When to treat tricuspid regurgitation?

De Bonis Michele, MD

Department of Cardiac Surgery, San Raffaele University Hospital, Milan, Italy
When to treat tricuspid regurgitation?

- Isolated primary TR
- Functional TR in patients undergoing left-sided valve surgery
- Late TR following left sided valve surgery
When to treat tricuspid regurgitation?

- **Isolated primary TR**
- Functional TR in patients undergoing left-sided valve surgery
- Late TR following left sided valve surgery
Guidelines for intervention in tricuspid valve disease

**ACC/AHA 2006**

**Class I**
- Tricuspid valve repair is beneficial for severe TR in patients with MV disease requiring MV surgery. *(Level of Evidence: B)*

**Class IIa**
1. Tricuspid valve replacement or annuloplasty is reasonable for severe primary TR when symptomatic. *(Level of Evidence: C)*
2. Tricuspid valve replacement is reasonable for severe TR secondary to disease/abnormal tricuspid valve leaflets not amenable to annuloplasty or repair. *(Level of Evidence: C)*

**Class IIb**
- Tricuspid annuloplasty may be considered for less than severe TR in patients undergoing MV surgery when there is pulmonary hypertension or tricuspid annular dilatation. *(Level of Evidence: C)*

**Class III**
1. Tricuspid valve replacement or annuloplasty is not indicated in asymptomatic patients with TR whose pulmonary artery systolic pressure is less than 60 mm Hg in the presence of a normal MV. *(Level of Evidence: C)*
2. Tricuspid valve replacement or annuloplasty is not indicated in patients with mild primary TR. *(Level of Evidence: C)*

**ESC 2007**

<table>
<thead>
<tr>
<th>Class</th>
<th>Severe TR in a patient undergoing left-sided valve surgery</th>
<th>IC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Severe primary TR and symptoms despite medical therapy without severe right ventricular dysfunction</td>
<td>IC</td>
</tr>
<tr>
<td></td>
<td>Severe TS (±TR), with symptoms despite medical therapy&lt;sup&gt;a&lt;/sup&gt;</td>
<td>IC</td>
</tr>
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<td>IC</td>
</tr>
<tr>
<td></td>
<td>Moderate organic TR in a patient undergoing left-sided valve surgery</td>
<td>IIaC</td>
</tr>
<tr>
<td></td>
<td>Moderate secondary TR with dilated annulus (&gt;40 mm) in a patient undergoing left-sided valve surgery</td>
<td>IIaC</td>
</tr>
<tr>
<td></td>
<td>Severe TR and symptoms, after left-sided valve surgery, in the absence of left-sided myocardial, valve, or right ventricular dysfunction and without severe pulmonary hypertension (systolic pulmonary artery pressure &gt; 60 mmHg)</td>
<td>IIaC</td>
</tr>
<tr>
<td></td>
<td>Severe isolated TR with mild or no symptoms and progressive dilation or deterioration of right ventricular function</td>
<td>IIbC</td>
</tr>
</tbody>
</table>
Guidelines for intervention in tricuspid valve disease

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Tricuspid valve repair is beneficial for severe TR in patients with MV disease requiring MV surgery. *(Level of Evidence: B)*

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ESC 2007

Class

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<td>IC</td>
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</tbody>
</table>

Severe isolated TR with MILD or NO SYMPTOMS and progressive DILATATION/DERETERIORATION of RV function → IIb C

Severe TR and symptoms, after left-sided valve surgery, in the absence of left-sided myocardial, valve, or right ventricular dysfunction and without severe pulmonary hypertension (systolic pulmonary artery pressure > 60 mmHg)

Severe isolated TR with mild or no symptoms and progressive dilation or deterioration of right ventricular function
When to treat tricuspid regurgitation?

- Isolated primary TR
- Functional TR in patients undergoing left-sided valve surgery
- Late TR following left sided valve surgery
# Guidelines for intervention in tricuspid valve disease

## ACC/AHA 2006

### Class I

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## ESC 2007

### Class Ic

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### Class IIa

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### Class IIb

Tricuspid annuloplasty may be considered for less than severe TR in patients undergoing MV surgery when there is pulmonary hypertension or tricuspid annular dilatation. *(Level of Evidence: C)*

### Class III

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# Guidelines for intervention in tricuspid valve disease

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## ESC 2007

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</tr>
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</table>
Tricuspid annulus dilatation

TT apical 4-chamber view in late diastole

Surgical view

≥ 4 cm or 21 mm/m²

septal to anterior leaflet distance
Tricuspid annulus dilatation

Asymmetric annular dilatation


Antero-septal to antero-posterior commissure distance > 7 cm
Less than severe functional TR in patients undergoing left-sided valve surgery

Studies supporting concomitant tricuspid annuloplasty
Progression of not significant TR (≤2+) (untreated at the time of initial MV surgery)

<table>
<thead>
<tr>
<th>Before Surgery</th>
<th>After Surgery</th>
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</thead>
<tbody>
<tr>
<td><strong>Group 1</strong> (MVR)</td>
<td><strong>Group 2</strong> (MVR + TVR)</td>
</tr>
<tr>
<td>Grade 0</td>
<td>54</td>
</tr>
<tr>
<td>Grade 1</td>
<td>102</td>
</tr>
<tr>
<td>Grade 2</td>
<td>7</td>
</tr>
<tr>
<td>Grade 3</td>
<td>0</td>
</tr>
<tr>
<td>Grade 4</td>
<td>0</td>
</tr>
<tr>
<td>Mean TR grade</td>
<td>0.7 ± 0.5&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> p = 0.027 Mann–Whitney.  
<sup>b</sup> p < 0.001 Mann–Whitney.

In pts who did not receive concomitant tricuspid annuloplasty -progression of none or mild TR to 3+ or 4+ occurred in 34% of the cases

Tricuspid annuloplasty prevents right ventricular dilatation and progression of tricuspid regurgitation in patients with tricuspid annular dilatation undergoing mitral valve repair

Nico R. Van de Veire, MD, PhD, Jerry Braun, MD, Victoria Delgado, MD, Michel I. M. Versteegh, MD, Robert A. Dion, MD, PhD, Robert J. M. Klautz, MD, PhD, and Jeroen J. Bax, MD, PhD

Objectives: We hypothesize that concomitant tricuspid annuloplasty in patients with tricuspid annular dilatation who undergo mitral valve repair could prevent progression of tricuspid regurgitation and right ventricular remodeling.

Methods: In 2002, 80 patients underwent mitral valve repair. Concomitant tricuspid annuloplasty was performed in 13 patients with grade 3 or 4 tricuspid regurgitation. In 2004, 102 patients underwent mitral valve repair. Concomitant tricuspid annuloplasty was performed in 21 patients with grade 3 or 4 tricuspid regurgitation and in 43 patients with an echocardiographically determined tricuspid annular diameter of 40 mm or greater. Patients underwent transthoracic echocardiographic analysis preoperatively and at the 2-year follow-up.

Results: In the 2002 cohort right ventricular dimensions did not decrease (right ventricular long axis, 69 ± 7 vs 70 ± 8 mm; right ventricular short axis, 29 ± 7 vs 30 ± 7 mm); tricuspid regurgitation grade and gradient remained unchanged. In the 2004 cohort right ventricular reverse remodeling was observed (right ventricular long axis, 71 ± 6 vs 69 ± 9 mm; right ventricular short axis, 29 ± 5 vs 27 ± 5 mm; P < .0001); tricuspid regurgitation diminished (1.6 ± 1.0 vs 0.9 ± 0.6, P < .0001), and transtricuspid gradient decreased (28 ± 13 vs 23 ± 15 mm Hg, P = .021). Subanalysis of the 2002 cohort showed that in 23 patients without grade 3 or 4 tricuspid regurgitation but baseline tricuspid annular dilatation, the degree of tricuspid regurgitation was worse at the 2-year follow-up. Moreover, this caused right ventricular dilatation. Subanalysis of the 2004 cohort demonstrated reverse right ventricular remodeling and decreased tricuspid regurgitation in 43 patients with preoperative tricuspid annular dilatation who underwent tricuspid annuloplasty.

Conclusions: Concomitant tricuspid annuloplasty during mitral valve repair should be considered in patients with tricuspid annular dilatation despite the absence of important tricuspid regurgitation at baseline because this improves echocardiographic outcome. (J Thorac Cardiovasc Surg 2011;141:1431-9)
Echocardiographic-based treatment of functional tricuspid regurgitation

Antonio M. Calafiore, MD, a Angela L. Iacò, MD, a Antonella Romeo, MD, b Salvatore Scandura, MD, c Rocco Meduri, MD, b Egidio Varone, MD, b and Michele Di Mauro, MD d

<table>
<thead>
<tr>
<th>Systolic TA grade (apical 4-chamber view)</th>
<th>FTR</th>
<th>≤24 mm</th>
<th>25–28 mm</th>
<th>&gt;28 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>No surgery</td>
<td>De Vega</td>
<td>Band</td>
<td></td>
</tr>
<tr>
<td>Moderate or greater</td>
<td>De Vega*</td>
<td>De Vega</td>
<td>Band</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>UT group (n = 110)</th>
<th>T group (n = 146)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preoperative</td>
<td>Postoperative</td>
</tr>
<tr>
<td>TV annulus in diastole (mm)</td>
<td>31 ± 3</td>
<td>29 ± 3</td>
</tr>
<tr>
<td>TV annulus in systole (mm)</td>
<td>25 ± 4</td>
<td>24 ± 3</td>
</tr>
<tr>
<td>Tenting area (cm²)</td>
<td>1.0 ± 0.6</td>
<td>0.8 ± 0.6</td>
</tr>
<tr>
<td>TVCD (mm)</td>
<td>7.2 ± 5.4</td>
<td>7.0 ± 5.5</td>
</tr>
<tr>
<td>RVD (mm)</td>
<td>28 ± 4</td>
<td>28 ± 6</td>
</tr>
<tr>
<td>TAPSE (mm)</td>
<td>19 ± 4</td>
<td>15 ± 3</td>
</tr>
<tr>
<td>SPAP (mm Hg)</td>
<td>34 ± 9</td>
<td>30 ± 8*</td>
</tr>
<tr>
<td>EF (%)</td>
<td>48 ± 7</td>
<td>47 ± 9</td>
</tr>
<tr>
<td>MR (from 1 to 4)</td>
<td>2.7 ± 1.1</td>
<td>0.4 ± 0.5</td>
</tr>
<tr>
<td>TR (from 0 to 4)</td>
<td>1.1 ± 0.4</td>
<td>1.0 ± 0.6</td>
</tr>
<tr>
<td>No TR</td>
<td>0</td>
<td>18 (16.4)</td>
</tr>
<tr>
<td>TR 1+</td>
<td>101 (91.8)</td>
<td>76 (69.1)</td>
</tr>
<tr>
<td>TR 2+</td>
<td>7 (6.4)</td>
<td>13 (11.8)</td>
</tr>
<tr>
<td>TR 3+/4+</td>
<td>2 (1.8)</td>
<td>3 (2.7)</td>
</tr>
<tr>
<td>Follow-up (mo)</td>
<td>12 ± 7</td>
<td></td>
</tr>
</tbody>
</table>

**Conclusions:** An aggressive strategy for FTR correction, using the sysTA, was able to reduce the FTR grade 1 year after surgery, but mitral surgery alone could not. (J Thorac Cardiovasc Surg 2010; 139:1-6)
Randomized study on prophylactic tricuspid annuloplasty

**Objective(s):** Late occurrence of severe tricuspid regurgitation (TR) is not uncommon after mitral valve surgery and it is associated with poor outcomes. Current guidelines suggest the opportunity of tricuspid annuloplasty in patients with moderate secondary TR with annular dilatation undergoing left-sided valve surgery to prevent TR progression. However, final conclusions about the role of prophylactic tricuspid annuloplasty are still lacking.

**Methods:** We enrolled 44 patients undergoing mitral valve surgery (both repair or replacement) presenting less than moderate (≤+2 degree) secondary TR and dilated tricuspid annulus (≥40mm) at preoperative echo. They were randomized to receive (n=22) or not (n=22) concomitant tricuspid annuloplasty (Cosgrove-Edwards annuloplasty ring) at the time of mitral valve surgery. Clinical and echocardiographic follow-up was performed at 12 months after surgery.

**Results:** Preoperative clinical and echocardiographic characteristics were comparable in the two groups. Operative mortality was 2.2% (one death in each group). At 12 months follow-up TR was completely absent in 15/21 (71%) patients receiving tricuspid annuloplasty and in 4/21 (19%) patients who did not (P=0.001). Severe TR (≥+3 degree) was present in 0/21 (0%) patients receiving tricuspid annuloplasty and 8/21 (38%) patients who did not (P=0.003). Pulmonary artery systolic pressure significantly decreased from baseline in all cases (P<0.001) and it was comparable in the two groups (41 ± 8 mmHg vs 40 ± 5 mmHg; P=0.4). Right ventricular dimensions improved in patients receiving tricuspid annuloplasty (RV long axis from 71±7 to 65±8 mm; P=0.01; RV short axis: 33±4 vs 27±5 mm; P=0.001) but it remained unchanged in the control group (RV long axis from 72±6 to 70±9 mm; P=0.08; RV short axis: from 34±5 to 33±5 mm; P=0.1). 6-minute walk test improved from baseline in both groups (P<0.001) but this improvement was greater in patients receiving tricuspid annuloplasty than patients who did not (+115±23 m from baseline vs +75±35 m; P=0.008).

**Conclusions:** Prophylactic tricuspid annuloplasty in patients with dilated tricuspid annulus undergoing mitral valve surgery did not add operative risk and it was associated with a reduced rate of TR progression and better echocardiographic and clinical outcomes.
Moderate Tricuspid Regurgitation With Left-Sided Degenerative Heart Valve Disease: To Repair or Not to Repair?

Jose L. Navia, MD, Nicolas A. Brozzi, MD, Allan L. Klein, MD, Lee Fong Ling, MBBS, Chanapong Kittayarak, MD, Edward R. Nowicki, MD, MS, Lillian H. Batizy, MS, Jiansheng Zhong, MS, and Eugene H. Blackstone, MD

Annals of thoracic Surgery 2011 Nov. 15
Moderate TR in left sided valve surgery

Early and late results with repair and no repair
Predictors of progression of less than severe functional TR

- LV dysfunction
- RV dilatation/dysfunction
- AF
- Pace-maker leads
- PHT
Less than severe functional TR in patients undergoing left-sided valve surgery

Studies discouraging concomitant tricuspid annuloplasty
Clinical and Echocardiographic Impact of Functional Tricuspid Regurgitation Repair at the Time of Mitral Valve Replacement

Vincent Chan, MD, Ian G. Burwash, MD, B-Khanh Lam, MD, MPH, Titus Auyeung, BS, Anthony Tran, BS, Thierry G. Mesana, MD, PhD, and Marc Ruel, MD, MPH

Divisions of Cardiac Surgery and Cardiology, and Department of Epidemiology and Community Medicine, University of Ottawa, Ottawa, Ontario, Canada

Background. The indications for tricuspid valve repair in the setting of mitral valve disease and concomitant tricuspid regurgitation (TR) remain unclear. We examined patients undergoing mitral valve replacement (MVR) to determine the effect of TR and tricuspid valve repair on survival, functional status, and postoperative TR.

Methods. Between 1990 and 2005, 624 patients underwent MVR. Data included detailed serial echocardiographic tricuspid valve measurements, functional status, and survival data. Preoperative TR exceeded 2+ in 231: 125 received tricuspid repair and MVR, whereas 106 received MVR alone. Clinical and echocardiographic follow-up were complete (average, 6.8 ± 4.8 years). Parametric and semi-parametric tests were used to analyze outcomes.

Results. TR exceeding 2+ at operation was associated with a 53% increase in late death (p = 0.003). Tricuspid repair prevented echocardiographic progression of TR and improved congestive heart failure symptoms (both p < 0.01). Overall survival did not improve (p = 0.3). A trend to worsening TR in patients was noted with a larger tricuspid annulus diameter and without significant (≤ 1+) TR preoperatively (odds ratio, 1.4 per cm increase in annulus diameter; p = 0.5), but this was not associated with worse functional or vital outcomes.

Conclusions. In patients undergoing MVR, tricuspid repair is indicated when TR exceeds 2+ to alleviate heart failure symptoms, but without significantly improving survival in this population. TR of 2+ or less may not require repair. Echocardiographic tricuspid annular dimensions alone, in the absence of significant (≤ 1+) TR preoperatively, should not dictate the performance of tricuspid repair.

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Functional tricuspid regurgitation at the time of mitral valve repair for degenerative leaflet prolapse: The case for a selective approach

Oguz Yilmaz, MD, a Rakesh M. Suri, MD, DPhil, a Joseph A. Dearani, MD, a Thoralf M. Sundt III, MD, a Richard C. Daly, MD, a Harold M. Burkhart, MD, a Zhuo Li, MS, b Maurice Enriquez-Sarano, MD, c and Hartzell V. Schaff, MD a

<table>
<thead>
<tr>
<th>Follow-up time</th>
<th>Total</th>
<th>Grade &lt; 3*</th>
<th>Grade ≥ 3*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>696</td>
<td>581 (83.5)</td>
<td>115 (16.5)</td>
</tr>
<tr>
<td>Predischal</td>
<td>627</td>
<td>517 (82.4)</td>
<td>110 (17.5)</td>
</tr>
<tr>
<td>≤1 y</td>
<td>250</td>
<td>212 (84.8)</td>
<td>38 (15.2)</td>
</tr>
<tr>
<td>1-3 y</td>
<td>207</td>
<td>165 (79.7)</td>
<td>42 (20.3)</td>
</tr>
<tr>
<td>3-5 y</td>
<td>145</td>
<td>112 (77.2)</td>
<td>33 (22.8)</td>
</tr>
<tr>
<td>&gt;5 y</td>
<td>109</td>
<td>77 (70.6)</td>
<td>32 (29.4)</td>
</tr>
</tbody>
</table>

Conclusions: Clinically silent nonsevere tricuspid valve regurgitation in patients with degenerative mitral valve disease is unlikely to progress after mitral valve repair. Tricuspid valve surgery is rarely necessary for most patients undergoing repair of isolated mitral valve prolapse. (J Thorac Cardiovasc Surg 2011;142:608-13)
Moderate functional TR
Intraoperative view of the tricuspid valve
Remodeling tricuspid annuloplasty
When to treat tricuspid regurgitation?

- Isolated primary TR
- Functional TR in patients undergoing left-sided valve surgery
- Late TR following left sided valve surgery
The presence of **significant TR** after MV surgery is strictly related to **late** mortality!
Late TR after left-sided valve surgery (mainly MV surgery) is associated to lower survival

Kwak JJ et al.
Am Heart J 2008;155:732-7

Song H et al.
Heart 2009;95:931-936.
Outcome of surgery for TR late after MV replacement or repair
## Hospital mortality for late TR surgery

<table>
<thead>
<tr>
<th></th>
<th>Year</th>
<th>Hospital mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>King</td>
<td>1984</td>
<td>25%</td>
</tr>
<tr>
<td>Kaul</td>
<td>1991</td>
<td>23.5%</td>
</tr>
<tr>
<td>Staab</td>
<td>1999</td>
<td>8.8%</td>
</tr>
<tr>
<td>Izumi</td>
<td>2002</td>
<td>14.2%</td>
</tr>
<tr>
<td>McCarthy</td>
<td>2004</td>
<td>37%</td>
</tr>
<tr>
<td>Dong-A Kwon</td>
<td>2006</td>
<td>25%</td>
</tr>
<tr>
<td>Kwak</td>
<td>2008</td>
<td>16.6%</td>
</tr>
</tbody>
</table>
Late survival after surgery for TR following MV replacement or repair

King et al.  

Staab ME et al.  
J Heart Valve Dis. 1999 Sep;8(5):567-74
Late survival after surgery for TR following MV replacement or repair

Tricuspid valve repair: Durability and risk factors for failure

Patrick M. McCarthy, MD
Sunil K. Bhudia, MD
Jeewanantham Rajasekaran, MSc
Katherine J. Horrcher, RN
Bruce W. Lytle, MD
Delos M. Cosgrove, MD
Eugene H. Blackstone, MD

Objectives: To compare durability of tricuspid valve annuloplasty techniques, identify risk factors for repair failure, and characterize survival, reoperation, and functional class of surviving patients.

Methods: From 1990 to 1999, 700 patients (mean age 65 ± 12 years, 51% New York Heart Association functional class III or IV, and mean right ventricular systolic pressure 56 ± 16 mm Hg) underwent tricuspid valve annuloplasty for functional regurgitation using 4 techniques: Carpentier-Edwards semi-rigid ring, Cosgrove-Edwards flexible band, De Vega procedure, and customized semicircular Peri-Guard annuloplasty. Of these patients, 89% had concomitant mitral valve surgery. A total of 2245 follow-up transthoracic echocardiograms were retrieved. Tricuspid regurgitation was analyzed, and risk factors for worsening regurgitation were identified, by univariable ordinal longitudinal methods.

Results: Tricuspid regurgitation 1 week after annuloplasty was 3+ or 4+ in 14% of patients. Regurgitation severity was stable across time with the Carpentier-Edwards ring (P = .7), increased slowly with the Cosgrove-Edwards band (P = .05), and rose more rapidly with the De Vega (P = .002) and Peri-Guard (P = .0005) procedures. Risk factors for worsening regurgitation included higher preoperative regurgitation grade, poor left ventricular function, permanent pacemaker, and repair type other than ring annuloplasty. Right ventricular systolic pressure, ring size, preoperative New York Heart Association functional class, and concomitant surgery were not risk factors. Tricuspid reclosure was rare (3% at 8 years), and hospital mortality after reclosure was 37%.

Conclusions: Tricuspid valve annuloplasty did not consistently eliminate functional regurgitation, and across time regurgitation increased after Peri-Guard and De Vega annuloplasties. Therefore, these repair techniques should be abandoned, and transatrial pacing leads should be replaced with epicardial leads.

McCarthy et al. JTCVS 2004;127:675

Survival after surgery for late TR:
19% at 3 years
Why the results of surgery in this setting are so poor?
Surgery for TR late after MV repair or replacement

- TV repair/replace
- Complete preservation of the tricuspid apparatus
- Beating heart (no aortic Xclamping)
- Median sternotomy or right antero-lateral thoracotomy
Severe late TR due to annular dilatation and leaflets tethering
Severe TR late after MV surgery

Medical management

Symptoms of right heart failure + Hepatic/renal dysfunction

Referred for surgery

Poor surgical outcome

Surgery for late TR is a high risk procedure

Surgical referral further delayed
Reluctance to operate on these pts
How to improve early and late outcomes of surgery for late TR after MV repair or replacement?

- *early surgical treatment of late TR* before the occurrence of right ventricular dysfunction

- *prevention of late TR* by addressing more aggressively and effectively the tricuspid valve during the primary MV operation
How to improve early and late outcomes of surgery for late TR after MV repair or replacement?

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Guidelines for intervention in tricuspid valve disease

**ACC/AHA 2006**

<table>
<thead>
<tr>
<th>Class I</th>
<th>Tricuspid valve repair is beneficial for severe disease requiring MV surgery. <em>(Level of Evidence: C)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Class IIa</td>
<td>1. Tricuspid valve replacement or annuloplasty for primary TR when symptomatic. <em>(Level of Evidence: C)</em></td>
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<tr>
<td></td>
<td>2. Tricuspid valve replacement is reasonable for severe TR secondary to disease/abnormal valve leaflets not amenable to annuloplasty or repair. <em>(Level of Evidence: C)</em></td>
</tr>
<tr>
<td>Class IIb</td>
<td>Tricuspid annuloplasty may be considered for less than severe TR in patients undergoing MV surgery when there is pulmonary hypertension or tricuspid annular dilatation. <em>(Level of Evidence: C)</em></td>
</tr>
<tr>
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<td>1. Tricuspid valve replacement or annuloplasty is not indicated in asymptomatic patients with TR whose pulmonary artery systolic pressure is less than 60 mmHg in the presence of a normal MV. <em>(Level of Evidence: C)</em></td>
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<tr>
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**ESC 2007**

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## Guidelines for intervention in tricuspid valve disease

### ACC/AHA 2006

**Class I**

Tricuspid valve repair is beneficial for severe TR disease requiring MV surgery. *(Level of Evidence: C)*

### ESC 2007

**After left sided valve surgery**

- severe TR and symptoms OR progressive RV dilatation/dysfunction (even in only mildly symptomatic pts)

### ACC/AHA 2006

**Class IIa**

1. Tricuspid valve replacement or annuloplasty is reasonable for primary TR when symptomatic. *(Level of Evidence: C)*

2. Tricuspid valve replacement is reasonable for severe TR secondary to disease/abnormal tricuspid valve leaflets not amenable to annuloplasty or repair. *(Level of Evidence: C)*

### ESC 2007

**After left sided valve surgery**

- Severe TS (±TR), with symptoms despite medical therapy\(^a\)
- Severe TS (±TR) in a patient undergoing left-sided valve intervention\(^a\)
- Moderate organic TR in a patient undergoing left-sided valve surgery
- Moderate secondary TR with dilated annulus (>40 mm) in a patient undergoing left-sided valve surgery
- Severe TR and symptoms, after left-sided valve surgery, in the absence of left-sided myocardial, valve, or right ventricular dysfunction and without severe pulmonary hypertension (systolic pulmonary artery pressure > 60 mmHg)
- Severe isolated TR with mild or no symptoms and progressive dilation or deterioration of right ventricular function

### ACC/AHA 2006

**Class IIb**

Tricuspid annuloplasty may be considered for less than severe TR in patients undergoing MV surgery when there is pulmonary hypertension or tricuspid annular dilatation. *(Level of Evidence: C)*

### ACC/AHA 2006

**Class III**

1. Tricuspid valve replacement or annuloplasty is not indicated in asymptomatic patients with TR whose pulmonary artery systolic pressure is less than 60 mm Hg in the presence of a normal MV. *(Level of Evidence: C)*

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How to improve early and late outcomes of surgery for late TR after MV repair or replacement?

- *early surgical treatment of late TR* before the occurrence of right ventricular dysfunction

- *prevention of late TR* by addressing more aggressively and effectively the tricuspid valve during the primary MV operation
Current results of tricuspid annuloplasty are suboptimal

McCarthy et al. JTCVS 2004;127:675
Navia et al. JTCVS 2010;139
To improve the results, the surgical treatment of TR has to be tailored to the stage of the disease.
TR due to annular dilatation alone

remodeling
annuloplasty with a semirigid ring is associated with the most durable results
TR due to annular dilatation associated to significant leaflets’ tethering
Conclusion:

Patients with extensive leaflet tethering (>1.0 cm) require additional maneuvers to ensure valve competence. (J Am Soc Echocardiogr 2007;20:1236-1242.)
Tricuspid leaflet augmentation

Clover technique
When to treat tricuspid regurgitation?

- **Severe isolated TR** in presence of symptoms or progressive RV dilatation/dysfunction

- **Functional TR**
  - severe
    - Annular dilatation alone → ring annuloplasty
    - Annular dilatation + severe tethering of the leaflets → ring annuloplasty + additional procedures (or TV replacement)
  - less than severe
    - tricuspid repair performed according to the dilatation of the tricuspid annulus rather than to the degree of TR

- **Severe TR late after MV surgery** in presence of symptoms or progressive RV dilatation/dysfunction
Thank you!

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