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## Commentary: Papillary muscle relocation for secondary mitral regurgitation: A never-ending story

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Secondary (functional) mitral regurgitation (MR) is a well-described pathophysiological entity as a result of left ventricular dysfunction, dislocation of papillary muscles, and subsequent tethering of the mitral leaflets. Various operative techniques have been proposed with the aim to correct the altered mitral valve apparatus at different levels using undersizing annuloplasty alone or in conjunction with papillary muscle relocation or even with chordal cutting. However, all of these therapeutic options have been associated with early or late recurrence of MR and most of them were abandoned. The Cardiothoracic Surgical Trials Network<sup>1</sup> demonstrated that repairs with annuloplasty fail, thus replacement is warranted. But when patients with a durable repair in this study were compared with replacement, their 2-year mortality was 9% versus 23% and their left ventricular end systolic diameter was 44 mm versus 65 mm. Probably, when durable surgical repair could be achieved, it would still be associated with better outcome compared with replacement. The debate is how to determine candidacy for mitral repair, and eventually how to surgically treat these patients with functional MR.

In a very interesting article, a group from Atlanta propose a biomechanical study to close this gap.<sup>2</sup> The authors developed a chronic swine model of ischemic MR to test the hypothesis that papillary muscle approximation (PMA) relieves tethering forces and improves coaptation geometry and hemodynamics.<sup>2</sup> Results demonstrated that PMA relieves tethering forces (reduced tenting area to

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### CENTRAL MESSAGE

Correcting the subannular apparatus in secondary mitral regurgitation makes the difference.

$27.31 \pm 43.38 \text{ mm}^2$ ) and, when added to annuloplasty, restores physiological leaflet mobility and significantly reduces the regurgitant fraction (from 16.3% to 3.7%).

In comparison to previous studies on the same subject, the article has the merit to:

- Be translational. Other evidence-based studies like that from Hvass and colleagues,<sup>3</sup> Nappi and colleagues,<sup>4</sup> and Fattouch and colleagues<sup>5</sup> reported favorable results when acting on papillary muscles, but all of them were retrospective clinical series based on the limitations coming from surgical practice. The study from Zhan-Moodie and colleagues<sup>2</sup> is the first to provide the mechanistic basis for adopting PMA.
- To test the mitral valve under different conditions. At baseline, after induction of a functional MR, after undersizing annuloplasty (to 30 mm and 26 mm), and after concomitant PMA with both ring sizes. This meticulous approach corroborates the initial hypothesis and demonstrates the effectiveness of adding PMA without the need for extensive annular downsizing.

Despite all these interesting aspects, the possibility to correct severe functional MR should also consider the lack of data on long-term durability and the widespread availability of less-invasive transcatheter devices. The Cardiovascular Outcomes Assessment of the MitraClip Percutaneous Therapy Trial for patients with secondary MR demonstrated improvement in survival, hospitalization, symptoms, and quality of life in patients with persistent symptoms and left ventricle dysfunction (mean left ventricular end-systolic dimension,  $52 \pm 9 \text{ mm}$ , mean left ventricular end-diastolic dimension,  $62 \pm 7 \text{ mm}$ , left ventricular ejection fraction between 20% and 50%, and mean effective regurgitant orifice area,  $0.31 \text{ cm}^2$ ) compared with those randomized to medical therapy.<sup>6</sup> These important facts could justify

a first reconstructive attempt on the mitral valve using a less-invasive approach instead of a more-invasive open procedure, regardless of the duration of the result.

Similar experimental studies should always be encouraged in the surgical community to support the efficacy of new treatments, but to be effective, results should also be translated into clinical practice and validated over time. In the meantime, surgical treatment of secondary MR should follow the recommendations of practice guidelines<sup>7</sup> and chordal-sparing mitral valve replacement be preferred over repair.

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