Percutaneous Techniques for Mitral Valve Disease

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KEYWORDS

• Mitral valve • Transcatheter • Valvular heart disease
• Mitral regurgitation

THE MITRAL VALVE

To appreciate the mechanistic role of current percutaneous therapies, it is important to understand the anatomic and functional properties of the mitral valve apparatus. The mitral valve is complex anatomic structure. Its proper function strictly depends on the structural and functional integrity of its individual components, which include the mitral valve annulus, leaflets, chordae tendineae, and subvalvular apparatus, including the papillary muscles and left ventricular wall (**Fig. 1**). Derangement of one or more these components characteristically typically results in flow-limiting (ie, stenosis) or regurgitant valvular dysfunction. In either case, a thorough appreciation of the disease mechanisms is essential for the conceptualization and development of alternative, less-invasive, percutaneous mitral valve therapies.

MITRAL STENOSIS—PERCUTANEOUS THERAPIES

Since its introduction in 1984 by Inoue and colleagues,[1] percutaneous mitral balloon valvuloplasty (PMV) has been used successfully as an alternative to open or closed surgical mitral commissurotomy in patients with symptomatic rheumatic mitral stenosis.[2–14] PMV is safe and effective and results in excellent immediate hemodynamic outcome, low complication rates, and improved clinical benefit. Sustained clinical and hemodynamic improvements have been previously reported and are similar to those of surgical mitral commisssurotomy. Nevertheless, because of the less-invasive nature of PMV, currently it is considered the preferred therapy for relief of mitral stenosis in symptomatic patients with rheumatic heart disease.

Proper patient selection is a fundamental step when predicting the immediate results of PMV (**Fig. 2**). Candidates for PMV require precise assessment of mitral valve morphology.[1–5,15] The echocardiographic score (Echo-Sc) is currently the most widely used method for predicting PMV outcome.[7–11] Leaflet mobility, leaflet thickening, valvular calcification, and subvalvular disease are each scored from 1 to 4, yielding a maximum total Echo-Sc of 16.[14] An inverse relationship exists between the Echo-Sc and PMV success.

Both-Immediate, and intermediate follow-up studies have shown that patients with Echo-Sc less than or equal to 8 have superior results and significantly greater survival and combined event-free survival than patients with Echo-Sc greater than 8.[6,9,10] Long-term follow-up results, however, are scarce,[12,13,16] and although earlier studies have reported that PMV results in good immediate hemodynamic and clinical improvement in most patients with mitral rheumatic stenosis,[6–14,16] superior long-term follow-up results are seen in a selected group of patients with Echo-Sc less than or equal to 8. The authors have recently reported other clinical and morphologic predictors of long-term PMV success (**Fig. 3**) that include pre-(mitral valve area, history of previous surgical commissurotomy, age, and mitral

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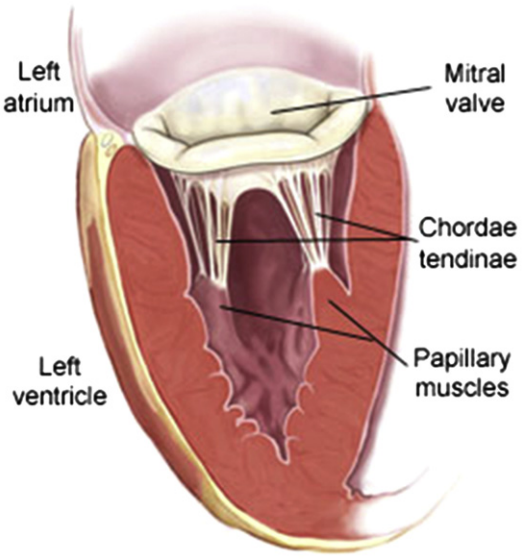

Fig. 1. The mitral valve apparatus.

regurgitation [MR]) and post-PMV variables (MR $\geq$3 and pulmonary artery pressure), that may be used in conjunction with the Echo-Sc to further optimally identify candidate patients for PMV.[17,18]

Percutaneous Mitral Balloon Valvuloplasty Technique

PMV is more frequently performed using the double-balloon (**Fig. 4**) or the Inoue single-balloon technique (**Fig. 5**).[1,19–22] In either case, right and left heart pressure measurements, cardiac output, and oxygen saturation determinations should be routinely performed before and after PMV. The mitral valve area (MVA) is calculated with the Gorlin formula. Left ventriculography is performed before and after PMV to assess the severity of MR using Sellers' classification. The effective balloon-dilating area by used is calculated using the standard geometric formulas normalized to body surface area.[19]

There has been some controversy as to whether or not the double-balloon or Inoue technique provides superior immediate and long-term results. The authors have reported that the double-balloon technique results in larger post-PMV mitral valve area and a lower incidence of severe post-PMV MR.[22] No significant differences in event-free survival at long-term follow-up between the two techniques were observed, however. Thus, the Inoue and the double-balloon techniques seem equally effective techniques of PMV. Failure rates of PMV are variable (1% to 15%) and highly dependent on operator experience. PMV-related morbidity and mortality are low and similar to surgical commissurotomy. It is estimated that the PMV procedural mortality rate ranges between 0% and 3%. Hemopericardium however may be seen in up to 12% of cases. Systemic embolization has been reported in 0.5% to 5% of cases. In spite of this, one of the most concerning complications of PMV is the development of severe MR after balloon inflation which occurs

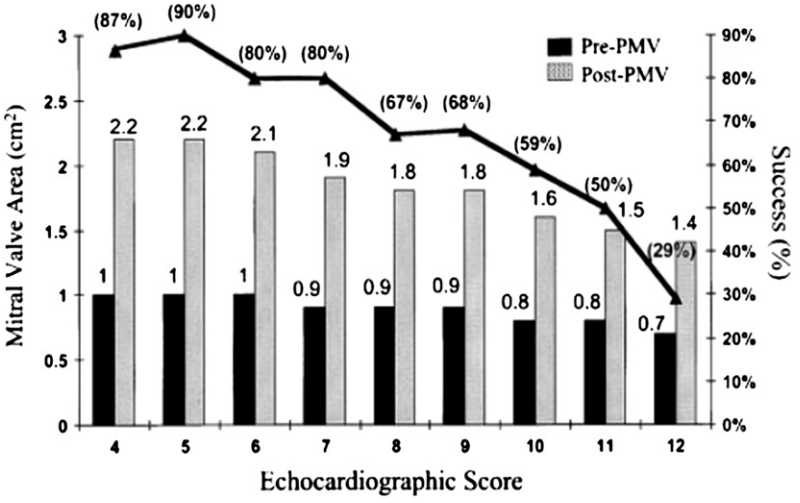

Fig. 2. Relationship between the Echo-Sc and changes in mitral valve area after PMV (*bar graph*) and relationship between the Echo-Sc and PMV success (*line with filled triangles*). Numbers at the top of rectangular bars represent mean mitral valve areas before (*black bars*) and after (*shaded bars*) PMV for each Echo-Sc. Percentages in parentheses represent PMV success rate at each Echo-Sc. (*From* Palacios IF, Sanchez PL, Harrell LC, et al. Which patients benefit from percutaneous mitral balloon valvuloplasty? Prevalvuloplasty and postvalvuloplasty variables that predict long-term outcome. Circulation 2002;105(12):1465–71; with permission.)