, Lebanon, NH 03766. E-mail address: Alexander.Iribarne@hitchcock.org.

At a routine 2-week follow-up appointment, the pacemaker was interrogated. Loss of ventricular lead capture at maximal output was seen and it was noted that the pacemaker had automatically switched from bipolar to unipolar pacing in the ventricular channel, just 1 day prior to her follow-up appointment. A wide variation in lead impedances was also observed. A chest radiograph suggested likely RV lead perforation (Figure 1), subsequently confirmed with computed tomography (CT) imaging (Figure 2A–C). The patient was hemodynamically stable and a transthoracic echocardiogram showed no pericardial effusion. Given the location of the lead, the decision was made to proceed to the operating room for surgical pacemaker lead removal. In the operating room, the previous pacemaker incision was opened, the generator exposed, and the ventricular lead detached from the pulse generator. Concurrently, a median sternotomy was performed and the pericardium opened. There was no pericardial effusion. The ventricular lead was found to pass through the ventricular septum, within 1 cm of the left anterior descending artery (Figure 3A), exiting the left ventricle and through the left pleura (Figure 3B). A pledgeted horizontal mattress suture was placed and the lead removed, with good hemostasis. The lead was abutting but not entering the lung parenchyma. A bipolar epicardial ventricular lead was placed and attached to the previous generator, and the patient was discharged home 4 days later, without complication. In follow-up, she has been doing well and has had no further syncopal episodes.

Discussion

RV perforation is a known, although rare and serious, complication of pacemaker lead implantation.¹ Estimates of the frequency of pacemaker lead perforation suggest an incidence of <0.8%² and that when these complications occur, they often manifest within 48 hours. Clinically manifest subacute or late perforation (variously described as from greater than 48 hours to greater than 5 days after implantation)³ is more

KEY TEACHING POINTS

- Even with confirmed right ventricular septal pacemaker lead placement, right ventricular perforation can still occur.
- Evaluation for a ventricular perforation should include a computed tomography scan.
- Subsequent management is likely to include an open surgical procedure for lead removal.

unusual and might be underdiagnosed. Hirschl and colleagues showed that asymptomatic lead perforation may be present in as many as 15% of patients with pacemakers or defibrillators, with atrial lead perforation being more common than ventricular lead perforation.⁴ Interestingly, in this patient, there were no lead pacing characteristics that were suggestive of lead dysfunction with asymptomatic perforation. In various retrospective studies, the risk of perforation has inconsistently appeared to be related to lead type (defibrillator versus pacemaker), fixation mechanism (active versus passive fixation), lead caliber, female sex, age, body habitus,

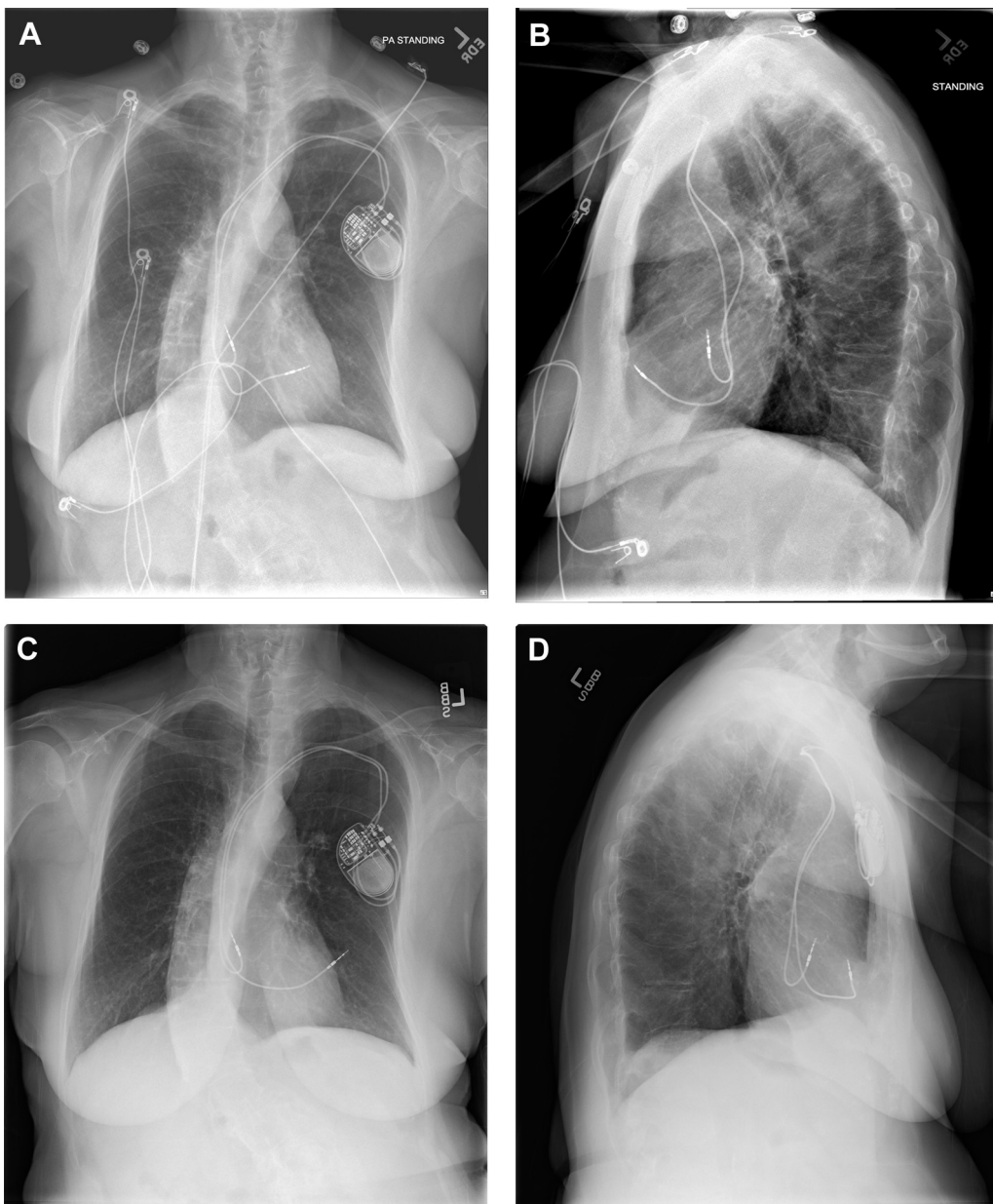


Figure 1 Postimplant chest radiograph showing septal right ventricular lead placement (A: posteroanterior view; B: lateral view) on day 0, and subsequent image on day 14 (C: posteroanterior view; D: lateral view) showing overt perforation with extension of lead into the left pleural space.

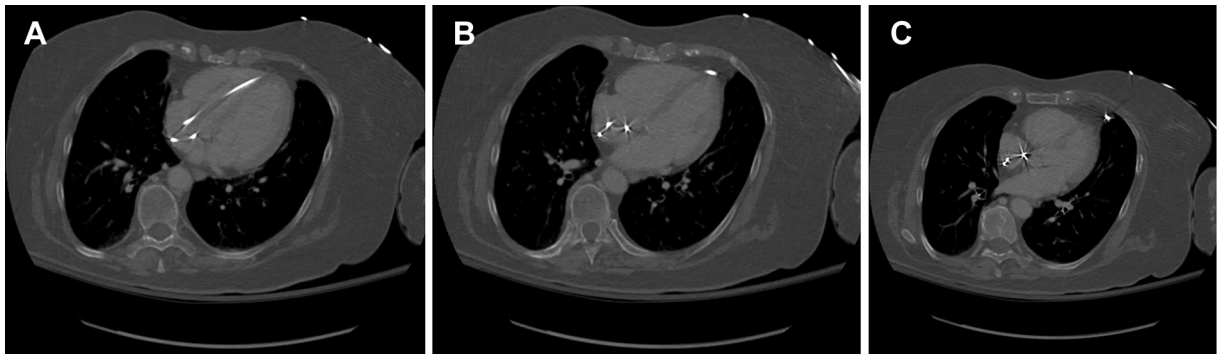


Figure 2 Computed tomography in sagittal section demonstrating ventricular lead (A), exiting the myocardium (B) with tip near the left lingula parenchyma (C).

and steroid use. CT scan is considered the gold standard for evaluating for perforation,⁵ but there can be difficulties with interpretation secondary to beam-hardening artifact from the lead. There is also no clear consensus on appropriate management of lead perforation in stable patients, as individual characteristics can affect the risks of transvenous lead extraction versus an open surgical procedure.^{6,7}

It is assumed that placement of a ventricular lead on the RV septum would avoid this complication entirely, as it seems unlikely that a lead would perforate through the thick ventricular septal tissue. In a study of 8 perforations in 1419 patients, RV lead perforation was only seen with apical lead placement.⁶ In another study where the majority of RV lead perforations were confirmed to be apical, the RV wall thickness was measured at 1.5 ± 0.5 mm at the apex, with a typical helix length of 1.8 mm for the active fixation leads used,⁸ suggestive of a mechanism that requires lead placement in a thin-walled structure for

perforation to occur. In our case, the ventricular lead appeared to be well sited on the septum on a postoperative chest radiograph, without excessive redundancy, and yet at surgery the lead was confirmed to have passed through the ventricular septum, below the left anterior descending artery, through the thick free wall of the left ventricle and then through the pericardium. On echocardiogram, there were no unusual features of myocardial tissue that would have suggested an increased tendency to perforation.

Conclusion

This case illustrates that even with confirmed RV septal pacemaker lead placement, RV perforation can still occur. If the clinical presentation is suggestive, the patient should be evaluated with consideration for a CT scan and possible open surgical procedure for lead removal.

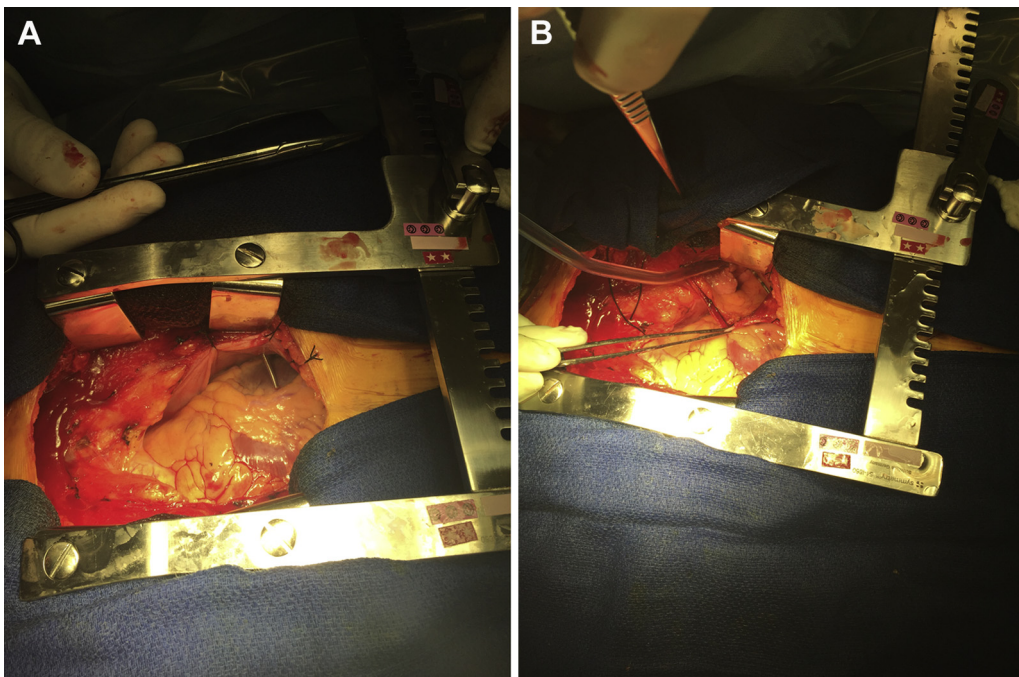


Figure 3 A: Intraoperative image of ventricular lead exiting the left ventricle in close proximity to the left anterior descending artery and entering the left pleura. B: The pleura is opened and retracted with forceps, and the ventricular lead is seen abutting the lingula of the left lung.

References

1. Phibbs B, Marritt HJ. Complications of permanent transvenous pacing. *N Engl J Med* 1985;312:1428–1432.
2. Carlson MD, Freedman RA, Levine PA. Lead perforation: incidence in registries. *Pacing Clin Electrophysiol* 2008;31:13–15.
3. Laborderie J, Barandon L, Ploux S, Deplagne A, Mokrani B, Reuter S, Le Gal F, Jais P, Haissaguerre M, Clementy J, Bordachar P. Management of subacute and delayed right ventricular perforation with a pacing or an implantable cardioverter-defibrillator lead. *Am J Cardiol* 2008;102:1352–1355.
4. Hirschl DA, Jain VR, Spindola-Franco H, Gorss JN, Haramati LB. Prevalence and characterization of asymptomatic pacemaker and ICD lead perforation on CT. *Pacing Clin Electrophysiol* 2007;30:28–32.
5. Nichols J, Berger N, Praveen J, Datta D. Subacute right ventricle perforation by pacemaker lead presenting with left hemothorax and shock. *Case Rep Cardiol* 2015;2015:983930.
6. Sterlinksi M, Przybylski A, Maciag A, et al. Subacute cardiac perforations associated with active fixation leads. *Europace* 2009;11:206–212.
7. Schwerg M, Stockburger M, Schulze C, Bondke H, Poller WC, Lembcke A, Melzer C. Clinical, anatomical and technical risk factors for postoperative pacemaker or defibrillator lead perforation with particular focus on myocardial thickness. *Pacing Clin Electrophysiol* 2014;37:1291–1296.
8. Kondoh H, Funatsu T, Taniguchi K. Late left ventricular perforation by active fixation pacemaker lead implanted in the right ventricular septum. *J Card Surg* 2012;27:530–531.