BIOMECHANICS OF FAILED ISCHEMIC MITRAL VALVE REPAIR: DISCOVERING NEW FRONTIERS

To the Editor:

We had the pleasure of reading “Repairing the Mitral Subvalvular Apparatus: The New Frontier,”¹ and we would like to share our thoughts on this argument. The surgical management of moderate and severe ischemic mitral regurgitation (IMR) has still not provided a definite solution to this life-threatening condition. Failure of mitral repair has a not-negligible occurrence, as demonstrated by the increasing introduction of transcatheter valve therapy to solve the issues of patients who require reintervention. Why is the treatment of failed mitral repair considered a “bête noire” for the cardiac surgeon?

The surgical treatment of IMR requires peremptorily complete surgical revascularization and a valve repair or replacement.^{2,3} In the Cardiothoracic Surgery Network study, mitral regurgitation recurrence was significantly higher in patients who underwent coronary artery bypass grafting alone at 2 years, and mitral regurgitation recurrence had a significant negative impact on left ventricular end-systolic stroke volume index and reverse remodeling (47.8 ± 20.8 mL vs 36.3 ± 15.1 mL in patients without mitral regurgitation recurrence; $P = .001$),⁴ indicating that an approach of coronary artery bypass grafting alone provides only a partial resolution of IMR pathophysiology and translates into less than long-lasting effects on global and local remodeling. The high mitral regurgitation recurrence rate also seen in the undersizing annuloplasty group, however, highlights the presence of unconsidered factors profoundly influencing the end results of this procedure. Several studies are currently pointing at the benefits of adding subvalvular repair to undersizing annuloplasty, with the rationale of correcting the geometric alteration affecting the left ventricle and equalizing the balance between closing and tethering forces, along with revascularization.¹⁻³

We previously reported that a double-row overlapping suture to undersize mitral posterior annuloplasty was associated with a low risk of mitral regurgitation recurrence

at 18 months’ follow-up in a randomized comparison with a simple row suture. This produced durable reduction of the anteroposterior diameter and increase in the coaptation length because of anterior relocation of the coaptation point. Nevertheless, long-term follow-up at 5 years would be needed to demonstrate its clinical benefit.⁵ Addressing the parameters of coaptation and tenting, along with left ventricular geometry, by an action on the papillary muscle might be considered a further advance in the development of this new paradigm in surgical care of IMR, represented by subvalvular apparatus surgery.

We agree with Charles and Kron¹ that a “reductionist” approach to IMR repair is no longer acceptable. We have therefore developed a biomechanical model aimed at tailoring the type and extent of the subvalvular surgical approach in each case.⁶ The geometric variables inserted in the model actually reflect the parameters normally characterizing the type and degree of IMR involved in the surgical decision making at the time of the operation (anteroposterior diameter of the mitral annulus, tenting height associated with tenting area, postoperative interpapillary distance, and papillary muscle displacement resulting from their approximation).⁶ In our group, we are currently investigating the application of this model to the clinical scenario, and we believe that the results of this approach may yield an answer to the current issues of IMR surgery, providing a basis to predict outcomes of repair procedures and assist physicians’ discussions with patients about the risks, benefits, and expectations of surgical treatment of IMR.

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WHICH ISCHEMIC MITRAL VALVES SHOULD BE REPAIRED AND HOW? TIME WILL TELL

Reply to the Editor:

We enjoyed reading the letter to the Editor “Biomechanics of Failed Ischemic Mitral Valve Repair: Discovering New Frontiers” by Nappi and Spadaccio,¹ and appreciate the opportunity to comment further. Ischemic mitral regurgitation (IMR) is without question a nuanced disease process that encompasses a complex pathophysiology. The Cardiothoracic Surgical Trials Network (CTSN) completed 2 multicenter, randomized IMR trials that improved our understanding of appropriate treatment for moderate and severe regurgitation, but there are still many unanswered questions.^{2,3} Drs Nappi and Spadaccio are attempting to answer some of those questions with their work on papillary muscle approximation and the subvalvular apparatus.⁴

When discussing IMR, it is important to clarify the severity of regurgitation using a standardized technique for evaluation. When conducting the IMR trials, the CTSN used criteria recommended by the American Society of Echocardiography for defining moderate versus severe regurgitation.⁵ Combining multiple degrees of IMR together minimizes the complexity of this ventricular disease process and limits the validity of research findings.

In the CTSN’s severe IMR trial, the rate of recurrent moderate or severe mitral regurgitation at 2 years was lower in the replacement group compared with the repair group (3.8% vs 58.8%, $P < .001$), but there were no significant differences in 2-year survival or degree of reverse remodeling.³ Of note, patients who were repaired without recurrence had very good outcomes. This brings up 2 new questions that need to be addressed: How do we determine which patients will benefit from repair and how do we identify the best repair strategy for each patient? With new repair techniques and better patient selection, we can significantly advance the management of IMR.

We applaud Drs Nappi and Spadaccio on the development of their biomechanical model for predicting the type of subvalvular approach that should accompany each mitral valve repair. This type of scientific solution may allow us to tailor our repair strategy depending on the specific geometric characteristics of each valve and subvalvular apparatus. We look forward to the application of this model in the clinical scenario to determine whether outcomes after repair can be improved. Predicting how to repair IMR on an individualized basis will allow for more patients to avoid recurrence, and hopefully that will translate to an improvement in long-term outcomes.

The results of the moderate and severe IMR trials conducted by the CTSN have been helpful in shaping the discussion regarding IMR management. In both trials, it cannot be overlooked that there were no survival differences between groups at 2 years.^{2,3} Although it would be nice to worry about the degree of recurrence only, patient-centered outcomes such as survival and quality of life are the true definition of success. Randomized clinical trials with extended follow-up are necessary to obtain such results. Restrictive annuloplasty with an individualized approach to the subvalvular apparatus is a logical solution to prevent recurrence of mitral regurgitation and provide long-term, meaningful outcomes.

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