Two myths have been prevalent regarding heart valve disease: that the valves are simply mechanical flaps, and that the importance to the patient of regurgitation in particular relates almost entirely to ventricular function only. The paper in this issue of JACC: Cardiovascular Imaging by Han et al. (1) provides a more comprehensive picture that counterbalances these concepts.

The investigators set out to characterize mitral valve prolapse (MVP) by cardiovascular magnetic resonance (CMR) imaging, and found it could match the diagnostic sensitivity and specificity of transthoracic echocardiography. The 3-dimensional (3D) CMR image can be sectioned in a parallel series of long-axis views to analyze segmental anatomy and provide a "road map" for repair (2). There are several messages from this study pertinent to cardiovascular imaging: 1) Understanding the basic principles of image acquisition affects interpretation of results—CMR provides a blunted measure of leaflet thickness and, to a lesser extent, leaflet length, likely caused by a partial volume effect from surrounding blood pool. 2) Three-dimensional acquisitions achieve their maximum value by providing not only 3D images but also spatially registered 2D views to explore segmental anatomy, as displayed admirably by O’Gara et al. (3) for 3D transesophageal echocardiography in the March issue of JACC: Cardiovascular Imaging. The 3D acquisition has therefore contributed in many ways to our understanding of mitral valve disease, including improved diagnostic specificity, inspiration for annuloplasty ring design, and analysis of valve mechanics based on showing the 3D saddle shape of the valve (4–10). A caveat is that the most useful segmental anatomy may be best derived from nonparallel views transecting the mitral coaptation line to intersect opposing central, medial, and lateral segments of both leaflets derived from a 3D scout view (3,11).

The greatest novelty comes from the deeper and more profound look that CMR provides into the biology of the valve and its linked myocardium, made possible in part by a technological advance, the improved spatial resolution provided by 3D acquisition of images with delayed gadolinium (Gd) enhancement. Such enhancement occurs when the kinetics of Gd excretion is different in 2 adjacent compartments, so that over time, one compartment enhances more than the other. This has been a powerful tool for delineating infarcted and scarred myocardium, which excrete Gd slower than viable tissue (12–15). Han et al. (1) report frequently delayed Gd enhancement in both the mitral leaflets themselves and the papillary muscle (PM) tips in patients with MVP and not in control subjects. This complementary and unique tissue characterization requires further exploration, but indicates biological differences in both the valve tissue and the myocardium directly linked to it.

Delayed Gd enhancement reinforces understanding of the myxomatous valve as one in which the processes of altered cell and extracellular matrix biology, normally quiescent in adult life, are reactivated (16,17). Noninvasive imaging may therefore be of value in confirming such intrinsic changes, with potential for strengthening phenotypic characterization in genetic studies of familial MVP...
Mitral valve disease is therefore not a bystander but a primary actor in the entire clinical picture. We have recently recognized that mitral regurgitation plays an independent role in altering the biology of the remodeling ventricle after myocardial infarction (33,34), and strongly determines prognosis in the non-ischemic setting as well (35,36). This CMR study suggests a direct impact of the prolapsing valve on a ventricular structure. The PM damage may in turn exacerbate prolapse in a vicious cycle, potentially explaining the frequently observed but as yet unexplained mid to late systolic onset of leaflet displacement, characteristic of the yield stress phenomenon in mechanical engineering in response to a critical threshold overcoming a counteracting force (Ajit P. Yogananthan, PhD, personal communication, 1996). In summary, the study by Han et al. (1) reinforces a new way of thinking of standardizing cardiovascular imaging based on exploring 3D images in registered 2D views. It provides a deeper and more profound look into valve biology and the impact of valvular heart disease on the myocardium to which it is inseparably linked, with the potential to monitor, understand, and ultimately treat underlying pathophysiological mechanisms.

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Reprint requests and corresponding author: Dr. Robert A. Levine, Massachusetts General Hospital, Cardiac Ultrasound Laboratory, Yawkey 5-068, 55 Fruit Street, Boston, Massachusetts 02114. E-mail: rlevine@partners.org.
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