Rheumatic mitral valve disease successfully managed with mechanical circulatory support before mitral valve replacement surgery

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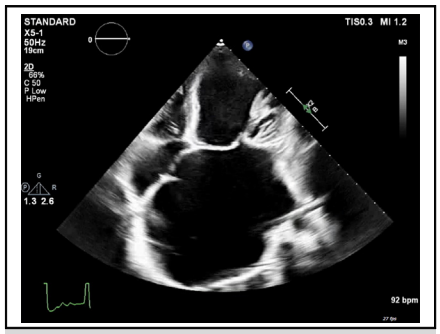

Transesophageal echocardiography, midesophageal 4-chamber view of a giant left atrium.

CENTRAL MESSAGE

Cardiogenic shock in severe mitral valvulopathy associated with GLA delays surgical treatment. Optimization through temporary percutaneous mechanical circulatory support can limit the surgical risks.

Severe mitral stenosis, most commonly from rheumatic heart disease (RHD), contributes to increased left atrial pressure and volume compensatory changes to overcome obstructive valvular physiology. Left atrium (LA) enlargement, a poor prognostic factor in morbidity and mortality, occurs due to myocyte reconstruction after pathologic LA fluid and pressure overload and may lead to atrial fibrillation (AF). Compression of the left ventricle (LV), left main bronchus, right lung, and esophagus can cause chest pain, dysphagia, edema, hoarseness, and dyspnea; in some cases, patients progress to hemodynamic instability.[1] We present a case of severe mitral valvulopathy associated with giant left atrium, which was complicated by cardiogenic shock and pulmonary edema and required temporary mechanical circulatory support via TandemHeart (LivaNova) as a bridge to surgical mitral valve replacement. The Institutional Review Board of The University of Texas Health Science Center at Houston did not approve this study, as the institution does not require approval to publish case reports. The subject provided informed written consent for publication of the data.

CASE PRESENTATION

A 26-year-old Hispanic woman with RHD and AF presented to an outside hospital with dysphagia, dyspnea, and a fever of 102.9 °F. She arrived in AF with a rapid ventricular rate, received intravenous fluids and metoprolol succinate, and was then transferred to our center for a higher level of care.

The patient's lab results revealed a lactic acid concentration of 3.8 mmol/L, a white blood cell count of 20.6 × 10^3/μL, and a brain natriuretic peptide level of 588 pg/mL. A urinalysis showed 92 white blood cells per high power field. Chest radiography and computed tomography are shown in Figure 1. A transthoracic echocardiogram revealed an anteroposterior diameter of the LA of 9.0 cm, compression of the right atrium (RA), severe mitral stenosis with a mitral valve area of 1.5 to 1.6 cm^2 (calculated by planimetry), a heart rate of 104 bpm, and a mean gradient of 11 mm Hg (Figure 2). In addition, the patient had severe mitral regurgitation with a regurgitant fraction of 58%, a right ventricular systolic pressure of 60 mm Hg, a left ventricular ejection fraction of 50% to 55% (as determined by the Simpson method), and an LA volume index of 474 mL/m^2.

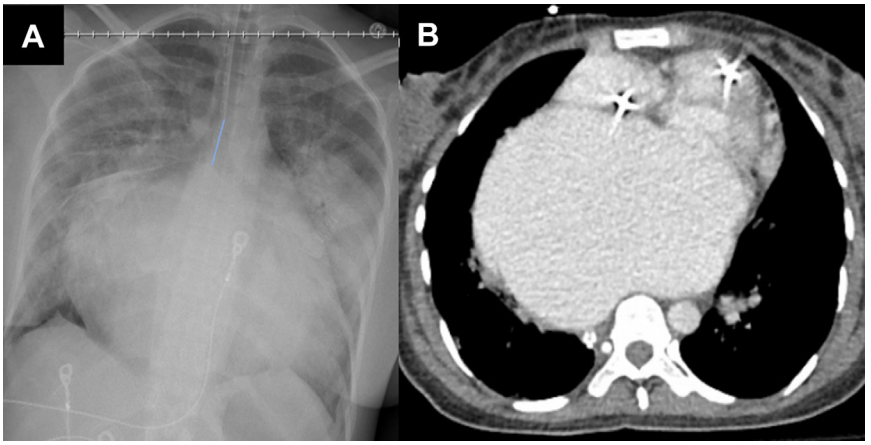

FIGURE 1. Imaging shows a gigantic left atrium and pulmonary edema. A, Anterior-posterior chest radiograph on hospital day 4. B, Computed tomography of the abdomen and pelvis with contrast from hospital day 7.

We treated the patient for resistant pyelonephritis with meropenem and vancomycin and saw an initial improvement in the shock state. She then developed cardiogenic shock requiring norepinephrine, endotracheal intubation from pulmonary edema, and high mechanical ventilator support, including paralysis. On hospital day (HD) 4, she underwent right axillary artery conduit creation for the delivery of TandemHeart (LivaNova), a percutaneous left ventricular assist device (pVAD). Intraoperative transesophageal echocardiography did not reveal intracardiac thrombus. After device placement, cardiac hemodynamics showed a heart rate of 135 bpm (AF), an RA pressure of 7 mm Hg, a mean pulmonary capillary wedge pressure of 13 mm Hg, a mean pulmonary artery pressure of 35 mm Hg, and a pulmonary artery oxygen saturation of 51.5% (Table E1). She had a cardiac output of 2.76 L/minute and a cardiac index of 2.06 L/minute/m^2 by the Fick equation with a pVAD flow of 2.7 L/minute. Within 24 hours, lactic acid concentration decreased to 1.7 mmol/L.

Treatment included continuous intravenous bumetanide and heparin. On HD 12, we performed an open sternotomy and mitral valve replacement with a 27 mm On-X mitral valve (On-X Life Technologies Inc). The patient underwent pVAD removal, a device-associated RA thrombectomy, atrial septum repair, LA appendage ligation, and resection with subclavian artery repair. She was extubated on HD 13 and discharged home on HD 23. In the clinic 9 days after discharge, she could perform all activities of daily living without difficulty.

DISCUSSION

This case exemplifies the unique management of RHD-related mitral valve disease with the use of a pVAD as bridge-to-destination therapy. Cardiogenic shock in patients with severe mitral valve stenosis is treated with medical optimization before surgery, which includes inotropes and diuresis.

Patients with giant left atrium have a high risk for thrombosis because of the increased blood viscosity from low shear force and turbulence, especially when valvular AF is present.[2] Novel oral anticoagulants are not recommended for patients with LA thrombus and

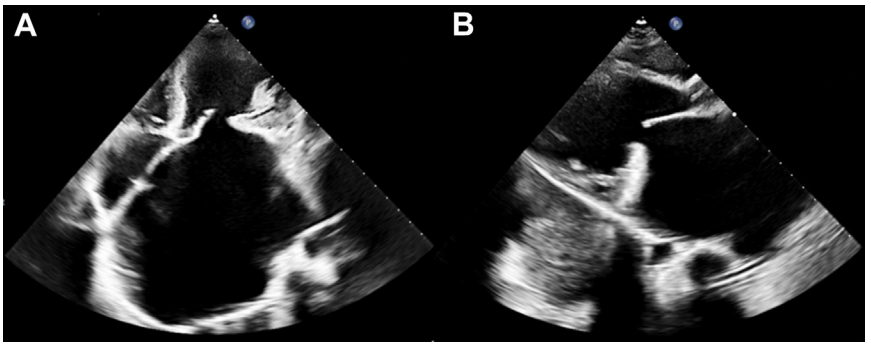

FIGURE 2. Transthoracic echocardiogram. Apical 4-chamber (A) and parasternal long views (B) showing 9-cm giant left atrium from anteroposterior measurement.

valvular AF, but rather vitamin K antagonist treatment is advised.[3]

The standard treatment for severe combined mitral stenosis and regurgitation is mitral valve replacement surgery; however, our patient also had cardiogenic shock and pulmonary edema, preventing traditional treatment options. Hemodynamic assistance from a pVAD has shown immediate postoperative reversal of group II pulmonary hypertension and provided cardiac support in similar patients with nonischemic cardiomyopathy.[4,5] The decision was made to proceed with emergency mechanical circulatory support that optimized pulmonary capillary wedge pressure, as well as bypassed the dysfunctional mitral valve. TandemHeart placement allowed further medical optimization for bridge-to-destination therapy and a successful mitral valve replacement surgery.

Whether to replace the mitral valve alone or in combination with an LA reduction surgery remains controversial; however, some studies have shown that combining LA reduction with mitral valve surgery with or without ablation and the Cox-maze procedure has resulted in lower rates of atrial arrhythmia.[E1]

In our case, the decision to use the TandemHeart device was made because of the need to bypass the dysfunctional mitral valve and effectively unload the LV. Through the interatrial septal puncture, TandemHeart allows LA drainage of oxygenated blood into the femoral artery (or in our case, the right subclavian artery conduit), bypassing mitral valve, LV, and aortic valve pathology. Ventricular septal defects, ventricular rupture, and cardiogenic shock from mitral valve disease are indications for TandemHeart use. Device complications include bleeding, thrombosis, limb ischemia, and LA catheter migration to the RA, which may result in deoxygenated blood bypassing the lungs.[E2] Data on bridge-to-destination use of TandemHeart for mitral valve surgery is limited.[E3] Our case report highlights the potential of this device as a therapeutic option.

CONCLUSIONS

In cases of severe mitral valve stenosis with concomitant cardiogenic shock unable to hemodynamically tolerate surgery alone, clinicians should consider stabilization with pVAD before surgical intervention.

Conflict of Interest Statement

Dr Salas de Armas has research-related financial interests in Abiomed unrelated to the present work. All other authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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TABLE E1. Patient hemodynamics*

Hemodynamics		
Before device placement	**After device placement**	**Before discharge (postoperative day 11)**
- Arterial line pressure: 78/47 mm Hg - MAP: 56 mm Hg - CVP: 20 mm Hg - HR: 130 bpm†	- RAP A wave: 8 mm Hg - RAP V wave: 9 mm Hg - Mean RAP: 7 mm Hg - RV pressure: 38/7 mm Hg - RVEDP: 8 mm Hg - PAP: 42/34 mm Hg - Mean PAP: 35 mm Hg - PCWP A wave: 14 mm Hg - PCWP V wave: 14 mm Hg - Mean PCWP: 13 mm Hg - CO: 2.76 L/min - CI: 2.06 L/min/m^2 - SVR: 1651.4 dynes/s/cm^5 - PVR: 637.4 dynes/s/cm^5 - TPG: 22 mm Hg - PA oxygen saturation: 51.5% - HR: 135 bpm†	- Arterial line pressure: 118/65 mm Hg - MAP: 84 mm Hg - CVP: 7 mm Hg - PAP: 20/9 mm Hg - Mean PAP: 14 mm Hg - CO: 3.5 L/min - CI: 2.9 L/min/m^2 - Svo_2: 50% - HR: 99 bpm†

MAP, Mean arterial pressure; *CVP*, central venous pressure; *HR*, heart rate; *RAP*, right atrial pressure; *RV*, right ventricle; *RVEDP*, right ventricular end-diastolic pressure; *PAP*, pulmonary artery pressure; *PCWP*, pulmonary capillary wedge pressure; *CO*, cardiac output; *CI*, cardiac index; *SVR*, systemic vascular resistance; *PVR*, pulmonary vascular resistance; *TPG*, transpulmonary pressure gradient; *PA*, pulmonary artery; *SVo_2*, venous oxygen saturation. *Measurements were taken before device placement, after device placement, and before discharge (postoperative day 11). †Atrial fibrillation.