Mitral Valve Replacement for Restenosis After Repeat Percutaneous Mitral Valvuloplasty

Nandita S. Scott, MD, Arthur E. Weyman, MD

Cardiac Unit, Massachusetts General Hospital, Boston, MA

Percutaneous mitral valvuloplasty (PMV) produces good results for symptomatic mitral stenosis or restenosis if valve morphology is suitable. However, complications such as atrial septal defect have severe hemodynamic effects, and repeat PMV is not always appropriate. The patient in this case had already undergone multiple PMVs and was a candidate for valve replacement.
[Rev Cardiovasc Med. *2002;3(3):148–151*]

Key words: Atrial septal defect • Mitral stenosis • Percutaneous mitral valvuloplasty • Restenosis

Percutaneous mitral valvuloplasty (PMV) is considered the procedure of choice for patients with symptomatic mitral stenosis and suitable valve morphology.[1] PMV also produces good results for restenosis and can provide symptomatic relief in up to 90% of cases for many years.[2] However, in some cases, the complications of PMV itself preclude repeat procedures and may require mitral valve replacement. We describe a patient with multiple PMVs producing hemodynamically significant atrial septal defects (ASDs) requiring mitral valve replacement and ASD closure.

History

A 67-year-old woman with a history of rheumatic mitral stenosis had PMV in 1990. Three years after the PMV, her mitral valve area by planimetry was 1.5 cm^2 with a peak gradient of 17 mm Hg and mean gradient of 10 mm Hg. A small ASD with left-to-right flow was noted. The patient remained asymptomatic until 1995, when atrial fibrillation and congestive heart failure developed. Her mitral valve area by planimetry was 1.1 cm^2. A second PMV was performed for restenosis, and the post-procedure mitral valve area was 2.1 cm^2 with a mean gradient of 3 mm Hg. The patient presented in 2001 with NYHA class 3 symptoms presumed secondary to hemodynamically significant mitral stenosis.

In some cases, the complications of PMV itself preclude repeat procedures and may require mitral valve replacement.

Physical Examination

On physical examination the patient appeared comfortable at rest. The heart rate was 80 beats per minute and irregularly irregular, and the blood pressure was 130/80 mm Hg. Her jugular venous pressure was 6 cm H_2O above the sternal angle. Carotid upstroke was normal. On cardiac auscultation, a 2/6 holosystolic and a 1–2/6 diastolic rumble were both heard at the apex. An opening snap was also present. There was no S_3 or S_4. The patient had bilateral lower extremity edema.

Diagnostic Test

On transthoracic echocardiography the mitral valve demonstrated doming with restricted leaflet tip excursion (Figure 1). There was valvular and subvalvular thickening, as well as calcification (mitral valve score = 9). The mitral valve area was 1.1 cm^2, with peak gradient 17 mm Hg and mean gradient 6 mm Hg. There was moderate mitral and tricuspid regurgitation. The right ventricular systolic pressure was estimated at 38 mm Hg by continuous-wave Doppler. The right ventricle was dilated, with diffuse hypokinesis. The interatrial septum had two discrete defects, each measuring approximately 0.5 cm in diameter (Figure 2). There was marked left-to-right shunting between the atria. The mean velocity of flow across one of the defects was 210 cm/s. Using a defect diameter of 0.5 cm, the left-to-right flow across each defect was 2.5 L/min, or 5 L/min for both defects together. The cardiac output at cardiac catheterization was 3.0 L/min. Therefore, the estimated pulmonary-to-systemic flow ratio was 2.7:1.

Management

The diagnostic test confirmed the presence of rheumatic mitral restenosis with increased gradients across the valve. Although previous PMVs had resulted in 5-year symptom-free periods and there was no significant pulmonary hypertension, the procedures had produced

Figure 1. *Parasternal long axis echocardiographic view of mitral valve. During diastole, there is restriction of mitral leaflet opening excursion; the leaflets are markedly thickened and calcified, consistent with rheumatic mitral stenosis.*
LA, left atrium; LV, left ventricle.

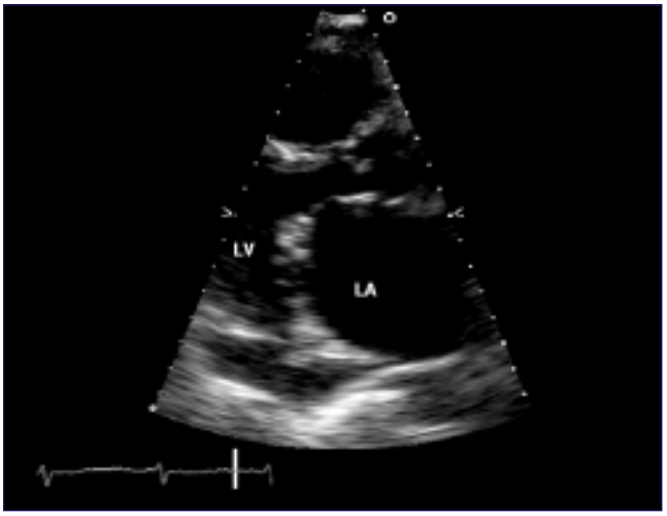
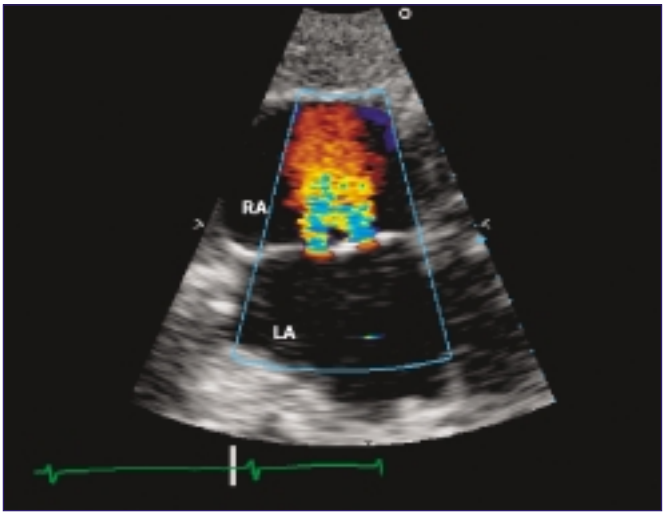


Figure 2. *This subcostal view demonstrates two discrete jets entering the right atrium through the interatrial septum. The atria are markedly dilated.*
LA, left atrium; RA, right atrium.



two ASDs with hemodynamically significant left-to-right shunting. The shunt flow, combined with the moderate tricuspid regurgitation, resulted in right ventricular dysfunction and dilatation.

Although a third PMV was considered, it was felt that this would likely cause greater interatrial shunting and thus was not indicated. The patient underwent mitral valve replacement and surgical closure of the ASDs. She recovered well postoperatively and was discharged.

Discussion

Closed commissurotomy was the original basis of therapy for thickened and fused rheumatic leaflets. Closed surgical commissurotomy was first performed in the 1920s via a transatrial or transventricular approach.[3,4] With the development of cardiopulmonary bypass, open mitral commissurotomy (with direct visualization of the valve) and mitral valve replacement became an alternative procedure. Percutaneous mitral valvuloplasty, developed in the 1980s, is a catheter-based approach in which one or more balloons are inflated within the valve orifice to split the commissures. Open commissurotomy and percutaneous valvuloplasty have similar short- and long-term benefits.[5]

In patients who have a congenital, probe-patent foramen ovale, the procedures are shorter and the incidence of ASDs lower.

Balloon valvuloplasty has obvious benefits over surgery, including greater ease of delivery, elimination of the need for a thoracotomy, and shorter hospital stay. It is considered the procedure of choice for patients with symptomatic mitral stenosis and suitable valve morphology, provided there is no evidence of left atrial thrombus or significant mitral regurgitation.[1] Morphologic features of the mitral valve determined by transthoracic echocardiogram are of value for assessing patient suitability for PMV. A mitral valve score derived from a grading system of leaflet mobility, thickening, subvalvular thickening, and calcification has been developed (Table 1). A score less than 8 is associated with good outcome at PMV.[6]

During percutaneous valvuloplasty, the mitral valve is approached from the left atrium by crossing the interatrial septum; thus, the development of ASDs is an unavoidable complication. In patients who have

Table 1
Mitral Valve Characteristics to Determine Suitability for Percutaneous Mitral Valvuloplasty

Grade	Mobility	Subvalvular Thickening	Valvular Thickening	Calcification
1	Highly mobile leaflet with only leaflet tips restricted	Minimal thickening just below the mitral leaflets	Near normal thickness (4–5 mm)	A single area of increased echo brightness
2	Leaflet mid and base portions have normal mobility	Thickening of chordal structures extending up to one third of the chordal length	Mid-leaflets normal, considerable thickening of margins (5–8 mm)	Scattered area of brightness confined to leaflet margins
3	Valve continues to move forward in diastole, mainly from base	Thickening extends to the distal third of the chords	Thickening extends through the entire leaflet (5–8 mm)	Brightness extending into the mid-portion of the leaflets
4	No or minimal forward movement of the leaflets in diastole	Extensive thickening and shortening of all chordal structures extending down to the papillary muscles	Considerable thickening of all leaflet tissue (>8–10 mm)	Extensive brightness throughout much of the leaflet tissue

Data from Wilkins et al.[6]

a congenital, probe-patent foramen ovale, the procedures are shorter and the incidence of ASDs lower.[7] In most patients the defects are small and close spontaneously. However, of the 738 patients enrolled in the National Heart, Lung, and Blood Institute Balloon Valvuloplasty registry, hemodynamically significant ASDs ($Q_p/Q_s > 1.5$) occurred in 2% of patients treated with the single-balloon and 12% of those treated with the double-balloon technique.[8]

The ASD in patients with mitral stenosis is of greater hemodynamic significance than a similar-sized defect in a patient with a congenital lesion, because the left atrial pressure is much higher. In this case, for example, the left-to-right shunt flow was roughly 5 L/min because of the high pressure gradient and flow velocity between the two atria. In contrast, a defect of similar size with normal pressures would typically result in a shunt with less than half the volume. In addition, when restenosis occurs following PMV, the hemodynamic effect of the defect will increase as left atrial pressure increases. Although the effect of the defect on left atrial pressure should be positive, in that it unloads the atrium and increases effective compliance, the volume load must be borne by the right heart and in this case was presumably primarily responsible for the right ventricular failure (given that there was no significant pulmonary hypertension).

In conclusion, PMV is the procedure of choice for treatment of mitral stenosis or restenosis with suitable valve morphology, because its long- and short-term benefits are similar to those of open commissurotomy. However, in some cases the complications of the procedure itself, such as the creation of ASDs, preclude a repeat procedure, as illustrated in this case review. In the presence of elevated left-sided pressures, an ASD is of greater hemodynamic significance, because it promotes left-to-right shunting. Thus, even an anatomically small defect may require closure to prevent further right-heart dilation and decreased function. The use of percutaneous ASD closure devices in this situation has been described,[9] but it would prevent later passage of catheters across the interatrial septum for repeat PMV and thus limit future therapeutic options for mitral stenosis. ■

References

1. Bonow RO, Carabello B, DeLeon AC Jr, et al. ACC/AHA Guidelines for the Management of Patients with Valvular Heart Disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Patients With Valvular Heart Disease). *J Am Coll Cardiol*. 1998;32:1486–1588.
2. Suri RK, Pathania R, Jha NK, et al. Closed mitral valvotomy for mitral restenosis: experience in 113 consecutive cases. *J Thorac Cardiovasc Surg*. 1996;112:727–730.
3. Cutler EC, Levine SA. Cardiotomy and valvulotomy for mitral stenosis: experimental observations and clinical notes concerning an operated case with recovery. *Boston Med Surg J*. 1923;188:1023–1027.
4. Souttar HS. The surgical treatment of mitral stenosis. *BMJ*. 1925;1:603–606.
5. Farhat MB, Ayari M, Maatouk F, et al. Percutaneous balloon versus surgical closed and open mitral commissurotomy. *Circulation*. 1998;97:245–240.
6. Wilkins GT, Weyman AI, Abascal VM, et al. Percutaneous balloon dilatation of the mitral valve: and analysis of echocardiographic variables related to outcome and the mechanism of dilatation. *Br Heart J*. 1988;60:299–308.
7. Bozat T, Sarokamos C, Koca VV, Akkaya VV. The feasibility of using patent foramen ovale during mitral balloon valvuloplasty. *J Invas Cardiol*. 1998;10:545–547.
8. The National Heart, Lung and Blood Institute Balloon Valvuloplasty Registry Participants. Multicenter experience with balloon mitral commissurotomy: NHLBI Balloon Valvuloplasty Registry report on immediate and 30-day follow-up results. *Circulation*. 1992;85:448–461.
9. Zanchetta M, Onorato E, Rigatelli G, et al. Use of Amplatzer septal occluder in a case of residual atrial septal defect causing bidirectional shunting after percutaneous Inoue mitral balloon valvuloplasty. *J Invas Cardiol*. 2001;13:223–226.

Main Points

- Percutaneous mitral valvuloplasty is the procedure of choice in patients with symptomatic mitral stenosis and suitable valve morphology.
- The benefits of PMV are similar to those of open commissurotomy.
- PMV is an easier procedure than surgery, makes thoracotomy unnecessary, and requires a shorter hospital stay.
- Evidence of left atrial thrombus and significant mitral regurgitation are contraindications for PMV.
- PMV creates an atrial septal defect, which in the presence of mitral stenosis has greater hemodynamic effects than with normal pressure and may require valve replacement and defect repair.