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Case Report

Feasibility of Low-Seated Composite Aortic Conduit for Surgical Treatment of Prosthetic Valve Endocarditis: A Case Report

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ABSTRACT

Background: A 49-year-old male presented with a delayed diagnosis of infective endocarditis leading to extensive intracardiac destruction. Such cases present technical challenges to operative debridement as crucial anchoring points for replacement conduits are compromised.

Case Presentation: Our patient presented at age 49 with nausea, lethargy, and diarrhea 2 weeks after recent travel. His prior history included bioprosthetic valve replacement for a bicuspid aortic valve. The patient was first given a trial of antimicrobials for a suspected UTI. Subsequently, he was admitted briefly to an outside hospital for a "cardiac work-up," which returned negative. The patient sought care for the third time, during which he developed unstable supraventricular tachycardia, prompting echocardiography 16 days following the onset of symptoms. Echocardiography demonstrated a 6 cm abscess cavity invading the interventricular septum with a fistula into the left ventricular outflow tract, multiple ventricular septal defects (VSD), and suspected fistulae into the right ventricular outflow tract. The patient was treated with valve explant and extensive debridement. A valved-conduit for the aorta could not be sewn to the aortic annulus in the usual fashion due to destruction and debridement of the annulus, so a neo-annulus was created using the anterior leaflet of the mitral valve and the left ventricular outflow tract of the heart below the level of the VSDs. A mechanical-valved conduit was implanted onto the neo-annulus. A pacemaker was subsequently implanted.

Conclusion: In patients with extensive intracardiac destruction with the compromise of the aortic annulus due to infective endocarditis, a low-seated, mechanical-valved conduit implanted directly to the aorto-mitral curtain and left ventricular outflow tract should be considered a novel, durable reconstructive option that allows complete debridement of infected tissues.

Case Description

Infectious endocarditis (IE) is a devastating pathology, with in-hospital mortality rates of 15-20% and an increasing prevalence over the past 30 years [1, 2]. IE is characterized by bacterial production of biofilms, which protect bacteria from host defenses and make IE excessively difficult to manage medically. Surgical treatment can enhance host defenses through manual debridement and biofilm disruption, however, operations for IE are associated with the greatest mortality of any valve disease and carry a high risk of neurologic complications. Effective treatment relies on early diagnosis, prompt antimicrobial initiation, and appropriate timing of surgery. We submit a unique case of extensive extracardiac and intracardiac destruction caused by a case of prosthetic valve endocarditis that necessitated seating of a composite aortic valve and root graft (Bentall) directly onto the aortomitral curtain to facilitate complete debridement.

Our patient was a 49-year-old male with a prior medical history of hypertension, ascending aortic aneurysm, bicuspid aortic valve status post aortic valve replacement 14 years prior to presentation with 25 mm MagnaValve, and a cerebrovascular accident of the middle cerebral artery 6 months prior to presentation for which he was taking apixaban.

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The patient's course of illness was notable for difficulty in diagnosis. He first sought care for complaints of nausea, diarrhea, and lethargy 2 weeks following a trip to New England. Records demonstrated he was treated empirically for a UTI at that time. Symptoms persisted after treatment, so he presented to an outside hospital, where he was discharged after a negative "cardiac work-up." The patient presented for the 3rd time and was empirically started on IV vancomycin, ceftriaxone, and metronidazole. On hospital day 2, he had an episode of unstable supraventricular tachycardia to the heart rate of 150s, prompting ICU transfer for amiodarone drip administration. The patient continued to experience multiple runs of non-sustained ventricular tachycardia and bradycardia-dependent polymorphic ventricular tachycardia, for which he underwent temporary transvenous pacemaker insertion. Blood cultures were drawn and returned positive for *Streptococcus constellatus*. The patient was transitioned to IV vancomycin, ceftriaxone, and gentamycin and transferred to our hospital for continued work-up of suspected endocarditis.

Upon transfer, an echocardiogram was performed and demonstrated severe aortic valve thickening/calcification and low flow, low gradient severe aortic valve stenosis and regurgitation with a peak velocity of 4.1 m/s and AV of area 0.91 cm^2. A massive abscess cavity was identified anterior, medial, and lateral to the aortic valve - the abscess extended 3 cm radially, 6 cm circumferentially, and into the interventricular septum for an axial extent of 7 cm. A fistula was visualized from the abscess cavity into the left ventricular outflow tract about 2.5 cm below the aortic valve. Vegetations were suspected on the aortic valve but poorly visualized. The right ventricular outflow tract was found to be compressed by the abscess with suspicion of additional fistulae to the right-sided structures. Following neurology clearance, our patient was taken to the operating room 3 days after transfer to our institution.

Intraoperatively, the patient was found to have an ascending aortic aneurysm measuring 4.9 cm, severe stenosis of his prosthetic aortic valve, and an extensive circumferential aortic root abscess with frank purulence noted at the lateral aspect of the left coronary button. Both coronary buttons were removed, and extensive debridement of infected tissue near the aortic root was performed. The infected tissue extended into the atrioventricular septum and multiple ventricular septal defects were noted. The anterior mitral leaflet appeared intact. However, the area of the conduction system was involved with the root abscess and was debrided. The previously placed aortic valve was removed and the ventricular septal defects were repaired primarily using pledgeted sutures. The abscess cavity was also seen extending under the main pulmonary artery (PA). This was extensively debrided and the main PA above the pulmonary valve was opened to assess for fistulae between the abscess and PA; no fistulae were found, and the main PA was closed. The heart was thoroughly irrigated with vancomycin and neomycin/polymyxin/bacitracin antibiotic solutions.

Given the extent of abscess involvement and debridement, the aortic annulus lacked the structural integrity needed to support the implantation of a composite aortic valve and graft (Bentall procedure). Therefore, a neo-annulus was created on the aorto-mitral curtain around the superior border of the anterior mitral leaflet and the left ventricular outflow tract below the level of the closed VSDs (Figure 1). An On-X 25-mm valve graft conduit was used and sutured to the neo-annulus. Both coronary buttons were re-implanted and hemostasis was secured. Following adequate hypothermia, hypothermic circulatory arrest with retrograde cerebral perfusion was initiated. A hemiarch anastomosis was performed at a level proximal to the innominate artery using a 28 mm Gelweave graft. Cardiopulmonary bypass was then resumed through the Gelweave graft and the graft-to-graft anastomosis was performed. Of note, all grafts were soaked in rifampin for added anti-bacterial resistance. Total cardiopulmonary bypass time was 309 minutes. Cross-clamp time was 249 minutes, and circulatory arrest time was 11 minutes.

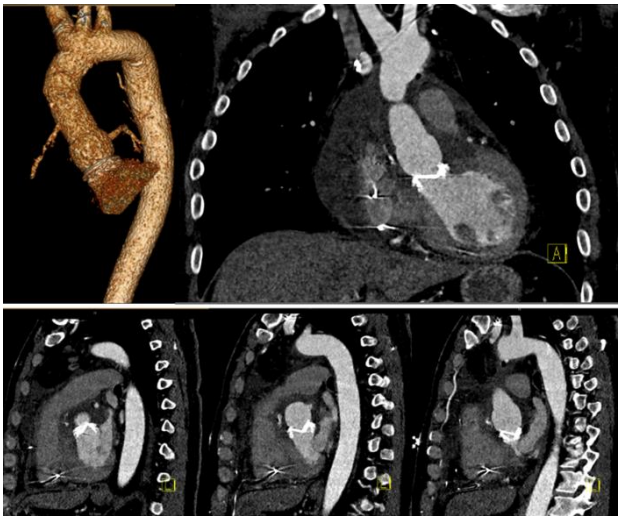

Figure 1: 1-week post-operative CT Angiogram images and 3D reconstruction illustrating mechanical Bentall seated on aorto-mitral curtain.

Post-Operative Course

The patient was transferred to the ICU on milrinone and nicardipine. He was extubated on post-operative day 0, weaned off vasoactive drips by post-operative day 2, and transferred out of the ICU on post-operative day 2. Given continued complete heart block, a direct current permanent pacemaker was implanted on post-operative day 5. On post-operative day 11, the patient experienced a syncopal episode. TTE revealed a large pericardial effusion. The patient was urgently brought to the operative room for a mediastinal washout, which revealed pinpoint bleeding from the innominate vein. Hemostasis was obtained, and the patient was adequately resuscitated with blood products. The patient recovered uneventfully and routine post-operative imaging (CTA and TTE) were unremarkable. He was discharged to an acute inpatient rehabilitation facility 4 days following his washout on a 6-week course of IV penicillin G and on a therapeutic dose of coumadin.

3 days following discharge, the patient was readmitted from inpatient rehabilitation for melanotic stools. An EGD revealed one non-bleeding gastric antral ulcer and 2 non-bleeding duodenal ulcers. An 8-week PPI course was initiated. An echocardiogram obtained during re-admission noted LVEF of 30% with severe LV dysfunction and moderate RV dysfunction. Patient was evaluated by physical/occupational therapy and discharged home with scheduled cardiology and cardiac surgery follow-up.

Discussion

Prosthetic valve endocarditis (PVE) has an incidence of 0.5-1% per patient-year and a mortality rate that approaches 30% at 1 year [3]. Delays in diagnosis can be life-threatening and foster further extracardiac and intracardiac destruction, leading to disseminated infection, life-threatening arrythmias, heart failure, and notable increases in operative complexity and morbidity/mortality. Recent evidence suggests that PVE is more invasive than native valve endocarditis and necessitates more frequent surgical intervention due to biofilm formation [2]. Current consensus guidelines recommend surgical treatment of endocarditis independently of completion of a full course of antibiotics for patients with annular or aortic abscess, heart block, or destructive penetrating lesions. Other recent reports concur that early surgery for PVE leads to superior outcomes and that PVE should not be a contraindication to even redo operations if needed [4, 5].

Operative management of endocarditis consists of removal of infected tissue, removal of high-risk sources of embolism, and restoration of the functioning valve and cardiac integrity [3, 6]. Based on tricuspid valve studies, valve repair is favoured over replacement, when possible [2]. Pacemaker dependence following surgery is not uncommon, with reported rates of near 13%, given resection of conduction system tissue during debridement [7]. Resection of other structures, such as the aortic valve and annulus, though described, pose a significant challenge to reconstruction following debridement.

Aortic annular abscesses are a well-known complication in advanced endocarditis and lead to higher rates of heart failure, fistula/pseudoaneurysm formation, and aortoventricular discontinuity [8]. Multiple groups have reported patients with aortic annular abscess that have been managed with annular reconstruction with a bovine pericardium patch and placement of a mechanical aortic valve [9, 10]. Baumgartner's group reports that small annular abscesses can be managed with local closure with pledgeted mattress sutures without increases in mortality. Alternative techniques they describe include using pericardial patches, St. Jude Dacron valved-conduits, and even homograft placement in cases of aortoventricular discontinuity. Treatment of annular abscess extension into the interventricular septum has also been described using a Konno procedure (incision from the right coronary cusp into the right ventricular outflow tract to facilitate aortic valve annuloplasty) or an Ozaki procedure (construction of a new aortic valve using autologous pericardium) [11, 12].

After an extensive literature search, we have only found one case report from 1 month prior to our report documenting an approach to seating an aortic conduit within the left ventricular outflow tract. Petrov *et al.* report good outcomes with this technique, which they have named the Calamari procedure due to the resemblance of the Dacron ring to a Calamari ring [13]. Our case illustrates the feasibility and safety of this technique when necessary for advanced disease. There are multiple theoretical risks of low conduit placement, including damage to the anterior leaflet of the mitral valve, conduction system damage, and difficulty obtaining hemostasis once the anastomosis is complete. However, this technique provides a "salvage" option for reconstruction when intracardiac tissue damage is extensive.

Our case highlights an innovative modification of a common procedure that may provide a crucial reconstructive option in cases of advanced endocarditis with aortic annular destruction. We also underscore the importance of maintaining a high index of suspicion for endocarditis and demonstrate the possible effects of a delayed diagnosis. Finally, we emphasize the importance of a multidisciplinary care team – in our case, including critical care, cardiology, infectious disease, psychiatry, vascular neurology, dental, physical therapy, and physical medicine/rehabilitation colleagues – for prompt, appropriate treatment and meaningful post-operative recovery for patients with endocarditis.

Conclusion

Early diagnosis and appropriate timing of surgery are crucial in the management of IE. We present a 49-year-old patient with a delayed diagnosis of IE and extensive aortic annular and ventricular septal destruction. We highlight the feasibility of seating a composite valved-conduit (Bentall) directly onto the aortomitral curtain and left ventricular outflow tract, rather than the aortic annulus, to facilitate reconstruction after thorough operative debridement.

Lessons Learned

Infective endocarditis (IE), if not treated promptly, can produce extensive intracardiac destruction. In cases with extensive destruction of the aortic annulus, it is feasible and safe to seat a composite valved-conduit (Bentall) directly onto the aortomitral curtain and left ventricular outflow tract.

Conflicts of Interest

None.

Funding

None.

References

1. Murdoch DR, Corey GR, Hoen B, Miró JM, Fowler Jr VG et al. (2009) Clinical presentation, etiology, and outcome of infective endocarditis in the 21st Century. *Arch Intern Med* 169: 463-473. [Crossref]
2. Vincent LL, Otto CM (2018) Infective Endocarditis: Update on Epidemiology, Outcomes, and Management. *Curr Cardiol Rep* 20: 86. [Crossref]
3. Pettersson GB, Hussain ST (2019) Current AATS guidelines on surgical treatment of infective endocarditis. *Ann Cardiothorac Surg* 8: 630-644. [Crossref]
4. Lalani T, Chu VH, Park LP, Cecchi E, Corey GR et al. (2013) In-hospital and 1-year mortality in patients undergoing early surgery for prosthetic valve endocarditis. *JAMA Intern Med* 173: 1495-1504. [Crossref]
5. Weber C, Petrov G, Luehr M, Aubin H, Tugtekin SM et al. (2021) Surgical results for prosthetic versus native valve endocarditis: A multicenter analysis. *J Thorac Cardiovasc Surg* 161: 609.e10-619.e10. [Crossref]

6. Ghanta RK, Pettersson GB (2021) Surgical Treatment of Infective Endocarditis in Elderly Patients: The Importance of Shared Decision Making. *J Am Heart Assoc* 10: e022186. [Crossref]
7. Hill TE, Kiehl EL, Shrestha NK, Gordon SM, Pettersson GB et al. (2019) Predictors of permanent pacemaker requirement after cardiac surgery for infective endocarditis. *Eur Heart J Acute Cardiovasc Care* 10: 329-334. [Crossref]
8. Baumgartner FJ, Omari BO, Robertson JM, Nelson RJ, Pandya A et al. (2000) Annular abscesses in surgical endocarditis: anatomic, clinical, and operative features. *Ann Thorac Surg* 70: 442-447. [Crossref]
9. Masaki N, Ogasawara T, Matsuki K (2017) Aortic Valve Infective Endocarditis with an Annular Abscess. *Intern Med* 56: 2951-2952. [Crossref]
10. Croon SI, Angkasuwan A, van Straten AH, Khamooshian A, Elenbaas TW et al. (2020) Surgical treatment and long-term outcome of aortic valve endocarditis with periannular abscess. *Neth Heart J* 28: 345-353. [Crossref]
11. Doi T, Nagao K, Obi H, Higashida A, Aoki M et al. (2021) Application of the Konno procedure for infective endocarditis in native bicuspid aortic valve with annular abscess extending into the interventricular septum. *J Surg Case Rep* 2021: rjab428. [Crossref]
12. Ngo HT, Nguyen TT, Nguyen HC, Camilleri L, Thanh LN et al. (2020) Bicuspid reconstruction surgery in a patient suffering from aortic valve infective endocarditis with annular abscess using Ozaki's procedure: A case report. *Int J Surg Case Rep* 76: 266-269. [Crossref]
13. Petrov A, Diab AH, Taghizadeh-Waghefi A, Wilbring M, Alexiou K et al. (2022) Aortic root reinforcement in aortic valve endocarditis with annular abscess: The Calamari procedure. *J Card Surg* 37: 2202-2204. [Crossref]