Aortic Valve Thrombosis after Valve-Sparing Aortic Root Replacement and Insertion of an Extracorporeal Left Ventricular Assist Device, Masked by Mediastinal Packing

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Abstract
Aortic valve (AV) or aortic root thrombus related to a left ventricular assist device (LVAD) is a relatively uncommon but potentially life-threatening complication. In the present report, we describe a complex case where echocardiographic diagnosis of AV thrombosis was obscured by the presence of mediastinal packing in a patient who underwent valve-sparing aortic root replacement and insertion of the CentriMag™ LVAD for postcardiotomy cardiogenic shock. A large AV thrombus may develop rapidly in patients with LVADs. This case highlights the importance of a careful and thorough transesophageal echocardiography examination in detecting this complication and in altering surgical management.

Keywords: Aortic valve, thrombus, transesophageal echocardiogram, ventricular assist device

Introduction
Aortic valve (AV) thrombus is relatively uncommon in patients with mechanical circulatory support, but it potentially leads to devastating complications such as coronary artery obstruction, myocardial infarction, and cerebrovascular accidents.[1,2] Transesophageal echocardiography (TEE) is considered a suitable modality for diagnosing AV thrombus.[2,3] In the present report, we describe a complex case where TEE diagnosis of AV thrombosis was initially obscured by the presence of mediastinal packing in a patient who received a left ventricular assist device (LVAD) for postcardiotomy cardiogenic shock.

A 21-year-old male with Marfan syndrome underwent elective AV-sparing aortic root replacement (David-V procedure)[4] with 26 mm GORE-TEX™ graft (Gore Medical, Flagstaff AZ, USA) and mitral valve repair with implantation of multiple neochords and a Simplici-T™ (Medtronic, Minneapolis, MN, USA) band annuloplasty for 50-mm aortic root aneurysm and mitral valve prolapse leading to moderate mitral regurgitation.

Separation from cardiopulmonary bypass (CPB) was complicated by recurrent ventricular fibrillation (VF). The patient required multiple electrical cardioversion, boluses of amiodarone, and a return to CPB for stabilization. The patient continued to have hemodynamic instability in attempts to separate from CPB, and at this point TEE detected new anterior wall akinesis of the left ventricle (LV). The CPB was reinitiated, and the left coronary button was revised twice. After several aortic cross-clamps and CPB runs, deterioration in global LV function ensued, requiring inotropic support of 0.1 mcg/kg/min of epinephrine and 0.5 mcg/kg/min of milrinone. Considering the history of Marfan syndrome and recurrent VF episodes, it was deemed safer to implant a temporary LVAD as a bridge to recovery instead of an intra-aortic balloon pump. The inflow and outflow cannulas of the CentriMag™ (Thoratec, Pleasanton, CA, USA) were inserted in the LV apex and in the proximal aortic arch, respectively. The patient was successfully weaned from CPB with hemodynamic support of the CentriMag™ on the first

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attempt. The total CPB and aortic cross-clamp time were 297 and 181 min, respectively. The patient subsequently developed severe coagulopathy and significant blood loss, requiring administration of multiple blood products and recombinant activated factor VII (rFVIIa). To control ongoing microvascular bleeding, mediastinal packing was inserted around the surgical sites. The patient’s chest was closed, and he was transferred to the cardiovascular Intensive Care Unit.

On the postoperative day 1, hemodynamics remained stable on LVAD flow of 4.5 L/min and 3500 revolutions/min. There was no significant chest tube output. Intravenous unfractionated heparin was initiated to maintain partial thromboplastin time above 70 s. A coronary angiogram showed no significant stenosis or obstruction to coronary flows. On the postoperative day 2, focused bedside transthoracic echocardiography (TTE) was performed. Apical views revealed recovery of LV ejection fraction to 40% on reducing LVAD flow to 1 L/min with AV opening. No abnormality was reported in regards to the AV. On the postoperative day 3, the patient returned to the operating room for resternotomy, off-pump decannulation of LVAD cannulas, and removal of mediastinal packing. Initial TEE examination confirmed adequate biventricular function at minimum LVAD flow settings. The AV and aortic root were poorly visualized in any of the midesophageal views due to an acoustic shadow casted by the mediastinal packing [Figure 1 and Video 1]. On further examination, although deep transgastric long-axis view was suboptimal, there was an echogenicity in the aortic root suspicious of a mass [Figure 2 and Video 2] and a turbulent flow across the AV on color flow Doppler [Figure 3]. The peak and mean pressure gradients across the AV were 57 and 30 mmHg, respectively. Following removal of mediastinal packing, midesophageal long-axis view of AV revealed a large independently mobile mass (measuring 25 mm × 30 mm) on the aortic side of AV [Figure 4, Videos 3 and 4]. Epiaortic echocardiogram confirmed this finding [Figure 5]. Due to the obstructive nature and size of the thrombus, a decision was made to institute CPB and explore the AV. Surgical inspection revealed a large thrombus adherent to AV cusps which also protruded into the left ventricular outflow tract. After thrombectomy, the patient was weaned from CPB uneventfully. TEE confirmed full removal of the AV mass [Figure 6 and Video 5] and normal AV function. The patient subsequently developed postoperative delirium but was discharged home 2 weeks later.

**Discussion**

The CentriMag™ is one of the most commonly used extracorporeal ventricular assist devices designed for short-term single or biventricular support. Its effectiveness as “bridge to decision” or “bridge to myocardial recovery” has been demonstrated in a variety of conditions including refractory heart failure, acute donor graft failure, postcardiotomy cardiogenic shock, and right heart failure post-LVAD implantation.
However, the CentriMag™ is associated with serious life-threatening complications including thrombosis at a reported rate of 7% (95% confidence interval: 5–11%).[5] Optimal anticoagulation is a fine balance between the risks of bleeding and thrombosis. To date, there are no specific recommendations on optimal anticoagulation regimen in patients with extracorporeal LVADs, and intravenous heparin remains the mainstay therapy.[1] Despite adequate systemic anticoagulation, AV thrombus has occurred as described in this case report.[9] In the review by Barrick et al., three out of 10 case reports of AV or aortic root thrombus in the setting of a LVAD involved CentriMag™.[1] Thrombus was diagnosed relatively soon postoperatively, and the shortest time interval between LVAD implantation and thrombus detection was 2 days, which is similar to this case.[1] In this case, a less invasive TTE examination was chosen to assess the recovery of LV function in the cardiovascular Intensive Care Unit, but TTE images are often suboptimal in this setting due to inability to position the patient adequately and the presence of bandages. Factors contributing to thrombus formation include use of rFVIIa, the presence of vascular graft in the aortic root, and stagnant aortic root flow due to reduced AV opening.

A large, obstructing AV thrombus may develop rapidly in the setting of the CentriMag™ LVAD. Although TEE has high sensitivity for detecting AV or aortic root thrombus, the presence of a foreign material such as mediastinal packing around the aortic root may obscure this life-threatening complication. A high index of suspicion and thorough TEE examination are essential for its detection.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Barrick BP, Smeltz A, Ganesh A, Arora H, Kumar PA. Aortic valve thrombus in a patient with an extracorporeal left ventricular assist device: The dilemma of management. J Cardiotoracic Vasc Anesth 2016;30:196-9.

2. Tanna MS, Reyentovich A, Balsam LB, Dodson JA, Vainrib AF, Benenstein RJ. et al., Aortic root thrombus complicated by left main coronary artery occlusion visualized by 3D echocardiography in a patient with continuous-flow left ventricular assist device. Echocardiography (Mount Kisco, NY). 2017:34:306-310.

3. Saric M, Armour AC, Amaout MS, Chaudhry FA, Grimm RA, Kronzon I, et al. Guidelines for the use of echocardiography in the evaluation of a cardiac source of embolism. J Am Soc Echocardiogr 2016;29:1-42.
4. Ouzounian M, Rao V, Manlhiot C, Abraham N, David C, Feindel CM, et al. Valve-sparing root replacement compared with composite valve graft procedures in patients with aortic root dilation. J Am Coll Cardiol 2016;68:1838-47.

5. Borisenko O, Wylie G, Payne J, Bressmo S, Smith J, Yonan N, et al. Thoratec centriMag for temporary treatment of refractory cardiogenic shock or severe cardiopulmonary insufficiency: A systematic literature review and meta-analysis of observational studies. ASAIO J 2014;60:487-97.

6. Shuhaiber JH, Jenkins D, Berman M, Parameshwar J, Dhital K, Tsui S, et al. The papworth experience with the levitronix centriMag ventricular assist device. J Heart Lung Transplant 2008;27:158-64.

7. Takayama H, Soni L, Kalesan B, Truby LK, Ota T, Cedola S, et al. Bridge-to-decision therapy with a continuous-flow external ventricular assist device in refractory cardiogenic shock of various causes. Circ Heart Fail 2014;7:799-806.

8. Mohite PN, Zych B, Popov AF, Sabashnikov A, Sáez DG, Patil NP, et al. CentriMag short-term ventricular assist as a bridge to solution in patients with advanced heart failure: Use beyond 30 days. Eur J Cardiothorac Surg 2013;44:e310-5.

9. Demirozu ZT, Frazier OH. Aortic valve noncoronary cusp thrombosis after implantation of a nonpulsatile, continuous-flow pump. Tex Heart Inst J 2012;39:618-20.