

# The use of a needle's eye snare to extract a leadless pacemaker in a patient with a persistent bacteremia



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## Introduction

The Micra Transcatheter Pacing System (Medtronic, Minneapolis, MN) is a leadless pacemaker (LP) that is associated with a low rate of implant-related complications and, during initial experience, a very low infection rate by comparison with that observed for transvenous pacing systems.<sup>1</sup> Potential indications for LP explantation/extraction include dislodgement, suboptimal pacing performance, the use of LPs as a bridge between permanent transvenous systems following device infection, or infection of the LP itself. There is currently no consensus on a possible role of LP extraction at end of service.<sup>2</sup> Autopsy reports have shown the potential for complete encapsulation of LP, which raises concern about the feasibility and, potentially, safety of extraction of chronically implanted LPs.<sup>3</sup>

Given the relative novelty of LP, data on device explantation/extraction are limited to a handful of case reports. There are currently no dedicated tools for LP device explant. Case reports to date have described techniques that typically involve capturing the device with a gooseneck snare via a deflectable sheath introduced through a femoral vein.<sup>4</sup> The needle's eye snare is widely used during extraction of chronically implanted leads<sup>5</sup>; however, its use has not hitherto been reported for the extraction of LPs. Given the likely growth in LP implantation, further work is required to develop effective techniques for device extraction. We report on the use of a needle's eye snare in combination with a steerable sheath through a large-bore access sheath to extract an LP in a patient with persistent bacteremia.

**KEYWORDS** Pacemaker extraction; Leadless pacemaker; Pacemaker infection; Pacemaker explantation; Persistent bacteremia; Needle's eye snare (Heart Rhythm Case Reports 2022;8:699–701)

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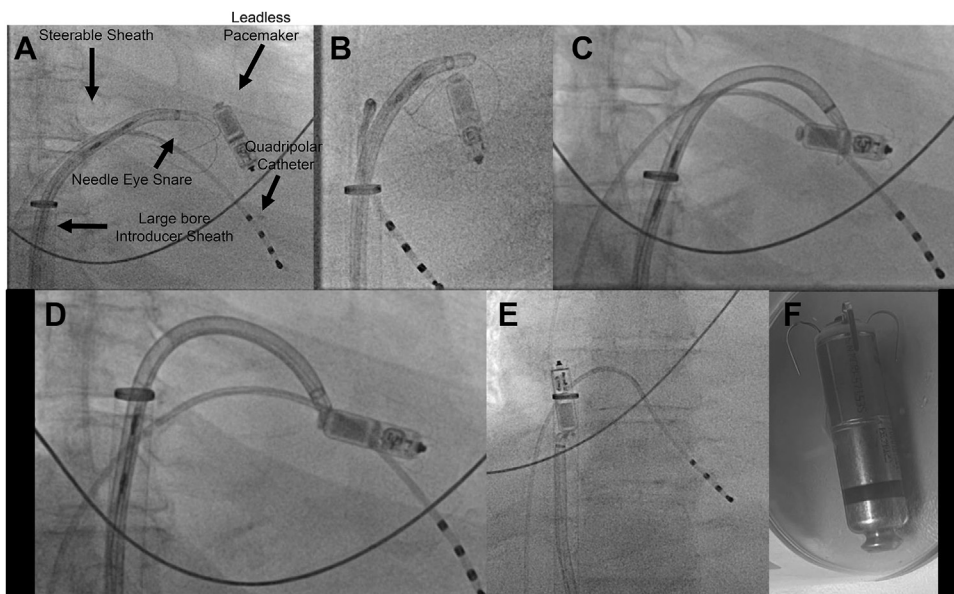
## KEY TEACHING POINTS

- Despite the apparently low rate of leadless pacemaker-associated infection, in the presence of a persistent bacteremia extraction should be considered.
- As the rate of leadless pacemaker implants increases, the need for effective and safe extraction techniques will become increasingly important.
- A needle's eye snare in conjunction with a steerable sheath is a useful tool to explant a leadless pacemaker anchored with retractable tines.

## Case report

A 51-year-old female patient with a history of cardiac sarcoidosis, preserved left ventricular systolic function, and a dual-chamber pacemaker implanted 11 years previously for intermittent third-degree atrioventricular block presented to her local hospital with malaise and a fall. Two years previously, her pacemaker generator had been explanted, the leads capped, and an LP implanted to facilitate radiotherapy of a left-sided breast cancer. Serial pacemaker checks following the LP implantation had documented a very low ventricular pacing requirement.

On admission the patient was febrile and appeared unwell, with tachycardia and tachypnea but without hypotension or hypoxia. Blood culture isolated *Staphylococcus aureus*. A chest radiograph and urine analysis were unremarkable. Following initial empirical broad-spectrum antibiotic therapy with oral rifampicin, intravenous (IV) vancomycin, and IV gentamicin, treatment was rationalized to IV vancomycin alone, based on culture sensitivities. The bacteremia persisted and blood culture continued to isolate the same organism. No source of infection was identified by computed tomography of the abdomen and pelvis. Transesophageal echocardiography demonstrated a mass on one of the redundant transvenous pacing leads, although positron emission tomography/



**Figure 1** Retrieval of the leadless pacemaker (LP) using the needle's eye snare through a steerable and large-bore sheath. **A:** Introduction of the needle's eye snare through the Agilis (Abbott) and Micra (Medtronic, Minneapolis, MN) introducer sheaths, right anterior oblique view. **B:** Same as panel A but seen in left anterior oblique view. **C:** The "cobra head" component of the needle's eye snare has been advanced over the LP and partially closed but not tightened. **D:** The "cobra head" component of the needle's eye snare has been tightened around the proximal retrieval feature of the LP. **E:** Extraction of the Micra LP through the Micra introducer sheath. **F:** The LP immediately post extraction. There is no evidence of adherent material or encapsulation.

computed tomography did not demonstrate fluorodeoxyglucose uptake consistent with an infective vegetation. She was treated as having pacing lead-associated infective endocarditis and transferred to our center for further management.

Following transfer the patient remained pyrexial and unwell. The redundant transvenous pacing leads were therefore extracted under general anesthesia in an uncomplicated procedure. The extracted leads were considered to have been removed in their entirety. Pustulant and friable tissue was noted adherent to the lead tips and lead tip culture demonstrated the same species of *S. aureus* that had been identified by blood culture. The LP was left in situ, as it was thought likely that it would have become endothelialized and it was considered to be an unlikely source of infection.

The patient continued to deteriorate with persistent fever, worsening inflammatory markers, and new thromboembolic events, including right upper-lobe pulmonary emboli. The picture was in keeping with a disseminated *S. aureus* infection and it was agreed that the patient should also undergo LP extraction.

Right and left femoral venous access was gained under ultrasound guidance. Under fluoroscopic guidance a temporary pacing wire was introduced into the right ventricle through a 6F SafeSheath. A 23F Micra Introducer Sheath (Medtronic, Minneapolis, MN) was passed via the right femoral vein to the right atrium over an Amplatz Super-Stiff Wire (Cook, Indianapolis, IN). An 8F steerable sheath (Large-curl Agilis; Abbott, Chicago, IL) was then inserted through the Micra Introducer Sheath. Finally, a 20 mm Needle's Eye Snare (Cook) with the outer sheath removed was passed through the steerable sheath. The steerable sheath and needle's eye snare assembly was advanced into the right ventricle. The

snare was passed around the body of the LP and partially closed without deployment of the snare threader. The snare assembly was then carefully retracted until the proximal retrieval feature was engaged and was then fully tightened. The LP was extracted using simple traction and withdrawn through the Micra introducer sheath. On visual inspection the LP was intact, with no adherent material (Figure 1). The sheaths were removed and a Z-suture was placed in the groin. The Supplemental Video demonstrates the aforementioned technique. During the procedure there was no acute arrhythmia or hemodynamic instability.

Following the removal of the LP, the patient's inflammatory markers improved and she became afebrile. Once a 6-week course of antibiotics was completed, another LP was reimplanted successfully without complication. On follow-up in device clinic, 3 months after discharge, the patient remained well.

## Discussion

Current experience of LP extraction is limited. As the use of these devices grows, there will inevitably follow a need to extract them. The combination of a needle's eye snare through a steerable sheath and long large-bore access sheath provides an alternative to the techniques described in the existing literature.

There are many potential complications when removing an LP. These include vascular injury, trauma to the myocardium and/or tricuspid valve, pericardial effusion, and embolization of the LP system. Any extraction technique should look to limit these risks.

The Micra introducer sheath, although large-bore, has a hydrophilic coating and, with ultrasound-guided femoral venous

access and serial dilation, is associated with limited morbidity in experienced hands. This allows atraumatic access to the inferior vena cava / right atrium junction and provides a clear path for LP removal. Careful venous closure must also be considered with either a hemostatic suture, femoral compression system, or alternative vascular closure methods.

In this case alternatives such as the Goose Neck Snare (Medtronic) were not used owing to the local extensive experience with the use of the needle's eye snare for the extraction of broken lead fragments. A steerable sheath should be considered to allow precise directional movement of the snare. The circumference, deformability, and shape of the snare loop enables it to be advanced around the body of the LP easily and safely. The shape and diameter of the needle's eye portion of the snare, and its stiffness, provides an open loop that locks into the LP's proximal retrieval feature precisely and securely when retracted back into the steerable sheath. Ensuring engagement of the proximal retrieval feature prior to applying traction is vital to ensure safe explantation of the LP. Despite its stiffness, the nitinol loop deforms easily against the myocardial wall and therefore may increase safety in manipulating it around the heart. There may be a learning curve, as the needle's eye snare is used less frequently as an extraction tool in some centers, when compared to alternatives such as the goose-neck snare.

Given the relative ease of extraction in this case and the absence of adherent tissue to the LP, there is no clear evidence that the LP was encapsulated 2 years after implantation. LP endothelialization may affect the ease of extraction of these devices; however, identifying the extent to which this process has occurred is challenging.

A disadvantage of our technique is that it cannot deliver counter-traction. During extraction of chronically implanted transvenous leads, counter-traction supports the tensile strength of the lead and reduces the risk of complications such as tricuspid valve disruption or significant myocardial tissue avulsion.<sup>6</sup> The large-bore Micra introducer sheath is unlikely to be suitable for this purpose owing to its inherent rigidity, regardless of the snare used. However, given the inherently smaller surface area that the LP has, it is likely there will be fewer sites of fibrous adherence to myocardial

structures compared with transvenous leads. In addition, the LP's nitinol tines straighten out with minimal traction to allow it to slide out of the tethering scar. Simple traction may therefore be sufficient in most cases, but the development of dedicated tools to allow for counter-traction may be required.

LP infection appears to be rare. Although the extracted LP did not undergo microbiological examination, the clinical course implies that it was the source of persistent bacteremia. Device endothelialization may protect LPs from bacterial colonization. In this case there was no clear evidence that the LP had become encapsulated, potentially increasing the risk of device-associated infection.

## Conclusion

Our technique of using a needle's-eye snare in combination with a steerable sheath through a large-bore access was successful in extracting an LP that had been implanted 2 years previously. In our case, LP removal was associated with resolution of a persistent bacteremia in a patient with previously extracted transvenous leads.

## Appendix Supplementary data

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.hrcr.2022.07.012>.

## References

1. Tjong FVY, Reddy VY. Permanent leadless cardiac pacemaker therapy. A comprehensive review. *Circulation* 2017;135:1458–1470.
2. Bhatia N, Kiani S, Merchant F, et al. Life cycle management of Micra transcatheter pacing system: data from a high-volume center. *J Cardiovasc Electrophysiol* 2021; 32:484–490.
3. Kiani S, Faisal M, El-Chami M. Extraction of a 4-year-old leadless pacemaker with a tine-based fixation. *Heart Rhythm Case Rep* 2019;5:424–425.
4. El Chami M, Merchant F. Femoral extraction of transvenous leads and leadless pacemakers—a review of the data, tools, and procedural steps. *Pacing Clin Electrophysiol* 2019;42:1248–1252.
5. Bracke F, Dekker L, Gelder B. The Needle's Eye Snare as a primary tool for pacing lead extraction. *Europace* 2013;15:1007–1012.
6. Jain S, Clancy J. Lead extraction: from traction to technology. *EP Lab Digest* 2021; 21:8–10.