restrictive ≥ 45 mm threshold rather than the guideline-directed liberal ≥ 40 mm?

The current study further demonstrates the lingering impact of comorbid AF on progression of TR after MV surgery despite a high percentage of patients (97%) receiving surgical maze procedure and despite a high percentage (87%) of patients free of AF on follow-up. These results are hard to ignore despite the various sources of bias accepted by the authors, and it seems reasonable to be more aggressive in proceeding with concomitant TV repair during MV repair in patients with AF. However, it is worth emphasizing that the study fails to define a clear size threshold for concomitant intervention on the TV in patients with AF or whether it should be done irrespective of annular diameter.

In conclusion, further work needs to be done to define the optimal size threshold for TV intervention in the subgroup of patients with secondary TR with AF, and furthermore there is a need for well-designed randomized studies to

weed out the controversies of TV repair during MV surgery, especially in the current era of rapidly evolving and effective percutaneous valve therapies.

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Commentary: Late tricuspid valve insufficiency following mitral valve repair: A marker or a cause for inferior outcome?

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The ongoing debate on the appropriate surgical approach to patients with moderate or less tricuspid valve regurgitation at the time of mitral valve (MV) repair for degenerative disease is far from being resolved. This is not because of lack of extensive observational research, it is simply due to the

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CENTRAL MESSAGE

In this issue, the contribution of McCarthy and colleagues to the field is significant. They highlight the importance of AF, even when treated effectively, as a risk factor for recurrent TR.

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fact that the clinical question of whether and when to repair a leaking tricuspid valve (TV) at the time of surgery is very complex to answer and the current tools and evidence we

have may not be sufficient to answer such questions and guide the surgical community to the right approach.

WHAT DO WE KNOW ABOUT THE DEVELOPMENT OF LATE MODERATE OR MORE TV REGURGITATION?

The late development of significant (moderate or greater) TV regurgitation is not very common. David and colleagues¹ found an incidence of 13.6% over 15 years of follow-up with older age, unrepaired moderate-to-severe tricuspid regurgitation (TR), pacemaker implantation, preoperative atrial fibrillation (AF), and recurrent mitral regurgitation (MR) as significant predictors for late TR. Chikwe and colleagues² reported that 9% of patients with mild or less TR at the time of isolated MV repair developed moderate or greater TR at a mean follow-up of 7 years.

In this issue of the *Journal*, McCarthy and colleagues³ describe their experience with a large group of patients undergoing MV operations with less than moderate preoperative TR. The incidence of late moderate or more TR with a mean follow-up of 4 years was 11.3% and similar to the incidence described by the Toronto group.¹ The rate of late TR was only 8% for patients with no history of AF at the time of operation and 25% in patients with AF and was significantly greater in adjusted and propensity-matched comparisons. Despite effective and near-universal application of surgical AF ablation, the presence of AF at the time of initial operation for degenerative MV disease predicted an increased likelihood of late TR, and the presence of late TR was an independent predictor of mortality. The authors did not examine the impact of endocardial pacemaker/defibrillator leads as a predictor of late TR but in their previous reports have demonstrated that this is a risk factor for the development of TR.⁴ Although tricuspid annular dimensions were incompletely measured, the authors also found greater likelihood of late significant in association with tricuspid annular dimensions greater than 4.5 cm.³

IS THERE AN INCREASED RISK IN PERFORMING TV REPAIR AT THE TIME OF MV REPAIR?

The evidence suggests that patients with TV insufficiency are usually older, with a greater incidence of AF, and a greater degree of biventricular dysfunction. In some studies, the addition of a TV repair was not documented to be associated with increased risk of perioperative mortality.¹⁻³ In contrast, one large registry-based series associated TV repair with significantly greater levels of postoperative morbidity, with a nearly 3-fold greater rate of new pacemaker implantation in the group undergoing concomitant TV repair (5.4% vs 14.7%).⁵

We suggest that surgeons approach this information with caution, as the majority of detailed information about this

clinical challenge comes from observational studies done by high-volume MV surgeons. The addition of TV repair requires greater cardiopulmonary bypass time, is associated with an increased need for postoperative pacemaker insertion, fixes the annulus and base of the right ventricle, and leaves an additional foreign body in the heart.

WHICH PATIENTS SHOULD BE TREATED FOR SECONDARY TV?

In 2005, Dreyfus and colleagues⁶ described the importance of TV annular dilatation secondary to MV disease. The findings directed surgeons' attention not only to the degree of TR but also suggested that the presence of annular dilatation portended progressive TR. Since that paper was published, awareness of the potential significance of TV annular dilatation and long-term outcomes following MV repair has grown. The most heated debate surrounds the threshold for intervention on the TV at the time of MV operation and is exemplified by highly variable rates (ranging from 10% to 65%) of concomitant TV in practice.⁷

In contemporary practice, surgeons rarely repair the TV if there is less than moderate preoperative TR. The Cardiothoracic Surgical Trials Network randomized trial is examining the worth of TV repair in patients with degenerative MR and has randomized patients with either moderate TR or less than moderate TR and tricuspid annular diameter greater than 40 mm. Results of this trial are eagerly awaited and will provide important guidance. It is important to remember that most data available to answer this question have limited length of follow-up. Given that life expectancy following MV repair for degenerative MR is equivalent to normal in many cases, it is crucial that we continue to follow these patients and assess the rate and impact of late TR and further understand atrial fibrillation in this context.⁸

It is clear that despite the relatively low incidence of late moderate TR, TV repair with an annuloplasty is associated with low rates of late TR and perhaps improved right ventricular function.^{1-3,8} The contribution of McCarthy and colleagues suggests that the presence of AF, even when effectively treated in the operating room in the absence of significant TR, can predict a substantial rate of TR at follow-up.

FUTURE QUESTIONS THAT NEED TO BE ANSWERED

There is no doubt that a better understanding of the pathophysiology of TR at the time of operation and in late follow-up is required. The importance of AF in late development of TR is not surprising but definitely suggests that there is more than just the degree of TR and the annular size that impacts late outcome. The current evidence lacks consistent assessment of right heart physiology and structure and the importance of early intervention in patients

with MV disease based on basic physiological aspects of the left ventricle secondary to the diastolic overload. We do not have good data regarding the impact of failing MV repair and MV dysfunction on the right and left atria and on the role of the severity of pulmonary vascular disease. We also do not know whether the major publications discussed truly represent surgical outcomes, as centers with excellent reputations in MV repair do get referrals earlier and probably see less of the significant impact of long-standing MR in their patient populations.

We want to bring attention to another potential modifier on late outcomes. David and colleagues¹ demonstrated that late recurrence of MR and early TR were associated with late moderate TR. Therefore, it is important to look at the quality of the MV repair, both early and late, in addition to the TV repair, to understand the potential impact on long-term outcome.

In summary, the contribution of McCarthy and colleagues³ to the field is significant, as they have highlighted the importance of AF, even when treated effectively and consistently, as a risk factor for recurrent TR.

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Commentary: Gate of success and corridor of failure

Tomasz A. Timek, MD, PhD

Functional tricuspid valve regurgitation is a poorly understood entity most frequently associated with left-sided valvular pathology. Although historically little heed was paid to the “forgotten” valve, current surgical guidelines chart a more aggressive course in addressing functional tricuspid insufficiency.¹ However, there is ample controversy in the literature whether less than moderate tricuspid

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CENTRAL MESSAGE

Tricuspid annular dilatation of 45 mm or more and preoperative atrial fibrillation may predispose to progression of tricuspid insufficiency in patients with degenerative mitral regurgitation.

regurgitation (TR) should be treated at the time of left-sided valvular surgery.^{2,3} In the current issue of the *Journal*, McCarthy and colleagues⁴ from Northwestern University

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