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EDITORIAL COMMENT

The Interventional Cardiologist and Structural Heart Disease

The Need for a Team Approach*

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There has been an explosion in the field of interventional cardiology since Andreas Gruentzig performed the first percutaneous transluminal coronary angioplasty more than 30 years ago. With the development of a multitude of steering wires, balloons, rotablators, and stents, percutaneous coronary intervention (PCI) can now be performed in nearly any patient with coronary artery disease—"flying solo" by the interventionalist. The interventional cardiologist has now entered into treatment of structural heart disease. However, as opposed to therapy of coronary artery disease, catheter-based therapy of structural heart disease requires a team approach, with the interventionalist and a noninvasive cardiovascular imager collaborating to achieve optimal success.

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In patients with coronary disease, it is the invasive cardiologist who obtains and interprets the images that determine suitability for PCI. High-resolution digital imaging, with 2- and 3-dimensional coronary mapping create an excellent road map for the interventional procedure. Thus, all information required for analysis and performance of a PCI is under the control of the interventional cardiologist. Treatment of structural heart disease is markedly different, as the conventional tools of the invasive cardiologist (fluoroscopy and hemodynamic pressure measurements) are inadequate in this therapeutic arena. Direct imaging of valvular and myocardial structures is required, and thus the interventionalist cannot "go it alone."

Percutaneous mitral balloon valvotomy (PMBV) was 1 of the first successful catheter-based therapies for structural heart disease and has now become the procedure of choice for selected patients with mitral stenosis. It is essential in this procedure to have the team approach of the interventionalist and the noninvasive imager. Not only is a targeted echocardiogram of critical importance to select candidates for PMBV, but simultaneous echocardiography also is of great utility to guide the procedure and assess results. Although the latter is not necessarily done by all laboratories that perform PMBV, this team approach is certainly utilized by "centers of excellence." Optimal results require not only a highly experienced interventionalist, but also a dedicated, knowledgeable cardiovascular imager.

During the initial evaluation of a patient being considered for possible PMBV, it is important to determine the suitability for valvotomy using specific information from echocardiography (1). The current assessment of valve morphology used by many laboratories is a "mitral valve score," which incorporates valve mobility, valve calcification, valve thickening, and the degree of subvalvular fusion (2). However, the final decision on whether to proceed with PMBV should not be based only upon a single number. Inherent in the evaluation is the understanding that the mechanism of decreasing gradient and increasing the mitral valve area by PMBV is commissural splitting (3). Thus, an important factor in determining the suitability of the valve for PMBV is the appearance of the commissures, assessed by a 2-dimensional echocardiographic short-axis view. The presence or absence of severe calcification of 1 or both commissures is an inde-

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pendent determinate of acute success during the procedure as well as for the long-term outcome (4). The emphasis on directly examining the commissures may extend treatment to some patients with unfavorable scores (e.g., severe leaflet calcification and decreased mobility without severe calcification of the commissures). Other patient subsets whose results may not be predicted by a simple score include: 1) the elderly patient with nonrheumatic mitral stenosis caused by annular calcification encroaching into the base of the mitral valve leaflet; and 2) the patient with severe mitral inflow obstruction due to severe subvalvular fusion and little commissural fusion; neither of these patient subsets should undergo PMBV. A full understanding of the morphologic features and the effect of PMBV on the entire mitral valve apparatus is thus required by both a noninvasive echocardiographer and the interventionalist to determine which patients should be considered for PMBV.

Once the decision has been made to proceed with PMBV, echocardiography during the procedure is of great value. In some centers, catheter manipulation is performed primarily under fluoroscopic guidance, which provides only indirect information. Simultaneous echocardiography (transthoracic or transesophageal echocardiography or intravascular ultrasonography) will directly show the relationship of the catheter to myocardial structures, and thus will aid in optimizing the results of the procedure. In patients with distorted anatomy due to enlarged left atrium, echocardiography can be used to ensure that the catheter crosses the level of the fossa ovalis. Not only does this avoid potential complications but also a transseptal puncture through the muscular portion of the septum may result in difficult manipulation of the balloon catheter. Echocardiography is useful when directing the catheter across the mitral valve, as the balloon initially tends to position at the lateral annulus in the left atrium. The retraction and counterclockwise rotation of the catheter required to cross the mitral valve is not intuitive based on fluoroscopy but is easily visualized by echocardiography. The echocardiogram can be used to avoid the complications that occur when a catheter is placed directly into the subvalvular apparatus and assures that the balloon is properly seated across the mitral valve, which might not be evident using fluoroscopy alone. Finally, hemodynamic evaluation of transmitral gradient and severity of mitral regurgitation is easily performed by Doppler echocardiography, more accurately than by catheterization hemodynamics.

The Inoue balloon has now made it possible to perform sequentially larger inflations across the mitral valve during the procedure. One of the major unanswered questions during a PMBV procedure is "when to stop"; e.g., what is the optimal size of the balloon inflation? The optimal balloon inflation size will vary depending not only upon the patient's size but also upon the valve morphology. The conventional approach in most catheterization laboratories is to sequentially increase the balloon size until there has been a pre-determined reduction in gradient or increase in mitral valve area. However, if this approach alone is followed, there may be some patients in whom severe mitral regurgitation will develop and others who will have a suboptimal result.

Again, one needs to return to the basic concept that the mechanism of successful PMBV is opening the fused commissures (Fig. 1) The article by Messika-Zeitoun et al. (5) in this issue of *iJACC* provides important outcome data on the value of commissural splitting assessed by echocardiography. In this large observational study of 875 patients, those with good immediate PMBV results (mitral valve area $>$1.5 cm2 and no significant regurgitation) were divided into 3 groups based upon the degree of residual commissural fusion after the procedure. At 10 years, two-thirds of the patient population had excellent outcomes (survival free of death, mitral surgery, or repeat dilation in patients with New York Heart Association functional class I to II). However, the 10-year rate of a good functional result was 76%, 57%, and only 39%, respectively, according to complete opening of 2, 1, or neither commissure. These results, which come from a highly experienced team of noninvasive and invasive cardiologists, emphasize the importance of directly assessing the commissures at the time of the PMBV. Incorporation of all variables (status of commissures, valve morphology, transmitral gradient, left atrial pressure, age, and activity level of patient) are necessary for joint decisions by the "team" to obtain optimal results from PMBV.

Interventional cardiology is becoming its own specialty and rapidly separating itself from the rest of cardiovascular medicine, as evidenced by its own subspecialty boards, separate subspecialty meetings, and now even different subspecialty journals (*JACC: Cardiovascular Interventions* and *JACC: Cardiovascular Imaging*). However, if an interventionalist wishes to enter into the arena of the treatment of structural heart disease, it is of great importance that a "team" be formed with the clinician and

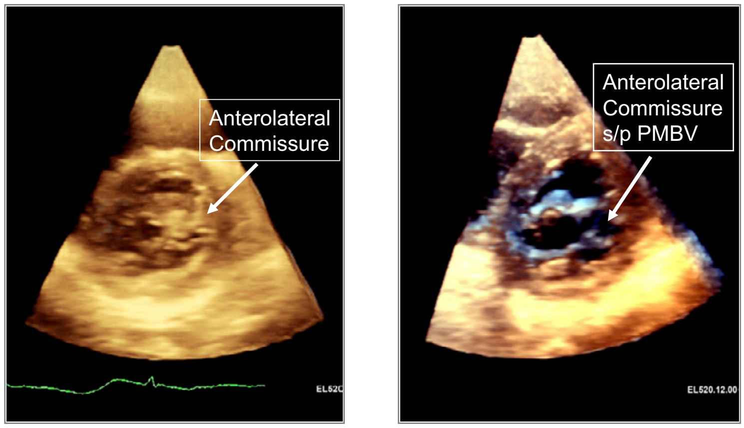

Figure 1. Mechanism of Percutaneous Mitral Balloon Valvotomy

The mechanism of percutaneous mitral balloon valvotomy is the splitting of fused commissures. **(Left)** Parasternal short-axis view from a 3-dimensional echocardiogram illustrating asymmetric fusion of the anterolateral commissure. **(Right)** Complete opening of the fused anterolateral commissure after successful percutaneous mitral balloon valvuloplasty (PMBV). This results in a lowering of the diastolic gradient and improvement in mitral valve area. s/p = status post.

noninvasive cardiovascular imager. Acquisition and interpretation of cardiac imaging may be outside the scope of many interventional cardiologists and outside the capabilities of most catheterization laboratories. Thus, a well-functioning team for diagnosis and treatment of structural heart disease may need to be designed and implemented on top of existing resources—but in the end, that is best for optimal patient care and safety.

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