

Double trouble: Management of implantable cardioverter-defibrillator infection in the setting of severe aortic stenosis



Tahmeed Contractor, MD,* Joshua M. Cooper, MD, FACC, FHRS,[†] Purvi Parwani, MD,* Islam Abudayyeh, MD,* Manolo Garcia Rubio, MD,* Ravi Mandapati, MD, FHRS*

From the *Department of Cardiology, Loma Linda University Medical Center, Loma Linda, California, and [†]Section of Cardiac Electrophysiology, Temple University Hospital, Philadelphia, Pennsylvania.

Introduction

Cardiac implantable electronic devices (CIED) have found an increasing use in the management of arrhythmias as well as congestive heart failure, and are being utilized in patients with major comorbidities.¹ This increased utilization in a medically complex population has been associated with an increase in the number of CIED infections, which carry a high morbidity and mortality, necessitating lead extraction as a part of management.^{2,3} Outcomes of patients treated with antibiotics alone is poor as compared to those in whom lead extraction is performed, owing to the inability of antibiotics to clear the infection from the indwelling foreign material.⁴

Severe aortic stenosis (AS) can increase the risk of surgery.⁵ Although the risk of lead extraction in patients with severe AS has not been systematically assessed, the fluctuations in blood pressure and intravascular volume status that often occur during this procedure can lead to a significant risk of hemodynamic compromise. Considering the morbidity and mortality associated with each condition alone, the management of a patient with both severe AS and a CIED infection is particularly challenging and is associated with significant risk.

We present a case of CIED infection in the setting of severe AS and several other serious comorbidities. This report discusses the careful consideration of treatment options and emphasizes the value of an integrated multidisciplinary team approach and shared decision making in the management of such cases.

KEYWORDS Cardiac implantable electronic device; Lead endocarditis; Multidisciplinary team; Severe aortic stenosis; Shared decision making (Heart Rhythm Case Reports 2019;5:489–493)

Dr Contractor receives a speakers' honorarium for a fellows course from Phillips. This case was presented in 2018 at the UCLA/UCSD Lead Management symposium, for which a travel and lecture honorarium was received (T.C.). **Address reprint requests and correspondence:** Dr Tahmeed Contractor, Loma Linda University Medical Center, 11234 Anderson St, Loma Linda, CA 92354. E-mail address: tahmeedcontractor@gmail.com.

Case report

An 88-year-old woman with a history of biventricular implantable cardioverter-defibrillator (ICD) implantation presented with ICD generator pocket pain and purulent discharge from the wound after a recent generator change at an outside institution. She had a history of nonischemic cardiomyopathy with an estimated left ventricular ejection fraction (LVEF) of 10%, an incomplete left bundle branch block, and chronic obstructive pulmonary disease with severe kyphosis, requiring home oxygen (2 liters) for several years. She underwent placement of a biventricular ICD 10 years prior to presentation. Five years prior to presentation, she underwent placement of a new right ventricular lead owing to a fracture of the pace-sense portion of the ICD lead. Three months prior to presentation, she underwent a generator change owing to battery depletion. Because of subsequent wound dehiscence and device erosion as well as her comorbidities, she was treated with a pocket “wash-out” 2 months later, with full closure of the device pocket. The infected pocket did not heal, and she again presented with worsening pain and pocket discharge. She had poor functional capacity and required assistance with most of her activities of daily living. She was insightful into her current medical condition and was emotionally affected by her nonhealing wound with foul-smelling discharge.

On examination, she was a frail-appearing patient with severe kyphosis. Her vital signs were normal, including body temperature. Her ICD site had evidence of obvious infection, with a nonhealing incision, yellow-colored discharge, visible leads, and skin staples still in place from the recent attempt to salvage the pocket infection with debridement and irrigation (Figure 1A). On auscultation, she was found to have a late-peaking systolic murmur with absent S2. Laboratory findings revealed anemia of chronic disease with a hemoglobin of 7.8, acute-on-chronic renal failure with a creatinine of 3.4 (baseline 2.5 per patient), and thrombocytopenia with a platelet count of 90,000. The white blood cell count was normal (6.1). An electrocardiogram performed while inhibiting pacing showed incomplete left bundle branch block and a first-degree atrioventricular block.

KEY TEACHING POINTS

- Severe aortic stenosis can increase the risk of a lead extraction procedure owing to blood pressure fluctuations during the procedure from vagal effects, venotomy site bleeding, temporary right ventricular inversion during lead traction, and a risk of vascular or cardiac perforation.
- When valve replacement is not a feasible option, such as in the setting of device infection, balloon aortic valvuloplasty prior to lead extraction can be performed to reduce the severity of stenosis.
- A multidisciplinary team approach that includes an electrophysiologist, cardiac surgeon, echocardiography specialist, structural cardiologist, and cardiac anesthesiologist is essential to perform safe and effective lead extraction in high-risk patients.

A chest radiograph (Figure 1B) revealed the biventricular ICD system with an additional right ventricular pace-sense lead, severe kyphosis, and chronic interstitial lung disease. On transthoracic echocardiography, she had low-flow, low-gradient AS with an estimated aortic valve area of 0.7 cm² with gradient of 39 mm Hg (Figure 2). She had late-peaking Doppler signal with a dimensionless index of 0.17. Looking at the overall physical examination and echocardiographic picture, her AS was thought to be severe. Transesophageal echocardiography did not reveal any significant vegetations on the leads or valves and confirmed severe AS with greatly reduced aortic cusp mobility. The device and leads were manufactured by Biotronik (Berlin, Germany). The models of the leads were as follows: right ventricular

pace-sense lead, 350974 Setrox S 53; coronary sinus lead, 355148 Corox OTW-S 75-BP; right ventricular ICD lead, Linnox SD 65/16; right atrial lead, Setrox S 45.

Management options were discussed with the patient, her family, and several specialties, including electrophysiology, echocardiography, cardiac surgery, interventional cardiology, and cardiac anesthesia. On the one hand, there was a risk of leaving an untreated CIED infection that increased her morbidity, mortality, and quality of life; and on the other hand, there was a significant risk of treatment (lead extraction)-related complications, especially given the major comorbidities, including low-flow low-gradient AS, reduced LVEF, chronic lung disease, anemia, thrombocytopenia, and renal failure. We assessed the following treatment options: (1) palliative care and management with long-term suppressive antibiotics; (2) lead extraction without any aortic valve intervention; (3) transcatheter aortic valve replacement followed by lead extraction; (4) valvuloplasty followed by lead extraction.

The patient was not agreeable to a palliative care approach, given how emotionally distraught she was with the open wound. Lead extraction without any aortic valve intervention was considered; however, it was felt that any drop in the blood pressure or significant volume shifts during the procedure, owing to vagal effects, bleeding, right ventricular inversion, or perforation, would lead to rapid hemodynamic deterioration and ultimate demise of the patient. In the setting of acute infection, percutaneous aortic valve replacement was also not felt to be a good option because of the risk of infecting the new valve prosthesis. A multidisciplinary team discussion with the patient and her family was conducted and, with a shared decision-making philosophy, it was decided to pursue an aortic valvuloplasty followed by lead extraction. After a collaborative discussion with the various clinical teams who would be involved, it was further decided to perform these procedures in the same setting as

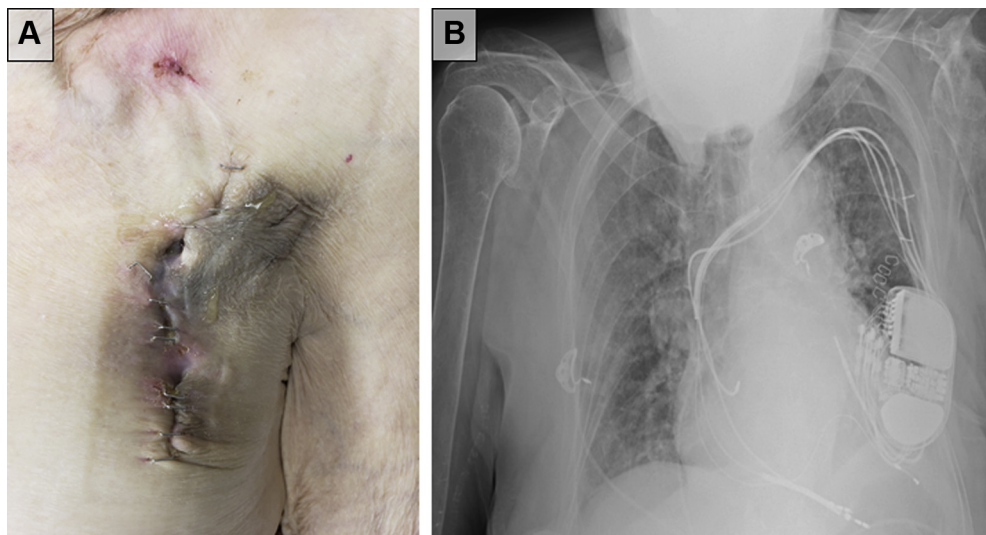


Figure 1 A: Device pocket site showing evidence of infection with a nonhealing wound. B: Chest radiograph showing biventricular implantable cardioverter-defibrillator with a pace-sense right ventricular pacemaker lead.

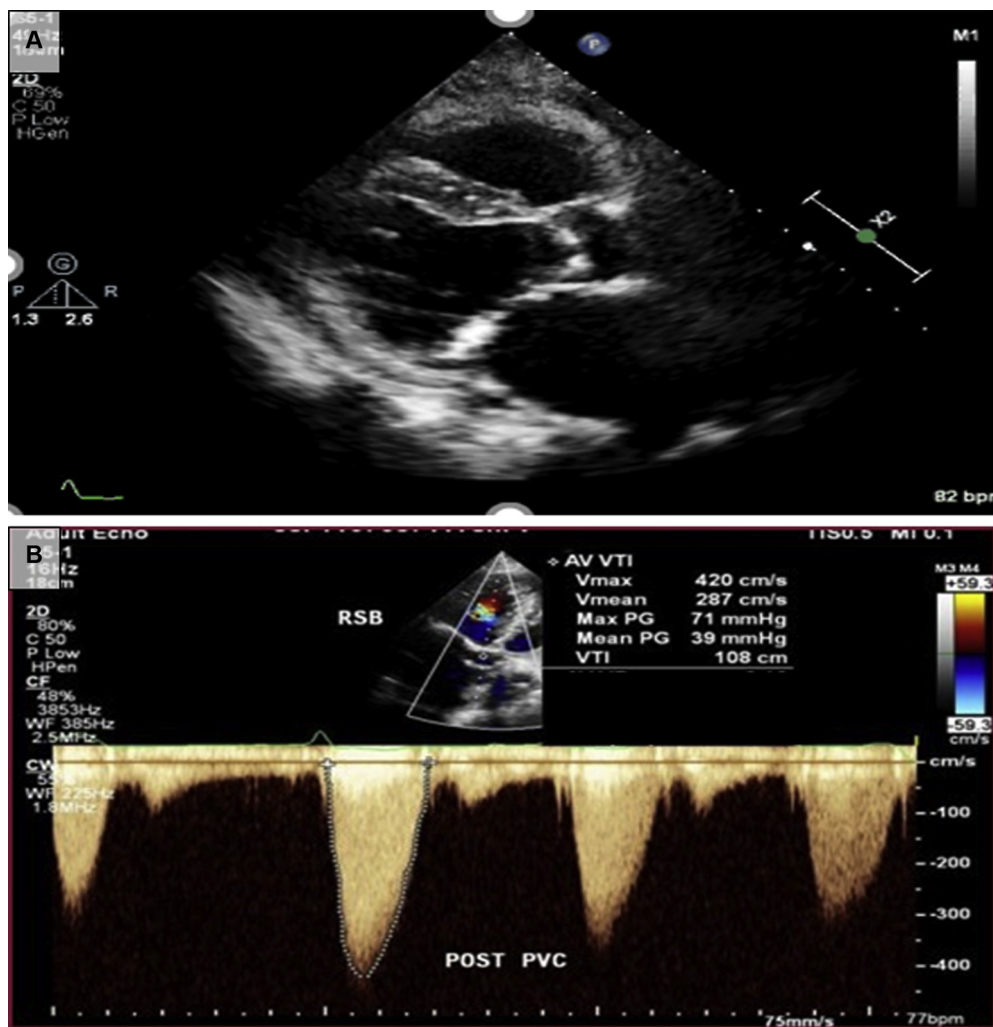


Figure 2 Aortic valve on presentation. **A:** Parasternal long-axis view showing heavily calcified valve with small orifice area during systole. **B:** Continuous-wave Doppler across the aortic valve showing a mean gradient of approximately 40 mm Hg in the post-premature ventricular contraction (POST PVC) beat. RSB = right sternal border.

opposed to staged procedures, in order to minimize the total time under general anesthesia.

The sequential procedures were performed with continuous transesophageal monitoring. Valvuloplasty was completed first with a 20-mm nucleus balloon (NuMED, Hopkinton, NY). Rapid ventricular pacing was not attempted during valvuloplasty because of the concern for inducing ventricular arrhythmias in the setting of her significantly reduced LVEF. Following balloon valvuloplasty, the severity of AS was reduced to “moderate,” without any complications such as annular rupture or aortic regurgitation (Figure 3). The aortic valve area was now 1 cm² with a mean gradient of 15 mm Hg. A Bridge Occlusion Balloon (Phillips, San Diego, CA) was prophylactically placed via the femoral vein over a stiff wire, ready to deploy in the superior vena cava and left innominate vein (covering the proximal coil of the ICD lead) in the event of a major laceration to these central venous structures. Lead extraction was then performed using a 14 French Glidelight laser sheath (Phillips, San Diego, CA). Complete procedural success was achieved, with no

immediate complications. After extensive capsulectomy and pocket hemostasis was achieved, a vacuum-assisted closure device or “wound-VAC” was placed to facilitate wound healing. The patient recovered well from the procedure and was discharged home on a course of intravenous antibiotics. She decided against using a wearable cardiac defibrillator at the time of discharge, and was not interested in biventricular ICD reimplantation when this option was discussed at follow-up visits.

Discussion

To the best of our knowledge, this is the first case of balloon aortic valvuloplasty (BAV) prior to lead extraction in a patient with CIED infection and severe AS. Patients with this unfortunate combination of medical issues can carry a significant risk of morbidity and mortality during lead extraction to treat their device infection. When valve replacement is not a feasible option, BAV can be performed to reduce the severity of stenosis prior to extraction.

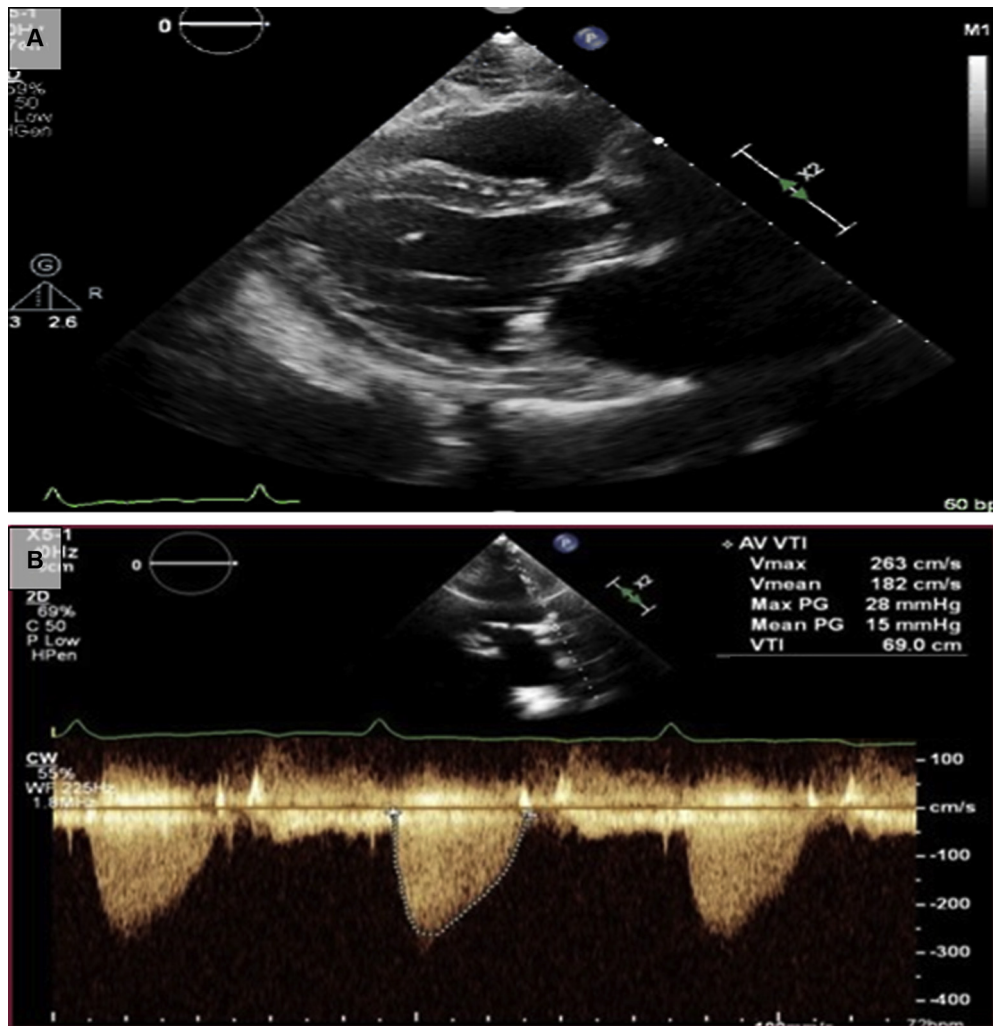


Figure 3 Aortic valve after balloon aortic valvuloplasty. **A:** Parasternal long-axis view showing improved opening of the aortic valve during systole. **B:** Continuous-wave Doppler across the aortic valve showing a mean gradient of approximately 15 mm Hg.

Risk models have been proposed to predict mortality risk based on the clinical setting and comorbidities. Based on 1 such model, the predicted 30-day mortality in our patient was 51% owing to her numerous medical comorbidities.⁶ Although valvular disease was not a statistically significant variable in this multiregression analysis, severe AS can present a major problem in the context of performing a procedure, particularly one such as lead extraction where there is a reasonable likelihood of blood pressure fluctuations owing to vagal effects, venotomy site bleeding, temporary right ventricular inversion during lead traction, and a risk of vascular or cardiac perforation.

Percutaneous BAV has historically been used as a palliative measure in patients with severe AS when valve replacement is not a viable option. Use of BAV is currently indicated in severe AS patients with hemodynamic instability as a bridge to valve replacement, and prior to noncardiac surgery to decrease surgical risk, per European Society of Cardiology guidelines.⁷ Improvement in valve area and gradient can last up to 12 months following a BAV, although it usually does not last so long.⁸ While overall procedural risks of BAV

are low at 2%–5%, complications include vascular hemorrhage, tamponade, aortic regurgitation, and annular rupture, which can be fatal.⁷ The role of BAV in the setting of severe AS to reduce the risks of lead extraction has hitherto not been studied. However, it is biologically plausible that reducing the severity of AS can reduce the risk associated with hemodynamic fluctuations that are not uncommon during the lead extraction procedure. In this case, we elected not to rapidly pace the patient during the BAV, usually done to facilitate balloon stability during inflation, owing to her reduced ejection fraction and risk for inducing sustained ventricular arrhythmias.

This case also highlights the importance of an integrated multidisciplinary team approach as well as shared decision making in the management of complex patients. The importance of an “arrhythmia team” that includes several specialties while treating cardiac arrhythmias in challenging clinical situations has been described.⁹ In this case, the “lead management team” included an electrophysiologist, cardiac surgeon, echocardiography specialist, structural cardiologist, and cardiac anesthesiologist. This group

collaborated effectively, discussing all treatment options and considering the potential risks and benefits of each. These options were then presented to the patient and her family, taking the time to explain the implications of each choice with regard to quality of life, risks, and potential benefits. The final treatment decision was made using a shared process of information exchange, deliberation, and decision making, and respecting the wishes of the patient herself, who was competent to make her own health care decisions. While many would have felt palliative care was a reasonable option, given the estimated 50% mortality from her multiple comorbidities, this was not in keeping with the patient's goals of care, which included her views on what would be an acceptable quality of life.

Conclusion

We report a case of CIED infection and severe AS with several other comorbidities. Using a multidisciplinary team approach and shared decision making with the patient, lead extraction was successfully performed after a balloon valvuloplasty was used to reduce her procedure-related risk.

References

1. Kurtz SM, Ochoa JA, Lau E, et al. Implantation trends and patient profiles for pacemakers and implantable cardioverter defibrillators in the United States: 1993–2006. *Pacing Clin Electrophysiol* 2010;33:705–711.
2. Voigt A, Shalaby A, Saba S. Continued rise in rates of cardiovascular implantable electronic device infections in the United States: temporal trends and causative insights. *Pacing Clin Electrophysiol* 2010;33:414–419.
3. Sohail MR, Uslan DZ, Khan AH, et al. Management and outcome of permanent pacemaker and implantable cardioverter-defibrillator infections. *J Am Coll Cardiol* 2007;49:1851–1859.
4. Peacock JE Jr, Stafford JM, Le K, et al. Attempted salvage of infected cardiovascular implantable electronic devices: Are there clinical factors that predict success? *Pacing Clin Electrophysiol* 2018;41:524–531.
5. Kertai MD, Bountioukos M, Boersma E, et al. Aortic stenosis: an underestimated risk factor for perioperative complications in patients undergoing noncardiac surgery. *Am J Med* 2004;116:8–13.
6. Brunner MP, Yu C, Hussein AA, et al. Nomogram for predicting 30-day all-cause mortality after transvenous pacemaker and defibrillator lead extraction. *Heart Rhythm* 2015;12:2381–2386.
7. Saia F, Marrozzini C, Ciucu C, et al. Emerging indications, in-hospital and long-term outcome of balloon aortic valvuloplasty in the transcatheter aortic valve implantation era. *EuroIntervention* 2013;8:1388–1397.
8. Eltchaninoff H, Durand E, Borz B, et al. Balloon aortic valvuloplasty in the era of transcatheter aortic valve replacement: acute and long-term outcomes. *Am Heart J* 2014;167:235–240.
9. Fumagalli S, Chen J, Dobeanu D, Madrid AH, Tilz R, Dagres N. The role of the Arrhythmia Team, an integrated, multidisciplinary approach to treatment of patients with cardiac arrhythmias: results of the European Heart Rhythm Association survey. *Europace* 2016;18:623–627.