Extraction of a misplaced left ventricular pacing lead with complete embolic cerebral protection and intracardiac echocardiography visualization

Humberto Butzke da Motta, MD, Rémi Kouz, MD, Marcio Sturmer, MD, Alexios Hadjis, MD, Giuliano Becker, MD, Maxime Cerantola, MD

From the Division of Cardiology, Hôpital du Sacré-Cœur de Montréal, Université de Montréal, Montreal, Canada.

Introduction

Misplacement of pacing leads in the left ventricle (LV) is rare and is associated with embolic complications. We present a case of extraction of a left ventricular lead using continuous intracardiac echocardiography visualization and complete encephalic circulation protection with 2 transcatheter cerebral embolic protection devices.

Case-report

A 76-year-old woman with a history of well-controlled hypertension, dyslipidemia, and hypothyroidism underwent dual-chamber pacemaker implantation with 2 Medtronic 4076 leads in 2020 for high-degree atrioventricular block. She was admitted to our hospital owing to neurologic symptoms. She reported 3 episodes of transitory blindness of her right eye during the past 2 weeks, which had resolved spontaneously, without other associated symptoms.

Upon admission, the patient was asymptomatic. The vital signs were normal, as well as the physical examination. A 12-lead electrocardiogram (Figure 1A) showed sinus rhythm and ventricular pacing with a right bundle branch block and left posterior fascicular block morphology. A head computed tomography without contrast did not identify any acute ischemia or bleeding. A chest radiograph (Figure 1C and 1D) demonstrated the presence of a dual-chamber pacemaker with a well-positioned right atrial lead, and a ventricular lead bypassing the midline approximately at the same level where the atrial electrode was positioned, with a trajectory toward the topography of the left ventricular posterior wall. A transthoracic followed by a transesophageal echocardiogram (Figure 1B) was performed, showing a normal ejection fraction and the presence of an electrode bypassing the interatrial septum and crossing the mitral valve toward the LV, with mild mitral regurgitation and a 5 × 3 mm mass adhered to the electrode inside the left atrium. The white cell count was normal, as were inflammatory markers. Hemocultures were negative.

Anticoagulation with intravenous heparin was started. After 10 days, a repeat transesophageal echocardiogram was performed, which did not identify any thrombus or masses adhered to the lead.

After a discussion with the patient and family regarding the risks associated with long-term LV endocardial leads, including the risk of stroke and systemic embolism, as well as treatment options, informed consent was obtained for endovascular lead extraction. Computed tomography angiography imaging performed for procedural planning demonstrated the presence of bovine aortic arch anatomy (Figure 1E). The procedure was performed at the electrophysiology laboratory, under general anesthesia and with surgical backup. Bilateral radial artery access was obtained, as well as femoral venous access. A temporary pacemaker

KEY TEACHING POINTS

- The malposition of a pacing lead in the endocardial left ventricle is a rare complication of pacemaker and defibrillator implantation and is associated with embolic events if not promptly recognized.
- The utilization of 2 transcatheter cerebral embolic protection devices should be considered for the extraction of these leads, especially when patients present with neurologic symptoms and when a thrombus or mass is identified on cardiac imaging.
- Intracardiac or transesophageal echocardiography during extraction procedures is strongly encouraged to guide intrasprocedural troubleshooting and identify complications early.

KEYWORDS Left ventricular lead extraction; Malpositioned left ventricular pacing lead; Transcatheter cerebral embolic protection; Complete cerebral embolic protection; Intracardiac echocardiography
(Heart Rhythm Case Reports 2024;10:326–329)

Address reprint requests and correspondence: Dr Maxime Cerantola, Division of Cardiology, Hôpital du Sacré-Coeur de Montréal, 5400 Boul Gouin O, Montréal, QC, Canada H4J 1C5. E-mail address: maxime.cerantola.med@ssss.gouv.qc.ca.

https://doi.org/10.1016/j.hrcr.2024.02.009

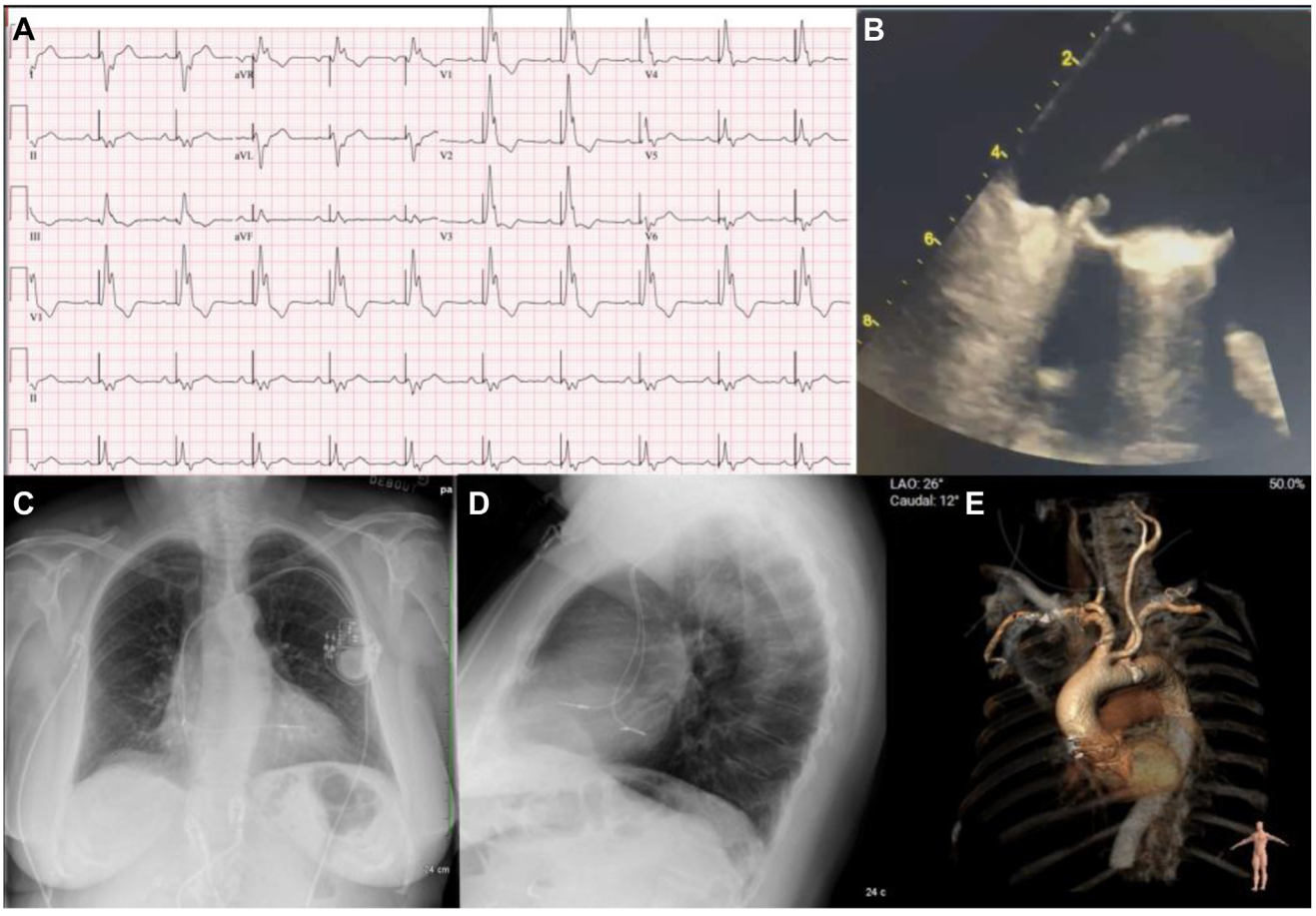

Figure 1 **A:** Twelve-lead electrocardiogram at presentation. **B:** Transesophageal echocardiogram with mass adhered to the pacing lead. **C, D:** Chest radiographs, posteroanterior (**C**) and lateral (**D**) incidences. **E:** Reconstruction of a preprocedural computed tomography angiography of the aorta demonstrating a bovine aortic arch.

was positioned at the right ventricle through the right femoral vein and an intracardiac echocardiography (ICE) catheter was inserted through the left femoral vein. The pacemaker pocket was opened, the leads were dissected to their insertion, and the device was disconnected. A left axillary vein puncture was performed, and a guidewire was left in place

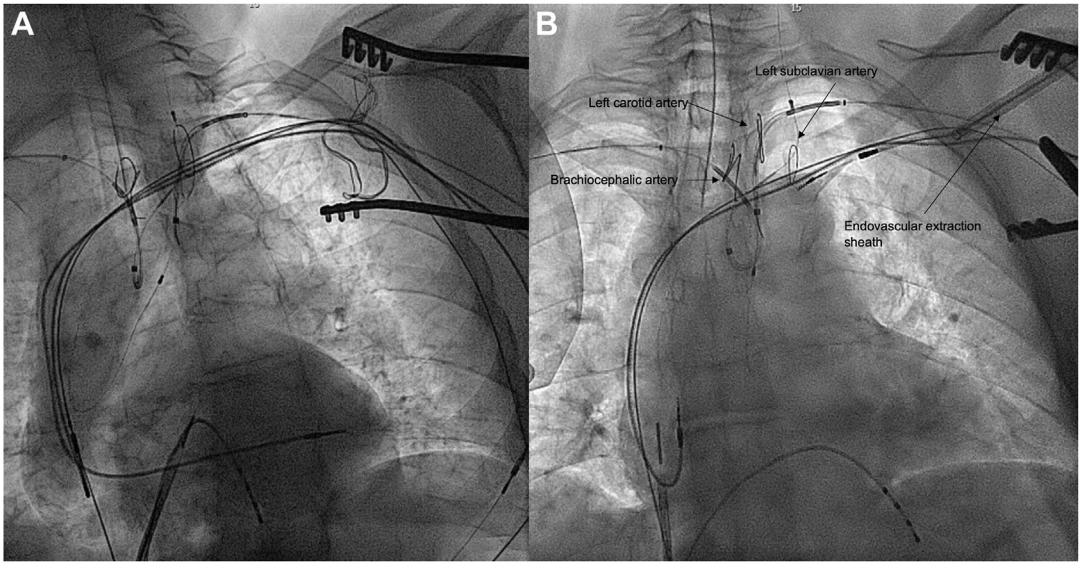

Figure 2 **A:** Deployment of the cardiac embolic protection devices through both radial arteries. **B:** Lysis of proximal vascular adhesions with the 11F controlled-rotation dilator sheath set; sentinel embolic protection filters positioned in the brachiocephalic, left carotid, and left subclavian arteries.

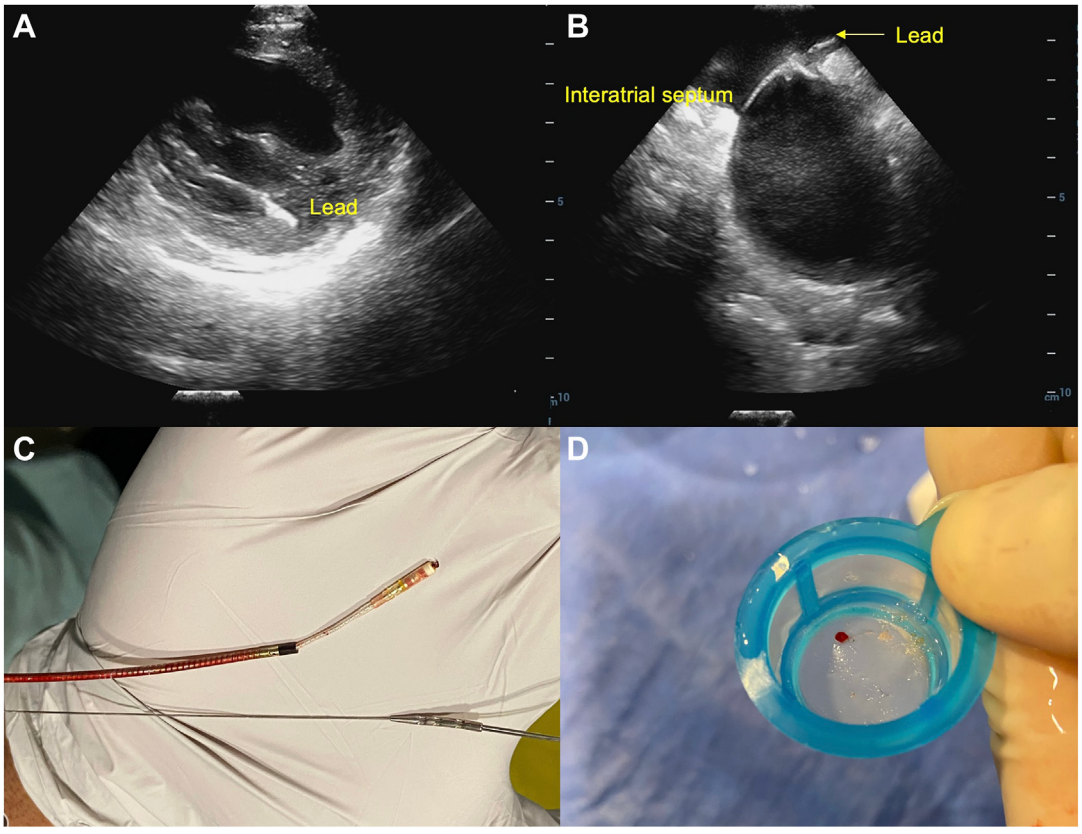

Figure 3 **A:** Pacing lead attached to the posterior left ventricle. **B:** Lead being removed with its end passing through the interatrial septum. **C:** The extracted ventricular lead. **D:** Fibrinous material and thrombus embolized during the procedure and intercepted by the embolic protection devices.

to secure access patency throughout the procedure. After a bolus of intravenous heparin aiming for an activated clotting time of 250 seconds, 2 transcatheter cerebral embolic protection (TCEP) devices (Sentinel; Boston Scientific, Marlborough, MA) were positioned through both radial arteries at the brachiocephalic artery and the left carotid and left subclavian artery, to protect the anterior and posterior circulations bilaterally (Figure 2A). The TCEP device inserted through the right radial artery was deployed with the 2 filters in a standard fashion, with the first filter being positioned in the brachiocephalic trunk and the second in the left carotid artery. For the TCEP device inserted through the left radial artery, the proximal filter was deployed in the subclavian artery and the distal filter was not deployed and left unsheathed in the aorta. After the withdrawal of the ventricular lead active fixation screw, the lead was transected and a locking stylet (Lead Locking Device—LLD EZ; Philips, San Diego, CA) was inserted up to its tip and deployed. Upon live visualization of the lead on ICE (Figure 3A and 3B) to monitor for possible traction on the mitral valve leaflets or subvalvular apparatus, the lead was withdrawn to the right atrium with manual traction. There were no significant adhesions to the LV or the mitral valve. A slight resistance was felt when the electrode tip was crossing the interatrial septum and was overcome by careful manual traction sustained for a few seconds. Vascular adhesions were present at the initial portion of the left subclavian vein and were undone (Figure 2B) with an 11F controlled-rotation dilator sheath set (Evolution RL; Cook Medical, Bloomington, IN). There was no interaction between the ventricular and right atrial leads, allowing for the maintenance of the atrial electrode. After the complete removal of the ventricular lead (Figure 3C), the interatrial septum and mitral valve were carefully inspected, without any signs of significant interatrial communication or mitral regurgitation. No pericardial effusion was present. The TCEP devices were withdrawn and anticoagulation was reversed with protamine. Inspection of the filters demonstrated the presence of fibrin and thrombus (Figure 3D). Pocket hemostasis was performed and a right ventricular pacing lead was positioned through the axillary venous access. A new dual-chamber pacemaker device was inserted and the pocket was closed. Given the initial presentation with neurologic symptoms, we opted to prescribe anticoagulation for 1 month, starting 48 hours after the procedure. The patient tolerated the intervention well and recovered without complications, being discharged the following day. She remains asymptomatic during follow-up.

Discussion

The first description of a misplaced lead in the LV was reported in 1969.[1] In 1 single-center case series, the incidence of inadvertent lead malposition in the LV was 0.34% over 5 years, and the factors independently associated with this

complication were the presence of scoliosis, congenital heart disease with or without previous surgery, and device implantation performed by an inexperienced provider.[2] The presence of a right bundle branch block morphology on a 12-lead electrocardiogram and a postprocedure chest radiography showing a lead with a posterior trajectory toward the ventricle should raise suspicion for a lead malposition in the LV or in the coronary sinus. If recognized early, with the utilization of the left anterior oblique incidences during the implant, the lead can be rapidly repositioned with minor negative consequences only. However, if unrecognized during or immediately after the implant, the risk of thromboembolic complications such as stroke or transient ischemic attack can be as high as 40%.[3] In these cases, treatment options consist of anticoagulation for the prevention of embolic events and endovascular or open surgical extraction.

Extraction of leads in the LV may induce embolization of adhered debris and thrombus. The Sentinel device (Boston Scientific, Marlborough, MA) was designed for encephalic protection during transcatheter aortic valve replacement (TAVR), through the capture and removal of embolized debris with filters positioned in the brachiocephalic trunk and the left carotid artery.[4] Only 1 TCEP device deployment is possible for TAVR procedures, as a second device would interfere with the delivery of the TAVR valve. The posterior circulation of the brain is therefore left unprotected during TAVR procedures. TCEP devices have been used off-label during other procedures also associated with increased embolic risk, such as mitral valve interventions, left atrial appendage occlusion,[5] pulmonary vein isolation,[6] and during treatment of left ventricular assist device outflow graft obstruction.[7] Although the use of a single TCEP device and incomplete cerebral embolic protection has been reported for a malpositioned left ventricular lead extraction,[8] this is, to our knowledge, the first reporting of complete cerebral embolic protection using 2 sentinel devices.

The presence of anatomical variations can render the use of embolic protection devices more challenging. The bovine aortic arch is the most common aortic arch variation and is defined by the presence of a shared origin of the left common carotid and brachiocephalic arteries. The safety and feasibility of the use of TCEP devices in patients with bovine aortic arch, such as in the case presented, has been previously demonstrated.[9]

Intracardiac imaging with transesophageal echocardiography or ICE is strongly recommended by the 2017 HRS expert consensus statement on cardiovascular implantable electronic device lead management and extraction.[10] In the reported case, imaging with ICE was crucial to monitor for the presence of possible interactions or adhesions of the lead to the mitral valve or subvalvular mitral apparatus, and with the interatrial septum. Damage to these structures during the procedure could lead to significant acute mitral regurgitation or interatrial communication. Fortunately, we did not encounter significant adhesions to these structures. Had that not been the case, careful advancement of the extraction device under ICE visualization through the interatrial septum and the mitral valve in order to liberate the lead could be considered as a last resort to avoid a surgical extraction.

To our knowledge, this is the first case report of a misplaced left ventricular electrode extraction performed with the utilization of 2 TCEP Sentinel devices, providing complete procedural embolic cerebral protection. The case also illustrates the value of a multidisciplinary approach involving cardiac imaging, interventional cardiology, and cardiac electrophysiology for the treatment of complications associated with the long-term presence of a misplaced pacing lead in the LV.

Funding Sources: None.

Disclosures: The authors have no conflicts of interest relevant to this work to disclose.

References

1. Stillman MT, Richards AM. Perforation of the interventricular septum by transvenous pacemaker catheter. Am J Cardiol 1969;24:269–273.
2. Ohlow MA, Roos M, Lauer B, Von Korn H, Geller JC. Incidence, predictors, and outcome of inadvertent malposition of transvenous pacing or defibrillation lead in the left heart. Europace 2016;18:1049–1054.
3. Van Gelder BM, Bracke FA, Oto A, et al. Diagnosis and management of inadvertently placed pacing and ICD leads in the left ventricle: a multicenter experience and review of the literature. Pacing Clin Electrophysiol 2000; 23:877–883.
4. Kapadia SR, Makkar R, Leon M, et al. Cerebral embolic protection during transcatheter aortic-valve replacement. N Engl J Med 2022;387:1253–1263.
5. Qintar M, Asala EA, Frisoli T, et al. Utility of cerebral embolic protection in non-TAVR transcatheter procedures. Cardiovasc Revasc Med 2022; 35:29–31.
6. Gopinathannair R, Elbey MA, Eshcol J, Seligson FL, Atkins D, Lakkireddy D. Use of a cerebral protection device to facilitate pulmonary vein isolation in a patient with left atrial mass arising from the interatrial septum. Cardiovasc Electrophysiol 2021;32:2601–2603.
7. Joury A, Patel RAG, Wever-Pinzon J, et al. Cerebral protection during percutaneous intervention for left ventricular assist device outflow graft obstruction. Catheter Cardiovasc Interv 2022;100:266–273.
8. Thosani A, Raina A, Liu E, Lasorda D, Chenarides J. Malpositioned endocardial left ventricular pacing lead extraction with transcatheter cerebral embolic protection in the setting of multiple prior embolic strokes. HeartRhythm Case Rep 2019; 5:552–554.
9. Tagliari AP, Ferrari E, Haager PK, et al. Feasibility and safety of cerebral embolic protection device insertion in bovine aortic arch anatomy. J Clin Med 2020; 9:4118.
10. Kusumoto FM, Schoenfeld MH, Wilkoff BL, et al. 2017 HRS expert consensus statement on cardiovascular implantable electronic device lead management and extraction. Heart Rhythm 2017;14:e503–e551.