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Case Reports

Management of Rheumatic Mitral Stenosis With Annular Calcification During HeartMate 3 Implantation

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There is a lack of data-driven consensus on the treatment of mitral stenosis at the time of left ventricular assist device implantation. The presence of severe mitral annular calcification further complicates mitral valve intervention. This case report presents a 72-year-old woman with severe mitral stenosis and severe annular calcification with end-stage ischemic cardiomyopathy who underwent HeartMate 3 (Abbott Cardiovascular) implantation. The mitral valve pathology was successfully managed with concomitant open balloon valvuloplasty and surgical commissurotomy on a fibrillating heart without aortic cross-clamp. This approach avoided the need for mitral valve replacement and the potential risks associated with annular decalcification and reconstruction. Longer follow-up is needed to determine its effectiveness over time. ***(Tex Heart Inst J. 2022;49(6):e217736)***

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Patients who require left ventricular assist device (LVAD) may have coexisting mitral valve (MV) pathologies, typically mitral regurgitation (MR) and, less commonly, mitral stenosis (MS).[1] Intervention for MS is required because it compromises LVAD function.[2] Many patients who undergo MV surgery also have some degree of mitral annular calcification (MAC). This case report presents a case of successful open balloon valvuloplasty with commissurotomy at the time of HeartMate 3 implantation in a patient with severe rheumatic MS and MAC.

Case Report

A 72-year-old woman was admitted with exacerbation of heart failure (New York Heart Association [NYHA] class IV). She had a history of ST-segment elevation myocardial infarction in 2017, with stents placed in the diagonal and left circumflex coronary artery; ischemic cardiomyopathy with multiple admissions for heart failure despite maximally tolerated doses of guideline-directed medical therapy; atrial fibrillation; and rheumatic MS that was first diagnosed in 2013.

Transthoracic echocardiogram (TTE) demonstrated a left ventricular (LV) ejection fraction (EF) of 22% with an LV end-diastolic internal diameter of 6.1 cm, a moderately dilated left atrium without thrombus, and a normal right ventricle. The entire apical wall, apical cap, and midanteroseptal and inferoseptal wall were akinetic. There was also severe MAC, severe MS (peak gradient, 22 mm Hg; mean, 13 mm Hg), mild MR, and a normal aortic valve (Fig. 1A and Fig. 1B). Severe MAC was also seen on chest computed tomography (Fig. 2). Left heart catheterization showed patent stents and chronically occluded proximal left anterior descending artery with collaterals from the diagonal and right coronary artery. There was no other obstructive coronary disease. Right heart catheterization revealed normal right atrial pressure (5 mm Hg), mildly elevated pulmonary artery pressure (32/19 mm Hg) and wedge pressure (16 mm Hg), and normal cardiac index (2.7 L/min/m^2 [Fick], 2.4 L/min/m^2 [thermodilution]). She was not eligible for heart transplant because of age and other comorbidities (chronic obstructive pulmonary disease, history of lung cancer status post–right lower lobectomy, multiple sclerosis, and substantial functional limitation) but was considered an ap-

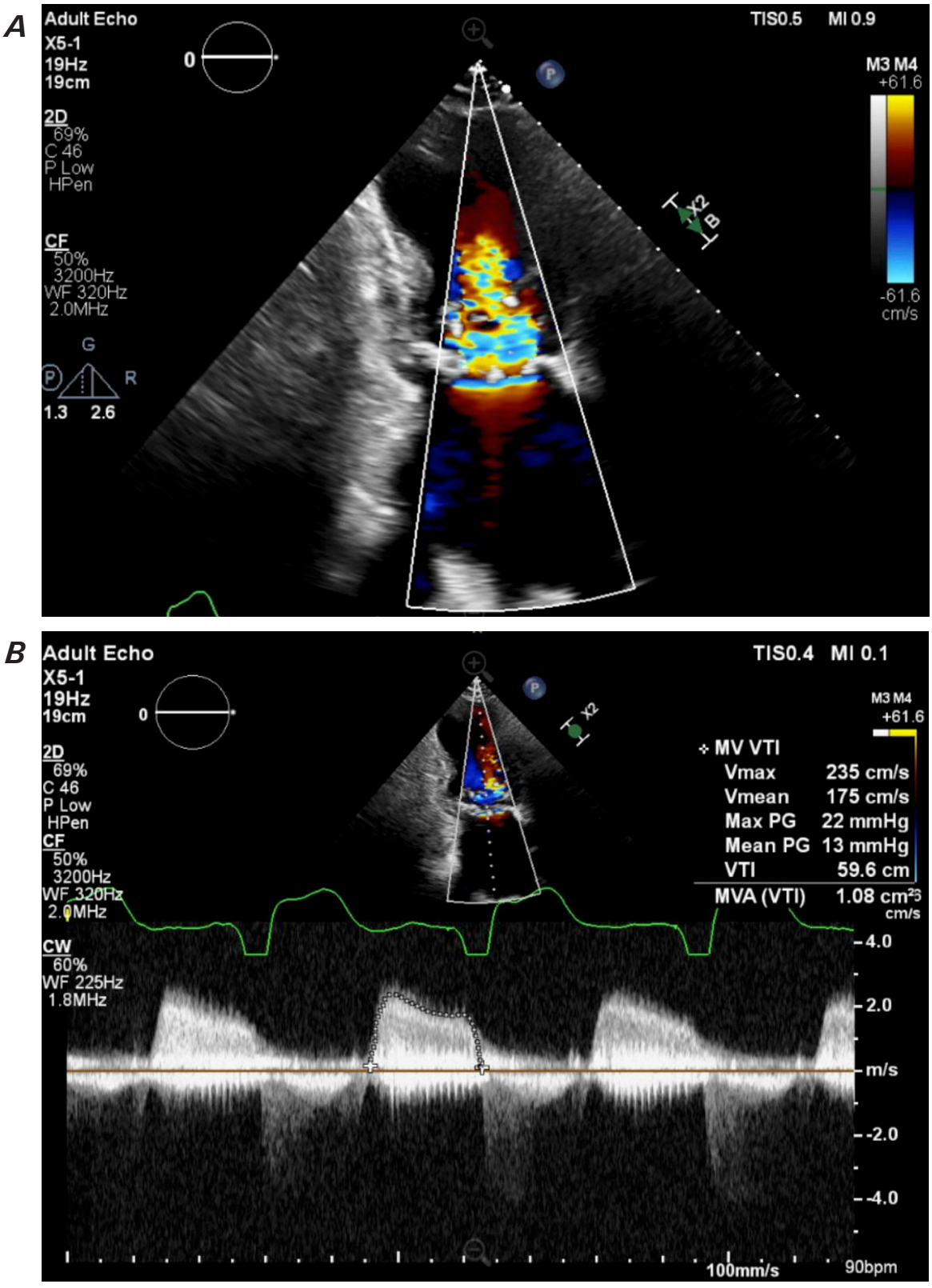

***Fig. 1 A**) Preprocedural transthoracic 2D echocardiogram demonstrates severe mitral stenosis in apical long-axis view with color Doppler flow. **B**) Preprocedural transthoracic continuous-wave spectral Doppler echocardiogram of the mitral valve demonstrates maximum and mean gradients across the stenotic mitral valve.*

2D, 2-dimensional; MV, mitral valve; MVA, mitral valve area; PG, pressure gradient; Vmax, maximum velocity; Vmean, mean velocity; VTI, velocity time interval.

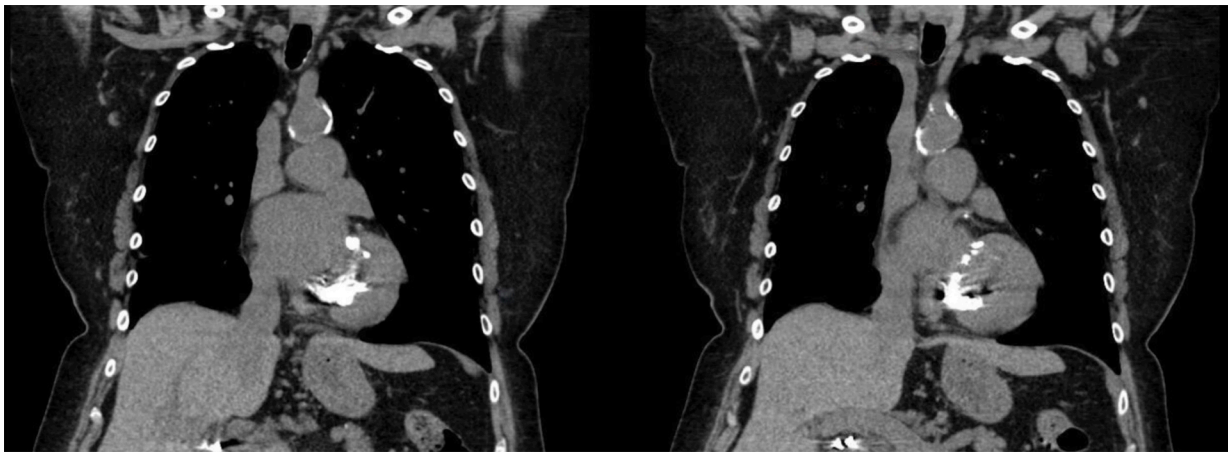

Fig. 2 *Chest computed tomography demonstrating severe mitral annular calcification*

propriate candidate for LVAD as destination therapy (INTERMACS level 4). Preoperative percutaneous balloon mitral valvuloplasty was considered to address the MS but was deemed too high risk given her low EF, calcified mitral leaflets, and severe MAC.

HeartMate 3 (Abbott Cardiovascular) was subsequently implanted, with concomitant left atrial appendage ligation and MV intervention. Cardiopulmonary bypass was initiated via a standard median sternotomy. After opening the LV apex and emptying the LV, visualization of the MV was difficult. Physicians thus performed a left atriotomy on a fibrillating heart once the patient was cooled without aortic cross-clamp. The MV leaflets were extremely calcified, with commissure fusion and circumferential MAC. Next, balloon valvuloplasty was performed through the left atriotomy with serial dilation, starting with a 23-mm and finally a 28-mm balloon (Z-MED, Braun Interventional Systems, Inc). Bilateral surgical commissurotomy was also performed to ensure complete release of the stenotic orifice. The area was thoroughly irrigated to minimize risk of embolization. Closure of the left atrial appendage was also performed with a 35-mm clip (AtriCure). The HeartMate 3 was then implanted in a usual fashion. Total bypass time was 102 minutes. Post–cardiopulmonary bypass transesophageal echocardiogram (TEE) revealed improved gradient across the MV down to 4 mm Hg (Fig. 3A and Fig. 3B). She was extubated on postoperative day (POD) 2 and ambulated on POD 4. She required dual ionotropic support for right ventricular dysfunction, which was tapered off by POD 5. She received 81 mg aspirin daily and coumadin with heparin bridge, with a goal international normalized ratio of 2 to 3 for post-LVAD anticoagulation. Repeat TTE at discharge demonstrated trivial MR and no MS, with a peak gradient of 2 mm Hg and mean gradient of 1 mm Hg. At 12-month follow-up, she was doing well with improved exercise tolerance (NYHA class II), and TTE showed no MS, mild MR, and normal LVAD function.

Discussion

Currently, there is no data-driven consensus on the preferred treatment of MS at the time of LVAD implantation. Substantial MS can limit LV inflow, decrease LVAD flow, and increase left atrial and pulmonary artery pressures, potentially causing or exacerbating right heart failure. Therefore, correction of moderate or severe MS at the time of LVAD implantation is recommended.[3] Previous International Society for Heart and Lung Transplantation guidelines suggested valve replacement with a tissue valve for moderate or worse MV stenosis at the time of LVAD implantation.[2] However, this was based on level C evidence and is rarely reported in the literature. Other methods of MV intervention have been described. Mohite et al[4] performed transapical mitral commissurotomy through the LV apical hole concomitantly with HeartWare LVAD (Medtronic) implantation in a patient who had mild MS resulting from prior MV repair for MR. In addition, transcatheter MV replacement via a transapical approach with concomitant LVAD implantation was reported in a patient with moderate bioprosthetic MS.[5] Transapical balloon valvuloplasty under TEE guidance at the time of temporary LVAD placement has also been described in a patient with severe MS, mild to moderate MR, severe MAC, end-stage ischemic cardiomyopathy, and porcelain aorta.[6] In all these cases, the authors adopted a transapical approach to avoid prolonged cardiopulmonary bypass, cardioplegic arrest, and additional atriotomy associated with the conventional exposure of the MV. In this case, physicians attempted to visualize the MV through the LV apex. However, this was difficult and thus precluded safe MV intervention.

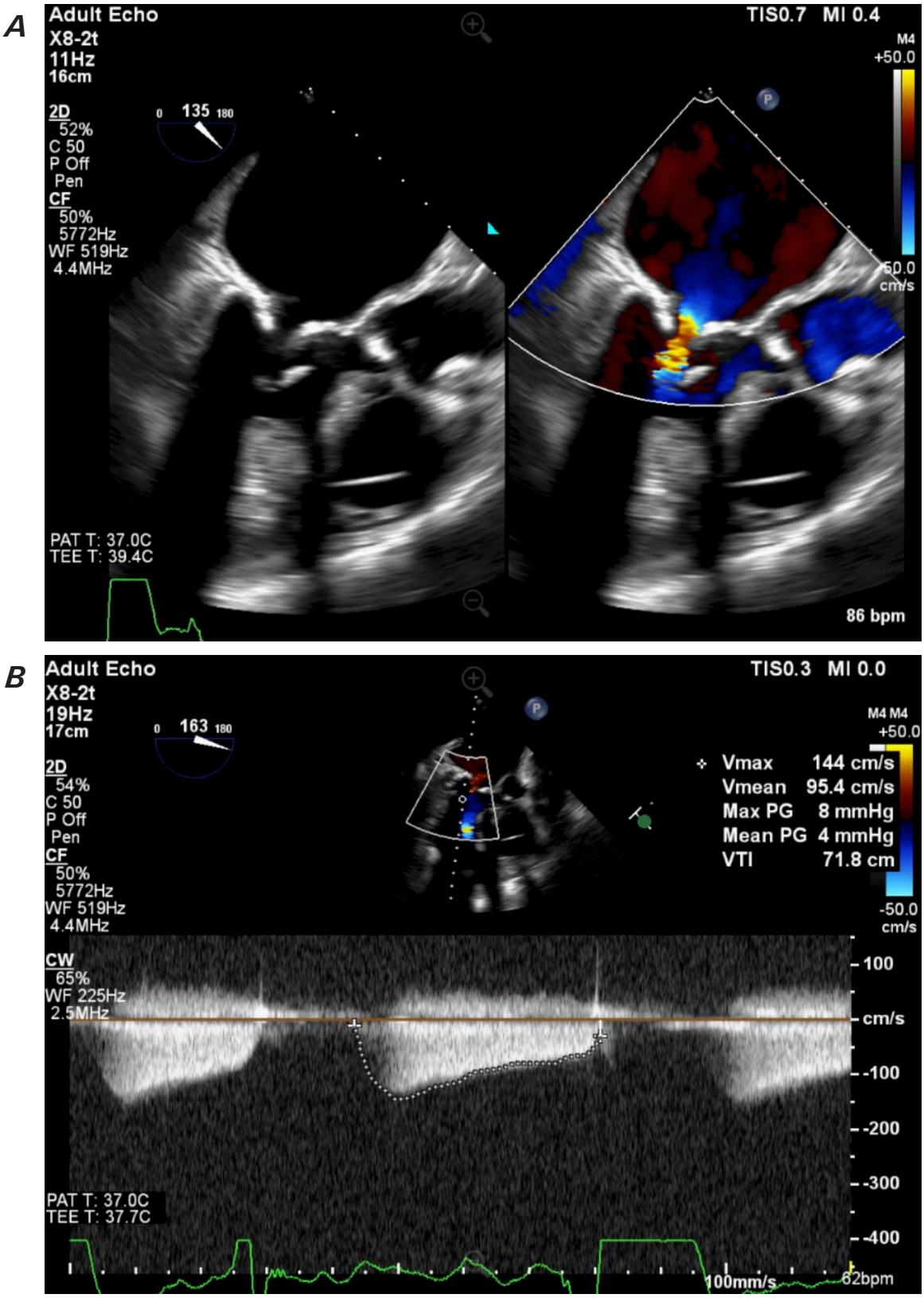

***Fig. 3 A**) Post–cardiopulmonary bypass transesophageal echocardiogram demonstrates flow across the mitral valve in midesophageal long-axis view with color Doppler flow. **B**) Post–cardiopulmonary bypass transesophageal continuous-wave spectral Doppler echocardiogram demonstrates improved gradient across the mitral valve.*

MVA, mitral valve area; PG, pressure gradient; Vmax, maximum velocity; Vmean, mean velocity; VTI, velocity time interval.

The presence of severe circumferential MAC further complicated this case. Surgical MV intervention in the setting of severe MAC is associated with high operative morbidity and mortality.[7] Sewing a prosthetic MV to a calcium bar can lead to substantial paravalvular leak and valve dehiscence and risk injury to vital surrounding structures. Furthermore, annular decalcification, if performed, can weaken the annulus and increase the risk of catastrophic atrioventricular groove disruption. Methods of annular reconstruction to avoid such complications are technically complex and require longer bypass times. In severely hostile MAC that is predominantly stenotic with minimal regurgitation, extra-anatomical bypass of the MV from the left atrium to the LV apex has been reported as a last resort.[8] However, this would not be feasible in the setting of LVAD implantation.

Performing a balloon valvuloplasty with surgical commissurotomy to completely release the stenotic mitral orifice allowed clinicians to avoid MV replacement and potential risks associated with annular decalcification and reconstruction. The initial balloon size was selected based on measurement of the diameter of the MV orifice using 2-dimensional echocardiography. Balloon valvuloplasty was done at the time of open surgery instead of percutaneously because clinicians believed that direct visualization of the MV during surgery allowed safer dilation when circumferential MAC is present. In addition, potential damage to the MV apparatus can be promptly addressed, intra-atrial septal puncture is avoided, and the consequence of possible excessive MR postdilation can be minimized with the LVAD in place. However, in the event of a future relapse of MS, percutaneous balloon valvuloplasty may be the only option given the high risk of repeated surgical intervention.

Conclusion

Open balloon valvuloplasty and surgical commissurotomy are technically feasible for the management of severe rheumatic MS with severe MAC in patients undergoing LVAD implantation, especially when transapical exposure through the LV apex is inadequate. This approach avoids the need for MV replacement and potential risks associated with annular decalcification and reconstruction. Longer follow-up is needed to determine its effectiveness over time.

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