Have We Found the Surgical Solution for Ischemic Mitral Regurgitation?  

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The article by deVarennes et al in the current issue of *Circulation* details the outcomes in 44 patients with severe (4+*) Carpentier type IIIb ischemic mitral regurgitation undergoing mitral valve repair consisting of posterior leaflet extension with bovine pericardium, coupled with remodeling annuloplasty, with or without coronary revascularization.1 Dissatisfied with the long-term results of annuloplasty alone, this group added posterior leaflet extension in an attempt to improve long-term mitral valve competency in this complex group of patients. Chronic ischemic mitral regurgitation (IMR), also referred to as functional mitral regurgitation (MR), is present in 10% to 20% of patients with coronary artery disease.2 It is associated with a markedly worse prognosis and is a common cause of congestive heart failure in this patient grouping. Critical in the discussion of this topic is a definition of the entity at hand. Borger et al put forth a concise definition of chronic IMR as follows: “Chronic IMR should be defined as mitral regurgitation occurring more than one week after MI with (1) one or more left ventricular segmental wall motion abnormalities; (2) significant coronary artery disease in the territory supplying the wall motion abnormality; and (3) structurally normal mitral valve leaflets and chordae tendineae.”3

Myocardial infarction sets in motion a cascade of events that can lead to mitral insufficiency. Among these are distortion and remodeling of the left ventricle, which displace the papillary muscles away from the mitral annulus. This phenomenon places excessive tension on the chordae, with the resultant restriction in leaflet motion leading to failed coaptation.4–7 This leaflet tethering is compounded by left ventricular contractile dysfunction and dilation.8 A concomitant outcome of this cascade of events is mitral annular dilatation. Once IMR is established and diastolic LV volume and wall stress increases, left ventricular mass also increases without an accompanying increase in end-diastolic wall thickness, leading to generalized loss of contractile function.9–10 When these processes are set in motion, they exacerbate one another, leading to progressively more IMR.

It is widely agreed that chronic IMR is strongly associated with poor outcomes in patients with coronary artery disease.2,3 There is controversy in the literature, however, as to whether correction of functional IMR actually improves outcomes. Retrospective investigations have failed to demonstrate that correction of IMR benefits long-term survival.11 Rather, long-term outcome is determined by the course of ventricular ischemia, remodeling, and dysfunction. Patients with chronic IMR are at markedly higher risk of heart failure compared with patients without IMR.12 Furthermore, this risk is proportional to IMR severity. This well-described association of IMR and survival has resulted in the surgical corollary that eliminating MR at the time of surgical revascularization should improve outcomes. Most surgeons would recommend adding a mitral valve procedure at the time of coronary artery bypass grafting if there is moderate or greater (3+ to 4+) IMR.13,14 This logic, however, has not been borne out by the data. This finding may be a reflection of the fact that functional IMR is a manifestation of advanced ischemia and infarction-related ventricular remodeling. Furthermore, survival of these patients is primarily dictated by the extent of their ischemic cardiomyopathy. An alternative explanation would suggest that annuloplasty alone is unable to completely and permanently eliminate IMR. The rationale of undersizing annuloplasty is that it increases leaflet coaptation, thereby decreasing regurgitation. Undersizing annuloplasty is simple to perform and was, for a time, widely adopted by the cardiac surgery community.15,16 Numerous rings, partial, total, flexible, rigid, have been employed, and it is impossible to determine that any specific type of ring confers a particular advantage. A singular exception has been the poor long-term results obtained with pericardial annuloplasty bands.17 After the initial promising reports on undersized mitral annuloplasty, including low perioperative mortality rates, studies at various centers began to reveal recurrence of mitral regurgitation in a significant proportion of patients in follow-up. Recurrence rates as high as 28% have been demonstrated in these series.18–20 This has led many investigators to examine alternative surgical therapies.

Given the failure of undersizing annuloplasty to permanently control chronic IMR in the face of progressive ventricular remodeling, and also given the increasing realization that IMR is a disease of the ventricle, not the valve, attention is currently being focused on alternative strategies to favorably affect the outcome in this high-risk group of patients. It must be borne in mind, however, that concomitant MV surgery roughly doubles the perioperative risk of coronary artery bypass grafting.21 Therefore, especially given the lack
of evidence of a survival benefit from surgical treatment of IMR, it behooves the surgical community to be circumspect in addressing the mitral valve in these patients.

Alternative therapies that have been proposed include cutting of the second order chordae tendineae to the anterior and posterior leaflet. Secondary chords are most responsible for leaflet restriction and tethering in chronic IMR. Animal studies have suggested that improved leaflet coaptation and reduced MR can be accomplished by this method without decreasing LV function. This has been applied clinically with promising early results. Several approaches to repositioning of the papillary muscles have been introduced. Perhaps the most promising is surgical relocation of the posterior papillary muscle, wherein a suture is used to connect the posterior papillary muscle to the mitral annulus adjacent to the right fibrous trigone, followed by insertion of a mitral annuloplasty ring. This suture between the papillary muscle and the mitral annulus is shortened to alleviate tethering of the P3 segment and to increase leaflet coaptation. This procedure has a low mortality and promising intermediate-term results.

The current study applies an alternative technique to improve leaflet coaptation. On the basis of the now well-accepted deficit in coaptation due to tethering of a portion of P2 and P3, the authors have addressed this deficiency by inserting an elliptical strip of bovine pericardium, measuring 1 cm×3.5 to 4.5 cm, into the posterior mitral leaflet. The strip encompasses the area from the middle of P2 and the entirety of P3 and extends to the posterior commissure, augmenting the posterior leaflet in this vicinity. This procedure is supplemented by placement of a semirigid annuloplasty band sized to approximate the surface area of the anterior leaflet. The most common ring size was 28, with sizes 24 through 30 being employed. The operative mortality was a bit high at 11%. With average follow-up to 38 months, 92% of the patients were in New York Heart Association class I at follow-up to 2 years. Thirty-two of 44 patients improved by 1 to 3 NYHA classes. Actuarial freedom from moderate to severe mitral regurgitation was 90%, 93%, and 100% at 2, 3, and 4 years, respectively. Two patients in their series developed progressive severe left ventricular remodeling and recurrent regurgitation, necessitating reoperation.

The authors state, and I concur, that this technique should be easily reproducible and should offer positive results in the early and midterm postoperative period. It is to be hoped that operative safety could be improved with increasing experience. Obviously, given the clinical complex of coronary artery disease and IMR, long-term follow-up in larger series will be essential. It should be noted that mitral valve replacement, with careful attention to total preservation of the subvalvular apparatus, should remain a viable option in this setting.

Although it is accepted that mitral valve repair offers survival benefit over replacement in patients with organic mitral valve disease, a similar benefit in IMR has been difficult to demonstrate. Chordal-sparing mitral valve replacement, employing either a biological or mechanical prosthesis, offers the most durable solution to IMR. Indeed, such definitive resolution of IMR might help to elucidate the contribution of MR, or lack thereof, to the long-term outcome of patients with coronary artery disease and IMR.

**References**


**Disclosures**

None.


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