Radiofrequency thermal wire for crossing subclavian vein occlusion allows lead upgrade in patient with pre-existing transvenous device

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Introduction

Indications for upgrading pre-existing cardiac devices and an aging population have resulted in an increase in the number of patients who have venous occlusions, which potentially can prevent the implantation of new leads. We describe the use of a thermal wire using burst radiofrequency to cross an occlusion that proved resistant to standard wire and catheter techniques.

Case report

A 60-year-old man was admitted electively in 2021 for insertion of a left ventricular lead, which required radiofrequency to cross a chronic left subclavian vein occlusion. A dual-chamber defibrillator had been implanted after an anterior myocardial infarct in 2001. Subsequently, the patient had developed first-degree atrioventricular block (PR 220 ms) and left bundle branch block with a QRS duration of 190 ms, and his transthoracic echocardiogram showed a dilated left ventricle measuring 8.3 cm in diastole, with severe left ventricular dysfunction—left ventricular ejection fraction 21% (Simpson's biplane). One year prior to the admission the patient was admitted to another hospital for right atrial lead extraction and upgrade to cardiac resynchronization defibrillator by insertion of new atrial and left ventricular leads. The atrial lead was extracted and a new lead inserted into the right atrium, but the coronary sinus could not be found with standard catheters or an electrophysiology ablation catheter and it was recommended that the patient should undergo a surgically inserted epicardial left ventricular lead.

The patient preferred a further attempt at percutaneous lead insertion, and an electrocardiogram gated computed tomography scan demonstrated the presence of a patent coronary sinus, and so the patient was referred to this center for a further attempt at left ventricular lead implantation. However, the venogram on the day showed the left subclavian vein was occluded proximally (Figure 1). The distal vein was cannulated with a micropuncture needle and then a 5F sheath was inserted. A 4F KA2 hydrophilic catheter (Merit Medical, South Jordan, UT) was inserted within the sheath, followed by a V18 ControlWire guidewire (Boston Scientific, Marlborough, MA). Attempts to cross the occlusion resulted in a contained dissection (Figure 1B). A 0.0035 inch straight radiofrequency nitinol PowerWire (Baylis Medical, Montreal, Canada) was inserted through the KA2 catheter and connected to the RFP-100A Puncture Generator (Baylis Medical). A 1-second pulse of radiofrequency allowed the passage of the wire through the occlusion (see Figure 1C, Supplemental Video). The PowerWire was advanced into the inferior vena cava to confirm that it was located within the vasculature. The PowerWire was exchanged for a Mailman wire guidewire. A 4 × 8 Sterling Monorail (Boston Scientific) noncompliant balloon was inflated to 6 atmospheres in the proximal subclavian vein, which allowed the KA2 catheter to advance past the occlusion, and the 0.0024 inch wire was exchanged for a 0.35 wire (Figure 1D). A Mustang 9.0 mm × 40 mm (Boston Scientific) over-the-wire balloon was inflated to 8 atmospheres from the superior vena cava sequentially back into the pocket (Figure 1E).

KEY TEACHING POINTS

- Increasing demand for device upgrades will result in more patients with chronic venous occlusions presenting for additional leads.
- Adjunctive techniques and technology can assist implantation.
- Radiofrequency-powered wires can cross occlusions where other techniques have been unsuccessful.

KEYWORDS Chronic venous occlusion; Cardiac resynchronization therapy; Device; Radiofrequency thermal wire; Pacemaker leads; Fibrous venous occlusion

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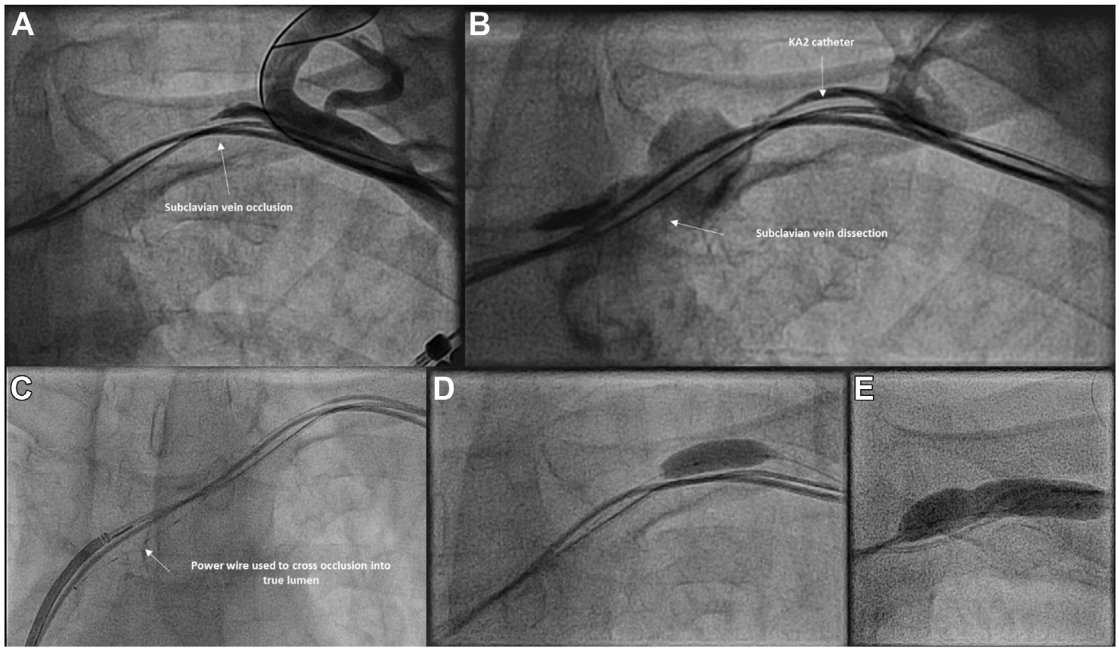

Figure 1 **A:** The micropuncture wire in the left subclavian vein and direct contrast injection through the 5F sheath demonstrates an occlusion just proximal to the first rib. **B:** Attempts to cross the lesion with a KA2 catheter and V18 ControlWire guidewire (Boston Scientific, Marlborough, MA) result in a dissection. **C:** Using the PowerWire (Baylis Medical, Montreal, Canada) through the KA2 catheter, the occlusion is crossed and the PowerWire is advanced into the true lumen. Then after exchanging the PowerWire through the KA2 for an angioplasty wire the lesion is dilated with a 4 × 8 Sterling Monorail (Boston Scientific) noncompliant balloon (Figure 1D) and subsequently a Mustang 9.0 mm × 40 mm over-the-wire balloon (Boston Scientific) (Figure 1E).

The coronary sinus was intubated and a left ventricular lead was implanted using standard techniques.

Discussion

Chronic venous occlusions present a challenge that can prevent implantation of new leads in patients with pre-existing leads. In those patients with occlusions, alternative methods of entering the vasculature from the alternative side and tunneling the lead, extraction of the existing leads, leadless systems, and surgical implanted leads present the greater risk of complication than crossing an occlusion.

Crossing stenosis allows the fibrous tissue to be disrupted using angioplasty balloons. However, mechanical recannulation using catheters and hydrophilic wires can be unsuccessful. Adjunctive techniques using electrocautery have been described using short bursts of standard electrocautery at 30–50 watts,[1] or the excimer laser. The PowerWire uses low power (5–25 W), which vaporizes the occluding tissue while designed to cause minimal collateral damage to the surrounding tissue. The radio-opaque tip is atraumatic and it has 5 radio-opaque marker bands spaced 1 cm apart to allow easy visualization under fluoroscopy. Interventional radiologists have described using the PowerWire to cross chronic caval and subclavian occlusions.[2,3] In this case, we used the PowerWire inside the KA2 catheter to direct the wire across the occlusion and applied forward pressure on the wire while the burst power button was pressed. We confirmed the wire was in the vasculature by imaging in 2 orthogonal views and advancing the wire down into the inferior vena cava. An advantage of the PowerWire over conventional hydrophilic wires is the ability to direct the PowerWire to face the occlusion using a catheter, whereas conventional wires tend to track collaterals or dissection flaps. It is not uncommon for a single or multiple iatrogenic dissection flaps to be created by trying to pass a wire, which can frustrate the wire's ability to find a channel leading through the occlusion. Potential complications of this technique include extravascular excursion of the wire, which could damage other structures. The wire is small in diameter, and the duration of the burst is short, minimizing the risk.

Appendix

Supplementary Data

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.hrcr.2023.02.006.

References

1. Forest JR, Kim D, May TP. Percutaneous electrosurgical technique for treatment of subclavian vein occlusion: application of transcaval techniques. HeartRhythm Case Rep 2017;3:551–554.
2. Baerlocher MO, Asch MR, Myers A. Successful recanalization of a longstanding complete left subclavian vein occlusion by radiofrequency perforation with use of a radiofrequency guide wire. J Vasc Interv Radiol 2006;17:1703–1706.
3. Iafrati M, Maloney S, Halim N. Radiofrequency thermal wire is a useful adjunct to treat chronic central venous occlusions. J Vasc Surg 2012;55:603–606.