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CASE REPORT
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Management of exposed pacemaker caused by burns

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Abstract

Annual implants of cardiovascular implantable devices (CIEDs) are increasing, thus increasing the risk of device exposure. This case presents CIED management issues following traumatic thermal injury. A 59-year-old female presented to intensive care with 42% total body surface area burn involving tissue over her pacemaker generator. Electrophysiologists interrogated and reprogrammed the pacer and observed the patient over 72 hours without pacing. Serratia bacteremia developed and cardiology recommended device removal. The pacemaker generator and leads were removed by cardiothoracic and burn surgery. Postoperatively, asystole required emergency transvenous pacing wire placement. During bacteremia treatment, cardiology planned to pace with an active-fixation screw-in lead with long-term plans to place a single right ventricular chamber leadless pacemaker because of the extensive burns. The patient developed fungemia and the family opted for comfort care. This case report discusses the management of a CIED exposed after a traumatic thermal burn, including device extraction.

Keywords: burns, pacemaker, bacteremia

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Introduction

This case report presents the unique aspects required for managing a patient with extensive chest burns resulting in exposure of a permanent pacemaker (PPM). Cardiovascular disease remains a leading cause of death in the United States, and as the population ages, the number of cardiovascular implantable electronic devices (CIEDs), including PPMs and internal cardioverter defibrillators (ICD), continues to rise. More than 300,000 CIEDs are implanted annually in the United States [1], and implantation rates are rising [2, 3]. With the increased incidence of CIEDs as well as geriatric trauma, it is reasonable to expect traumatic CIED exposures to present more frequently at trauma centers. This review presents the unique considerations for patients presenting with CIED exposure caused by thermal trauma. At the time this case presented, recommendations for CIED focused on general guidelines for device exposure without addressing the specific challenges in the burn patient population.

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Case report

A 59-year-old female was transferred to our burn intensive care unit (BICU) with a full thickness burn covering 42% of her total body surface area and an inhalation injury sustained in a gas explosion. Her past medical history included chronic obstructive pulmonary disease, hypertension, and sinus node dysfunction requiring permanent PPM placement. The chest burn included a full thickness burn of the tissue covering the PPM (Figure 1). After excising frankly necrotic tissue above the PPM, there was an incomplete layer

of subcutaneous tissue remaining over the device, leaving it partially exposed. Plication of defects in the tenuous fibrous capsule allowed for temporary closure, which was reinforced with a layer of cadaveric allograft with hopes of deferring definitive closure until the patient was further along in recovery.

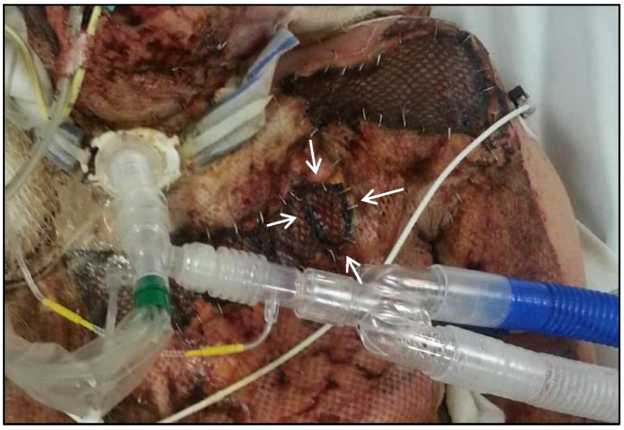

Fig. 1. Indicates the exposed pacemaker generator in the chest wall

Cardiology interrogated the patient's dual chamber PPM, which upon presentation was programmed in a DDD mode (where both the right atrium and right ventricle can be sensed and paced and the device can trigger right ventricular pacing if it detects an atrial-sensed event or inhibit atrial or ventricular pacing off of an intrinsic atrial or ventricular-sensed event, respectively) with set rate of 60-130 bpm. This interrogation revealed a very low lifetime burden of ventricular pacing (< 1%) and low-moderate atrial pacing burden (30%). Because of the possibility that the degree of atrial pacing might be secondary to device settings (i.e. the patient's intrinsic sinus rate may drop into the 50s on occasion), the PPM was reprogrammed to VVI mode (only ventricular pacing and sensing, with inhibition of RV pacing when an intrinsic ventricular depolarization is sensed) with a lower rate limit of 40 beats per minute. This reprogramming allowed observation to determine if pacing was truly required.

As blood cultures were negative without clinical signs of systemic or localized infection, cardiology recommended the pacemaker remain in place during this evaluation. For the next 72 hours following PPM reprogramming, the patient did not require any pacing, including during intraoperative grafting procedures. She then developed sepsis with Serratia marcescens bacteremia and was treated with broad-spectrum antibiotics. Cardiology recommended PPM removal without replacement.

Cardiothoracic surgery planned the PPM generator and lead extraction in the operating room suite located within the BICU. Preoperative planning included obtaining additional central access for possible fluid resuscitation in the case that a vessel was damaged during extraction and venovenous cardiopulmonary bypass (CPB) or transvenous pacing became necessary (Table 1). Preparing for potential intraoperative complications, CPB capabilities were immediately available. The goal was to avoid CPB if possible, as this patient would tolerate poorly complications associated with CPB. The principles for intraoperative and perioperative management during cardiovascular implantable device extraction are listed in Table 2. After burn surgery removed the graft covering the PPM generator, cardiothoracic surgery removed the device and leads with gentle traction. Burn surgery then closed the soft tissue over the previous generator site. The procedure was performed without CPB. The right femoral introducer remained. On POD 2, the patient had an episode of progressive sinus bradycardia and then sinus arrest causing asystole that responded to pharmacological therapy. Transcutaneous pacing was problematic due to the extensive burns with recent grafting. A balloon-tipped transvenous pacing wire was placed via the right femoral venous introducer sheath emergently at bedside. Pacing capture was reliable initially but not over the next several days. The team considered placing a temporary active-fixation "screw-in" lead to the right ventricle for long-term ventricular pacing during bacteremia therapy, but the patient was unstable. A new balloon-tipped temporary pacing wire was placed at bedside via the right internal jugular vein rather than transporting to the electrophysiology laboratory. Long-term management for PPM required further discussion because of the lack of available skin tissue to create a pacemaker generator pocket using the anterior pectoral or the abdominal region. The family decided to withdraw care following fusarium fungemia.

Discussion

Traumatic exposure resulting in exposed PPM represents a unique management issue and one that will probably occur more frequently with the increasing number of CIED placements, including PPMs. The initial cardiology evaluation for a trauma event with CIED involves ensuring device functionality. For this case, cardiology recommended continued close observation for infection while determining if the PPM was required. The hope was to remove the PPM without replacing it, thus eliminating further complications related to a CIED.

A common mechanism of PPM infection is contamination of the generator pocket, with a reported incidence ranging from 0.13% to 19.9% [4-7]. Hematogenous seeding of the pacemaker or lead during bacteremia from other distant infectious sources occurs less frequently [4].

Staphylococcal species represent the majority of CIED infections [7]. When a CIED infection is associated with bacteremia, Staphylococcus aureus is the most likely organism [8]; gram-negative bacilli have a much lower incidence of CIED infection associated with bacteremia [9]. The placement of a new PPM requires thorough evaluation in all patients following infection, as successful permanent discontinuation of the device following removal has been demonstrated in one-third to one-half of cases [7]. In this case, due to the low pacing burden, it was believed the PPM could be safely extracted without temporary pacing.

Current America Heart Association recommendations do not indicate CIED removal if there are no signs of a device infection with gram-negative bacteremia [7]. However, these recommendations do not address the burn population with gram-negative bacteria colonizing the wound. In patients who receive appropriate antibiotics for gram-negative bacteremia and then relapse without a defined source of infection, CIED removal is recommended [8]. All hardware should be removed for patients with an established CIED infection, as the relapse rate is high with retained hardware [10]. Removal of the hardware does involve significant, life-threatening risks (Table 1). Though these complications have low incidence, they necessitate expectant management and planning (Table 2) [11], including immediate CPB availability.

A literature review did not reveal specific management recommendations for burn patients with possible percutaneous exposure of PPM or risk of CIED infection from a distant infected site. Current recommendations for antibiotic duration after CIED removal are 10-14 days for pocket site infection and at least 14 days with bacteremia; continued bacteremia despite device removal and appropriate antibiotics or complicated infections may require treatment with 4-6 weeks of antibiotics (e.g., endocarditis) [8].

Emergent pacing was required following the asystolic episode after PPM removal. The extensive burn and grafting of the entire chest caused difficulty with transcutaneous pacing. The femoral central venous access introducer sheath placed for intraoperative rapid fluid resuscitation allowed emergent balloon-tipped pacing catheter placement at the bedside. Another possibility as a temporizing measure was a transesophageal atrial pacing catheter; this was not a long-term solution, as movement can disrupt pacing [12].

Table 1. Pacemaker lead removal complications [4, 11]

Myocardial damage/perforation
Valve damage (especially tricuspid)
Bleeding including hemopericardium, cardiac tamponade, and hemothorax
Subclavian vein laceration
Emboli (pulmonary, septic, air, thrombotic)
Lead damage (tip fracture, fragment migration)
Bacteremia/septicemia
Cerebral vascular accident
Arrhythmia/cardiac arrest
Death

Table 2. Recommended precautions for PPM lead removal in critically ill patients. In this case, the patient was a burn patient in the BICU who was unlikely to recover from stunned myocardium after a cardiopulmonary bypass (CPB)

Additional perioperative preparations for implanted pacemaker removal

- Type and cross for blood products
- Obtain central access for emergent CPB and/or transvenous pacing and vasoactive medication administration
- Perform echocardiogram to evaluate cardiac function and lead anatomy
- Prepare equipment to assist in lead extraction

Operating Room

- Primed CPB machine and perfusionist in room ready to assist with bypass capabilities if required
- Blood products available with capability for rapid transfusion
- General anesthesia
- Transesophageal echocardiogram
- Transvenous pacer and pacing capabilities available
- Defibrillator, pacer, and resuscitation equipment including cardiac paddles available
- Pericardiocentesis tray available

Monitoring

- Continuous invasive arterial blood pressure monitoring and standard ASA monitors forectopy, arrhythmias, and hemodynamic instability

Procedure

- Chest prepared/draped for possible thoracotomy
- Use proper sheath technique and maintain tension during removal utilizing counterpressure, countertraction, and powered tips (laser or electrosurgical) for more efficient extraction[13]
- With sudden onset hypotension, consider cardiac tamponade, hemorrhagic shock, and/or myocardial rupture and be prepared to rapidly access introducer for CPB

Long-term options for pacing included placement of a transvenous active-fixation (screw-in) temporary pacing wire as a bridge to PPM re-implantation while clearing the bacteremia. Placement of an active-fixation lead attached to a pacing generator allows reliable pacing, and earlier patient mobilization, and it carries a low risk of adverse events such as lead dislodgement, severe bradycardia, and local infection [13]. This is advantageous for burn patients who are transported frequently for wound care and to the OR and for early mobilization.

Alternative anatomic locations for long term PPM when the chest wall is not an option include the abdomen and femoral locations. Due to the extensive burn area in this patient, neither location was a viable option to create a generator pocket. Femoral pacemaker implantation via the femoral vein with a generator pocket could be appropriate for a permanent femoral pacemaker when the burn involvement includes the anterior chest and abdomen [14]. With recent advances in technology there is the option of percutaneous placement of a leadless pacemaker [15]. This may represent a future option for the traumatic thermal patient population and avoids generator pocket creation.

Conclusions

This case report details the management of an exposed PPM following a traumatic thermal injury to the chest wall and abdomen. The PPM generator and leads were surgically extracted following Serratia bacteremia, and it was initially believed that the pacemaker could be removed without replacement due to the low pacing burden. The perioperative management including CPB and pacing capabilities during the perioperative period are discussed. The patient postoperatively developed asystole requiring temporary pacing during lead placement. We discuss both temporary pacing and permanent pacemaker implant options for this patient.

Conflict of interest

Nothing to declare

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References

1. Bonawitz SC. Management of exposure of cardiac pacemaker systems. Ann Plast Surg 2012; 69: 292-295. doi: 10.1097/SAP.0b013e31822350cc
2. Zhan C, Baine WB, Sedrakyan A, Steiner C. Cardiac device implantation in the United States from 1997 to 2004: a population-based analysis. J Gen Intern Med 2008; 23 Suppl 1: 13-19. doi: 10.1007/s11606-007-0392-0
3. Greenspon AJ, Patel JD, Lau E, Ochoa JA, Frisch DR, Ho RT, et al. Trends in permanent pacemaker implantation in the United States from 1993 to 2009: increasing complexity of patients and procedures. J Am Coll Cardiol 2012; 60: 1540-1545. doi: 10.1016/j.jacc.2012.07.017
4. Koutentakis M, Siminelakis S, Korantzopoulos P, Petrou A, Priavali H, Mpakas A, et al. Surgical management of cardiac implantable electronic device infections. J Thorac Dis 2014; 6 Suppl 1: S173-179. doi: 10.3978/j.issn.2072-1439.2013.10.23
5. Conklin EF, Giannelli S Jr, Nealon TF Jr. Four hundred consecutive patients with permanent transvenous pacemakers. J Thorac Cardiovasc Surg 1975; 69: 1-7
6. Bluhm G. Pacemaker infections. A clinical study with special reference to prophylactic use of some isoxazolyl penicillins. Acta Med Scand Suppl 1985; 699: 1-62
7. Sohail MR, Uslan DZ, Khan AH, Friedman PA, Hayes DL, Wilson WR, et al. Management and outcome of permanent pacemaker and implantable cardioverter-defibrillator infections. J Am Coll Cardiol 2007; 49: 1851-1859. doi: 10.1016/j.jacc.2007.01.072
8. Baddour LM, Epstein AE, Erickson CC, Knight BP, Levison ME, Lockhart PB, et al. Update on cardiovascular implantable electronic device infections and their management: a scientific statement from the American Heart Association. Circulation 2010; 121: 458-477. doi: 10.1161/CIRCULATIONAHA.109.192665
9. Uslan DZ, Sohail MR, Friedman PA, Hayes DL, Wilson WR, Steckelberg JM, et al. Frequency of permanent pacemaker or implantable cardioverter-defibrillator infection in patients with gram-negative bacteremia. Clin Infect Dis 2006; 43: 731-736. doi: 10.1086/506942
10. Chu VH, Crosslin DR, Friedman JY, Reed SD, Cabell CH, Griffiths RI, et al. Staphylococcus aureus bacteremia in patients with prosthetic devices: costs and outcomes. Am J Med 2005; 118: 1416. doi: 10.1016/j.amjmed.2005.06.011
11. Smith HJ, Fearnot NE, Byrd CL, Wilkoff BL, Love CJ, Sellers TD. Five-years experience with intravascular lead extraction. U.S. Lead Extraction Database. Pacing Clin Electrophysiol 1994; 17: 2016-2020
12. Hesselvik JF, Ortega RA. Simultaneous transesophageal atrial pacing and transesophageal echocardiography in cardiac surgical patients. J Cardiothorac Vasc Anesth 1998; 12: 281-283
13. Braun MU, Rauwolf T, Bock M, Kappert U, Boscheri A, Schnabel A, et al. Percutaneous lead implantation connected to an external device in stimulation-dependent patients with systemic infection – a prospective and controlled study. Pacing Clin Electrophysiol 2006; 29: 875-879. doi: 10.1111/j.1540-8159.2006.00454.x
14. Mathur G, Stables RH, Heaven D, Ingram A, Sutton R. Permanent pacemaker implantation via the femoral vein: an alternative in cases with contraindications to the pectoral approach. Europace 2001; 3: 56-59. doi: 10.1053/eupc.2000.0135
15. Chew DS, Kuriachan V. Leadless cardiac pacemakers: present and the future. Curr Opin Cardiol 2018; 33: 7-13. doi: 10.1097/HCO.0000000000000468