ventricular arrhythmias who required an esophagectomy for persistent bleeding and sepsis. Because of the patient's hemodynamically compromised status and sepsis at the time of operation, I did not oversee the gastric staple line. The lesser curve staple line dehiscence 2 weeks later, which I attributed to a combination of diabetes, peripheral vascular disease, hypotension at time of operation, and sepsis. The staple line along the lesser curve of the stomach separated for almost its entire length. The patient was treated with reoperation including muscle flap closure and drainage. The dehiscence was eventually healed, and she was discharged, but she returned within several months and eventually died of respiratory failure.

Based on this experience, I agree with the authors' recommendations to oversee all gastric staple lines.

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Ring, string, chordal cutting: All or nothing?

To the Editor:

We read with interest the article by Langer and Schäfers.¹ We congratulate the authors

for performing this study regarding this on-focus topic. This new procedure described is a step forward in the surgical treatment of ischemic mitral regurgitation (IMR). Nevertheless, we would like to point out the following issues.

The first issue is regarding the patient population; indeed, 12 patients presenting with severe IMR ($\geq$ level III) were included in the study. Unfortunately, the follow-up showed unfavorable evolution of the mitral regurgitation despite the surgery in this category of patients.² It is therefore difficult to evaluate the benefit of this procedure in such a patient population. We believe that moderate IMR at rest worsened on exercise could be the best indication.

Second, the nature of IMR treated is highly important to point out. Acute IMR with a high troponin level should be distinguished from chronic IMR to correctly analyze the outcomes. The benefit of mitral surgery in comparison with myocardial revascularization is difficult to evaluate in acute IMR.

The third remark is related to the nature of the tenting mechanism itself: Was it an anterior or anterior and posterior mitral valve tenting phenomenon?

The interpretation of echocardiographic results is also of great importance. The short-term reported results are interesting. Residual mitral regurgitation varied between levels 0 and I by combining the "ring and string" procedure. Nevertheless, these results should be evaluated on exercise for 2 reasons. First, the myocardial behavior on effort could be different than at rest, despite myocardial revascularization.³ Second, the small diameter of mitral rings used in this study (average of 28 mm) needs to

be evaluated on exercise to measure the gradients and to eliminate any tendency to mitral stenosis that could be associated to the small diameter of used rings.

Inspired by Messas and colleagues' work,⁴ we previously reported the first clinical case of chordal cutting through aortotomy⁵ (Figure 1). Since then, we have performed this procedure in patients using the same method with and without associating annuloplasty in chronic IMR with anterior leaflet tenting. In all cases this procedure considerably reduced the tenting phenomenon. All patients were evaluated postoperatively by exercise treadmill echocardiography protocol, showing favorable results. Therefore, "chordal cutting" should be considered as an effective technique to treat IMR because our results show the feasibility, the effectiveness (consistent reduction of IMR), the absence of secondary marginal chordal rupture, and the absence of delayed ejection fraction alteration. One of the explanations for this favorable effect could be the avoidance of undersizing mitral annulus strategy that we have adopted, allowing optimal opening of the anterior mitral leaflet.

The main advantage of the "string" technique is to offer a "seat belt" for the left ventricle, limiting deleterious remodeling. Therefore, this technique could be considered complementary to the "chordal cutting," especially because both could be achieved through aortotomy.

The multiplication of surgical treatment options offered in case of IMR clearly shows that it is still a difficult and highly debated subject that is far from being closed. None of the isolated reported techniques are subject to

Figure 1. Operative view, before chordal cutting procedure, through aortotomy showing the retracted anterior mitral valve and the anterior (A) and posterior (B) basal chordae (1). The coronary and noncoronary aortic leaflets (stars).

consensus to date. The factors involved in the postoperative regression of IMR are too complex and numerous to be attached to a given procedure. Thus, the association of all these techniques may represent the best approach to treat this pathology. We should not forget that some colleagues would still be partisan of the “nothing” technique, preferring to implant the mitral prosthesis with chordal conservation instead of multiplying the techniques.

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Reply to the Editor:

We appreciate the comments by Dr Fayad and colleagues. We agree on some details, but we definitely disagree on some important aspects.

Dr Fayad indicates that our patient population was unfavorable to document the benefit of the RING + STRING approach for patients with ischemic mitral regurgitation (IMR), because in this category of patients, the likelihood of residual/recurrent mitral regurgitation after mitral valve repair is extremely high. We agree on the risk of recurrence, but we feel that this high-risk subgroup of patients is ideal as a

tough test of any therapeutic intervention. All patients included in our case series exhibit a combination of annular dilatation (Carpentier type I leaflet motion) and severe leaflet tethering (Carpentier type IIb leaflet motion) due to papillary muscle displacement. According to Calafiore et al,¹ mitral valve replacement is the treatment of choice for this patient subgroup with tenting height exceeding 10 mm. The RING + STRING approach however has been shown to allow mitral valve repair in this high-risk subgroup.

Dr. Fayad also points out that the nature of IMR is highly important. This is certainly true. We would like to emphasize that all of the patients in our case series suffered from ischemic cardiomyopathy (EF < 30%) with severe chronic IMR, as mentioned above. The experimental concept of the STRING technique had been previously evaluated in a sheep model of acute mitral regurgitation.² However, this model of acute IMR also showed the pathogenetic features of IMR (ie, annular dilatation, leaflet tethering due to papillary muscle displacement) and allowed to build the experimental basis for this new concept of subvalvular repair.

Referring to Dr. Fayad's question about the nature of the underlying tenting phenomenon, we do think that “anterior or posterior tenting” are misleading terms for surgeons who are not experts in transesophageal echocardiography. All of our patients had a tenting height (ie, end-systolic orthogonal distance between the annular plane and the coaptation point of both leaflets) exceeding 10 mm visualized in the midesophageal left ventricular (LV) long axis view (approximately 150 degrees), due to displacement of the posterior papillary muscle (distance posterior papillary muscle tip; fibrosa exceeding 40 mm). In a few patients with excessive global LV dilatation, we have also observed displacement of the anterior papillary muscle. Based on our encouraging results with the STRING technique, we have started to place a second STRING suture to reposition both anterior and posterior papillary muscles; however, these patients are not included in the current investigation.

We completely agree with Dr. Fayad that echocardiographic evaluation in the follow-up under exercise conditions might demask latent mitral regurgitation as well as transmitral gradients and con-

tribute to our results. However, according to the current literature, undersized ring annuloplasty represents the treatment of choice for functional mitral regurgitation, and transmitral gradients (at rest) were negligible in the published series.^{3,4}

Chordal cutting has been a suggested method to relieve leaflet tethering by Messas et al.,⁵ but its effect on systolic LV function has been considered controversial.⁶ Detrimental effects associated with chordal cutting have been documented by measuring load-insensitive parameters of LV function (ie, end-systolic elastance, preload-recruitable stroke work) in a sheep model.⁷ We thus speculate that these negative effects may be even more pronounced in severely impaired ventricles. The STRING technique eliminates residual leaflet tethering after undersized ring annuloplasty and normalizes leaflet morphology under echocardiographic guidance in the loaded beating heart. The second-order chordae remain intact, and the STRING might thus function as a third-order chord to prevent further detrimental LV remodeling. Because our technique of papillary muscle repositioning corrects subvalvular pathologic conditions and has been effective even in high-risk patients (see supplemental material of our article available online: Intraoperative transesophageal evaluation of the RING + STRING technique in a patient with an EF of 10% and severe leaflet tethering with a tenting height of 19 mm), we do not think that supplementary chordal cutting should be added.

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