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Discordance Between Echocardiography and MRI in the Assessment of Mitral Regurgitation Severity

A Prospective Multicenter Trial

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ABSTRACT

BACKGROUND The decision to undergo mitral valve surgery is often made on the basis of echocardiographic criteria and clinical assessment. Recent changes in treatment guidelines recommending surgery in asymptomatic patients make the accurate assessment of mitral regurgitation (MR) severity even more important.

OBJECTIVES The purpose of this study was to compare echocardiography and magnetic resonance imaging (MRI) in the assessment of MR severity using the degree of left ventricular (LV) remodeling after surgery as the reference standard.

METHODS In this prospective multicenter trial, MR severity was assessed in 103 patients using both echocardiography and MRI. Thirty-eight patients subsequently had isolated mitral valve surgery, and 26 of these had an additional MRI performed 5 to 7 months after surgery. The pre-surgical estimate of regurgitant severity was correlated with the postoperative decrease in LV end-diastolic volume.

RESULTS Agreement between MRI and echocardiographic estimates of MR severity was modest in the overall cohort ($r = 0.6$; $p < 0.0001$), and there was a poorer correlation in the subset of patients sent for surgery ($r = 0.4$; $p = 0.01$). There was a strong correlation between post-surgical LV remodeling and MR severity as assessed by MRI ($r = 0.85$; $p < 0.0001$), and no correlation between post-surgical LV remodeling and MR severity as assessed by echocardiography ($r = 0.32$; $p = 0.1$).

CONCLUSIONS The data suggest that MRI is more accurate than echocardiography in assessing the severity of MR. MRI should be considered in those patients when MR severity as assessed by echocardiography is influencing important clinical decisions, such as the decision to undergo MR surgery. (J Am Coll Cardiol 2015;65:1078–88) © 2015 by the American College of Cardiology Foundation.

Echocardiography is the most commonly used method for determining the severity of mitral regurgitation (MR) (1). In patients with severe MR, American College of Cardiology/American Heart Association guidelines advise surgery when there is left ventricular (LV) dysfunction, even in the absence of symptoms (1). Recently, physicians have debated whether these guidelines should be relaxed further, with proponents arguing that results are superior when there is earlier surgical intervention (2,3).

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In such cases, accurate assessment of MR severity becomes even more important.

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Many studies have been published regarding the ability of echocardiography to assess the severity of MR, either qualitatively or quantitatively. A common weakness of many of these studies is that they lack comparison with a "gold" or reference standard to validate their accuracy. Although several early studies compared echocardiography with invasive ventriculography (4–7), the consensus today is that echocardiography is superior to ventriculography for determining the severity of MR (1).

Current American Society of Echocardiography (ASE) guidelines for quantification of MR recommend an integrated approach that relies on multiple echocardiographic techniques (8). However, the guidelines are silent on the weighting of individual components and do not provide an approach to reconciling situations in which individual measures are inconsistent. In addition, there are limitations to echocardiographic techniques when regurgitant jets are noncircular, eccentric, or nonholosystolic.

Magnetic resonance imaging (MRI) is an alternative imaging modality that can accurately quantify the severity of MR (9–11). Using MRI, we previously demonstrated a tight coupling between regurgitant volume and LV end-diastolic volume (EDV) in patients with chronic primary MR (12). This is consistent with the notion that LV enlargement is an important compensatory mechanism that augments stroke volume and maintains constant forward flow in the setting of MR (13,14).

Previous studies have shown that after mitral valve (MV) repair or replacement, the left ventricle decreases in size as it remodels (15–18). The purpose of this study is to compare MRI with echocardiography in the assessment of MR severity and to determine the extent to which these modalities can predict the degree of LV remodeling after isolated MV surgery.

METHODS

This prospective multicenter study included 103 patients (age 61 ± 14 years, 57% male) with MR on echocardiography. Patients were recruited from the echocardiography laboratories of the participating institutions and from physician referrals. Exclusion criteria included more than mild aortic regurgitation, aortic stenosis, or mitral stenosis; planned coronary revascularization; intracardiac shunt; hypertrophic cardiomyopathy; pregnancy; and contraindication to MRI. Patients with incomplete or suboptimal echocardiographic studies were excluded. The institutional review board of each participating institution approved this research protocol.

ECHOCARDIOGRAMS. Echocardiograms were obtained and viewed using commercially available ultrasound machines (Acuson Sequoia, Siemens, Mountain View, California; iE33 xMATRIX, Philips, Andover, Massachusetts) and software (ProSolv, Fujifilm, Indianapolis, Indiana). Comprehensive echocardiograms were obtained to allow an integrated approach to the assessment of MR severity, as recommended by the ASE (8). Components included were mitral regurgitant jet dimensions, regurgitant volume and regurgitant orifice area calculated using the proximal isovelocity surface area (PISA) technique, mitral E wave, vena contracta, left atrial volume, LV dimensions, and pulmonary vein systolic flow characteristics. Transthoracic echocardiograms were acquired using the standard imaging views: parasternal long and short axes and the apical 2-, 3-, and 4-chamber views. Transesophageal echocardiograms were acquired in patients (n = 38, 37%) when the transthoracic evaluation was inadequate or technically difficult or when there was a need to further define MV morphology (1). Color Doppler interrogation of the MR jet was performed in multiple views. Vena contracta was measured in the modified parasternal long-axis view as the narrowest portion of the jet (8). PISA was measured in the apical 2-, 3-, and 4-chamber views with the lower Nyquist limit set at 32 to 42 cm/s and zoomed in on the area of flow convergence (8). Peak MR jet velocity and velocity time integral were determined using continuous-wave Doppler across the MV (8). MR volume and effective regurgitant orifice area were calculated based on the PISA measurement as previously described (8). For eccentric MR jets, angle correction was applied to improve the accuracy of the effective regurgitant orifice area and the regurgitant volume quantification (19). Pulmonary vein systolic flow was recorded using pulsed-wave Doppler interrogation of the right upper pulmonary vein and left-sided veins when possible (8). Pulmonary vein flow was categorized as either systolic predominant, systolic blunting, or systolic reversal (20). Mitral inflow velocities were determined per ASE guidelines (20). LV volumes were determined using the modified Simpson biplane method (21). Tricuspid regurgitant velocity was measured as the highest peak continuous-wave Doppler velocity as determined in multiple views. MV prolapse was defined as an abnormal systolic

ABBREVIATIONS AND ACRONYMS

ASE = American Society of Echocardiography
CI = confidence interval
EDV = end-diastolic volume
FOV = field of view
ICC = intraclass correlation coefficient
LV = left ventricular
MR = mitral regurgitation
MRI = magnetic resonance imaging
MV = mitral valve
PISA = proximal isovelocity surface area
TR/TE = repetition time/echo time