EMERGING TECHNIQUES

The Cardiac Implantable Device Has Been Extracted: What Next?

1SUBHA L. VARAHAN, MD, 2VICTOR PRETORIUS, MBchB and 1ULRIKA BIRGERSDOTTER-GREEN, MD

1Department of Cardiac Electrophysiology, University of California, San Diego, CA
2Cardiothoracic Surgery, University of California, San Diego, CA

ABSTRACT. With an increasing number of transvenous pacemakers, implantable cardioverter-defibrillators (ICDs), and cardiac resynchronization therapy (CRT), lead extraction volume has risen. In addition to focusing on procedural risks, attention needs to be placed on peri- and postoperative care as well. Patients with multiple medical problems can often have high in-hospital mortality despite a successful extraction. The need for pacing and defibrillator therapies after extraction need to be carefully considered, prior to re-implantation to ensure good clinical outcomes.

KEYWORDS. defibrillator, extraction, infection, pacemaker, wound care.

Introduction

The era of an increasing number of implanted transvenous pacemakers, implantable cardioverter-defibrillators (ICDs), and cardiac resynchronization therapy (CRT) has led to the natural progression of more lead extractions. Indications for lead extraction are varied and can include infected systems, endocarditis/septicemia, non-functioning leads, erosion of the device and leads through the skin, or venous thrombosis. Just as a meticulous plan is needed for how to extract the leads, so too is a detailed systematic peri- and postoperative contingency needed once the device and/or leads have been removed.

The true risk of lead extraction can be underestimated by focusing only on the procedural risks. Often patients who are undergoing transvenous lead extraction have multiple medical problems, which lead to high mortality rates despite a successful procedure. Several studies have tried to identify predictors of mortality. In one single-center experience, markers that identified in-hospital mortality within 30 days included elevated C-reactive protein (CRP), which was usually seen in patients with septicemia or bacteremia. Additionally, patients with severe heart failure also died within a year, despite re-implantation of CRT.1 The LEXiCon Study showed that patients with the highest risk of in-hospital mortality had a creatinine ≥2.0 mg/dl, diabetes mellitus, body mass index (BMI) ≥25 kg/m2, and infection (pocket infection or device-related endocarditis).2 Because of the high risk of mortality in this group of patients, more attention needs to be placed on the prevention, early detection, and expedited management of complications of lead extraction.3

Periprocedural set-up

Pacing indication

In the case of a patient who is pacemaker-dependent and undergoing a lead extraction, pacing support will be necessary during the procedure and until the patient can get a new permanent pacemaker (PPM). The device being removed should be interrogated prior to the procedure to determine if the patient is pacemaker-dependent, and, if so, should have a temporary transvenous wire placed prior to the extraction. The temporary transvenous wire should typically be placed through the femoral vein and should remain as pacing support as the device is being extracted. In cases where a permanent pacemaker can be re-implanted within a relatively short period (≤1 week), a temporary transvenous pacing wire is usually advanced from the jugular/subclavian venous system and can be
attached to a dual-chamber temporary pacing box after the temporary femoral pacing wire is removed.

In the case of an infected system, some patients will have to undergo several weeks of antibiotic therapy prior to re-implantation of a new system. In these cases, a “temporary” permanent pacemaker lead can be placed via the internal jugular vein (IJ), contralateral to the site of the device and lead extraction. We normally choose the right internal jugular (IJ) vein for the temporary permanent pacemaker as most initial implants are on the left side. The right IJ offers a direct and easier route for placement and lower chance of dislodgement. Routine central venous access should be obtained of the IJ in a sterile fashion and a peel-away introducer sheath should be deployed over the J-tipped wire, as routinely done for permanent pacemaker placement. A permanent right ventricular pacing lead should then be delivered through the sheath and screwed into the RV and appropriate slack should be placed. The introducer sheath can be broken at this time and the lead can be sutured to the neck. In the case when a patient is dependent on right atrial (RA) pacing and RV pacing, after initial IJ access is obtained with one J-tipped guidewire, a 6-French regular sheath can be placed over the J-tipped guidewire and another J-tipped guidewire can be advanced through the sheath. The sheath can then be removed and one wire can be clamped aside while initially placing the RV lead as described previously. The same process can then be repeated for the RA lead. After suturing one or both leads to the neck, the lead(s) are externally connected to a pacemaker generator, which is then secured to the patient’s neck via a Tegaderm™ (Figure 1). At this point, the temporary transvenous wire can be removed from the femoral vein. Patients can have the temporary permanent pacemaker for up to 6 weeks, or until it is safe to re-implant a new permanent system.

Timing of device re-implantation is critical in order to avoid a relapse in infection. A recent update on cardiac implantable electronic device (CIED) infections states that duration of antibiotic treatment should be 10–14 days for a pocket-site infection, ≥14 days for a bloodstream infection, and 4–6 weeks for a complicated infection such as endocarditis. Each patient after CIED removal should be carefully evaluated to see if they need to be definitely re-implanted. When re-implantation is indicated, it should be on the contralateral site or epicardially. If blood cultures are positive at time of removal, repeat blood cultures should be drawn after device removal and implantation of a new device should be delayed until the cultures have been negative for at least ≥72 h. New transvenous lead placement should be delayed for at least 14 days after device system removal when there is evidence of valvular infection.

Defibrillator indication

In the case of an RV shock lead that needs to be extracted, several issues need to be taken into consideration. If the patient had an ICD placed for secondary prevention and the device and lead need to be removed due to infection, clearly the patient cannot be re-implanted immediately and may need to undergo several weeks of antibiotic treatment. In those cases, patients can remain in the hospital while undergoing therapy or be discharged home with a wearable cardiac defibrillator (WCD). A database looking at all patients with a WCD between August 2002 and December 2006 revealed that when worn properly, survival is 73.6% in all events and 90% in ventricular tachycardia (VT) and ventricular fibrillation (VF) events. This was comparable to survival of ICD patients, especially those with traditional ICD indications, therefore accepting the use of the WCD as a satisfactory bridge to permanent ICD implantation. If the patient originally had a device implanted for primary prevention and the ejection fraction of the patient has subsequently improved, it is up to the discretion of the physician and patient to decide the risks and benefits of a new implant.

Wound care

Following removal of the device and extraction of the leads, it is essential to manage the wound with attention to detail while keeping future access requirements in mind.

The non-infected wound can usually be re-used for implantation of a new device system by following surgical principles of a clean and hemostatic wound. To aid the closure of the fibrotic capsule over a newly implanted device, we prefer to incise the capsule along the inferior and medial border with electrocautery. This usually affords sufficient space to close the mouth of the fibrotic capsule over the device. We believe this will lower the risk of device erosion at a later stage.

An infected device pocket poses a more complex problem. Although extensive debridement and immediate re-use or primary closure has been proposed and performed, we believe such an approach is inferior and can predispose the patient to have a recurrence of

Figure 1: Temporary permanent pacemaker via internal jugular (IJ) vein.
infection involving the device. For the infected wound we advocate an extensive, complete debridement of all avascular scar tissue and foreign material leaving behind only viable tissue. To enhance healing of the well-debrided wound, we now routinely place a Vacuum Assisted Closure therapy (VAC®; KCI, San Antonio, TX) drainage system. Prior to applying VAC® therapy, all effort is made to obtain good hemostasis and the central venous entry point of the lead is securely closed with a figure of eight suture. The VAC® system consists of a GranuFoam™ sponge material that gets fashioned to the wound dimensions but smaller by approximately 25% (Figure 2). After placing the GranuFoam™ in the wound, an occlusive clear adhesive covering is applied over the entire wound (Figure 3). A hole of 0.5 × 0.5 cm is made in the occlusive dressing at the center of the visible sponge. A vacuum connecting the tube system is applied to the wound (Figure 4). The vacuum system has variable settings but we routinely use continuous vacuum at 125 mmHg. As VAC® therapy is portable, the patient can ambulate with ease. We routinely change the VAC® dressing and GranuFoam™ every 72 h until the wound is ready for suture closure. The VAC® system functions by converting an open infected wound to a closed wound where wound drainage and pathogens are continuously drained away (Figure 5). The suction effect on the wound also enhances angiogenesis, promotes cell division, and causes local elaboration of growth factors.5 In our practice, we were able to perform delayed primary closure to these wounds within 3–6 days. For this closure we employ three to four widely spaced full-thickness mattress sutures. We place these sutures such that the skin edges are approximated but that the wound is not tightly closed to allow for any ongoing drainage to escape the wound, although this is rarely encountered. Alternatively the GranuFoam™ dressing can gradually be downsized as the wound contracts until the wound closes by secondary intent from granulation. In our experience, the VAC dressing system works equally well for both the sub-pectoral muscle and subcutaneous wounds. When venous access necessitates it, we have used the same site for a new device implant as early as 2 weeks following treatment of an infected pocket with the VAC system.

If VAC therapy is not available, the wound can still be managed by daily packing with Xeroform gauze until the wound closes by secondary intent, although this might take a very long time. In wounds where minimal evidence for infection was found despite positive blood cultures, one could consider extensive debridement with primary closure over a drain such as a ¼-inch Penrose after obtaining good hemostasis.

Access

Vascular access for re-implantation can often be difficult in cases of lead extraction. Total subclavian vein (SV) obstruction occurs in 8–12% of patients with prior leads.7,8 Prior to the lead extraction, venograms should usually be obtained ipsilateral and contralateral to the

Figure 2: GranuFoam™ sponge of the Vacuum Assisted Closure (VAC).

Figure 3: Wound with GranuFoam™ covered by an occlusive dressing.

Figure 4: Vacuum unit being attached to occlusive dressing and wound.
side of the device to determine if the veins are patent. If the leads and device being removed are not infected, reimplantation can be done on the ipsilateral side. If the ipsilateral vein is occluded, access can be maintained with the laser or mechanical sheath used to extract the lead. After the lead has been removed, an exchange-length long wire can be placed through the laser or mechanical sheath and a peel-away sheath introducer can be exchanged for the previous sheath for new lead placement. In cases where maintaining access with the laser or mechanical sheath may not be enough as the lumen of vein is still very small or occluded, subclavian vein venoplasty can be performed in cases when the implant needs to be ipsilateral (dialysis patients, occlusion of the vein on the contralateral side). In a series of 373 patients, venoplasty was successful in 371 patients by the implanting physician without any damage to the remaining leads or clinical complications.  

Conclusion

Given the rising number of explanted transvenous pacemakers, ICDs, and CRT, careful attention needs to be given to peri- and postoperative care. Infection of cardiac implantable electronic devices (CIEDs), heart failure, renal insufficiency, diabetes, and low BMI can contribute to high mortality rates despite successful procedures. Pacing and ICD indications along with wound care and vascular access issues need to be considered carefully prior to re-implantation to ensure clinical success.

References