Circulation: Cardiovascular Imaging

EDITORIAL

Exercise Stress Echocardiography in Degenerative Mitral Regurgitation

Back to the Origins

See Article by Utsunomiya et al

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The origins of current understanding of hemodynamics and of their echocardiography-based assessment are cardiac catheterization diagnostic techniques. Cardiac catheterization was essential for hemodynamic assessment and diagnosis in the 1950s and 1960s, and it was the gold standard for the validation of Doppler echocardiography developments in the 1980s and 1990s.[1] Furthermore, the assessment of hemodynamics during exertion began with cardiac catheterization[2] only to evolve substantially with echocardiography because of the noninvasive nature of this modality, making it more practical and easy to repeat at follow-up. The study of Utsunomiya et al[3] represents a return back to the origins, revalidating echocardiographic measures of pulmonary pressure and cardiac output during exercise with simultaneous cardiac catheterization and echocardiography in patients with degenerative mitral regurgitation. Echocardiography remains the first-line tool for the assessment of pulmonary artery pressure; however, current guidelines[4] lead to a return back to the origins, recognizing the limitations of echocardiography and, consequently, increasing the role of right heart cardiac catheterization at rest. Nevertheless, during exertion, Utsunomiya et al[3] found good agreement between echocardiographic and invasive measures of pulmonary artery pressure, of cardiac output, of pulmonary vascular resistance, and right ventricular contractile reserve, revalidating the use of supine bicycle stress echocardiography in primary mitral regurgitation. The aim of their study was not to validate exercise echocardiography but to define the mechanisms of exercise intolerance in hemodynamically significant primary mitral regurgitation.

Exercise intolerance and exertional symptoms represent a class I indication for intervention in patients with severe primary mitral regurgitation[5–7] and can be unmasked in asymptomatic patients with exercise testing alone or when combined with echocardiography.[8,9] Echocardiography adds the benefit of concomitant assessment of mitral regurgitation,[10,11] left ventricular and right ventricular functional reserve,[12,13] and pulmonary pressure[14,15] responses during exercise. An increase in the severity of mitral regurgitation,[11] lack of contractile reserve,[16] and systolic pulmonary arterial pressure rise to >60 mm Hg,[14] as well as exercise-induced right ventricular systolic dysfunction,[15] were found to have predictive value for the development of symptoms or other indications for intervention. Utsunomiya et al[3] focused on identifying parameters that correlate with exercise intolerance rather than predict it. They found exercise intolerance to correlate not only with dynamic mitral regurgitation and pulmonary hypertension but also with chronotropic incompetence, pulmonary vascular reserve (mean pulmonary artery pressure to cardiac output ratio slope), and right ventricular contractile reserve (tricuspid annulus plane systolic excursion to systolic pulmonary artery pressure ratio slope; Figure). Overall, the level of increase in

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pulmonary artery pressure depends on the right ventricular function, the ability to successfully recruit the pulmonary vasculature to accommodate the increased blood flow with exercise, the contribution (or proportion) of the reduction in the cross-sectional area of the pulmonary circulation, the changes in pulmonary vascular compliance, resistance and impedance, and the increase in left atrial pressure. In practice, parameters of pulmonary vascular reserve and right ventricular contractile function are relatively easy to calculate and add to a valve stress echo protocol in primary mitral regurgitation. Nevertheless, further evidence from a larger study of asymptomatic patients with severe mitral regurgitation is needed, before recommending routine use of these parameters in clinical practice.

An important contribution of this study is the addition of cardiopulmonary exercise testing to hemodynamic assessment, providing the benefit of an objective measure of exercise tolerance: the peak oxygen consumption (VO_2).[17] The addition of cardiac catheterization to echocardiography during exercise testing is impractical and demonstrated by this study to be unnecessary as well. However, cardiopulmonary exercise testing can be easily combined with echocardiography. Cardiopulmonary exercise testing was introduced in clinical practice[18] well before exercise echocardiography and using it to determine exercise tolerance represents as well a return back to the origins of diagnostic assessment. The detection of symptoms or exercise intolerance can be challenging not only in sedentary patients but also in patients used to physical exercise, who are less likely to complain of symptoms during usual daily activities. Admitting to symptoms depends on personality, mood, culture, idiosyncrasy, cognition, literacy, and socioeconomics.[17] The need for objective measures of exercise tolerance to inform the timing of intervention is particularly well recognized in degenerative mitral regurgitation, predominantly in young patients with valve morphology suitable for successful durable repair, likely to benefit from early mitral valve surgery.[5–7] Exercise tolerance depends on the ability of the cardiovascular system to increase oxygen supply during exertion, according to the increase in oxygen consumption, by increasing cardiac output; therefore, the peak oxygen consumption corresponds to the maximal exercise tolerance.[17] Cardiopulmonary exercise testing has been used for a wide range of applications, from determining the exercise tolerance of trained athletes to the assessment of heart failure patients. Returning back to the origins of physiological assessment, cardiopulmonary exercise testing may begin to play an important role in the timing of intervention in asymptomatic patients with valvular heart disease.

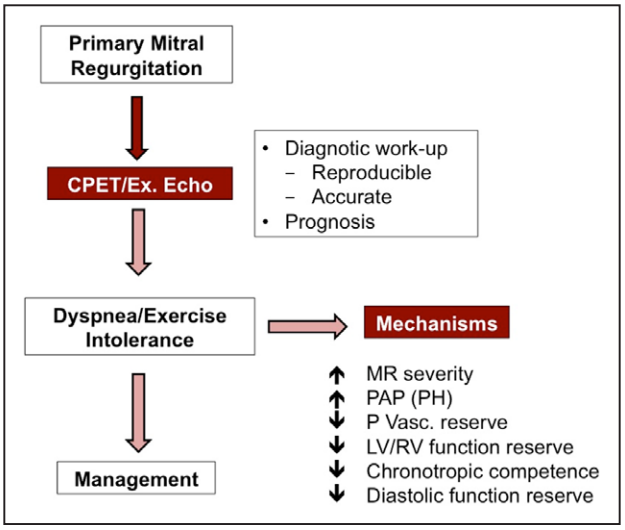

Figure. Role of exercise testing in patients with degenerative mitral regurgitation (MR). CPET indicates cardiopulmonary exercise test; Ex, exercise; LV, left ventricle; PAP, pulmonary artery pressure, PH, pulmonary hypertension; RV, right ventricle; Vasc, vascular; VO_2, peak oxygen consumption. Exercise intolerance: predicted peak VO_2<70%, limited workload.

ARTICLE INFORMATION

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Disclosures

None.

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