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Editorial Comment

Choosing the "Golden Moment" for Mitral Valve Repair*

WILLIAM J. STEWART, MD, FACC
Cleveland, Ohio

Patients with asymptomatic or minimally symptomatic mitral regurgitation present a dilemma for the clinician. Because the valve lesion itself causes increased preload and decreased afterload, the normal response of the left ventricle to mitral regurgitation should be a normal or low end-systolic volume, with a hyperdynamic ejection fraction that declines after corrective surgery (1). Assuming that there is significant (moderately severe or severe) mitral regurgitation without a primary coronary or myocardial process, significant secondary myocardial dysfunction should be suspected if the end-systolic left ventricular volume is even mildly increased or the ejection fraction is low normal or mildly decreased.

The report by Enriquez-Sarano et al. (2) in this issue of the Journal agrees with previous studies suggesting that preoperative depression of left ventricular ejection fraction (1,3) or elevation of end-systolic ventricular size (4–6) is predictive of reduced ejection fraction after surgical correction of mitral regurgitation.

Interplay between ventricular size and function. Enriquez-Sarano et al. further suggest that preoperative ejection fraction and end-systolic diameter by echocardiography *together* have more predictive power than either one alone. For example, a patient with ejection fraction <50% and end-systolic diameter >45 mm has a >70% likelihood of postoperative ventricular dysfunction (Table 3, Fig. 4 [2]). No previous study has demonstrated the interaction of these two easily obtainable, noninvasive variables in as usable a way.

The potential for occult left ventricular dysfunction in mitral regurgitation has been recognized in the past. Many previous studies have attempted to determine a simple guide to the optimal time for operative intervention in asymptomatic patients. Other echocardiographic variables studied include the end-systolic wall stress/end-systolic volume index ratio (6–8) and the systolic diameter/wall thickness ratio (9). Both showed significant, although not independent, effects on postoperative ejection fraction in the present study. One group found a correlation between left atrial size and outcome (9), unlike the current study. Not included in the current study were Doppler-derived estimates of pulmonary pressure (1) and the rate of change in left ventricular pressure over time (10), end-systolic stress-strain (11) and myocardial elastance (12), all of which have also been considered important factors in this decision. Unfortunately, a practical load-independent measurement of left ventricular function that would cleanly avoid the problems with ejection fraction has yet not been found. In the present study, end-systolic diameter and ejection fraction accounted for 52% of the variability in postoperative ejection fraction (2).

Integration of clinical and echocardiographic data. Assessments of left ventricular size and function are only one component of this complex clinical decision (13,14). In evaluating patients with pure isolated mitral regurgitation who are being considered for mitral surgery, I consider five elements: 1) symptoms, 2) left ventricular size, 3) left ventricular function, 4) significant pulmonary hypertension and 5) chronic or recurrent atrial fibrillation (14–18). If two or more of these factors are abnormal as a result of the valve, elective operation should be considered. If one or more are partially abnormal, the patient should be followed with clinical and echocardiographic study every 6 to 12 months. Trends toward functional deterioration outside the interobservation error, ~5 mm for left ventricular diameter (19,20), are also an important consideration.

Surgical repair may be indicated earlier or later depending on concomitant mitral stenosis, abnormalities of other valves, coronary artery disease, endocarditis, right ventricular dysfunction, pericardial disease or noncardiac factors influencing symptoms or operative risk. In patients with significant coronary disease or ischemic mitral regurgitation, one should be more aggressive with surgical recommendations or close follow-up, or both (18,21). Even a single bypassable coronary artery lesion in addition to severe mitral regurgitation may be a valid indication for earlier surgical intervention. In the study by Enriquez-Sarano et al (2), the group with ischemic mitral regurgitation had an 80% incidence of postoperative left ventricular dysfunction compared with 32% in the nonischemic group (2).

Mitral repair versus replacement. The choice of mitral repair versus replacement should also affect the decision on timing of mitral operation. I disagree with the current study, which states that this cannot be incorporated into current preoperative decisions. Further evaluation of their results to determine the effect on ejection fraction of repair or replacement might be interesting.

In the 1970s, the indications for correction of mitral regurgitation were New York Heart Association functional class III symptoms that could not be controlled with medical management (22–24). At that time, the only surgical option was valve replacement. The risks were death or development of progressive heart failure from myocardial dysfunction. Clinicians made decisions on the basis of echocardiographic predictors of myocardial dysfunction. The clinical solution was to delay operation as long as possible. As a result, surgical therapy for mitral regurgitation was associated with lower long-term

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From the Department of Cardiology, The Cleveland Clinic Foundation, Cleveland, Ohio.

Address for correspondence: Dr. William J. Stewart, Desk F 15, The Cleveland Clinic Foundation, 9500 Euclid Avenue, Cleveland, Ohio 44195.

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survival rates than any other common isolated valve lesion, including mitral stenosis, aortic regurgitation and aortic stenosis (25).

Today, the indications for operation for mitral regurgitation are different because valve repair is a feasible surgical option performed by experienced surgeons in 70% of cases (26). The risks of timely repair are low, with only a 2% perioperative mortality rate (26,27), whereas the risks of delay are higher, and valve replacement may be required, which has a 5% to 8% perioperative mortality risk rate and a much higher chance of "prosthetic valve diseases," including prosthetic endocarditis, ventricular dysfunction, inherent stenosis of the prosthesis and complications from thromboemboli or hemorrhage (28). The way in which clinicians make decisions should reflect a learned appraisal of likely surgical outcome, including that of valve repair versus replacement (29), which is at least as important in preoperative decisions as is the presence of occult myocardial dysfunction.

Echocardiography can accurately determine the mechanism of mitral regurgitation (30). The likelihood of repair versus replacement depends on the mechanism of dysfunction and varies from 20% to 90% (26). The feasibility of repair versus replacement also varies with the skills and experience of the individual surgeon (31). Whether repair or replacement is performed substantially affects perioperative risk (28) and postoperative myocardial function (32).

Choosing the "golden moment" for operation. Both surgical and medical options have inherent risks and benefits that should be considered carefully. Despite severe mitral regurgitation, it is difficult to expose an asymptomatic patient to minor or major perioperative complications, which occurred in 8% in the current study (2). By contrast, the patient managed medically should be informed of the potential for interval complications, endocarditis or progression of disease, which could result in an unrepairable valve and death. Recognizing the risks of waiting, some patients, including some with symptoms, may choose the "stitch in time" philosophy before two of the five categories previously listed are fully abnormal.

The optimal time for mitral surgery should be chosen on the basis of a comprehensive evaluation of the individual patient and the risks and benefits of either the medical or surgical approach. Our understanding of this field has been enhanced by the Enriquez-Sarano et al. study, the largest of its kind published to date. In patients with mitral regurgitation, the echocardiogram should be used for objective assessment of *left ventricular size and function* and for determining the *mechanism of the valvular dysfunction*, both of which impact the optimal timing, the "golden moment" for operative intervention.

References

1. Crawford MH, Souchek J, Oprian CA, et al. Determinants of survival and left ventricular performance after mitral valve replacement. Department of Veterans Affairs Cooperative Study on Valvular Heart Disease. Circulation 1990;81:1173–81.
2. Enriquez-Sarano M, Tajik AJ, Orszulak TA, McGood MD, Bailey KR, Frye RL. Echocardiographic prediction of left ventricular function after correction of mitral regurgitation: results and clinical implications. J Am Coll Cardiol 1994;24:1536–43.
3. Acar J, Michel PL, Luxereau P, Vahanian A, Cormier B. Indications for surgery in mitral regurgitation. Eur Heart J 1991;12:52–4.
4. Borow KM, Green LH, Mann T, et al. End-systolic volume as a predictor of postoperative left ventricular performance in volume overload from valvular regurgitation. Am J Med 1980;68:655–63.
5. Schuler G, Peterson KL, Johnson A, et al. Temporal response of left ventricular performance to mitral valve surgery. Circulation 1979;59:1218–31.
6. Zile MR, Gaasch WH, Levine HJ. Left ventricular stress-dimension-shortening relations before and after correction of chronic aortic and mitral regurgitation. Am J Cardiol 1985;56:99–105.
7. Carabello BA, Nolan SP, McGuire LB. Assessment of preoperative left ventricular function in patients with mitral regurgitation: value of the end-systolic wall stress-end-systolic volume ratio. Circulation 1981;63:1212–7.
8. Breisblatt W, Goodyer AV, Zaret BL, Francis CK. An improved index of left ventricular function in chronic mitral regurgitation. Am J Cardiol 1986;57:1105–8.
9. Reed D, Abbott RD, Smucker ML, Kaul S. Prediction of outcome after mitral valve replacement in patients with symptomatic chronic mitral regurgitation. The importance of left atrial size. Circulation 1991;84:23–34.
10. Pai RG, Bansal RC, Shah PM. Doppler-derived rate of left ventricular pressure rise: its correlation with the postoperative left ventricular function in mitral regurgitation. Circulation 1990;82:514–20.
11. Wisenbaugh T. Does normal pump function belie muscle dysfunction in patients with chronic severe mitral regurgitation? Circulation 1988;77:515–25.
12. Starling MR, Kirsh MM, Montgomery DG, Gross MD. Impaired left ventricular contractile function in patients with long-term mitral regurgitation and normal ejection fraction. J Am Coll Cardiol 1993;22:239–50.
13. Assey ME, Spann JJ. Indications for heart valve replacement. Clin Cardiol 1990;13:81–8.
14. Hammermeister KE, Fisher L, Kennedy W, Samuels S, Dodge HT. Prediction of late survival in patients with mitral valve disease from clinical, hemodynamic, and quantitative angiographic variables. Circulation 1978;57:341–9.
15. Schwarz F, Bottger J, Olschewski M, et al. Surgical indications in mitral valve stenosis, combined mitral valve defect or mitral valve insufficiency. Long-term prognosis of operated or drug-treated patients. Herz 1986;11:74–87.
16. Bertin A, Chaitman BR, Almazan A. Preoperative determinants of return to sinus rhythm after valve replacement. In: Cohn LH, editor. Cardiac Bioprostheses. New York: Yorke Medical Books, 1982:184–91.
17. Appelbaum A, Kouchoukos NT, Blackstone EH, Kirklin JW. Early risks of open heart surgery for mitral valve disease. Am J Cardiol 1976;37:201–9.
18. Hickey MS, Smith LR, Muhlbaier LH, et al. Current prognosis of ischemic mitral regurgitation. Implications for future management. Circulation 1988;78 Suppl I:I-51–9.
19. Felner JM, Blumenstein BA, Schlant RC, et al. Sources of variability in echocardiographic measurements. Am J Cardiol 1980;45:995–1004.
20. Kuecherer HF, Kee LL, Modin G, Cheitlin MD, Schiller NB. Echocardiography in series: evaluation of left ventricular systolic and diastolic function: importance of image acquisition, quantitation, and physiologic variability in clinical and investigational applications. J Am Soc Echocardiogr 1991;4:203–14.
21. Dion R. Ischemic mitral regurgitation: when and how should it be corrected? J Heart Valve Disease 1993;2:536–43.
22. Rapaport E. Should valvular replacement be reserved for symptomatic valvular heart disease? Cardiovasc Clin 1977;8:269–77.
23. Blomer H, Delius W, Sebening H. Natural history in patients with mitral and aortic valve disease. Z Kardiol 1977;66:159–69.
24. Braunwald E. Valvular heart disease. In: Wintrobe MM, editor. Harrison's Principles of Internal Medicine. New York: McGraw-Hill, 1974:1192–3.
25. Scott WC, Miller DC, Haverich A, et al. Operative risk of mitral valve replacement: discriminant analysis of 1329 procedures. Circulation 1985;72 Suppl II:II-108–19.

26. Cosgrove DM, Stewart [illegible] Mitral valvuloplasty. Curr Probl Cardiol 1989; 14:359–415.
27. Cosgrove DM, Chavez AM, Lytle BW, et al. Results of mitral valve reconstruction. Circulation 1986;74 Suppl I:I-82–87.
28. Cohn LH, Kowalker W, Bhatia S, et al. Comparative morbidity of mitral valve repair versus replacement for mitral regurgitation with and without coronary artery disease. Ann Thorac Surg 1988;45:284–90.
29. Antunes MJ. Conservative mitral valve surgery: has the progress changed the indications? Schweiz Med Wochenschr 1991;121:1946–53.
30. Stewart WJ, Currie PJ, Salcedo EE, Klein AL, Marwick TH, Cosgrove DM. Evaluation of mitral leaflet motion by echocardiography and jet direction by Doppler color flow mapping to determine the mechanism of mitral regurgitation. J Am Coll Cardiol 1992;29:1353–61.
31. Antunes MJ, Colsen PR, Kinsley RH. Mitral valvuloplasty: a learning curve. Circulation 1983;68 Suppl II:II-70–5.
32. Goldman ME, Mora F, Guarino T, Fuster V, Mindich BP. Mitral valvuloplasty is superior to valve replacement for preservation of left ventricular function: an intraoperative two-dimensional echocardiographic study. J Am Coll Cardiol 1987;10:568–75.