



Editorial

Mitral annulus enlargement in mitral regurgitation: Look to the north

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Mitral regurgitation (MR) remains the most common valvular heart disease encountered in clinical practice. Clinically significant MR results from a diverse range of pathology, categorized into primary (degenerative) MR resulting from abnormalities of the mitral valve leaflets or secondary (functional) MR resulting from abnormalities of the left ventricle (LV) and/or mitral annulus. Patients with primary MR may have leaflet prolapse with or without a flail segment and can also display concomitant elements of secondary MR. Pure secondary MR has traditionally been attributed to LV enlargement and dysfunction that subsequently results in leaflet tenting, mitral annular enlargement and leaflet malcoaptation [1]. The mitral annulus, part of the fibrous cardiac skeleton, connects the left atrium (LA) with the LV and is intimately involved in pathologic conditions that may affect either of these chambers.

In the current era of intense interest and investigation in the field of transcatheter mitral valve repair and replacement, a detailed understanding of the mechanism of MR and optimal methods of sizing the mitral annulus have become increasingly important. There exists a critical need to accurately size transcatheter devices to fit a complicated, dynamic, three-dimensional (3D) and non-planar mitral annulus. Furthermore, preventing the development of secondary MR, a disease with an adverse prognosis and limited therapeutic options is a high priority.

In this issue of International Journal of Cardiology, Boilève et al. performed an elegant 3D TEE imaging analysis to determine whether mitral annular area is affected more by LA vs. LV size in 5 groups of patients: AF, primary MR, secondary MR, mitral stenosis and a control group of patients in sinus rhythm without mitral valve disease [2]. 3D analysis of the mitral annulus was performed in end-diastole using offline software, while LA volume was measured in end-systole using the biplane area-length method. End-systolic and end-diastolic LV volumes were measured using the Biplane Simpson method. The largest annular areas were found in patients with primary MR ($18.2 \pm 4.5 \text{ cm}^2$ vs. 16.3 ± 3.9 in patients with secondary MR). Left atrial volume was

also the largest in the primary MR group ($97 \pm 59 \text{ mL}$). On linear correlation analysis, mitral annulus area was significantly correlated to both LV end diastolic volume ($r = 0.42$, $p < 0.0001$) and LV end systolic volume ($r = 0.29$, $p = 0.001$), but more closely to LA volume ($r = 0.62$, $p < 0.0001$). The findings were similar in the control group of patients without mitral valve disease or atrial fibrillation.

The finding that the mitral annulus size is most closely related to left atrial volume is particularly interesting since secondary MR is often believed to represent a disease of the LV primarily, yet the annular enlargement in these patients was more related to LA size rather than LV dimensions. On the contrary, when examining the secondary MR subset only, MA-area was not significantly correlated with LV end systolic or end diastolic volume, which raises questions about our understanding of the pathophysiology of secondary MR. Could the atrial enlargement be an important step in the mechanism of MR in secondary MR patients? These results are believable given that in clinical practice we encounter a different subset of patients with “atrial MR” who have severe MR that appears to be solely due to enlargement of the LA in absence of leaflet or LV abnormalities. Not explored in this study, yet an important consideration is the relative impact of mitral leaflet remodeling in various disease states, which plays a role in reduced leaflet coaptation and subsequent regurgitation.

This study also highlights the value of 3D imaging modalities for the assessment of complex cardiac anatomy and pathology. Given the close proximity of the mitral valve to the esophageal imaging window, 3D TEE provides high resolution images of the mitral annulus, leaflets, and subvalvular apparatus. 3D imaging gives us an opportunity to more fundamentally understand the various mechanisms of mitral regurgitation but also to more accurately size the annulus prior to possible transcatheter valve implantation. A comprehensive understanding of mitral annular remodeling, mitral leaflet remodeling, and subvalvular anatomy is critically important to pinpoint the mechanism of mitral regurgitation in various pathologic states, allowing for more targeted, patient-specific repair techniques.

The observation that mitral annular enlargement appears to be more closely linked to LA size than LV size is fascinating and deserves further exploration. As the authors acknowledge, a causal link cannot be determined between LA and mitral annulus size and this study only confirms association. Future studies may examine patients with “atrial MR” to look at the range of LA size and LV dimensions and another group of patients with diastolic dysfunction alone (without atrial fibrillation or mitral valve disease) to determine the range and extent of association between LA and mitral annulus size. Finally, incorporating measurement of leaflet area in combination with annular and chamber

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quantification may also yield important observations to help us further understand the mechanism of MR. Until then, when we see mitral annulus enlargement we should “look to the north”, that is the chamber to the north (the left atrium), where great promise and discoveries await.

Conflict of interest

The authors report no relationships that could be construed as a conflict of interest.

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