

Percutaneous electrosurgical technique for treatment of subclavian vein occlusion: Application of transcaval techniques

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Introduction

Occlusion of the subclavian vein is a relatively common complication following permanent pacemaker implants, with an incidence of up to 10%.^{1,2} This rarely manifests clinically, but it becomes a problem when upgrading pacemakers with additional leads. As the population ages the need to reaccess the occluded veins for cardiac resynchronization therapy or defibrillator leads is increasing. These occlusions can be frequently crossed with hydrophilic wires; however, there is no standard for treatment of wire-resistant lesions. Many of these patients will undergo contralateral device implants and risky laser lead extractions or epicardial leads. We present a safe, novel strategy for crossing chronically occluded subclavian veins with existing pacemaker leads using an angled stiff-tipped 0.014-in wire charged with electrocautery, enabling successful coronary sinus lead implant.

Case report

Case 1

A 63-year-old man with history of ischemic cardiomyopathy with ejection fraction 15%, chronically occluded right coronary artery and left anterior descending artery without revascularization, paroxysmal atrial fibrillation, new left bundle branch block with QRS duration 158 ms, and NYHA class III dyspnea presented for elective biventricular pacemaker upgrade. He had a prior attempt at a biventricular pacemaker upgrade that was unsuccessful owing to a totally occluded left subclavian vein. He was considered for an epicardial lead but was not an ideal candidate owing to his body habitus. A venogram was performed demonstrating a 1.6-cm occlusion of the left subclavian vein. Following opening of the left subclavian pocket, a 5F sheath was advanced to near the occlusion

and used as a platform. In a mother-daughter fashion an Astatto XS20 (Asahi, Aichi, Japan) 0.014-in wire was advanced to the occlusion through a 0.035-in PiggyBack converter wire (Vascular Solutions, Minneapolis, MN) through a 4F angled glide catheter (Figure 1). Next, the most proximal end of the wire was connected to an electrocautery pencil (Medtronic, Minneapolis, MN) with a hemostat and the wire was advanced through the occlusion along the existing lead while activating the cut mode on the pencil at 30 W. The wire initially looked like it may have traveled extravascularly, so it was pulled back to the occlusion and readvanced into the inferior vena cava (IVC). There was no contrast extravasation or hemodynamic consequence. The PiggyBack converter wire and subsequently the angled glide catheter were advanced over the Astatto across the occlusion. The PiggyBack wire was then exchanged for a Worley wire (Merit Medical, South Jordan, UT), which advanced easily to the IVC, and a venoplasty of the occlusion was performed with a Maverick 5.0 × 40-mm balloon (Boston Scientific, Minneapolis, MN) at a pressure of 10 atm for 60 seconds. Finally, a Worley sheath (Merit Medical, South Jordan, UT) was easily advanced into the right atrium and a coronary sinus lead was implanted, with successful upgrade (Figure 2).

Case 2

An 88-year-old man with an ischemic cardiomyopathy status post coronary artery bypass grafting, complete atrioventricular block treated with dual-chamber pacemaker implant, permanent atrial fibrillation, and NYHA class III dyspnea presented for elective biventricular pacemaker upgrade. He previously had an attempt at biventricular pacemaker upgrade that was stopped owing to an occlusion of the left subclavian vein. He was considered for an epicardial lead but was felt to be too high risk. The percutaneous implant was reconsidered. A venogram was performed demonstrating a 2-cm occlusion of the left subclavian vein with a very large collateral vein arising just proximal to the occlusion (Figure 3A). Numerous unsuccessful attempts were made to open the occlusion using wire escalation with a Whisper wire,

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KEY TEACHING POINTS

- Subclavian venous occlusion is relatively common following permanent pacemaker implant (10%–12%).
- Several techniques for crossing these occlusions have been described but are limited by requiring either surgical back-up or expensive devices and may require extensive training.
- Crossing of the chronically occluded vein for device upgrades can be done safely with standard equipment utilizing a simple percutaneous, electrosurgical strategy with a 0.014-in stiff-tipped wire and venoplasty.

Pilot 50, Pilot 150 (Abbott Vascular, Santa Clara, CA), and a stiff angled glide wire, all of which were supported by an angled glide catheter (Terumo, Somerset, NJ). Finally, we even failed crossing using the back end of the stiff angled glide supported by an angled glide catheter. At this point an 0.014-in Astato XS20 wire supported by a 4F angled glide catheter was advanced to the occlusion and angled parallel to the previously implanted pacemaker wires. Next, the proximal end of the wire was connected to an electrocautery pencil with a hemostat. The wire was advanced while activating cut mode on the pencil at 50 W for about 1 second. The first push allowed the wire to penetrate the proximal cap, though it became lodged in the fibrotic occlusion. Then a second 1-second activation of cut mode and wire pressure allowed the wire to traverse the remainder of the occlusion and freely pass into the superior vena cava and right heart. An 0.35-in PiggyBack wire converter was then advanced over the Astato wire and the glide catheter was removed. Next, a 5.0 × 40-mm Mustang balloon

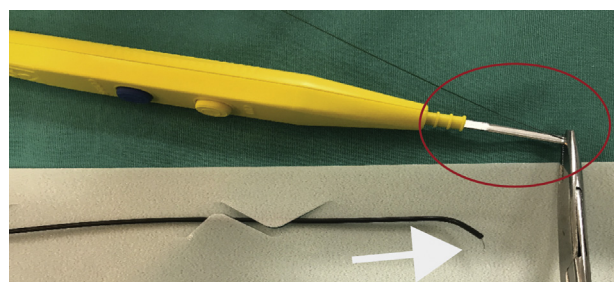


Figure 1 Percutaneous electrosurgical technique for crossing the subclavian vein chronic total occlusion. An Astato XS 20 0.014-in (Asahi, Aichi, Japan) wire is inserted through a 4F angled glide wire to the occlusion; it is important to be sure only the tip of the wire is exposed (*white arrow*). In preparation it is imperative to clamp the electrocautery pencil to the proximal-most end of the wire (*red circle*) and keep all metal and wet gauze off the wire to prevent dispersion of charge. The wire is advanced while applying 30–50 W of “cut” energy.

(Boston Scientific, Minneapolis, MN) was easily advanced across the chronic total occlusion and venoplasty performed at 10 atm. Finally, a 9F Worley sheath (Merit Medical, South Jordan, UT) was easily advanced across the previous occluded segment and a coronary sinus lead was implanted, with successful pacemaker upgrade (Figure 3B and C).

Discussion

Subclavian vein occlusion is commonly discovered during pacemaker upgrades and poses unique challenges when standard wiring techniques fail. Most of the time these lesions can be negotiated with a hydrophilic wire; however, occasionally these lesions are refractory to standard wiring techniques.³ Techniques for dealing with wire-refractory occluded subclavian veins in patients with ipsilateral pacemaker devices have been described, including accessing proximal to the occlusion, puncturing with a 75-cm 21 gauge needle, and use of an excimer laser.^{4–6}

We describe a novel technique utilizing an electrosurgical technique similar to standard transcaval crossing for accessing the aorta from the IVC to deliver large sheaths for transcatheter aortic valves or left ventricular support devices.⁷ This technique is simple, is cost-effective, and does not require surgical back-up. The Astato XS20 0.014-in wire is normally used in the peripheral space and was chosen due to the 20-g tip stiffness, though other stiff-tipped wires used for chronic total occlusions in the coronary space could be used as well. In order to advance the electrified guidewire, we use the continuous duty cycle electrosurgery setting (“cut mode”) to vaporize tissue rather than the interrupted duty cycle (“coagulate mode”) to heat tissue. The key to success is to insulate the 0.014-in stiff wire to deliver the bulk of the electrocautery charge to the tip of the wire using short bursts of cut mode energy under steady pressure with the tip of the wire angled parallel to the existing pacemaker leads. In preparation, it is imperative to clamp the electrocautery pencil to the proximal-most end of the wire (Figure 2) and keep all metal and wet gauze off the wire to prevent dispersion of charge. In these cases, the occluded segments were about 2 cm and it took 2 bursts of 50 W on cut mode to penetrate all the way through on 1 case. We chose the 50 W setting based on the success of the transcaval technique; however, we were also able to cross with a lower 30 W setting in 1 case. Crossing longer lesions may be limited by buildup of char on the wire. Of note, the original transcaval technique utilizes the PiggyBack converter wire to insulate the 0.014-in wire during cut mode; however, we accomplished similar insulation with the 4 F angled glide catheter in 1 case. There certainly exists some risk for the wire to perforate the vessel; however, the wire is small and unlikely to result in any harm in the venous system. Confirming wire position in orthogonal angles is useful. The electrical current is preferentially delivered to tissue, so the insulated leads should remain intact. Once the wire has negotiated

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