Sizing the Mitral Annulus
Is CT the Future?*
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The first surgical mitral annuloplasty using a bioprosthesis was performed in 1968 (1). Since that time, our understanding of mitral valve anatomy has increased due to enhanced imaging modalities, such as 2- and 3-dimensional (3D) echocardiography, magnetic resonance imaging, and computed tomography (CT). The mitral valve annulus has a dynamic 3D saddle shape with the maximum height of the saddle in the middle of the anterior part of the annulus, another rise along the posterior leaflet, and the deepest point at the commissures or fibrous trigones (2).

Mitral regurgitation (MR) is the second most common valvular heart disease and is divided into primary (also known as degenerative) and secondary (commonly referred to as functional). Primary MR is associated with excessive motion of the mitral valve leaflets, which are frequently myxomatous, chordal elongation or rupture, and dilation of the mitral annulus. Secondary MR may occur as a result of an ischemic or dilated cardiomyopathy with tenting or restriction of the mitral valve leaflets and annular dilation (3). The traditional surgical approach to either type of MR has been predominantly mitral repair with annuloplasty. Sizing of the mitral annulus is performed intraproactively according to 3 measures (intertrigonal distance, intercommissural distance, and surface of the anterior leaflet) and confirmed with the use of a sizer inserted into the annular space (4).

In this issue of JACC, Naoum et al. (5) described CT analysis of the mitral annulus in patients with moderate to severe MR using a D-shaped segmentation method. This technique has been previously published by the researchers and involves imaging the mitral annulus and then excluding the anterior peak to result in a more planar structure with reduced annular height (6). The posterior peak remains the same, as does the distance between the fibrous trigones, resulting in a D shape.

The goal of such analysis would be to optimize sizing for future transcatheter mitral valve implantation and minimize left ventricular (LV) outflow tract obstruction. In the current retrospective study, the investigators compared patients with significant MR with control subjects with no previous cardiac history. Using this technique, the mitral annuli of patients with either primary or secondary MR were larger than those of controls. Patients with primary MR were found to have larger mitral annuli than those with secondary MR despite larger LV volumes in the latter group (5). These findings are consistent with previous echocardiographic data, which demonstrated larger annular dimensions in mitral valve prolapse/flail compared with ischemic MR despite significantly greater LV dilation in the ischemic group, illustrating that annular remodeling can occur independently of LV remodeling (7).

Previous 3D echocardiographic studies have demonstrated that although annular dimensions may be similar in patients with dilated LV, even in the absence of secondary MR, those with secondary MR were more likely to have enlargement of the anterio-to-posterior diameter (8,9). This was also demonstrated in the current study; however, the differences were not found to be statistically significant. Naoum et al. (5) also suggested that secondary MR was more likely to be associated with dilation of the left atrium. These findings should be interpreted with some caution, given the low numbers of patients with secondary MR (n = 27), particularly those with non-ischemic cardiomyopathy (n = 8).

Evaluation of the mitral annulus using CT is not new; in fact, a previous smaller study compared mitral annular assessment of patients with secondary...
MR and normal controls with similar findings, but without truncation of the anterior peak (10). The challenge with both of these reports is the lack of comparison with 3D echocardiography, which has been used both pre-operatively and intraoperatively to evaluate mitral annular geometry (11–13). 3D transesophageal echocardiography has been demonstrated to be superior to 2-dimensional imaging of the mitral valve in the assessment of MR severity and anatomic evaluation and provides real-time imaging of the mitral valve in systole and diastole and assessment of annular dynamics without the use of ionizing radiation (14,15). In addition, 3D transesophageal echocardiography is recommended by the American Society of Echocardiography for the guidance of percutaneous procedures and is extensively used in transcatheter mitral leaflet repair (16).

Changes in the mitral annulus in the setting of MR are complex and include not only dilation but also flattening, which may be more regional depending on the underlying pathology (e.g., ischemic cardiomyopathy). The CT assessment described in the current paper, although intended for future transcatheter techniques, may represent an oversimplification of the mitral annulus, but it is too early to know. Ideally, comparisons with 3D echocardiography should be made to further correlate the 2 assessments and establish a gold standard. Ultimately, additional evaluation of this technique is required to establish normal ranges and understand the impact of MR from various pathologies on these measures prior to widespread use.

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REFERENCES


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