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Commentary: The importance of annulus in percutaneous mitral valve repair

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Principles for a successful and durable mitral valve repair include the preservation or restoration of normal leaflet motion, creation of a large surface of coaptation, and stabilization of the entire annulus with a remodeling annuloplasty.¹ Resection techniques and the use of artificial neochordae are the most common techniques associated with excellent long-term results. In the early 1990s, Alfieri and colleagues^{2,3} proposed an effective and reproducible technique that restores mitral valve competence through a “functional” rather than an anatomic repair. The Alfieri stitch or edge-to-edge technique involves a suture approximation of anterior and posterior mitral leaflets (double orifice) and has been adopted in different settings of mitral regurgitation (MR). It was used in developing the MitraClip system

CENTRAL MESSAGE

Annuloplasty is a primary component in mitral valve repair. MitraClip does not address the problem of annulus dilatation in chronic mitral regurgitation.

(Abbott Vascular, Temecula, Calif), the most common device used for the percutaneous treatment of MR.

Despite a simple concept, the edge-to-edge technique requires detailed echocardiographic information to avoid failure. One of major concerns associated with this procedure is the risk of mitral stenosis, especially if multiple clips are required to correct MR. Theoretically, the greater number of clips used, the higher the risk of developing a mitral valve gradient (MVG). In the MITRA-FR (Percutaneous Repair with the MitraClip Device for Severe Functional/Secondary Mitral Regurgitation) and COAPT (Cardiovascular Outcomes Assessment of the MitraClip Percutaneous Therapy for Heart Failure Patients with Functional Mitral Regurgitation) trials, the percentage of patients requiring at least 2 MitraClips was 54.3% and 61.5%, respectively.^{4,5} However, to date, no data have been reported on MVG.

In this issue of the *Journal*, Gooden and colleagues⁶ investigated the hemodynamic performance of the mitral

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valve after the implantation of multiple clips. In an acute MR porcine model assessed in vitro with a left heart simulator, MVG, MR fraction (MRF), and effective orifice area (EOA) were evaluated after implantation of 1 or 2 MitraClips and compared with a model without clips. Interestingly, the addition of a second clip was associated with improved MRF without a change in the MVG. However, EOA was decreased, albeit not statistically significantly so.

This interesting study concludes that there is a low risk of mitral stenosis when a second clip is added. Nevertheless, these results require careful interpretation, for several reasons. First, this study was performed with an acute model of MR achieved by cutting the chordae tendineae, where the annulus and left ventricular dimensions were apparently normal. Chronic MR is often associated with annulus dilatation and some degree of left ventricular dilatation. Consequently, the hemodynamic performance of valve with MitraClips might be different from that seen in the acute setting. Second, the estimation of annular and area dimension is considered a key element for a successful mitral valve repair. An echocardiographic study revealed that preprocedural mitral valve orifice area, anteroposterior and mediolateral mitral annular dimension were larger in patients with a mean MVG ≤ 4 mm Hg than in patients with MVG > 4 mm Hg after implantation of 1 or 2 clips. Interestingly, mitral valve orifice area was strongly associated with low MVG after 1 clip, but after 2 clips, the mediolateral annulus diameter more accurately predicted MVG compared with orifice area.⁷ In addition, an edge-to-edge procedure is contraindicated in small annuli.³ Third, EOA should be always related to body surface area (EOAi). Two patients with same EOA may have different EOAI values; the greater the body surface area, the lower the EOAI. In mitral valve replacement, an EOAI ≤ 0.9 cm²/m² was associated with higher pulmonary pressure and right-sided failure and poor survival.⁸

Fourth, the lack of annuloplasty is a limitation of the MitraClip procedure. In chronic MR, the annulus loses its physiological geometry and becomes flattened and more spherical. According to Carpentier and colleagues,⁹ annuloplasty is a primary component in mitral valve repair because it restores the 3:4 (vertical:transverse) annular physiological relationship and prevents future annular dilatation.⁹

The absence of annuloplasty is likely associated with increased stress on the sutures and on the valve apparatus, leading to accelerate failure of the repair.¹⁰

Finally, the mitral valve apparatus is a complex structure that requires timely coordination of the left ventricle, papillary muscles, chordae tendineae, and mitral annulus to achieve competent valve closure.¹¹ The Mitraclip addresses only 1 aspect of the mitral apparatus. Furthermore, secondary MR is a related to a ventricular disease rather than mitral valve disease.

Our findings indicate that MitraClip is an useful tool for the treatment of severe MR only in older patients with severe comorbidities that increase their surgical risk or have prohibitive risk of operation. However, the addition of a percutaneous mitral annulus ring might change the clinical scenario.

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