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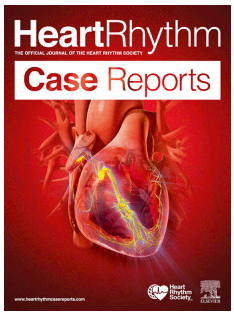

ACCIDENTAL EXTRACTION OF A LEAD REMNANT WITH A LEADLESS PACEMAKER DELIVERY SYSTEM

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HEART RHYTHM CASE REPORTS

ACCIDENTAL EXTRACTION OF A LEAD REMNANT WITH A LEADLESS PACEMAKER DELIVERY SYSTEM

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KEYWORDS: transvenous lead extraction, TLE, remnant, leadless pacemaker, delivery system, Micra, mental retardation

ABBREVIATIONS

CIED = cardiovascular implantable electronic device
ICD = implantable cardioverter defibrillator
LPM = Leadless pacemakers
MRSA = Methicillin-resistant Staphylococcus aureus
PM = pacemaker
SVC = superior vena cava
TEE = transesophageal echocardiography
TLE = transvenous lead extraction

1 │INTRODUCTION

Leadless pacemakers (LPM) have been developed to overcome the limitations commonly associated with conventional pacemaker systems. The main indications for 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 for 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 (for instance 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.

2 │ CASE REPORT

The 28-year-old male patient with a history of mental retardation underwent multiple cardiac surgeries because of a complex ventricular septal defect. These procedures included pulmonary banding and Botall'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 PM 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, MRSA) was identified prompting a combined gentamycin and vancomycin antibiotic therapy.

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

A day later TLE was performed under general anaesthesia. 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 11 Fr, Cook Medical, United States), 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, 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 cavo-tricuspid isthmus, necessitating multiple rotations at this site (Video 2). The ring finally detached from the isthmus, allowing the lead to be removed without radiologically visible remnants (Figure 1B, Video 3).

Considering the risk that the patient reopens the pocket due to their mental retardation, we decided to perform a single session leadless pacemaker 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. Upon 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, Video 4).

3 | 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 centre 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 leadless pacemakers or subcutaneous ICDs [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]. Although, in the current case, despite using intracardiac echocardiography, the radiotransparent remnant in the apex could not be visualized. While ICE 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 (TEE) during lead extraction and the 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 TEE 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 a leadless pacemaker, 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 anatomical 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 LPM during the same procedure to simplify the management of this complicated case. There is growing evidence supporting the feasibility and safety of the two-in-one procedure of TLE followed by immediate reimplantation with an LPM [4].

4 | FOUNDING SOURCES

The authors have no founding sources to disclose.

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6 | FIGURES

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 (SVC), 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.

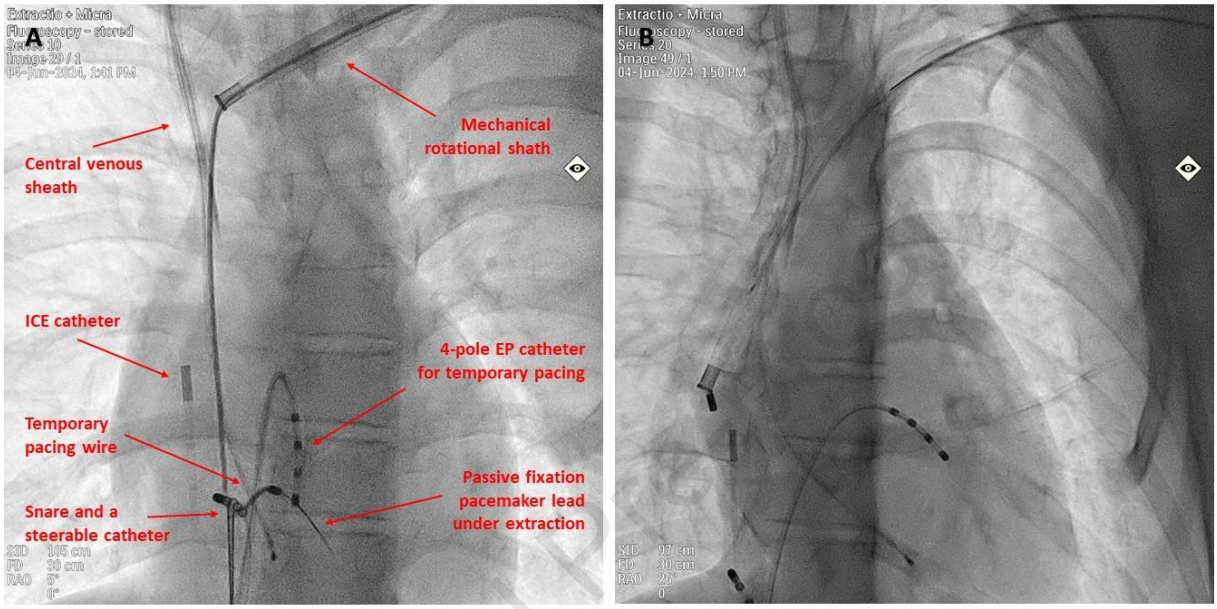
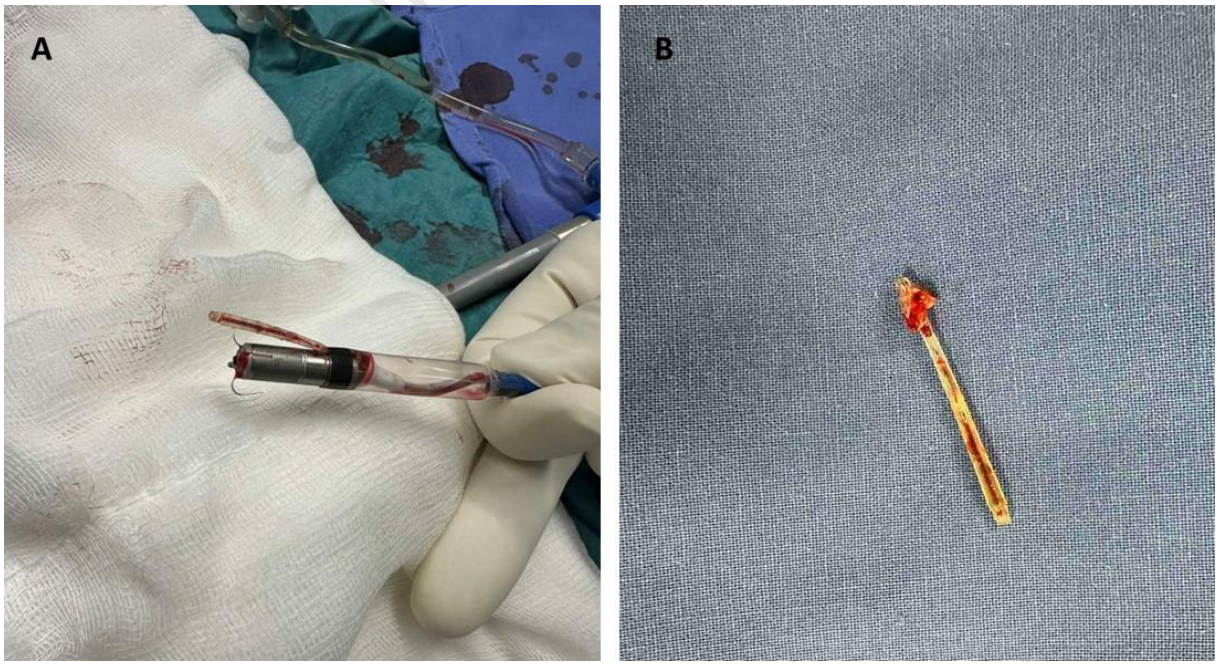
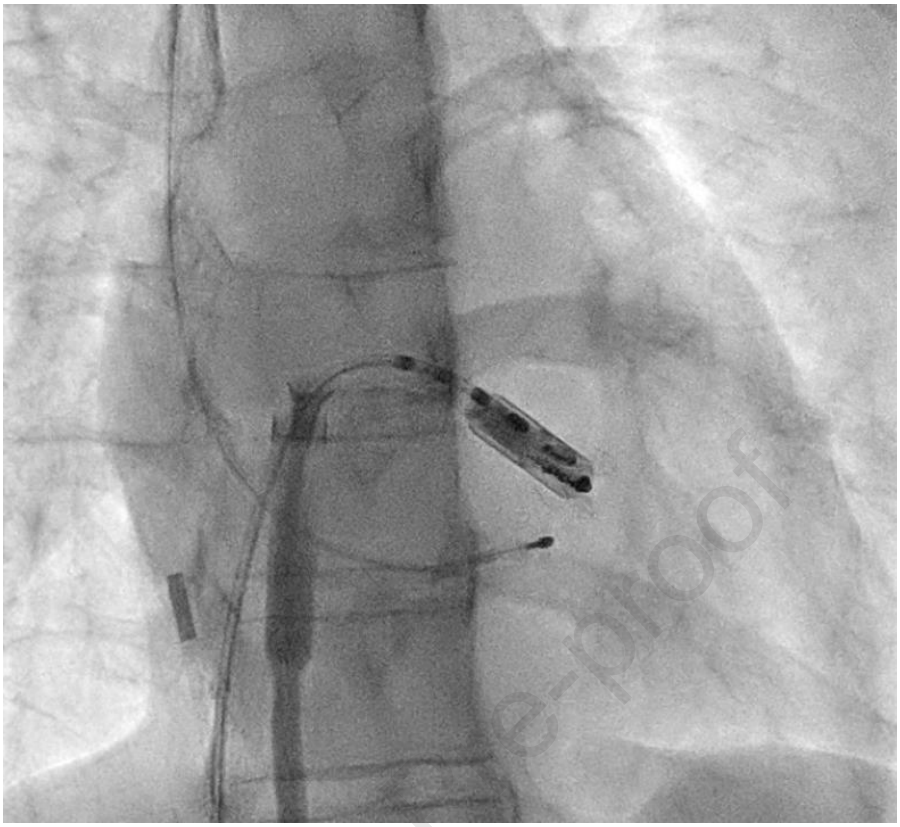


Figure 2 A lead remnant from the previous extraction stuck into Micra delivery sheath



209 **Figure 3** Final midseptal right ventricular position of the Micra AV device.



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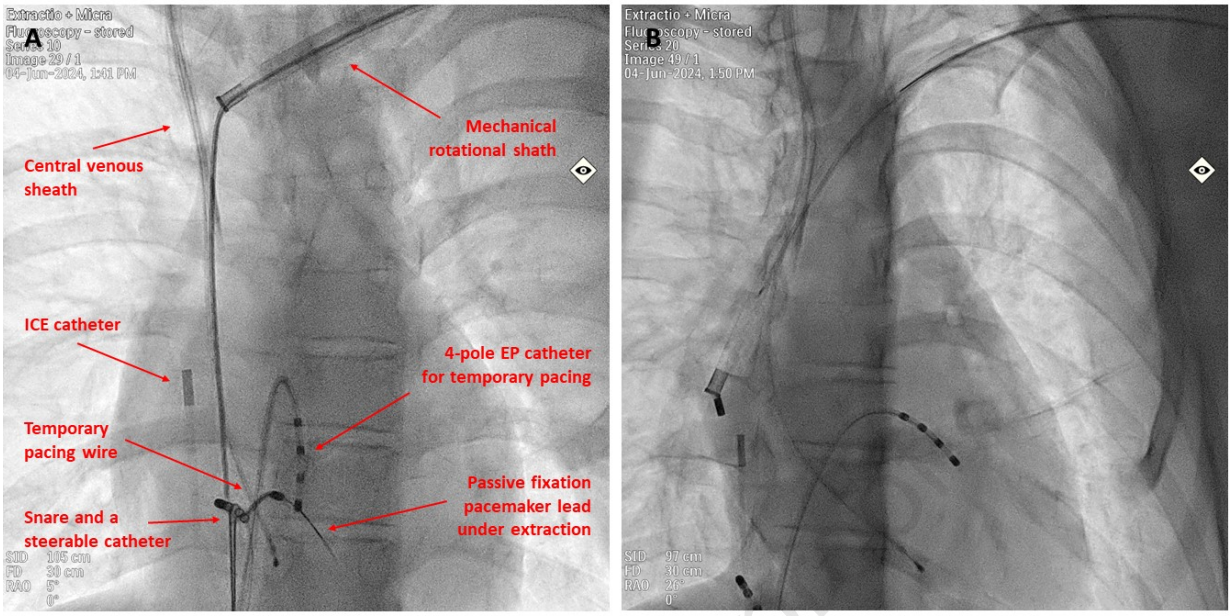

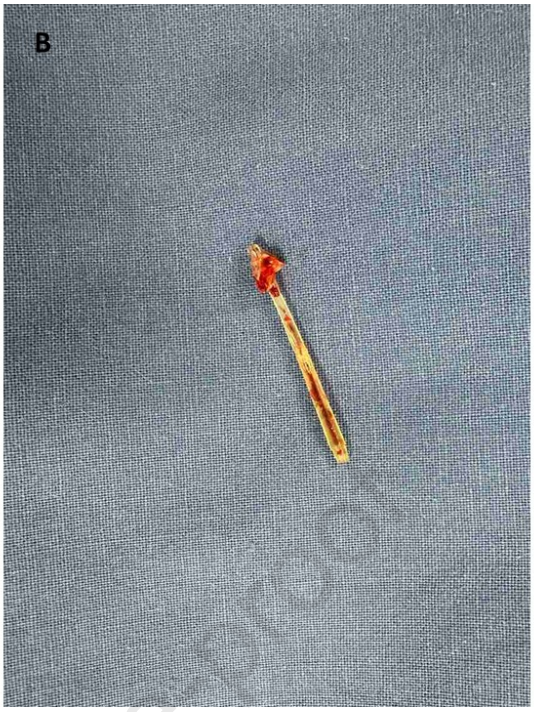

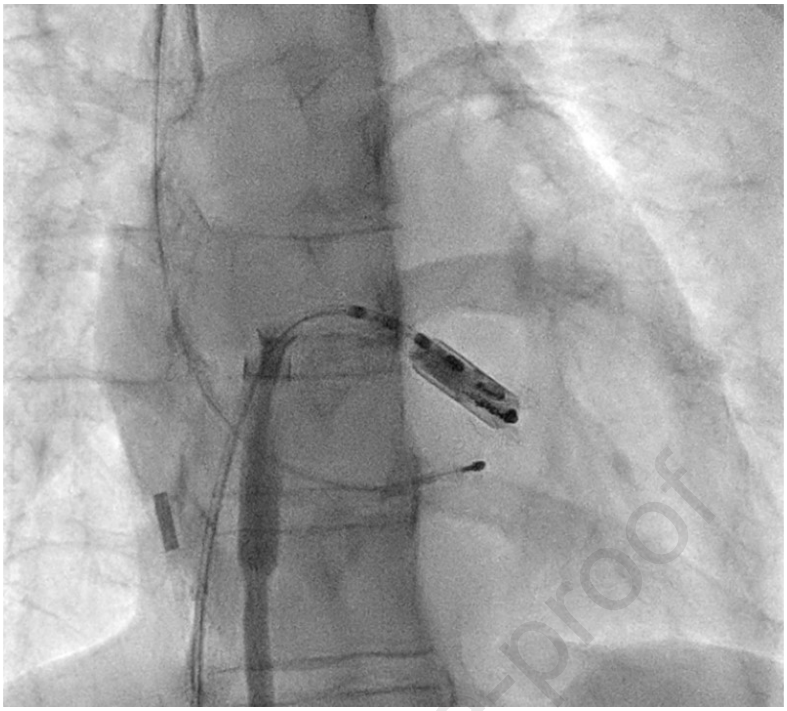

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Key teaching points:

- Managing CIED-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 ICE is useful in certain cases, TEE may be superior for visualizing the tricuspid valve and right ventricle, especially when complications such as system entrapment occur.
- Successful management of complex CIED 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.