Radiofrequency ablation–assisted extraction of a pacing lead fragment

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Introduction

Infected cardiac implantable electronic devices require complete extraction, but lead fracture makes complete extraction challenging. When conventional extraction techniques fail, innovative approaches are required. We present a patient with recurrent bacteremia whose pacing lead fractured during extraction, required a novel approach toward extracting the fragment.

Case Report

A 71-year-old man with ischemic cardiomyopathy and prior coronary artery bypass grafting surgery with a dual-chamber implantable cardioverter-defibrillator (ICD) placed 4 years earlier for a history of ventricular tachycardia was referred for lead extraction because of recurrent fever, vegetations on his atrial lead, and *Kocuria varians* bacteremia. He had a Guidant 4470 right atrial (RA) lead and a Guidant 0184 right ventricular (RV) lead (Guidant Corp, St. Paul, MN).

The RV lead was successfully extracted with a Liberator locking stylet and a Cook Evolution system (Cook Medical, Bloomington, IN) without difficulty. The Evolution system outer sheath was advanced to the right atrium and the rotational sheath was advanced to within the innominate vein; traction-countertraction with an external dilator facilitated removal of the RV lead. Traction of the RV lead did not show significant interaction with the RA lead. A locking stylet was inserted within the atrial lead, but it could not be advanced further than a position 1 cm proximal to the proximal electrode and was deployed at this location. As the Cook Evolution RL mechanical rotational dilator sheath was advanced over the lead, the locking stylet separated at the tip of the proximal electrode, stretching the silicone rubber coating. Further traction completely separated the silicone rubber coating, leaving behind the 2 electrodes and a portion of the silicone outer coating (Figure 1). The proximal fragment of the lead was removed and the pocket was closed.

The next day, the patient, desiring to avoid a repeat sternotomy, consented to additional percutaneous attempts to extract the lead fragment. Venous access was again obtained, and a venogram confirmed patency of the left internal jugular vein (IJV), innominate, and superior vena cava (SVC). A gooseneck snare was advanced through the left IJV, but it could not successfully snare the fragment. The silicone rubber coating appeared to be embedded in the wall of the SVC. Through a 10F long sheath in the right femoral vein (FV), a 0.014 inch guidewire (Pilot 50; Abbott Vascular Inc, Santa Clara, CA) was directed between the 2 adherent fragments between the proximal electrode and the adherent silicone using a reverse curve catheter (SOS Omni 2; AngioDynamics, Latham, NY) such that the wire tip was pointing in the caudad direction (Figure 2). The distal tip of the Pilot wire was snared and pulled back through the right FV sheath such that both ends of the wire were exiting the long sheath. With a loop formed around the lead

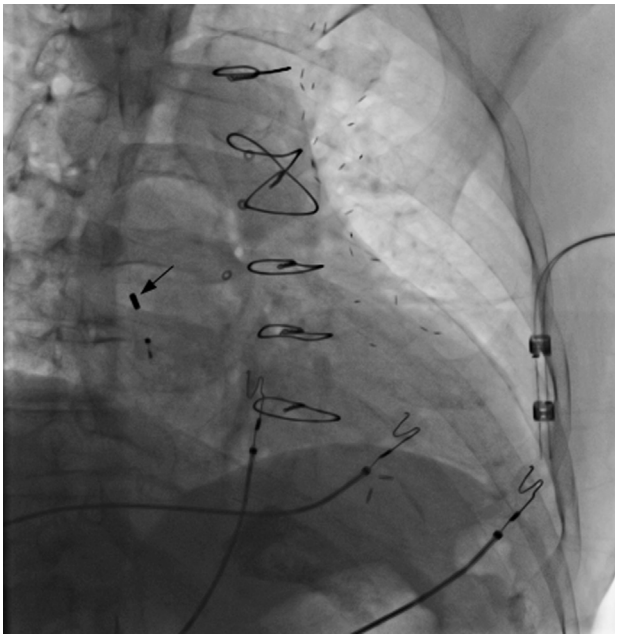

Figure 1 Fragments of the right atrial lead (*arrow*) on fluoroscopy.

KEYWORDS Implantable cardioverter-defibrillator; Lead extraction; Lead infection; Pacemaker; Radiofrequency ablation

ABBREVIATIONS **FV** = femoral vein; **ICD** = implantable cardioverter-defibrillator; **IJV** = internal jugular vein; **RA** = right atrial; **RF** = radiofrequency; **RV** = right ventricular; **SVC** = superior vena cava

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KEY TEACHING POINTS

- Infected device leads require complete extraction to allow cure.
- Fractured leads require the use of a retrieval device, and a gooseneck snare with a retrieval wire enables the operator to snare the lead fragment.
- Manual traction may be insufficient to free the lead fragment from the endocardium. In this case, radiofrequency ablation energy was applied to free the fragment during traction.

fragment, the sheath was advanced to the fragment. Both ends of the Pilot wire were simultaneously manually tugged, releasing the silicone coating adherent to the SVC, which was snared with the gooseneck snare. However, the proximal and distal electrodes remained embedded in the atrial myocardium, and the fragment still could not be extracted after 30 minutes of manual tugging. A 4 mm Blazer Prime radiofrequency (RF) ablation catheter (Boston Scientific, Natick, MA) was then inserted into the left FV. After additional attempts were made to free the fragments through traction, RF ablation was performed over the proximal and distal electrodes at 30–50 W up to 65°C at 30 seconds per lesion, with a total of 6 lesions, with close monitoring of impedance, while confirming that there was no diaphragmatic capture (Figure 3). After several ablation lesions were made, the ablation catheter was able to displace one end of the fragment cephalad; this free end was snared with the gooseneck snare. Continued traction on the Pilot wire allowed the fragment to be removed through the long sheath. Inspection after removal demonstrated a fibrin coating encasing the lead fragment and silicone insulation. There were no complications after the procedure. The patient remained afebrile with no further signs or symptoms of infection, and he underwent reimplantation of an ICD on the contralateral side 1 month later.

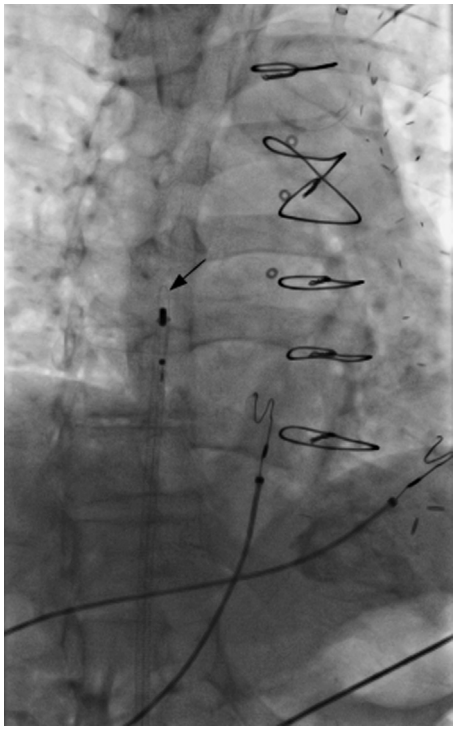

Figure 2 The 0.014 inch Pilot wire was used to form a loop to snare the lead fragment (*arrow*). The sheath is advanced to the lead fragment, allowing traction for attempted removal.

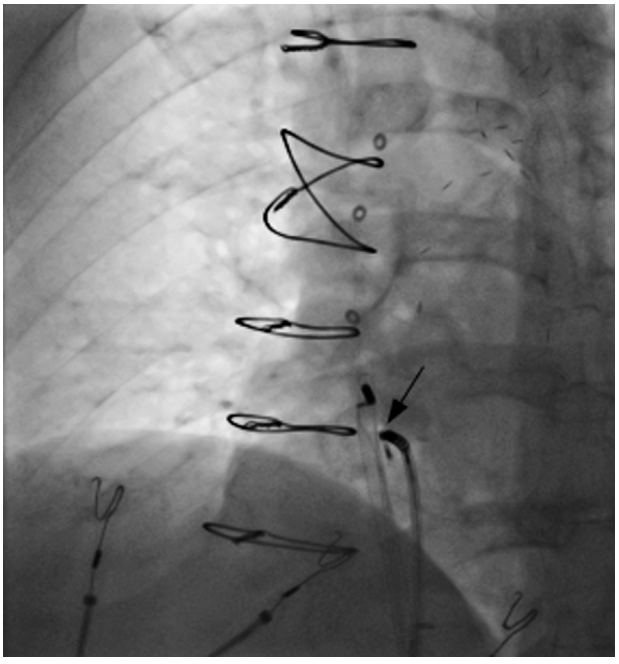

Figure 3 Radiofrequency ablation (*at point of arrow*) is performed over the pacing lead electrodes.

Discussion

Lead extractions are often required in patients with infections, lead fractures, and venous access complications. Complete extractions succeed in 88%–93% of attempts,[1] although extractions may be considered complete when fragments <4 cm are left.[2] However, cure of infection is unlikely if any fragment is left in situ. Fibrosis around the leads is increasingly common the longer they have been implanted. This can markedly increase the complexity of the procedure and the risk of complication. If the lead breaks during extraction, the remaining fragment may be too small to be extracted with a snare. Although ablation catheters have been used to aid in fragment extraction because of their maneuverability,[3] actual RF application is rarely used for the purpose of freeing electrodes during lead extraction. RF has been used to free an intact lead,[4] but its role in lead extraction remains undefined. Unipolar RF ablation may release adherent connective tissue at increased voltage in combination with manual traction. The exact relationship between traction and ablation in this case is not known for certain, but after extensive manual tugging did not affect the lead position and RF ablation did, we hypothesize that

RF ablation energy played a significant role. The use of both the Pilot wire and the gooseneck snare allows control during the extraction process, but alone it cannot remove the densely adherent hardware because of the extensive fibrosis. The combination of RF ablation with the wire and gooseneck snare is a potential tool for removing adherent pacing lead fragments. Additional studies are required to determine the efficacy and safety of this approach to retrieve pacing lead fragments from other locations and in other circumstances.

Conclusion

Treating device infections requires complete lead extraction, which is especially difficult if the leads were implanted several years prior. We demonstrate that the combination of RF ablation with a gooseneck snare is an effective means of extracting pacing lead fragments that cannot be extracted using conventional techniques.

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