Percutaneous mitral balloon valvotomy (PMV) has been accepted as an alternative to surgical mitral commissurotomy in the treatment of patients with symptomatic rheumatic mitral stenosis. Previous studies have demonstrated that PMV produces good immediate and long-term follow-up results in a selected group of patients with mitral stenosis.\textsuperscript{1-4}

Hemodynamic and clinical improvement is achieved in the majority of patients with rheumatic mitral stenosis. PMV resulted in a significant decrease in mitral gradient and an increase in mitral valve area with minimal morbidity and mortality. The majority of patients have a marked clinical improvement, and the hemodynamic and clinical improvement produced by PMV persist at long-term follow-up.\textsuperscript{3-4} On the other hand, surgical mitral commissurotomy has been used successfully for many years to treat patients with mitral stenosis. The results of closed or open surgical mitral commissurotomy have demonstrated favorable immediate and long-term hemodynamic and symptomatic improvement in selected patients with rheumatic mitral stenosis.

See p 245

Interpretation of long-term clinical follow-up of patients undergoing percutaneous mitral balloon valvuloplasty as well as their comparison with surgical commissurotomies series are confounded by heterogeneity in the patient population. Only few randomized studies have compared the results of PMV with those of surgical commissurotomy. In this issue of the journal, Farhat et al\textsuperscript{5} reported the results of a randomized trial designed to compare the immediate and long-term results of double-balloon PMV versus those of open and closed surgical mitral commissurotomy in a cohort of patients with severe rheumatic mitral stenosis. These patients were, from the clinical and morphological point of view, optimal candidates for both PMV and surgical commissurotomy (closed or open) procedures as demonstrated by a mean age of $<$30 years, absence of mitral valve calcification on fluoroscopy and two-dimensional echocardiography, and an echocardiographic score $\leq$8 in all patients. Their results demonstrate that the immediate and long-term results of PMV are comparable to those of open mitral commissurotomy and superior to those of closed commissurotomy. The hemodynamic improvement, in-hospital complications, long-term restenosis rate, and need for reintervention were superior for the patients treated with either PMV or open commissurotomy than for those treated with closed commissurotomy.

Patient selection is fundamental in predicting immediate outcome and follow-up results of PMV and surgical commissurotomy procedures. In addition to clinical examination, echocardiographic evaluation of the mitral valve and fluoroscopic screening for valvular calcification are the most important steps in patient selection for successful outcome. The evaluation of candidates for PMV requires a precise evaluation of both valve morphology and function for preprocedure decision making and follow-up of the patients. Two-dimensional echocardiography is currently the most widely used noninvasive technique for the evaluation of the morphological characteristics of the mitral valve, subvalvular apparatus, and the valve annular size. An important predictor of the immediate and long-term results of PMV is a morphological echocardiographic score developed at the Massachusetts General Hospital.\textsuperscript{6} In this score, leaflet rigidity, leaflet thickening, valvular calcification, and subvalvular disease are each scored from 1+ to 4+, yielding a maximum total echocardiographic score of 16. A higher score would represent a heavily calcified, thickened, and immobile valve with extensive thickening and calcification of the subvalvular apparatus. Among the four components of the echocardiographic score, valve leaflet thickening and subvalvular disease correlate the best with the increase in mitral valve area produced by PMV. An inverse relation between the increase in mitral valve area produced by PMV and the echocardiographic score has been demonstrated.\textsuperscript{3-6} A similar relation exists between the echocardiographic score and the percentage of patients obtaining a good result from PMV defined as a post-PMV mitral valve area of $\geq1.5$ cm\textsuperscript{2}, without $\geq2$ grade increase in the severity of mitral regurgitation and without left-to-right shunt of $\geq1.5:1$ across the interatrial septum. Patients with lower echocardiographic scores have a higher likelihood of having a good outcome from PMV with minimal complications and a hemodynamic and clinical improvement that persist at long-term follow-up.\textsuperscript{3} Long-term follow-up studies have shown that patients with echocardiographic scores $\leq8$ have a significantly greater survival and freedom from combined events (death, mitral valve replacement, redo PMV, and New York Heart Association class III or IV) than those patients with echocardiographic scores $>8$.\textsuperscript{3}

PMV complications are low and occur more frequently in patients with echocardiographic scores $>8$. Mortality and morbidity with PMV is low and similar to surgical commissurotomy. In the series from the Massachusetts General Hospital of 734 patients undergoing PMV, there was a 0.6%
mortality and a 1.3% incidence of thromboembolic episodes and stroke. Pericardial tamponade occurred in 0.8% of cases in this series. Tamponade occurs more frequently from transeptal catheterization and rarely from ventricular perforation. Severe mitral regurgitation (4+) occurred in 3% of the patients, with some of them requiring in-hospital mitral valve replacement. An increase in mitral regurgitation ≥2 grades occurred in 12.5% of patients. It is well tolerated in most patients, and more than half of them have less mitral regurgitation at follow-up cardiac catheterization. Effective balloon dilating area normalized by body surface area (EBDA/BSA) is the only predictor of increased mitral regurgitation with PMV. More recently, an echocardiographic score that predicts post-PMV mitral regurgitation has been proposed. This score evaluates uneven distribution of thickness in the anterior and the posterior leaflets, degree of commissural disease, and subvalvular disease, with each component graded 0 to 4. The total mitral regurgitation echo score is significantly higher in patients who develop severe mitral regurgitation. PMV is associated with a 15% incidence of left-to-right shunt immediately after the procedure. The pulmonary-to-systemic flow ratio is <1.5:1 in the majority of the patients. The incidence of left-to-right shunt through the atrial communication is greater in patients with echocardiographic scores >8.

The reliability of the echocardiographic score for predicting results of PMV is not optimal because results of the PMV are also related to other factors such as the presence of fluoroscopic mitral valve calcification, the age and sex of the patient, the presence of atrial fibrillation, pre-PMV mitral regurgitation and pulmonary hypertension, a history of previous surgical commissurotomy, the technique of PMV (double balloon versus Inoue), the severity of mitral stenosis before PMV, and the ratio of EBDA/BSA.

The presence of fluoroscopic visible calcification on the mitral valve is another important factor that influences the success of PMV. Patients with heavily calcified mitral valves have a poorer immediate outcome, as reflected in a smaller post-PMV mitral valve area. The long-term survival and event-free survival are significantly lower for patients with calcified mitral valves than for those with uncalcified valves. Furthermore, the survival and event-free survival curves become worse as the severity of valvular calcification becomes more severe. These findings are in agreement with several follow-up studies of surgical commissurotomy, which demonstrated that patients with calcified mitral valves had a significantly poorer survival compared with those patients with uncalcified valves.

Age is another important factor determining the immediate and long-term outcomes of PMV. We have previously reported a 46% success rate in patients ≥65 years. In this population, independent predictors of success included a lower echocardiographic score, lower pre-PMV NYHA functional class, and a larger pre-PMV mitral valve area. A low echocardiographic score was the independent predictor of survival, and the lack of mitral valve calcification was the strongest predictor of event-free survival.

The presence of atrial fibrillation is adversely related to the outcome of PMV. Patients in atrial fibrillation have clinical and morphological characteristics associated with inferior results after PMV such as older age, higher incidence of echocardiographic scores >8, and history of previous surgical commissurotomy. In patients with atrial fibrillation, PMV resulted in inferior immediate and long-term outcomes, as reflected in a smaller post-PMV mitral valve area and a lower event-free survival at long-term follow-up. In this group of patients with atrial fibrillation, post-PMV mitral regurgitation grade ≥3, echocardiographic score >8, and pre-PMV NYHA class IV are independent predictors of combined events at follow-up.

PMV also has been shown to be a safe procedure in patients with previous surgical mitral commissurotomy. Although a good immediate outcome is frequently achieved in these patients, event-free survival is greater among those patients without previous commissurotomy. However, when patients are carefully selected through the use of an echocardiographic score ≤8, the immediate outcome and long-term follow-up results are excellent and similar to those seen in patients without a history of previous surgical commissurotomy.

There is no unique technique of percutaneous mitral balloon valvuloplasty. Most of the techniques of PMV require transeptal left heart catheterization and use of the antegrade approach. Antegrade PMV is more frequently accomplished with either the double-balloon or the Inoue techniques. There is controversy as to whether the double-balloon technique versus the Inoue technique of PMV provides superior immediate and long-term results. Compared with the Inoue technique, the double-balloon technique results in larger mitral valve area and lesser degree of severe mitral regurgitation after PMV, particularly in patients with echocardiographic scores ≤8. However, despite the difference in immediate outcome between both techniques, there are no significant differences in survival, event-free survival, and restenosis at long-term clinical follow-up.

Comparison between PMV and surgical commissurotomy techniques is difficult in view of differences in patient clinical and mitral valve morphology characteristics among different series. Most surgical series have involved a younger population with optimal mitral valve morphology (pliable with no calcification and no evidence of subvalvular disease). Differences in age and valve morphology may account for the lower survival and event-free survival of PMV from United States and Europe. For example, in the series from the Massachusetts General Hospital, 497 patients with echocardiographic scores ≤8 and a mean age of 51±14 years have an 85% survival and a 45% event-free survival at 8-year follow-up. In contrast, 237 patients with echocardiographic scores >8 and a mean age of 63±14 years have a 55% 8-year survival, and only 20% of them were free of combined events at 8-year follow-up.

A larger number of patients with higher echocardiographic scores and mitral valve calcification may account for the 5-year 76% survival and a 51% combined event-free survival reported by Cohen et al in a group of 146 patients undergoing PMV. Furthermore, 39% of the patients in this later series were considered to be at high surgical risk because of the presence of important coexisting conditions or advanced age.

On the contrary, survival and event-free survival after PMV in optimal patients for this technique appear to be similar to those reported after surgical mitral commissurotomy. In the
series from the Massachusetts General Hospital, 202 optimal candidates defined as patients <65 years old, in normal sinus rhythm, with echocardiographic scores ≤8, without mitral valve calcification, and with pre-PMV mitral regurgitation ≤1 grade had an excellent immediate and long-term outcome as reflected in a 97% survival and 76% event-free survival at a median follow-up of 61 months.

In patients with optimal mitral valve morphology, surgical mitral commissurotomy has favorable long-term hemodynamic and symptomatic improvement. Similarly to PMV, patients with advanced age, calcified mitral valves, and those with atrial fibrillation had poorer survival and event-free survival after surgical commissurotomy. Several studies have compared the immediate and early follow-up results of PMV versus closed surgical commissurotomy in optimal patients for these techniques. The results of these studies have been controversial, showing either superior outcome from PMV12,13 or no significant differences between both techniques.14-16 Patel et al.12 randomized 45 patients with mitral stenosis and optimal mitral valve morphology to surgical commissurotomy and to PMV. He demonstrated a larger increase in mitral valve area with PMV (2.1±0.7 versus 1.3±0.3 cm²). Shrivastava et al13 compared the results of single-balloon PMV, double-balloon PMV, and closed surgical commissurotomy in three groups of 20 patients each. The mitral valve area after intervention was larger for the double-balloon technique of PMV. Postintervention valve areas were 1.9±0.8, 1.5±0.4, and 1.5±0.5 cm² for the double-balloon, the single-balloon, and the closed surgical commissurotomy techniques, respectively. On the other hand, Arora et al.14 randomized 200 patients with a mean age of 19±7 years and mitral stenosis with optimal mitral valve morphology to PMV and to closed mitral commissurotomy. Both procedures resulted in similar postintervention mitral valve areas (2.39±0.9 versus 2.2±0.9 cm² for the PMV and the mitrval commissurotomy groups, respectively) and no significant differences in event-free survival at a mean follow-up period of 22±6 months. Restenosis documented by echocardiography was low in both groups, 5% in the PMV group and 4% in the closed commissurotomy group. Turi et al.15 randomized 40 patients with severe mitral stenosis to PMV and to closed mitral commissurotomy. The postintervention mitral valve areas at 1 week (1.6±0.6 versus 1.6±0.7 cm²) and 8 months (1.6±0.6 versus 1.8±0.6 cm²) after the procedures were similar in both groups. Reyes et al.16 randomized 60 patients with severe mitral stenosis and favorable valvular anatomy to PMV and to surgical commissurotomy. They reported no significant differences in immediate outcome, complications, and 3.5-year follow-up between both groups of patients. Improvement was maintained in both groups, but mitral valve areas at follow-up were larger in the PMV group (2.4±0.6 versus 1.8±0.4 cm²).

Although these initial randomized trials results of PMV versus surgical commissurotomy are encouraging and favor PMV for the treatment of patients with rheumatic mitral stenosis with suitable mitral valve anatomy, there is a need for long-term follow-up studies to define more precisely the role of PMV in these patients. The report of Farhat et al.8 provides this long-term follow-up in a cohort of optimal candidates for PMV and clearly establishes the role of PMV in the treatment of these patients. The immediate and long-term results of PMV in these patients are similar to those obtained with open surgical commissurotomy and significantly superior to those obtained with closed surgical commissurotomy. The postintervention mitral valve areas achieved with PMV were similar to the one obtained after open surgical commissurotomy (2.5±0.5 versus 2.2±0.4 cm²) but larger than those obtained after closed commissurotomy. These initial changes resulted in an excellent long-term follow-up in the group of patients treated with PMV, which was comparable with the open commissurotomy group and superior to the closed commissurotomy group. Because open commissurotomy is associated with thoracotomy, need for cardiopulmonary bypass, higher cost, longer length of hospital stay, and a longer period of convalescence, PMV should be the procedure of choice for the treatment of these patients.

The inferior results of closed mitral commissurotomy presented by Farhat et al.8 are in disagreement with previous studies showing no significant differences in immediate and follow-up results between PMV and closed surgical mitral commissurotomy.14-16 However, as pointed out by Farhat, the increase in mitral valve area after closed commissurotomy is not uniform and often unsatisfactory. Regardless of this controversy, the report of Farhat et al provides further support to the concept that PMV should be the procedure of choice for the treatment of patients with rheumatic mitral stenosis who are from the clinical and morphological point of view optimal candidates for PMV.

References


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Farewell to Surgical Mitral Commissurotomy for Many Patients
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