Preservation of left ventricular function after degenerative mitral valve repair: Refocusing on timing, techniques, and teaching

Rakesh M. Suri, MD, DPhil,^a Maurice Enriquez-Sarano, MD,^b and Hartzell V. Schaff, MD^c

From the ^aDepartment of Thoracic and Cardiovascular Surgery, Cleveland Clinic Foundation, Cleveland, Ohio;

and Divisions of ^bCardiovascular Diseases and ^cCardiovascular Surgery, Mayo Clinic, Rochester, Minn.

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Address for reprints: Rakesh M. Suri, MD, DPhil, Department of Thoracic and Cardiovascular Surgery, Cleveland Clinic Foundation, 9500 Euclid Ave, J4-1, Cleveland, OH 44195 (E-mail: surir@ccf.org).

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Changes in left ventricular (LV) size and function are expected after correction of severe chronic degenerative mitral regurgitation. Although it was previously thought that a postoperative decrease in ejection fraction (EF) was related to inadequate myocardial protection, it is now recognized that elimination of regurgitant volume after mitral valve repair is often associated with an increase in LV end-systolic volume, producing a decline in EF while maintaining normal or increased LV stroke volume.¹⁻⁴

The report by Imasaka and colleagues⁵ investigated differences in myocardial performance after repair in relation to whether chordal replacement versus leaflet resection was used to correct posterior mitral leaflet prolapse in 72 consecutive patients. In addition to EF, end-systolic elastance, effective arterial elastance, and “ventricular efficiency” were assessed by echocardiography before and approximately 1 month after mitral valve repair. The authors suggest that chordal replacement resulted in significantly less reduction in LV EF and greater increases in end-systolic elastance than leaflet resection. They further posit that postoperative ventricular efficiency in the chordal replacement group was “superior” to that after leaflet resection, with multivariate analysis suggesting that LV EF and ratio of stroke work to pressure-volume area were better in patients undergoing neochordal repair.

This interesting work raises important questions. First, do the reported differences make sense physiologically? Second, are the echocardiographic parameters assessed robust enough to support the intended conclusion? Third, where does this work take us?

The notion that the resection of leaflet tissue itself alters ventricular performance to a greater degree than neochordal insertion is difficult to understand unless it relates to the authors’ preference for large quadrangular resection plus sliding leaflet plasty. In fact, it is unclear why a limited removal of a triangular segment of unsupported posterior leaflet tissue could have any impact on myocardial performance at all. The need for large resections in the report does lead us to suspect that baseline lesions

Long-term EF according to early postrepair EF less than 50% or 50% or greater. (Quintana E, Suri RM, Thalji NM, Daly RC, Dearani JA, Burkhart HM, et al. Left ventricular dysfunction after mitral valve repair—the fallacy of “normal” preoperative myocardial function. *J Thorac Cardiovasc Surg*. 2014;148:2752-60.)

Central Message

Changes in EF after correction of severe degenerative mitral regurgitation can be minimized by the performance of prompt mitral repair.

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within this small population ($n = 72$) may not have been similar, with more extensive removal of tissue required for those with diffuse myxomatous disease and neochordal implantation preferred for those with fibroelastic deficiency. The distinction is important, because these 2 pathologic extremes of the degenerative mitral disease spectrum also may be associated with differing ventricular-valvar complex physiology⁶ and may affect LV response after valve repair.

In regard to the echocardiographic values used to arrive at their conclusions, the authors admit that direct ventricular volume assessments using the modified Simpson’s rule were not performed but were replaced instead by extrapolations using linear dimensions obtained with the Teichholz method. This step is well known to potentially introduce large errors into subsequent calculations.⁷ Further, more than one fifth of patients had atrial fibrillation documented by the authors, further magnifying inaccuracies in the calculation of left heart volumes used in the report. This is unfortunate, because the veracity of the entire message relies on the volume assessments made using these imperfect estimates. Regarding the postulated association between poorer indices of function and atrial fibrillation, avoidance of tricuspid valve repair, or longer cardiopulmonary bypass times, while these interesting hypothesis-generating

FIGURE 1. Long-term EF according to early postrepair EF less than 50% or 50% or greater. LVEF, Left ventricular ejection fraction. (Reprinted from Quintana and colleagues.⁴)

findings were derived from a small population of patients they may be targets for future study.

Further challenging the strength of the presented message is the fact that there is a robust literature in existence supporting the safety, efficacy, and long-term durability of both posterior leaflet resection and neochordal replacement for posterior mitral leaflet prolapse.^{8,9} In the presence of normal EF (>60%), it is well understood that the correction of degenerative mitral regurgitation before significant ventricular dilation, even in asymptomatic patients, is critical to minimize postoperative LV dysfunction and facilitate reverse remodeling along with recovery of normal LV performance. We thus propose 3 “take-away” messages when considering degenerative mitral valve repair with the aim of preserving long-term LV function: (1) timing: highlighting the critical importance of timely mitral valve repair in asymptomatic patients before the decrease of EF less than 60% or enlargement of LV end-systolic dimension greater than 40 mm; (2) technique: reinforcing that limited triangular and neochordal replacement (performed with annuloplasty) are both associ-

ated with proven safety and durability, with no mid- to long-term clinical or echocardiographic differences in large longitudinal analyses to date; and (3) teaching: cardiovascular specialists that patients with postoperative LV dysfunction identified early after successful mitral valve repair should undergo long-term echocardiographic and clinical follow-up (Figure 1) and be considered as candidates for therapies that may assist with reverse LV remodeling. These key messages should be highlighted, instead of placing undue importance on the difficult to rationalize association between contemporary posterior leaflet repair strategy and long-term myocardial performance.

References

1. Ashikhmina EA, Schaff HV, Suri RM, Enriquez-Sarano M, Abel MD. Left ventricular remodeling early after correction of mitral regurgitation: maintenance of stroke volume with decreased systolic indexes. *J Thorac Cardiovasc Surg.* 2010;140:1300-5.
2. Suri RM, Schaff HV, Dearani JA, Sundt TM, Daly RC, Mullany CJ, et al. Recovery of left ventricular function after surgical correction of mitral regurgitation caused by leaflet prolapse. *J Thorac Cardiovasc Surg.* 2009;137:1071-6.
3. Suri RM, Schaff HV, Dearani JA, Sundt TM III, Daly RC, Mullany CJ, et al. Determinants of early decline in ejection fraction after surgical correction of mitral regurgitation. *J Thorac Cardiovasc Surg.* 2008;136:442-7.
4. Quintana E, Suri RM, Thalji NM, Daly RC, Dearani JA, Burkhardt HM, et al. Left ventricular dysfunction after mitral valve repair—the fallacy of “normal” preoperative myocardial function. *J Thorac Cardiovasc Surg.* 2014;148:2752-60.
5. Imasaka K, Tayama E, Tomita Y. Left ventricular performance early after repair for posterior mitral leaflet prolapse: Chordal replacement versus leaflet resection. *J Thorac Cardiovasc Surg.* 2015;150:538-45.
6. Clavel MA, Mantovani F, Malouf J, Michelena HI, Vatury O, Jain MS, et al. Dynamic phenotypes of degenerative myxomatous mitral valve disease: quantitative 3-dimensional echocardiographic study. *Circ Cardiovasc Imaging.* 2015;8:e002989.
7. Grossgasteiger M, Hien MD, Graser B, Rauch H, Motsch J, Gondan M, et al. Image quality influences the assessment of left ventricular function: an intraoperative comparison of five 2-dimensional echocardiographic methods with real-time 3-dimensional echocardiography as a reference. *J Ultrasound Med.* 2014;33:297-306.
8. David TE, Armstrong S, McCrindle BW, Manlhiot C. Late outcomes of mitral valve repair for mitral regurgitation due to degenerative disease. *Circulation.* 2013;127:1485-92.
9. Suri RM, Schaff HV, Dearani JA, Sundt TM III, Daly RC, Mullany CJ, et al. Survival advantage and improved durability of mitral repair for leaflet prolapse subsets in the current era. *Ann Thorac Surg.* 2006;82:819-27.