

Treating an infected transcatheter pacemaker system via percutaneous extraction



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Introduction

One of the most feared complications of a traditional pacemaker system is cardiac implantable electronic device infection. In such cases, a complete removal of the entire system is recommended.^{1,2} With the advent of the leadless transcatheter pacemaker system (TPS), the weak link—namely, the pacing leads that contribute to this problem—can be ultimately eliminated. At least 2 major studies have shown negligible infection rate with the leadless TPS.^{3–5} Nevertheless, this does not discount the possibility of an infection ever affecting a TPS. Should that happen, whether an extraction is warranted is yet to be recommended.⁶

Some studies on sheep have demonstrated the possibility of safely extracting the TPS percutaneously.^{7,8} The first-in-human extraction of a Micra TPS 3 weeks after implantation owing to elevated capture threshold was recently reported by Karim et al.⁹ In this report, we describe the world's first infected Micra TPS, which eventually led to its extraction percutaneously 1 month after implantation.

Case report

An 80-year-old woman presented with giddiness for 1 week. She had a background history of hypertension, stroke, and atrial flutter that was successfully cardioverted. Besides that, there was also a history of 5-day admission 2 months earlier for culture-negative urinary tract infection, which was adequately treated with ciprofloxacin. Electrocardiogram revealed junctional bradycardia (31 beats per minute) at presentation and atrial fibrillation with rapid ventricular response the following day. Because she could not tolerate rate control medication, a decision was made to implant the Micra TPS first and then initiate amiodarone or a beta-blocker. She received cefazolin at the time of implantation and another dose 12 hours after implantation, as per

institutional protocol. The procedure proceeded uneventfully with stable parameters (P wave at 6.3 mV, impedance of 530 ohms, and pacing threshold of 0.88 V at 0.24 ms) on discharge.

Twenty-two days later, she presented with a week's history of lethargy. Pacemaker interrogation demonstrated an increase in capture threshold from 0.88 V to 1.75 V at 0.24 ms with stable sensing and impedance. Echocardiography, electrocardiography, and chest radiograph did not reveal any significant abnormalities. She was then discharged.

Exactly 1 month after Micra TPS implantation, she developed fever, chills, and rigors. Methicillin-resistant *Staphylococcus aureus* (MRSA) was isolated in 2 separate blood cultures, for which vancomycin and rifampicin were initiated. Transesophageal echocardiography (Figure 1) demonstrated a vegetation (size: 1.2 × 0.9 cm) that was attached to the proximal retrieval. Device interrogation demonstrated a further increase in capture threshold to 4.38 V at 0.24 ms, 3 V at 0.4 ms, and 2.13 V at 1 ms. Pacing output was increased to 5 V at 0.4 ms. Despite a week of antibiotics with dosage adjustments based on therapeutic drug monitoring, blood culture still revealed MRSA. The subsequent plan was to extract the device percutaneously.

The left femoral vein was punctured (stenosed right femoral vein) and the 23 French Micra introducer sheath (Medtronic, Minneapolis, MN) was advanced to the right atrium, followed by an 8.5 French Agilis NxT medium-curl steerable sheath (St Jude Medical, Minnetonka, MN) within it. A 6 French Amplatz GooseNeck Snare (Covidien/Medtronic, Plymouth, MN) was advanced through a 6 French Multipurpose A1 catheter to provide for a better support during manipulation (Figure 2A). The proximal retrieval feature was captured at its waist with the snare after several attempts (Figure 2B). The device was then pulled into the introducer sheath with a moderate degree of counter-traction and the entire system was removed from the body in 1 piece (Figure 2C and D). There was no pericardial effusion on echocardiography, which was performed immediately and a day after extraction. Antibiotics were continued for a further 6 weeks and eventually the blood culture became negative in 2 separate samples.

KEYWORDS Leadless pacemaker; Transcatheter pacemaker system; Lead extraction; Infected pacemaker; Micra
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KEY TEACHING POINTS

- Methicillin-resistant *Staphylococcus aureus* screening should be performed for all patients prior to implantation, more so in patients who have a history of admission within the past 3 months.
- Antibiotic prophylaxis is mandatory for all patients at the time of implantation, regardless of any history of infection.
- The Micra transcatheter pacemaker system extraction technique should be included in the syllabus when teaching new implanters.

The extracted device had its proximal retrieval sheath covered with the vegetation that was observed on transesophageal echocardiography. On its opposite end, a thin layer of encapsulating tissue that resulted from local fibrous reaction appeared to be firmly attached only to all 4 fixation tines; this was removed, together with the device, during forceful traction (Figure 3). The device was subsequently sent for histopathology with particular interest in the vegetation at the proximal retrieval sheath. The analysis showed fragments of fibrinous material focally infiltrated by dense neutrophils admixed with few histiocytes, which was consistent with infected vegetation.

Discussion

At 25.9 mm, the Micra TPS is shorter than the lead fragments retained in the heart following an incomplete extraction in several experienced centers. Although most of these patients progressed to complete recovery from infection, it is not clear how many among them had distal lead endocarditis.⁷ Bacteremia caused by MRSA, the predominant organisms in

cardiac implantable electronic device infection, is associated with high mortality. These organisms form a protective biofilm on the surface of the Micra device, thus rendering them antibiotic-resistant. As such, the only intervention to resolve the infection should be a complete device extraction. Based on currently available guidelines, a new device can only be reimplanted no sooner than 2 weeks after the extraction.¹⁰

The proximal retrieval feature of the Micra TPS, which comprises the docking button and the waist, allows for the device to be extracted via the over-the-catheter approach with a snare. Whereas the previous experience with device extraction demonstrated the fixation tines capture method with a multiple-loop snare, we demonstrated the proximal retrieval feature capture method with a single-loop snare.⁹ The main drawback with our method is the risk of septic pulmonary embolism while manipulating the snare over the docking button and tightening the snare around the waist of the device. However, with careful manipulation and retraction of the device into the Micra introducer sheath, that risk can be mitigated.

Conclusion

Complete hardware removal is mandatory if elimination of the infection, especially MRSA, is to be achieved. What favored a percutaneous over a surgical extraction in this experience are the modest size of the vegetation (<1.5 cm) and the duration of implantation (1 month). Despite the limited worldwide experience, we have safely demonstrated the management of an infected leadless TPS by percutaneous extraction. To our knowledge, there are no data pertaining to the reimplantation of a Micra TPS following an infection. However, drawing conclusions from current guidelines for infected lead pacemaker systems, it would seem reasonable

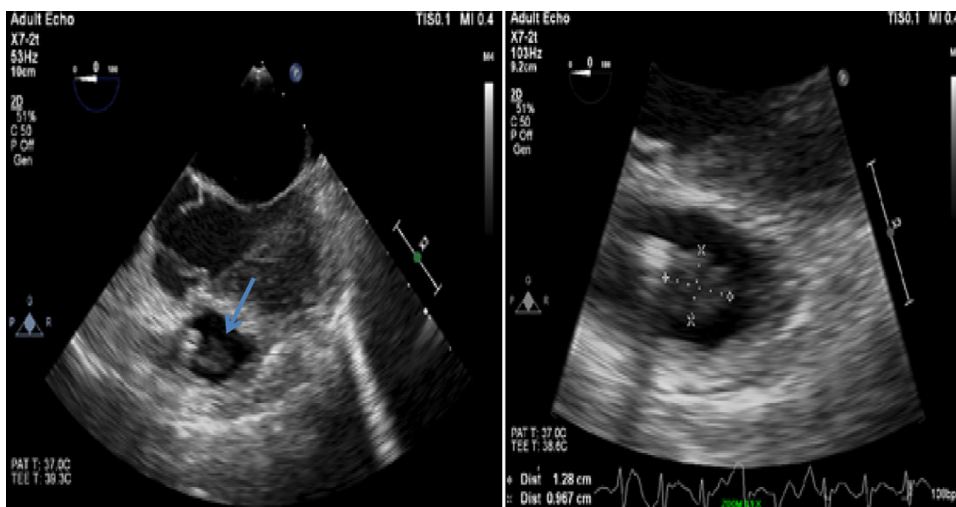


Figure 1 Vegetation seen on transesophageal echocardiography (arrow).

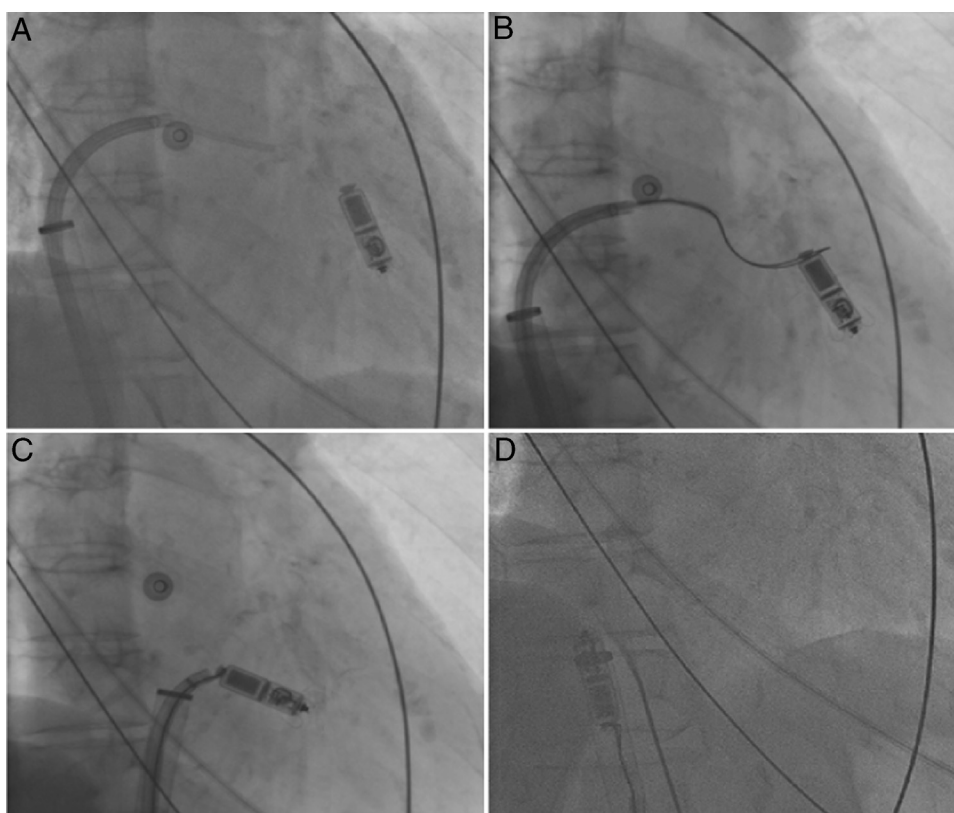


Figure 2 Steps of the extraction procedure. **A:** Grandmother-mother-child technique employed to direct the snare at the proximal retrieval feature. **B:** The snare is tightened around the waist of the retrieval feature. **C:** The transcatheter pacing system is retracted toward the introducer sheath. **D:** The entire system is pulled out in 1 piece.



Figure 3 The extracted device is seen with the vegetation attached to its proximal retrieval feature (arrow) and fibrous encapsulation at the fixation tines.

to delay reimplantation of a new Micra TPS for at least 2 weeks after the removal of the infected device.¹⁰

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