Should Moderate or Greater Mitral Regurgitation Be Repaired in All Patients With LVEF < 30%?

Mitral Valve Repair in Patients With Advanced Heart Failure and Severe Functional Mitral Insufficiency Reverses Left Ventricular Remodeling and Improves Symptoms

Michael A. Acker, MD

Mitral regurgitation (MR) is commonly observed in patients with heart failure and associated with a poor prognosis.1–3 Mitral valve repair or replacement to restore valve competency is a well-established procedure when there are symptoms of heart failure and the primary disease is of the valve leaflets. However, recent interest has focused on functional or secondary mitral insufficiency in which the valve leaflets are anatomically normal but do not fully coapt because of annular dilatation and restricted leaflet motion secondary to increased ventricular size and sphericity. Such a remodeled ventricle is often associated with an ejection fraction of ≤40% and heart failure symptoms of New York Heart Association (NYHA) class III or IV. Surgery in this situation is controversial, as the MR is the consequence and not the cause of left ventricular (LV) dysfunction, and the prognosis, therefore, is more related to the underlying cardiomyopathic process. In addition, it has been thought in the past that elimination of a low pressure runoff might worsen the overload of the left ventricle and contribute to the high mortality seen with mitral valve surgery in heart failure patients.

Progressive LV remodeling characterized by progressive LV dilatation and change to a more spherical shape can result in functional MR as a result of annular dilatation, papillary muscle displacement, and chordal tethering. The functional MR leads to an increased preload, increased wall tension, and increased LV workload, all of which contribute in a positive feedback loop to progressive heart failure. The presence of MR itself is the independent risk factor of poor outcome, both in nonischemic and ischemic etiologies.1–3 Even uncorrected mild MR, as well as moderate to severe MR associated with ischemic cardiomyopathy, is associated with reduced long-term survival.4 In addition, it is a progressive disorder in which MR-related LV volume overload promotes further LV remodeling leading to worsening MR.

Although it is clear that the advent of secondary mitral insufficiency is associated with a worse prognosis, it is unclear whether the worse outcomes stem from the MR itself or whether MR is simply a marker for worsening heart failure and that its correction will improve symptoms or survival. Ultimately, we must ask if there is evidence that the correction of functional MR impacts the heart failure syndrome. Specifically, can surgery be done in patients with advanced heart failure in LV dysfunction with an acceptable operative mortality? Is there evidence that the elimination of MR results in LV reverse remodeling? Finally, what evidence is
there that patient survival is benefited by the elimination of mitral insufficiency in functional MR secondary to idiopathic cardiomyopathy or ischemic cardiomyopathy?

Traditional teaching has been that surgical correction of MR in advanced heart failure patients with poor LV function was associated with prohibitive operative mortality.5,6 This view was challenged by Bolling and others >10 years ago.7–13 The traditional hypothesis held that the mitral valve functions as a “pop off valve” for the failing ventricle and surgical correction results in a prohibitive mortality. The Bolling hypothesis is that there is “annular solution for ventricular problem…such that reconstruction of the mitral valve annulus geometric abnormality by an undersized ring, restores valvular competency, alleviates excessive ventricular workload, improves ventricular geometry, and improves ventricular function.” Miller and his Stanford colleagues14 have reported, in an ischemic sheep model of MR, that the reduction of the annulus by a small ring reduces the radius of curvature of the LV at the base equatorial and apical levels. This decrease in the radius of curvature supports the concept that a small ring can restore a more elliptical ventricular shape. Surgical mortality of mitral valve replacement in the past was most likely the result of the loss of the subvalvular apparatus and not secondary to the loss of the pop off valve, as previously thought, underscoring the paramount importance of maintaining the integrity of annular and subvalvular continuity during mitral valve surgery.

Bolling was the first to show a reasonable operative mortality (5%) in a series of 140 class III and class IV patients with an ejection faction of <25%. He demonstrated improvement in LV ejection fraction and decrease in end-diastolic volumes over 3 to 5 years.7 There was also improvement in functional class in his series of patients. Bishay from the Cleveland Clinic had similar results in a similar group of heart failure patients.10

The most comprehensive analysis to date of correction of mitral valve insufficiency in advanced heart failure patients with LV dysfunction comes from Acker et al15 in their trial evaluating the safety and efficacy of mitral valve surgery with and without CorCap cardiac support device. The Acorn clinical trial, although not randomized to study the efficacy of mitral valve repair, did prospectively assess the safety and efficacy of mitral valve surgery in advanced heart failure patients in multiple centers in a prospective fashion. One hundred ninety-three patients were examined; 73% were in class III. Most were idiopathic or valvular patients. Only 6% were ischemic. The duration of heart failure was nearly 5 years—97% of patients were on angiotensin-converting enzyme inhibitors and 80% were on β-blockers. The mean LV ejection fraction was 23.9%, peak VO2 was 14, and LV end-diastolic dimension was nearly 70 mm. Remarkably, the operative mortality rate was only 1.6%, one of the lowest mortality rates of any series8,10,12 and especially noteworthy because it represents the outcome of nearly 30 different centers. Twelve-month cumulative survival was 86.5%, and at 2 years, the cumulative survival was 85.2%. Most patients received a complete small annuloplasty ring repair. Mitral valve insufficiency was reduced from 2.7 at baseline to 0.59 at 18 months and remained stable at that level. There was strong evidence of reverse ventricular remodeling by elimination of MR alone. A significant decrease in both LV end-diastolic volume and end-systolic volume was found at 2 years. The sphericity index increased and remained significant at 2 years, consistent with a more ellipsoid shape. LV mass decreased significantly at 2 years. Finally, the baseline NYHA class of 2.8 was reduced significantly to 2.2 at 2 years. In summary, for the patients with primarily nonischemic advanced heart failure and severe LV dysfunction, mitral valve surgery was shown to be safe, with a low operative mortality rate, and associated with significant reversal of LV remodeling compared with baseline as well as an improvement in NYHA functional class.15

There is also accumulating evidence in patients with ischemic mitral insufficiency that the combination of surgical revascularization and mitral valve repair will improve quality of life significantly.4,9,16–21 In multiple retrospective series, NYHA class improved from greater than NYHA class III to less than class II for up to 4 years of follow-up.4,16

LV reverse remodeling has also been demonstrated in several studies as a result of either MV repair alone or in combination with coronary artery revascularization for patients with ischemic disease. Acker et al demonstrated in primarily nonischemic cardiomyopathies a significant decrease in LVEDD volume as a result of mitral repair, and this reversal has remained significant up to 5 years.15 In ischemic cardiomyopathy patients, Bax and Braun have shown that combination of MV repair and coronary artery bypass results in a significant decrease in LVEDD up to 4 years after surgery.4,9,16 In addition, Fattouch et al11 have recently demonstrated in a randomized study of coronary artery bypass versus coronary artery bypass and mitral valve repair that the addition of MV repair improves postoperative NYHA functional class and ventricular remodeling, decreases pulmonary arterial pressure, and leads to a decrease in hospitalization for heart failure. In addition, these same studies also showed low operative mortality rates for combined mitral valve surgery and coronary artery bypass procedures in patients with significant LV dysfunction and advanced heart failure symptoms. Review of the literature shows that ischemic patients can also be operated on with mortality rates <5%, and many series suggest operative mortality of <2%. Clearly, the old theory that the mitral valve in heart failure patients functions as a pop off valve has been disproven.5,15,17–21 As Miller states, “We now recognize that ignoring an important degree of ischemic MR at the time of coronary artery bypass surgery is not prudent because it will only limit the potential functional benefits to be obtained from the operation and compound the patient’s poor life’s expectancy.”22
There are multiple studies suggesting that recurrent rates of mitral insufficiency after repair are in the 30% to 40% range. These studies generally fail to address ring selection and amount of downsizing as an important consideration for durable results in the ischemic MR population. The 2006 American College of Cardiology and American Heart Association guidelines as well as the 2007 European Society of Cardiology guidelines suggest that “mitral annuloplasty alone with a downsized annuloplasty ring is often effective in relieving ischemic MR,” and the 2007 European Society of Cardiology guidelines state that most patients with ischemic MR seem to benefit from valve repair from using an undersized rigid ring annuloplasty. Early failure with recurrent MR reported by McGee et al and Mihaljevic et al in ischemic heart failure patients after coronary artery bypass surgery and annuloplasty ring was likely caused by the use of a flexible band or ring. These results stand in sharp contrast to no recurrent MR seen up to 4 years when a rigid ring that has been downsized by 2 to 4 sizes. Spoor et al found that the recurrence rate with a flexible ring was 9.5% versus 2.5% with a nonflexible ring in patients with a preoperative ejection fraction <30% and no primary mitral pathology. The failure of a flexible band in ischemic MR can be explained by the fact that the intratrigonal distance is subject to dilatation for which a band does not provide protection. In addition, fixation of the septal lateral dimension is most important in preventing return of mitral insufficiency, and an undersized rigid ring will address that.

Currently, there are no randomized studies comparing mitral valve repair with medical management in patients with advanced heart failure and LV dysfunction. Wu et al between 1995 and 2002 published a retrospective propensity-matched analysis of consecutive patients with significant MR and LV dysfunction. They compared 126 patients who underwent mitral valve annuloplasty with the medical patients who did not undergo surgery. Valve repair did not predict the clinical outcome (survival, transplant, or VAD). This study was flawed in that it did not report changes in LV size or function or quality-of-life improvement. In addition, there was neither data on the presence of recurrent MR at the follow-up nor was the type of annuloplasty ring used noted.

In summary, current literature suggests that functional mitral insufficiency in patients with advanced heart failure and LV dysfunction can be corrected with a low operative mortality in either ischemic or nonischemic cardiomyopathies. There are multiple prospective but nonrandomized series that suggest both a symptomatic benefit, as well as a remodeling benefit, in patients who undergo mitral valve repair in idiopathic dilated cardiomyopathies and coronary revascularization with mitral valve repair in patients with ischemic cardiomyopathies. Currently, there is no evidence that elimination of mitral insufficiency in heart failure patients conveys a survival benefit. Despite lack of survival benefit, there is accumulating evidence in nonischemic class III patients that MV repair is certainly safe and results in symptomatic improvement, improved exercise capacity, and reversed remodeling. Whether this is true in patients with ischemic cardiomyopathy is less clear, and robust registries as well as randomized trials examining the question of mitral valve repair in ischemic cardiomyopathic patients with mitral insufficiency are needed.

References


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