Accidental extraction of a lead remnant with a leadless pacemaker delivery system

Mate Vamos, MD, PhD, Attila Benak, MD, Laszlo Saghy, MD, PhD, Tamas Szili-Torok, MD, PhD

From the Cardiac Electrophysiology Division, Cardiology Centre, Department of Internal Medicine, University of Szeged, Szeged, Hungary.

Introduction

Leadless pacemakers (LPMs) have been developed to overcome the limitations commonly associated with conventional pacemaker systems. The main indications for an LPM include obstruction of the venous route used for standard pacemaker implantation, pocket problems (eg, in the case of cachexia or dementia), or the increased risk of infection (eg, previous cardiovascular implantable electronic device [CIED] infection).[1]

In case of a CIED infection, recovery can only be expected after complete removal, for which transvenous lead extraction (TLE) has become the standard procedure.[2] By individual reassessment of the original CIED indication, unnecessary reimplantation can be safely avoided is some cases,[3] but in the vast majority, CIED should be reimplanted (eg, in patients with complete heart block) even during the same procedure.[4]

The current case highlights the complexities involved in managing CIED-related infections, particularly the challenges of extracting radiotransparent remnants. Patients with underlying mental health issues pose additional challenges.

Case report

A 28-year-old male patient with a history of intellectual disability underwent multiple cardiac surgeries because of a complex ventricular septal defect. These procedures included pulmonary banding and Botallo's ligament ligation, followed by full reconstruction. Postoperatively, a permanent pacemaker implantation was necessary due to a complete atrioventricular block, hence a single-chamber, passive fixation VVI system was implanted. Ten years later, the pacemaker generator had to be changed due to battery depletion.

After the generator replacement, most likely due to the continuous manipulation at the implantation site, a wound dehiscence and pocket infection developed. *Staphylococcus aureus* (ie, methicillin-resistant *S aureus*) was identified, prompting a combined gentamycin and vancomycin antibiotic therapy.

One month later, the patient was referred to our institution for TLE. His clinical issues were worsened by the fact that he inadvertently removed his pacemaker generator and parts of the lead, leading to a ventricular escape rhythm of 20–30

KEY TEACHING POINTS

- Managing cardiovascular implantable electronic device–related infections is complex, especially when dealing with radiotransparent remnants that may be missed by fluoroscopy.
- Multimodal imaging, including echo-guided extraction, may be necessary to ensure the thorough detection and removal of any radiotransparent remnants. Although periprocedural intracardiac echocardiography is useful in certain cases, transesophageal echocardiography may be superior for visualizing the tricuspid valve and right ventricle, especially when complications, such as system entrapment, occur.
- Successful management of complex cardiovascular implantable electronic device extractions, as demonstrated in this case, requires the availability of a full range of tools, experienced operators, and expertise in leadless technologies.
- Patients with mental impairments pose unique challenges, including the risk of self-harm or device manipulation, necessitating enhanced monitoring and tailored management strategies. In this case, the patient's mental condition required a one-session leadless pacemaker implantation to prevent further self-inflicted complications.

KEYWORDS Transvenous lead extraction; TLE; Remnant; Leadless pacemaker; Delivery system; Micra; Intellectual disability
(Heart Rhythm Case Reports 2025;11:129–132)

Address reprint requests and correspondence: Dr Mate Vamos, Cardiac Electrophysiology Division, Cardiology Centre, Department of Internal Medicine, University of Szeged, Semmelweis u. 8., 6725 Szeged, Hungary. E-mail address: vamos.mate@gmail.com.

https://doi.org/10.1016/j.hrcr.2024.10.023

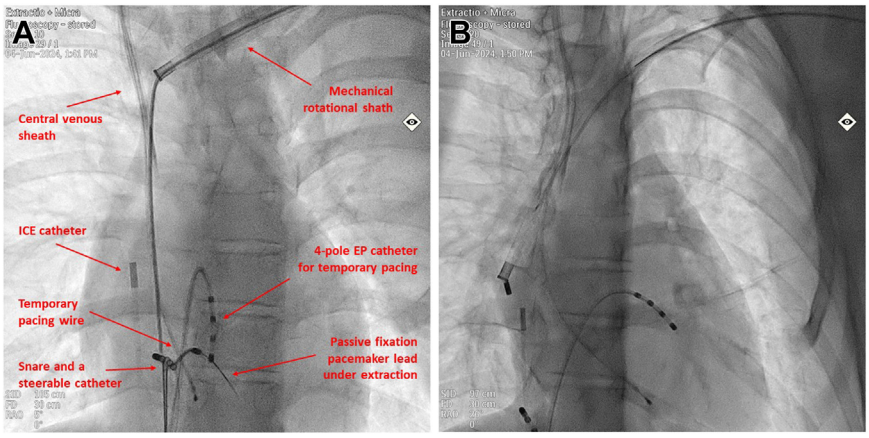

Figure 1 Transvenous extraction of a 10-year-old passive fixation right ventricular pacemaker lead. **A:** Due to massive adhesions on the lateral side of the superior vena cava, caudal traction was applied using a snare and a steerable catheter from the right femoral vein. **B:** Successful removal of the lead without radiologically visible residues. EP = electrophysiology; ICE = intracardiac echocardiography.

beats/min. A temporary pacemaker wire was urgently inserted via the right internal jugular vein.

One day later, TLE was performed under general anesthesia. After thorough debridement and bleeding control, the proximal end of the disintegrated lead was isolated and carefully prepared out from the pocket. A locking stylet could be introduced up to the distal tip of the lead. Using mechanical rotational sheaths (Evolution Shortie RL, Evolution RL 11F; Cook Medical), the adhesions at the entry point and in the brachiocephalic vein were dissected. Due to massive adhesions on the lateral side of the superior vena cava (SVC), a traction was applied caudally using a snare and a steerable catheter from the right femoral approach (Figure 1A, Supplemental Video 1). By successfully dissecting the adhesions within the SVC, the right atrium could be reached. The lead was adhered along the entire course in the cavotricuspid isthmus, necessitating multiple rotations at this site (Supplemental Video 2). The ring finally detached from the isthmus, allowing the lead to be removed without radiologically visible remnants (Figure 1B, Supplemental Video 3).

Considering the risk that the patient reopens the pocket due to their intellectual disability, we decided to perform a single-session LPM implantation. A Micra AV LPM (Medtronic) was introduced via the right femoral vein into the right ventricle. The initial positioning was challenging due to the small cardiac dimensions and a high threshold was measured at the first implantation site. On repositioning, the Micra device stuck at the entrance of the delivery sheath and could not be completely retracted into the sheath. The whole system was removed and a lead remnant from the previous extraction was identified as the cause of the obstruction (Figure 2). After removing the remnant, a successful LPM implantation was performed in a midseptal position with good and stable electrical parameters (Figure 3, Supplemental Video 4).

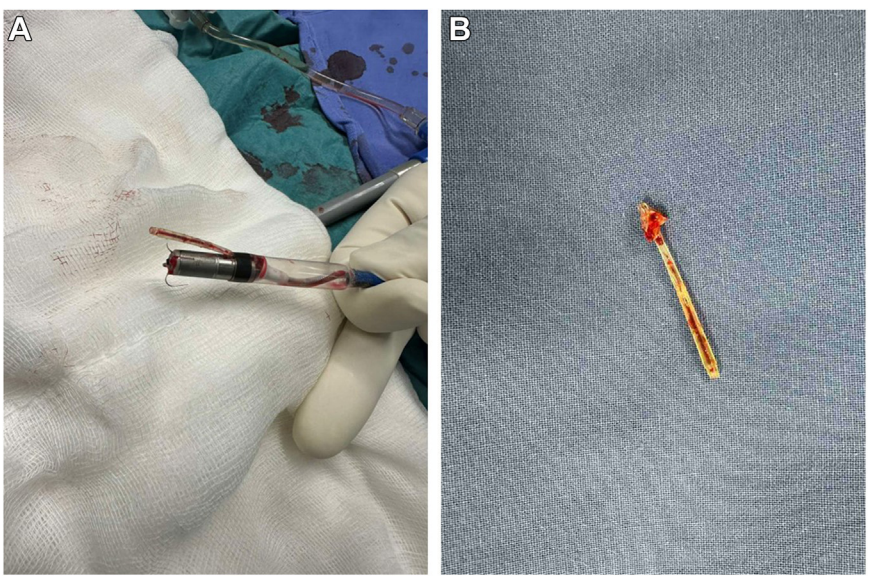

Figure 2 A lead remnant from the previous extraction. **A:** The remnant stuck into Micra delivery sheath. **B:** The extracted radiotransparent lead remnant.

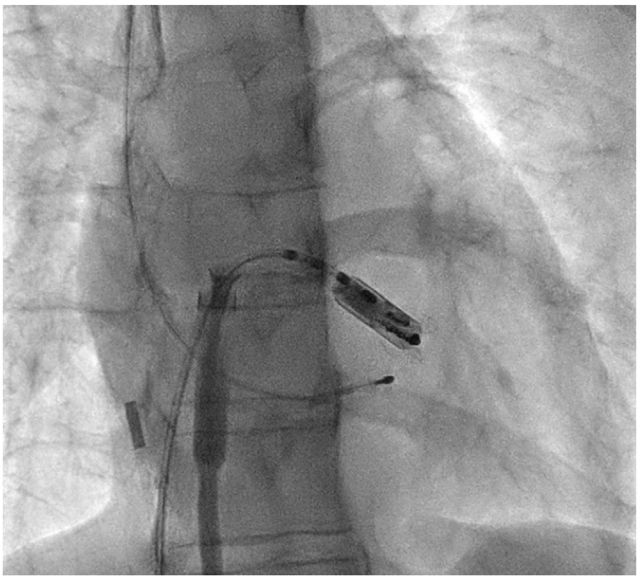

Figure 3 Final midseptal right ventricular position of the Micra AV device (Medtronic).

Discussion

The presented case underscores the challenges in managing CIED infections, including the extraction radiotransparent remnants and complications posed by the patient's mental condition. Thus, in a tertiary extraction center, optimally, the entire TLE arsenal, including heart surgery, should be available and operators should be experienced in the application of alternative device systems, such as LPMs or subcutaneous implantable cardioverter-defibrillators.[5,6]

In the current case, we used mechanically powered sheaths as first-line powered extraction tools.[7] We applied simultaneous traction from the femoral direction to increase separation and a more parallel alignment of the lead and SVC wall. This improved sheath alignment is particularly critical when powered sheaths are used.[8]

As commonly observed during the extraction of passive fixation leads, the absence of tensile force between the tip and the ring (due to the locking stylet stops at the ring) often results in the elongation of the lead and break at the ring, leaving a distal tip remnant behind. These silicone tube remnants can be easily missed by fluoroscopy if no metallic fragments are present, and multimodal imaging along with echo-guided extraction may be necessary.[9] In the current case, despite using intracardiac echocardiography, the radiotransparent remnant in the apex could not be visualized. Although intracardiac echocardiography is useful in visualizing the SVC during complex manipulations, it may not provide the best imaging of the tricuspid valve and right ventricle. The additional use of transesophageal echocardiography during lead extraction and LPM implantation, especially given the difficulties in recapturing the Micra, could offer superior visualization and support, as the LPM system could have been entrapped in the tricuspid valve apparatus, a complication that transesophageal echocardiography would likely detect.

Mental impairment poses unique challenges, including the risk of self-harm or device manipulation, necessitating enhanced monitoring and tailored management strategies. Although, to the best of our knowledge, this is the first case reporting reimplantation after self-extraction due to mental illness with an LPM, different strategies, such as sub-pectoral implantation to discourage future attempts, reimplantation at the contralateral site, or avoiding reimplantation in less indicated cases, have been reported in similar situations.[10–12] LPM mitigates such concerns and offers advantages by reducing the risks of infection, particularly those associated with device pockets. However, their implantation demands technical expertise, particularly in navigating anatomic challenges and managing complications, or even potential remnants of previous devices, as seen in this extraordinary case.

Although reimplantation of an infected CIED system is typically delayed after an antibiotic course after TLE, prolonged hospitalization can lead to increased costs and may be associated with other adverse events and morbidities. In the current case, we decided to perform a reimplantation of an LPM during the same procedure to simplify the management of this complicated case. There is growing evidence supporting the feasibility and safety of the 2-in-1 procedure of TLE followed by immediate reimplantation with an LPM.[4]

Funding Sources: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The open access article publishing charge was supported by the Foundation for Cardiology in Szeged (Szegedi Kardiológiáért Alapítvány).

Disclosures: Mate Vamos reports educational activity and an advisory relationship with Biotronik and educational activity on behalf of Medtronic, Novo Nordisk, and Pfizer. Tamas Szili-Torok reports educational activity and an advisory relationship with Biotronik, and, until 2022, he was in educational, advisory, and product development relationships with Ablacon Inc., Abbott, Acutus Medical, Biosense Webster, and Stereotaxis; the rest of the authors have no conflicts of interest.

Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.hrcr.2024.10.023.

References

1. Glikson M, Nielsen JC, Kronborg MB, et al. 2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy. Eur Heart J 2021;42:3427–3520.
2. Bongiorni MG, Burri H, Deharo JC, et al. 2018 EHRA expert consensus statement on lead extraction: recommendations on definitions, endpoints, research trial design, and data collection requirements for clinical scientific studies and registries: endorsed by APHRS/HRS/LAHRS. Europace 2018;20:1217.
3. Zsigmond EJ, Miklos M, Vida A, et al. Reimplantation and long-term mortality after transvenous lead extraction in a high-risk, single-center cohort. J Interv Card Electrophysiol 2023;66:847–855.
4. Maille B, Behar N, Jacon P, et al. Two-in-one procedure for transvenous lead extraction and leadless pacemaker reimplantation in pacemaker-dependent patients with device infection: streamlined patient flow. Europace 2024; 26:euae162. https://doi.org/10.1093/europace/euae162.
5. Sághy L, Zsigmond EJ, Benák A, et al. Transvenous lead extraction at the University of Szeged: 10-year experience. Orv Hetil 2023;164:1954–1964.
6. Benak A, Kohari M, Besenyi Z, Makai A, Saghy L, Vamos M. Management of cardiac implantable electronic device infection using a complete interdisciplinary approach. Herzschrittmacherther Elektrophysiol 2021;32:124–127.

7. Zsigmond EJ, Saghy L, Benak A, et al. A head-to-head comparison of laser vs. powered mechanical sheaths as first choice and second line extraction tools. Europace 2023;25:591–599.
8. Schaller RD, Sadek MM, Cooper JM. Simultaneous lead traction from above and below: a novel technique to reduce the risk of superior vena cava injury during transvenous lead extraction. Heart Rhythm 2018; 15:1655–1663.
9. Strachinaru M, Kievit CM, Yap SC, Hirsch A, Geleijnse ML, Szili-Torok T. Multiplane/3D transesophageal echocardiography monitoring to improve the safety and outcome of complex transvenous lead extractions. Echocardiography 2019; 36:980–986.
10. Corbisiero R, Levy M, Armbruster R, Muller D. Self-induced pacemaker mutilation 3 months after implant. J Innov Cardiac Rhythm Manage 2014;5:1630–1635.
11. Yıldız BS, Alihanoğlu Yİ, Kılıç İD, Evrengül H. An extraordinary case of cardiac pacemaker lead self-extraction. Turk Kardiyol Dern Ars 2015;43:750.
12. Che X, Abdelwahed YS, Wang X, Fang Y, Wang L. Pacemaker implantation in patients with major depression, should it be of concern? A case report and literature review. BMC Cardiovasc Disord 2020;20:279.