Mitrval valve prolapse (MVP) is a common disorder affecting 2% to 5% of the general population (7.8 million individuals in the United States and 176 million individuals worldwide), and it is the most important cause of primary mitral regurgitation (MR) requiring surgery. In addition to progressive MR, MVP is associated with endocarditis, heart failure, and even sudden death. In the setting of severe primary MR, the left ventricle (LV) is affected by a significant volume load leading to compensatory adaptations that vary considerably depending on the prolonged clinical course of MR. In acute MR, late systolic volume is reduced and afterload is low, but as the ventricle enlarges and adapts to the chronic volume overload, afterload gradually increases. During the compensated stage of chronic MR, LV enlargement results from remodeling of the extracellular matrix with dissolution of collagen and rearrangement of myocardial fibers. Moreover, new sarcomeres are added in series, and at the ventricular level, eccentric hypertrophy develops. Consequently, preload (at the sarcomere level), afterload (at the ventricular level), and LV ejection fraction (LVEF) are normal, whereas total stroke volume is increased as a result of the large end-diastolic volume. The transition to decompensated chronic MR may occur as a consequence of a progressive increase in regurgitant volume, a decrease in LV contractile function, an increase in afterload, or a combination of these factors. During this stage, LVEF typically declines to 50% to 60%. Finally, decompensated MR is characterized by substantial and progressive LV dilatation, elevated LV diastolic pressure, increased systolic wall stress, and an LVEF of <50%. The decline in LVEF is a consequence of depressed myocardial contractile state, LV afterload excess, or both. Although predominantly based on mitral valve replacement data, early echocardiographic studies have demonstrated a frequent decline in LVEF post surgery, even when MR was well compensated preoperatively. This was thought to be a consequence of an increase in LV afterload related to closure of the low-impedance left atrial leak, although others have postulated that the main culprit of LVEF decline postoperatively is the lack of preservation of the subvalvular apparatus in mitral valve replacement, as this leads to a more spherical LV and reduction of long-axis shortening. By contrast, valve repair or replacement with preservation of the subvalvular apparatus is less frequently associated with a significant fall in LVEF after surgery if MR is compensated preoperatively. The key is to identify, among patients who undergo mitral valve repair, the minority who will develop a reduction in postoperative LVEF (despite normal preoperative LVEF and LV cavity size) as a consequence of occult myocardial dysfunction.

**Editorial**

Left Ventricular Ejection Index as a Marker of Early Myocardial Dysfunction in Primary Mitral Regurgitation: Novel or Old in Disguise?

Francesca N. Delling, MD

On the basis of the 2014 American Heart Association/American College of Cardiology Valvular Heart Disease Guidelines, symptomatic patients with an LVEF of >30% or asymptomatic patients with an LVEF of ≤60% or LV end-systolic diameter (LVESD) of ≥40 mm should be treated surgically (class I). The optimal timing of surgery is less certain (class IIa) in asymptomatic patients with normal LV function (LVEF>60%) or normal LV end-systolic dimension (<40 mm). Some asymptomatic patients remain stable for years, but some develop irreversible LV systolic dysfunction. Surgical decisions in asymptomatic patients with preserved LV function often depend on associated factors, including patient preference, new onset atrial fibrillation, pulmonary hypertension, or high likelihood of successful mitral valve repair. Recently, physicians have debated whether the thresholds discussed above should be lowered, with proponents arguing that results are superior when there is earlier surgical intervention. The debate is further ignited by the lack of randomized trials evaluating the optimal management of asymptomatic patients with preserved LVEF and normal LV size, that is, whether early mitral valve repair is superior or comparable with conservative approach with expectant management. In this scenario, there is an emerging need to identify earlier markers of myocardial dysfunction able to identify, among asymptomatic patients with severe MVP-related MR and normal LV cavity size/function, those who might benefit the most from early mitral valve repair. This need was recently highlighted in the 2014 American Heart Association/American College of Cardiology Valvular Heart Disease Guidelines.

In a study in this issue of Circulation: Cardiovascular Imaging, Magne et al investigate the clinical and prognostic effect of a Doppler-based novel index of LV ejection index (LVEI) in primary MR due to MVP. The authors define LVEI
as the LVESD indexed to body size divided by the LV outflow tract (LVOT) time–velocity integral (TVI). As LVEI includes an estimate of LV contractility (LVOT TVI), the authors postulate it to be a better predictor of postrepair outcomes compared with classic parameters, such as LVEF and LVESD. Magne et al.12 retrospectively examine 278 patients who underwent mitral valve repair for primary MR by comparing echocardiography-derived preoperative LV diameters, LV stroke volume, LVEF, and LVEI in patients with and without postoperative LV dysfunction. They demonstrate that a preoperative LVEI of >1.13 is an independent predictor of postoperative LV dysfunction and a determinant of postoperative survival and cardiovascular mortality, even in patients with a preserved LVEF of >60%. They conclude that LVEI index may be used as a complementary parameter to risk stratify and guide decision making in patients with primary MR.

Among the strengths of the investigation is first and foremost the novelty of the echocardiographic index proposed. Second, LVEI can be easily obtained in every day clinical practice by using measurements that are part of a standard examination and, with regard to LVESD, already recommended by current valvular guidelines.10 An imaging parameter that does not require additional acquisition or postprocessing time has the potential to be better accepted (and used) by both sonographers and cardiologists. In addition, the correlation of LVEI with clinical outcomes, specifically postoperative LV dysfunction, overall survival, and cardiac death–free survival further highlights its appeal in clinical practice. Importantly, because LVEI was found to be a powerful determinant of postoperative outcomes even in patients with a preoperative LVEF of >60%, it may be considered a potential marker of early myocardial dysfunction.

Other imaging modalities have played an important role in identifying early substrates of abnormal systolic function in primary MR. Specifically, patients with postoperative LV dysfunction have been shown to have greater alterations in preoperative LV global longitudinal strain than patients with normal postoperative LVEF, suggesting that global longitudinal strain may be more sensitive than LVEF for the detection of latent LV dysfunction in patients with severe MR.13 Although global longitudinal strain provides a more global assessment of geometric changes occurring with MR progression compared with LVEI (LVESD is measured at the base), it may be considered a potential marker of early myocardial dysfunction.

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The various limitations of this article offer the opportunity for future research directions. A comparison of LVEI with other more global parameters of LV systolic function (eg, global longitudinal strain) is the obvious next step. Because the addition of a contractility measurement (LVOT TVI) seems to confer a prediction benefit to a unidimensional parameter, it is expected that a ratio of LV end-systolic volume/LVOT or 3D LV end-systolic volume/LVOT TVI will perform even better.

In conclusion, preoperative LVEI represents a novel and easy to obtain echocardiographic parameter able to predict postoperative LV dysfunction, overall survival, and cardiovascular mortality, at least in a preliminary retrospective analysis. The prognostic implications of LVEI remain strong even in patients with a preserved LVEF of >60%, indicating its potential to be used as a marker of early preoperative dysfunction. Nevertheless, LVEI is derived from LVESD (a unidimensional parameter) and cannot take into account the complex, global geometric changes that occur with progression of MR. Large prospective studies are needed to confirm the prognostic value of LVEI.

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References

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