GEOMETRIC DISTORTION OF THE MITRAL VALVE APPARATUS IN ISCHEMIC MITRAL REGURGITATION: SHOULD WE REALLY

FORFEIT THE OPPORTUNITY FOR A COMPLETE REPAIR?

To the Editor:

Badhwar and colleagues¹ present in the *Journal* a new pathoanatomic approach for the treatment of secondary ischemic mitral regurgitation (IMR) highlighting the importance of geometric alterations in the mitral valve (MV) apparatus. The classification is intended to guide the cardiologist and cardiac surgeon in individualizing the percutaneous or surgical intervention performed.¹

The primary cause of IMR is distortion of 3 geometric measures of the MV apparatus, which are (1) dilatation of the mitral annular anteroposterior diameter, (2) increase in the interpapillary muscle distance, and (3) an increase in the MV tenting area or volume. In the absence of severe left ventricle (LV) dilatation, and in the presence of viable myocardium (>5 myocardial segments), LV reverse remodeling after coronary revascularization results in an improved geometry of the MV apparatus and amelioration of the IMR in 40% to 50% of patients.² When electing to intervene surgically on moderate to severe IMR, chordae-sparing valve replacement or undersized annuloplasty ring repair is performed. At 2-year follow-up, however, approximately 60% of patients with repairs have recurrent MR, and those who have undergone chordae-sparing valve replacement have less LV reverse remodeling than those with a durable MV repair.³

The alternative to conventional surgery in patients at high or prohibitive risk is the percutaneous edge-to-edge repair (MitraClip; Abbott Vascular, Santa Clara, Calif), which was compared with medical therapy in the Cardiovascular Outcomes Assessment of the MitraClip Percutaneous Therapy (COAPT) and Percutaneous Repair With the MitraClip Device for Severe Functional/Secondary Mitral Regurgitation (MITRA-FR) randomized trials.^{4,5} Although no benefit was observed in MITRA-FR, MitraClip therapy in COAPT at 2-year follow-up was

FIGURE 1. The zone of ischemic mitral valve subject to traction of chordae tendineae. Necrosis of the myocardium adjacent to the posteromedial papillary muscle can exert traction, causing elongation and rupture of the chordae attached to the posteromedial commissure or to an adjacent P3 or A3 scallop with ischemic mitral valve prolapse (black highlighting). AC, Anterior commissure; PC, posterior commissure.

associated with 48%, 38%, and 41% reductions in heart failure hospitalizations, all-cause mortality, and cardiovascular mortality, respectively (all $P < .01$). Moderate or greater IMR recurred in 5% and 50% of MitraClip patients in COAPT and MITRA-FR at 1-year, respectively, underscoring the need for careful patient selection.⁶ Deserving of further consideration are the roles that tethering shape, the myocardial region previously infarcted, and the relationship between scar tissue formation and myocardial wall motion recovery play in the development of IMR and in the response to intervention.

First, the difference in vector forces in symmetric versus asymmetric tethering is overlooked as a criterion that helps gauge the success of planned MV intervention.^{3,7} Asymmetric posterolateral tethering and symmetric apical tethering are rarely corrected by revascularization alone, requiring concomitant MV replacement, repair alone, or repair combined with subvalvular intervention.⁷⁻¹⁰ Second, LV reverse remodeling is dependent on revascularization of the myocardial territories supplied by the right and left circumflex coronary arteries, in which percutaneous or surgical intervention favors improvement in IMR.¹¹ In cases of nonviable or scarred myocardium, combined ring annuloplasty and subvalvular repair should be strongly considered if the MV is repaired.^{8,10} We have also observed that necrosis of the adjacent myocardium can exert traction on the posteromedial papillary muscle, causing elongation and rupture of the chordae supplying the A3 and P3 scallops or posteromedial commissure, with ischemic MV prolapse that is often underappreciated (Figure 1).¹² Finally, similar to ring annuloplasty, the

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MitraClip does not correct the underlying LV substrate responsible for IMR. Focusing on the subvalvular apparatus and on the continued development of less invasive surgical and percutaneous approaches to addressing the MV unit is of paramount importance.¹³⁻¹⁵

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REPLY: PATHOANATOMIC CONSIDERATIONS FOR ISCHEMIC MITRAL REGURGITATION: HIGHLIGHTING THE

IMPORTANCE OF ANATOMIC AND PHYSIOLOGIC ASYMMETRY

Reply to the Editor:

Badhwar and colleagues¹ have proposed a pathoanatomic classification for ischemic mitral regurgitation (IMR) that categorizes degrees of annular dilatation, ejection fraction, and leaflet tethering; assigns grades of pathology; and aims to simplify and guide open surgical and catheter-based interventions. To that end, I have highlighted² a recent concept proposed by Grayburn and colleagues³ of further distinguishing physiologic or nonphysiologic (disproportionate) IMR.

The comments of Nappi and associates^{4,5} help us to refocus on anatomy and the variable presentations of IMR, including the effect of revascularization. This group,^{4,5} along with others,^{6,7} have noted that distinguishing symmetric from asymmetric posterolateral tethering, with the associated differential vectors and inter-papillary muscle distance; infarction of myocardium adjacent to the papillary muscle; the shape as well as the size of the tethering area (>3 cm²); the tenting height (>11 mm); and the left ventricular end-diastolic dimensions are important in selecting more individualized, effective, and durable therapies for IMR. They point out that therapies that focus on the mitral valve annulus alone (for example, an undersized annuloplasty ring) or only on the valve (for example, either MitraClip [Abbott Vascular, Santa Clara, Calif] or edge-to-edge repair) and that fail to address the asymmetric subvalvular and subannular tethering are associated with much higher longer-term failure rates. Conversely, although series of subvalvular repair are small, it appears that such approaches can be performed safely with no added mortality and that they may enhance the longer-term durability of IMR interventions. In meta-analyses, although New York Heart Association functional classes were similar, the incidence of greater than moderate mitral regurgitation and the mitral regurgitation grade were significantly lower (relative risk,