

Mini Review

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Should Moderate Tricuspid Regurgitation Always Be Repaired During Mitral Valve Surgery?

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Abstract

Tricuspid regurgitation (TR) frequently accompanies degenerative mitral regurgitation, and its persistence or progression after mitral surgery carries an adverse prognosis, while reoperation for isolated late TR is hazardous. Whether moderate TR should be corrected at the index mitral operation remains one of the most contested questions in valve surgery. The historical assumption that TR regresses once left-sided disease is corrected has proved unreliable, and tricuspid annular dilatation-independent of regurgitant grade-has emerged as the principal driver of late progression. Randomized and pooled data confirm that concomitant tricuspid annuloplasty markedly reduces TR progression, but at the cost of a several-fold increase in permanent pacemaker implantation and without a demonstrable early survival, functional, or quality-of-life benefit. This mini-review synthesizes the contemporary evidence and argues that current evidence does not support a universal strategy: moderate TR warrants near-universal consideration but selective, risk-stratified correction. Annuloplasty is well justified when moderate TR coexists with annular dilatation, atrial fibrillation, or pulmonary hypertension, and is more difficult to defend in their absence.

Keywords: Tricuspid regurgitation; mitral valve surgery; tricuspid annuloplasty; annular dilatation; valvular heart disease

Key Points

- Functional TR frequently fails to regress after mitral surgery, and residual or progressive TR is associated with heart failure and reduced late survival.
- Tricuspid annular dilatation, rather than regurgitant grade alone, is the principal predictor of late TR progression and the key operative criterion.
- Concomitant tricuspid annuloplasty reliably prevents TR progression but has not shown an early survival, functional, or quality-of-life benefit and substantially increases permanent pacemaker implantation.
- Moderate TR should be repaired selectively-when accompanied by annular dilatation, atrial fibrillation, or pulmonary hypertension-rather than in every case.
- A risk-stratified, heart-team-guided policy (Figure 1) best balances prevention of progression against the risk of conduction injury.

Introduction

Tricuspid regurgitation is among the most common valve lesions left untreated at cardiac surgery. It is present in a substantial proportion of patients presenting for degenerative mitral regurgitation (MR), and even mild-to-moderate TR independently predicts reduced long-term survival [1]. For decades, surgeons were guided by the classic observation that functional TR frequently regressed once the left-sided lesion was corrected, and the tricuspid valve was therefore commonly left alone [2]. This doctrine has not withstood scrutiny: residual or progressive TR after mitral surgery is associated with heart failure, poorer functional status and excess late mortality, and reoperation for isolated severe TR carries prohibitive risk [1,3]. The pertinent question is therefore not whether severe TR should be addressed-guidelines are unanimous that it should-but whether moderate TR, and lesser degrees accompanied by annular dilatation, warrant routine concomitant repair. The word “always” implies a categorical policy; the evidence supports a more discriminating position.

From Regurgitant Grade to Annular Geometry

The conceptual shift underpinning current practice is the recognition that the tricuspid annulus, rather than the instantaneous regurgitant grade, governs the natural history of functional TR. Dreyfus and colleagues demonstrated that the annulus is frequently dilated even when TR is trivial, and that annular dilatation (≥ 40 mm on echocardiography, corresponding to >70 mm measured intraoperatively) rather than regurgitant severity best predicts subsequent progression; on that basis they proposed dilatation as the operative criterion. Annular diameter is comparatively load-independent and reproducible, whereas echocardiographic TR grade under anesthesia is notoriously labile [3]. Observational and

small randomized series subsequently showed that prophylactic annuloplasty in dilated annuli prevents TR progression and adverse right ventricular remodeling and improves functional status, without a mortality penalty [4-6]. These data formed the basis for guideline statements that concomitant tricuspid annuloplasty is reasonable during left-sided surgery for moderate TR, and for lesser TR with annular dilatation or prior right heart failure [7,8]. Atrial fibrillation and pulmonary hypertension further identify patients whose TR is unlikely to regress and more likely to progress [9,10].

What the Randomized Evidence Shows

The pivotal contribution is the Cardiothoracic Surgical Trials Network (CTSN) trial, which randomized 401 patients undergoing surgery for degenerative MR-37% with moderate TR and the remainder with less-than-moderate TR and annular dilatation to mitral surgery alone or with tricuspid annuloplasty. Annuloplasty reduced the two-year composite of death, tricuspid reoperation, or TR progression from 10.2% to 3.9% (relative risk 0.37), an effect driven entirely by prevention of TR progression. Crucially, there was no accompanying benefit in survival, major adverse cardiac and cerebrovascular events, functional class, or quality of life, and the need for a permanent pacemaker rose almost six-fold (14.1% vs 2.5%) [11]. A 2025 meta-analysis of more than 3,000 patients reached concordant conclusions: annuloplasty reduced $\geq$ moderate TR progression (hazard ratio 0.34) but conferred no survival advantage out to 15 years while increasing perioperative pacemaker implantation more than five-fold [12]. Guideline-based cohorts similarly report durable freedom from significant TR under a consistent tricuspid policy, but again without a clear hard-outcome dividend within available follow-up [13]. The principal lines of evidence, with their benefits and limitations, are summarized in (Table 1).

Table 1: Summary of the principal evidence on concomitant tricuspid annuloplasty during mitral valve surgery for moderate or less-than-moderate tricuspid regurgitation. CTSN, Cardiothoracic Surgical Trials Network; HR, hazard ratio; QoL, quality of life; TR, tricuspid regurgitation.

Evidence Source	Principal Benefit	Key Limitation
Observational and single-centre series	Reduced late TR and adverse right ventricular remodelling	Selection bias; heterogeneous indications and technique
CTSN randomized trial	Reduced 2-year TR progression (10.2% to 3.9%)	Almost six-fold higher permanent pacemaker rate; no survival, functional, or QoL benefit
2025 pooled meta-analysis (>3000 patients)	Durable reduction in $\geq$ moderate TR progression (HR 0.34)	No survival advantage to 15 years; >5 -fold higher pace-maker rate
Guideline-based cohorts	Durable freedom from significant TR under a consistent policy	No clear hard-outcome benefit within available follow-up

The Case Against Reflexive Repair

Three considerations temper enthusiasm for a universal policy. First, TR does not progress in every patient, so a blanket approach inevitably overtreats those who would have remained stable; annular diameter, though the best available marker, is an imperfect predictor and captures geometry at a single time point rather than annular dynamics or right ventricular reserve. Second, the principal harm-permanent pacemaker implantation-is neither trivial nor transient. It is not a benign outcome, particularly in younger patients,

because lifelong right ventricular pacing may impair ventricular synchrony, complicate future transcatheter interventions, and itself aggravate tricuspid regurgitation; moreover, this harm accrues to precisely those patients who otherwise derive only an echocardiographic benefit [11,12]. Third, adding annuloplasty lengthens cardiopulmonary bypass and, in a minority, may escalate to tricuspid replacement [11]. It is telling that publication of the CTSN results was followed by a measurable decline in concomitant annuloplasty among eligible patients-a profession recalibrating benefit against harm rather than abandoning the procedure.

Toward A Risk-Stratified Answer

The reconciling principle is that the decision should be indexed to the probability of progression and the competing risk of conduction injury, not to the regurgitant grade in isolation (Figure 1). Moderate TR accompanied by annular dilatation, atrial fibrillation, or pulmonary hypertension carries a sufficiently high progression risk that concomitant annuloplasty is well justified and concordant with guidelines [7,8]. Conversely, isolated moderate

TR with a non-dilated annulus, sinus rhythm, normal pulmonary pressures and preserved right ventricular function-particularly in an older or higher-risk patient-is a setting in which the pacemaker hazard may outweigh a purely echocardiographic gain, and careful observation is defensible. Where repair is undertaken, a rigid or semi-rigid ring rather than a suture technique, with sutures sited to respect the atrioventricular node, mitigates both recurrence and conduction injury (Figure 1).

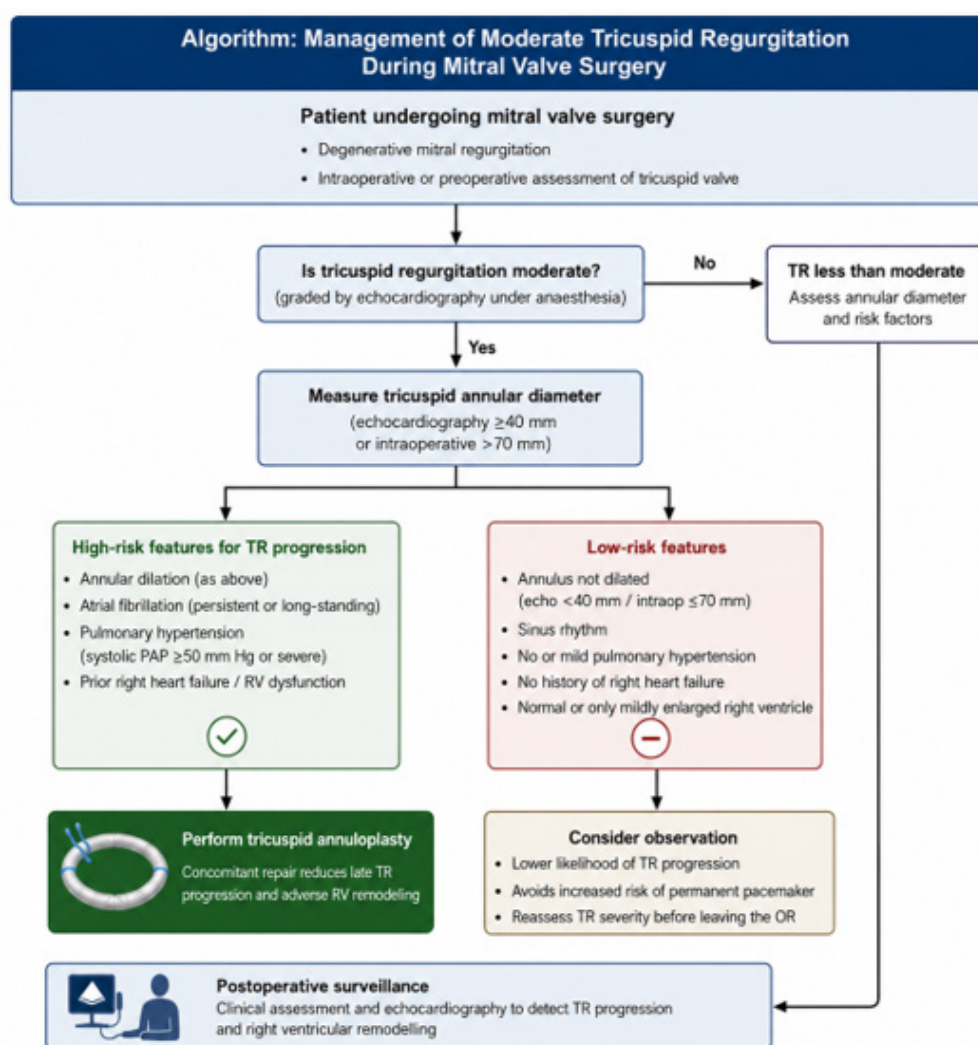


Figure 1: Decision-making algorithm for the management of moderate tricuspid regurgitation (TR) during mitral valve surgery. AF, atrial fibrillation; PAP, pulmonary artery pressure; RV, right ventricular.

Looking ahead, the emergence of transcatheter tricuspid interventions may in future alter the threshold for surgical correction, offering a lower-risk option for TR that progresses after mitral surgery; at present, however, the available evidence-largely confined to symptomatic severe TR-remains insufficient to influence intraoperative decision-making [14]. Longer-term follow-up of surgical cohorts is likewise required to establish whether the demonstrated reduction in TR progression ultimately translates

into a survival or heart-failure benefit; until then, the evidence favors judgement over reflex.

Conclusion

Moderate TR should not always be repaired during mitral valve surgery-but it should almost always be deliberately considered. The correct question at the operating table is not the TR grade alone but whether the annulus is dilated and whether atrial fibrillation or

pulmonary hypertension is present, weighed against the individual patient's tolerance of a materially increased pacemaker risk. A risk-stratified, annulus-centered and heart-team-guided policy, rather than a universal one, best serves patients undergoing mitral valve surgery. Future research should identify the imaging and clinical biomarkers that best predict which patients derive durable clinical benefit from prophylactic annuloplasty, so that a risk-stratified policy can be refined into a genuinely individualized one.

Conflicts of interest

The author declares no conflict of interest.

References

1. Nath J, Foster E, Heidenreich PA (2004) Impact of tricuspid regurgitation on long-term survival. *J Am Coll Cardiol* 43(3): 405-409.
2. Braunwald NS, Ross J Jr, Morrow AG (1967) Conservative management of tricuspid regurgitation in patients undergoing mitral valve replacement. *Circulation* 35(4 Suppl): I63-I69.
3. Dreyfus GD, Corbi PJ, Chan KM, Toufan B (2005) Secondary tricuspid regurgitation or dilatation: which should be the criteria for surgical repair? *Ann Thorac Surg* 79(1): 127-132.
4. Van de Veire NR, Braun J, Delgado V, Michel IMV, Robert AD, et al. (2011) Tricuspid annuloplasty prevents right ventricular dilatation and progression of tricuspid regurgitation in patients with tricuspid annular dilatation undergoing mitral valve repair. *J Thorac Cardiovasc Surg* 141(6): 1431-1439.
5. Chikwe J, Itagaki S, Anyanwu A, David HA (2015) Impact of concomitant tricuspid annuloplasty on tricuspid regurgitation, right ventricular function, and pulmonary artery hypertension after repair of mitral valve prolapse. *J Am Coll Cardiol* 65(18): 1931-1938.
6. Calafiore AM, Gallina S, Iacò AL, Marco C, Antonio B, et al. (2009) Mitral valve surgery for functional mitral regurgitation: should moderate-or-more tricuspid regurgitation be treated? A propensity score analysis. *Ann Thorac Surg* 87(3): 698-703.
7. Otto CM, Nishimura RA, Bonow RO, Blase AC, John PE, et al. (2021) 2020 ACC/AHA guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation* 143(5): e35-e71.
8. Vahanian A, Beyersdorf F, Praz F, Milan M, Stephan B, et al. (2022) 2021 ESC/EACTS guidelines for the management of valvular heart disease. *Eur Heart J* 43(7): 561-632.
9. McCarthy PM, Szlapka M, Kruse J, Olga NK, James DT, et al. (2021) The relationship of atrial fibrillation and tricuspid annular dilation to late tricuspid regurgitation in patients with degenerative mitral repair. *J Thorac Cardiovasc Surg* 161(6): 2030-2040.
10. Brescia AA, Ward ST, Watt TMF, Liza MR, Megan B, et al. (2020) Outcomes of guideline-directed concomitant annuloplasty for functional tricuspid regurgitation. *Ann Thorac Surg* 109(4): 1227-1232.
11. Gammie JS, Chu MWA, Falk V, Jessica RO, Alan JM, et al. (2022) Concomitant tricuspid repair in patients with degenerative mitral regurgitation. *N Engl J Med* 386(4): 327-339.
12. Jacquemyn X, Rohit G, Sá MP, Johannes B, Irsa H, et al. (2026) Concomitant tricuspid annuloplasty during degenerative mitral valve repair: a systematic review and meta-analysis. *Am J Cardiol* 262: 68-74.
13. Dreyfus GD, Essayagh B, Benfari G, Filip D, Shelley RH, et al. (2021) Outcome of consistent guideline-based tricuspid management in patients undergoing degenerative mitral regurgitation correction. *JTCVS Open* 7: 125-138.
14. Sorajja P, Whisenant B, Hamid N, Hursh N, Raj M, et al. (2023) Transcatheter repair for patients with tricuspid regurgitation. *N Engl J Med* 388(20): 1833-1842.