Case

A 59-year-old woman presented with heart failure and severe left ventricular (LV) dysfunction, ejection fraction (EF) 20%, due to herceptin therapy for breast cancer. She had been treated medically for more than 6 months, but symptoms and severe LV dysfunction persisted. Her ECG showed sinus rhythm with a left bundle branch block (QRS duration 167 ms). She was referred for placement of a biventricular implantable cardioverter-defibrillator (BiV/ICD). However, she had a history of bilateral mastectomy with right axillary lymph node dissection, radiation, and chemotherapy. During the course of her treatment, she had developed catheter-related left subclavian vein thrombosis with total occlusion, severe stenosis at the junction of the right brachiocephalic vein with the superior vena cava, and a catheter-related left femoral deep vein thrombosis (DVT) with residual moderate stenosis of the left femoral vein. Her right femoral vein was patent as determined by ultrasound imaging.

After careful discussion of the expected risks and benefits of a non-traditional approach, the patient elected to proceed with placement of a BiV/ICD via the right femoral vein. She also agreed to a hybrid approach, if placement of the LV lead via the femoral vein was unsuccessful, with epicardial placement of an LV lead and tunneling of a femoral access right ventricular (RV) pace/shock lead and atrial lead. She declined placement of a simple BiV pacemaker by an epicardial approach unless the BiV/ICD by femoral or hybrid approach failed. It was felt that placement of an epicardial BiV/ICD was not indicated as the risks associated with thoracotomy for patch placement were believed to outweigh the benefit of primary prevention of sudden death in this patient.

To accommodate the possibility of an epicardial approach, the procedure was performed in an operating room under general anesthesia. The chest, abdomen/pelvis, and right groin were prepped and draped. The right femoral vein was accessed proximal to the skin fold and just distal to the inguinal ligament under ultrasound guidance. Three J-wires were placed into the central circulation using the modified Seldinger technique. A separate incision was made approximately 2 cm proximal to the venous access site. This was carried down to the abdominal aponeurosis. Here, a pocket was formed cranial to the incision, between the fat and aponeurosis. The exposed ends of the J-wires were pulled under the skin and into the pocket. Through a standard sheath over a J-wire, a St. Jude Medical (SJM, St. Paul, MN) Durata 75 cm dual-coil ICD lead (model 7120) was passed into the right heart and positioned on the ventricular septum, and actively fixed. Test values are as shown in Table 1. Similarly, a SJM Tendril, 100 cm atrial lead (model 1688T) was placed in the lateral right atrium (RA), and actively fixed with test values shown in Table 1. Over
The third J-wire, a hemostatic sheath was placed. Through this a SJM 47 cm multipurpose curve sheath loaded with a 6F Polaris quadripolar steerable diagnostic catheter (Boston Scientific, Natick, MA) was advanced into the right heart. Once this long sheath was introduced into the coronary sinus (CS), the steerable catheter was removed, replaced with a 6F balloon wedge pressure catheter (Arrow International, Reading, PA), and a CS venogram performed. A SJM Quickflex 92 cm lead (model 1258T) was wedged into a posterolateral branch of the CS, with test values as shown in Table 1. Slack on the leads was purposely reduced compared with that for an upper extremity approach (Figure 1a). All three leads were reflected cranially and sutured to the aponeurosis using non-absorbable suture over the provided suture sleeves. The leads were connected to the SJM Unify generator (model CD3231-40). The device and excess leads were put in a large Parsonnet pouch (Bard Peripheral Vascular, Tempe, AZ), which was closed, then sutured to the aponeurosis at multiple points using non-absorbable suture. The proximal defibrillation coil was disabled. VF was induced twice, and successfully detected and treated twice by the ICD at 30 J. The pocket was closed with three layers of Vicryl sutures. The time required was 6 h 58 min for anesthesia, 3 h 41 min for the procedure, and 35.6 min for fluoroscopy with 2140 mGy and 21 ml of Iso 300 contrast delivered. Warfarin was initiated for prevention of deep vein thrombosis.

At 3 months’ follow-up, lead parameters were stable (Table 1). An upright posterior-anterior/lateral chest radiograph revealed generous slack on all leads (Figure 1b, c). A pelvis anterior-posterior and lateral hip radiograph revealed good lead wrap without migration and position of the device just above the femoral head (Figure 2). The patient reported that the device site was comfortable and that she had good mobility of her leg after an initial few weeks of pelvic discomfort post procedure. She reported marked improvement in her heart failure symptoms and improved exercise tolerance.

**Discussion**

Implantation of ICDs and pacemakers from the femoral approach due to limited upper extremity venous access has been successfully performed for many years. However, there are few reports of BiV/ICD implantation for anesthesia, 3 h 41 min for the procedure, and 35.6 min for fluoroscopy with 2140 mGy and 21 ml of Iso 300 contrast delivered. Warfarin was initiated for prevention of deep vein thrombosis.

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from this approach, and unique technical considerations with the femoral approach exist. Indeed, optimal lead slack for a femoral approach is unknown. Ensuring appropriate slack on all leads in both the supine and upright positions is important for preventing lead dislodgement, a frequent complication of femoral pacemaker implantations. It is also important for preventing interference between lead components when, for instance, two RV lead shock coils are present. Here, there was generous slack on the 3-month upright chest radiograph (Figure 1b, c) despite purposely little supine slack at implant (Figure 1a). Unlike placement of a device from the upper extremity, where excess slack is provided at time of implant to account for abdominal contents pulling down on the heart, and breast tissue pulling down on the pectoral device, lower extremity implant appears to require less slack at implant, as the upright position causes the heart to move closer to an abdominally placed generator, while there is little downward movement of the device in this location. In a report of an ICD placed by femoral approach, excess slack was provided for the ICD lead in order to have the proximal coil reside in the RA. However, on follow-up, this resulted in coiling of the lead such that there was contact of the two shock coils and reduced shock impedance. This could render the lead non-functional for the purpose of defibrillation. Since the proximal shock coil probably does not contribute favorably to the shock vector when the pulse generator is placed in the pelvis, it may be advisable in this case to choose a lead with only a single shock coil. Unfortunately, we did not have this lead immediately available in the longer length at the time of implant and therefore elected to use the dual-coil lead with the proximal coil disabled. Fortunately, the appropriate slack on the leads prevented contact of the two coils, and the shock impedance has remained stable (Table 1). The issue of best shock vector with pelvic location of the pulse generator also raises the issue of best placement of the RV lead tip. Here, we placed the lead high on the RV septum to bracket as much ventricle as possible between the RV coil and pulse generator, and this resulted in an acceptable defibrillation threshold.

The risk of DVT also remains undefined for femoral implantation of BiV/ICD. There was no phlebitis or DVT from the femoral approach pacemaker implant at a mean follow-up of 36.5 months in a series of 27 patients. However, defining the risk in a small series would be difficult and, even if low, would not necessarily extrapolate well to BiV/ICD implantations due to the greater number of leads and the different patient population in these cases. Although our patient’s history of catheter-related DVT occurred in the setting of malignancy and may not indicate a current increased risk of DVT, we elected to continue chronic warfarin therapy due to the unknown risk of this potentially deadly complication.

Finally, downward migration of the device and excess leads is a concern as it could interfere with patient comfort, ambulation, and predispose to skin erosion. This may be a greater concern with the larger devices due to their weight. Although we did not find reports of such complications due to migration in the literature, we elected to use the Parsonnet pouch to secure the excess lead to the device, and the device to the pelvic wall. This was tolerated well by the patient, and thus far the device and leads have remained in a stable location with good cosmetic appearance.

Implantation of a BiV/ICD system from a femoral vein approach appears to be a viable option in select patients with limited upper extremity venous access. In addition to the other hybrid options discussed with the patient, a fully subcutaneous ICD is an emerging technology that might be combined with epicardial pacing to achieve a similar outcome without the risks associated with endovascular leads. Further experience with atypical device configurations will be necessary to better define the risks and benefits to patients with limited venous access.

References

