Isolated tricuspid valve surgery: timing and indications

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Be conservative used to be the best way in most things

Conservative Management of Tricuspid Regurgitation in Patients Undergoing Mitral Valve Replacement

By Nina S. Braunwald, M.D., John Ross, Jr., M.D., and Andrew G. Morrow, M.D.

Summary:
In many patients with advanced mitral valve disease, associated tricuspid regurgitation is of a functional nature and secondary to right ventricular hypertension and dilatation of the tricuspid annulus. The present results indicate that in such patients tricuspid regurgitation will improve or disappear after mitral replacement and that tricuspid valve replacement is seldom necessary.

Circulation 1967;35:1-63

Repairing or replacing the mitral will improve the tricuspid. TV surgery is seldom necessary
One can easily ignore tricuspid insufficiency when fixing the left sided valves, because it always goes away spontaneously.

Nina Braunwald, 1967
The most remarkable fact about Braunwald’s paper is that, despite a large body of contradictory published work, the myth she perpetrated had an amazing life.

Robert Frater, 2006
Is indeed the ignored valve?
Techniques used in the past: before and after CPB

STS and EACTS meet in Latin América
Techniques used in the past

- Tricuspid
- Bicuspid (anterior to posterior suture)
- Bicuspid (posterior to septal suture)

STS and EACTS meet in Latin América
Is indeed the ignored valve?

STS and EACTS meet in Latin América

1973
Is indeed the ignored valve?

**Normal Annulus**

Deloche et al., Ann Chir Thorac Cardiovasc, 1973, 12

**Dilated Annulus**

STS and EACTS meet in Latin América
De Vega Suture Annuloplasty

Selective, adjustable and permanent annuloplasty.
An original technic for the treatment of tricuspid insufficiency

Healthcare: facts & lies

Most of the opinions in the media about our healthcare system are characterized by ignorance and/or political sectarianism
De Vega Suture Annuloplasty


STS and EACTS meet in Latin América
Is indeed the ignored valve?

Annulus dilatation: Surgical cut-off value 70 mm


STS and EACTS meet in Latin América
Is indeed the ignored valve?

Annulus dilatation: Echo cut-off value 40 mm (not evident who studied that) or 21 mm/m² as proposed by Colombo.

Antonio Colombo: San Raffaele Hospital, Milan

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Annuloplasty Rings for a reverse remodeling

Who has quantified what a MODERATE TR is?

We know mild and severe
## Indications for surgery in tricuspid disease

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<tr>
<th>Indication</th>
<th>Class</th>
<th>Level</th>
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<tr>
<td>Surgery is indicated in symptomatic patients with severe TS.</td>
<td>I</td>
<td>C</td>
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<tr>
<td>Surgery is indicated in patients with severe TS undergoing left-sided valve intervention.</td>
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<tr>
<td>Surgery is indicated in patients with severe primary, or secondary, TR undergoing left-sided valve surgery.</td>
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<tr>
<td>Surgery is indicated in symptomatic patients with severe isolated primary TR without severe right ventricular dysfunction.</td>
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<td>C</td>
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<tr>
<td>Surgery should be considered in patients with moderate primary TR undergoing left-sided valve surgery.</td>
<td>Ila</td>
<td>C</td>
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<tr>
<td>Surgery should be considered in patients with mild or moderate secondary TR with dilated annulus (≥ 40 mm or &gt; 21 mm/m²) undergoing left-sided valve surgery.</td>
<td>Ila</td>
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<tr>
<td>Surgery should be considered in asymptomatic or mildly symptomatic patients with severe isolated primary TR and progressive right ventricular dilation or deterioration of right ventricular function.</td>
<td>Ila</td>
<td>C</td>
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<td>After left-sided valve surgery, surgery should be considered in patients with severe TR who are symptomatic or have progressive right ventricular dilatation/dysfunction, in the absence of left-sided valve dysfunction, severe right or left ventricular dysfunction, and severe pulmonary vascular disease.</td>
<td>Ila</td>
<td>C</td>
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Recurrence TR: Ring vs Suture Annuloplasty

Tricuspid Valve Repair With an Annuloplasty Ring Results in Improved Long-Term Outcomes

Gilbert H. L. Tang, MD; Tirone E. David, MD; Steve K. Singh, MD; Manjula D. Maganti, MSc; Susan Armstrong, MSc; Michael A. Borger, MD, PhD

Background—The purpose of this study was to compare the long-term results of tricuspid valve (TV) repair with or without an annuloplasty ring.

Methods and Results—702 patients underwent TV repair at our institution (1978 to 2003), of which 493 had, predominantly, a De Vega procedure (no ring) and 209 had an annuloplasty ring (ring). TV pathology was functional (secondary) in 74% of patients. Concomitant procedures consisted of mitral valve surgery in 80% of patients, aortic valve surgery in 33%, and coronary bypass in 14%. Clinical and echocardiographic follow-up data were obtained. Follow-up was 99% complete and was 5.9±4.9 (mean±SD) years long. Ring patients were younger (59±14 years; P=0.001) and less likely to have coronary artery disease (10% versus 17%; P=0.02), more likely to be female (75% versus 65%; P=0.01) and having had previous cardiac surgery (56% versus 42%; P=0.001). Operative times were similar between the 2 groups. Long-term survival, event-free survival and freedom from recurrence TR were significantly better in the ring group, and there was a trend toward fewer TV reoperations. Multivariable analysis demonstrated that the use of an annuloplasty ring was an independent predictor of long-term survival (hazard ratio [HR], 0.7; 95% confidence interval [CI], 0.5 to 1.0; P=0.03) and event-free survival (HR, 0.8; CI, 0.6 to 1.0; P=0.04).

Conclusions—Placement of an annuloplasty ring in patients undergoing tricuspid valve repair is associated with improved survival and event-free survival. (Circulation. 2006;114(suppl 1):I-577–I-581.)
Is a “Ring” annuloplasty better?

According to some papers → Yes

An annuloplasty ring was an independent predictor of:

<table>
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<tr>
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<th>Hazard Ratio (HR)</th>
<th>95% CI</th>
<th>p value</th>
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<tbody>
<tr>
<td>Long-term Survival</td>
<td>0.6</td>
<td>0.5-0.9</td>
<td>0.01</td>
</tr>
<tr>
<td>Event-free Survival</td>
<td>0.3</td>
<td>0.1-0.7</td>
<td>0.008</td>
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STS and EACTS meet in Latin América
Annuloplasty Rings are forever…  James Bond

STS and EACTS meet in Latin América
Wave form of Tricuspid Annulus Motion

STS and EACTS meet in Latin América
Increased risk of dehiscence after tricuspid valve repair with rigid annuloplasty rings

Bettina Pfannmüller, MD, Torsten Doenst, MD, PhD, Katja Eberhardt, BS, Jörg Seeburger, MD, Michael A. Borger, MD, PhD, and Friedrich W. Mohr, MD, PhD

Objectives: Surgical management of tricuspid valve regurgitation mainly consists of tricuspid valve annuloplasty, usually performed with implantation of a rigid ring or a flexible band.

Methods: We performed a retrospective analysis on 820 patients who underwent tricuspid valve repair between March 2002 and July 2009 with either a flexible Cosgrove-Edwards band (n = 415; Edwards Lifesciences LLC, Irvine, Calif) or a rigid Carpentier-Edwards Classic annuloplasty ring (n = 405; Edwards Lifesciences). Mean patient age was 69.2 ± 9.5 years, 54.1% were female, and average logistic EuroSCORE was 13.3% ± 12.5%. Concomitant procedures were performed in 94.6% of patients (mitral valve surgery, 80.6%; aortic valve surgery, 28.2%; coronary artery bypass grafting, 24.5%; atrial fibrillation ablation, 44.5%). One fifth of the operations were reoperative procedures. Follow-up was 94% complete, with mean duration of 21.0 ± 19.0 months.

Results: Thirty-day mortality was 10.1% (Cosgrove-Edwards, 11.9%; Carpentier-Edwards, 8.4%), and 5-year survival was 62.4% (Carpentier-Edwards, 64.7%; Cosgrove-Edwards, 60.3%). Postoperative echocardiography showed significant improvement in tricuspid valve function, with reduction in tricuspid regurgitation grade from 2.3 ± 0.7 to 0.7 ± 0.7, and no differences between groups. Use of a Carpentier-Edwards ring, however, was associated with significantly higher risk of dehiscence (Carpentier-Edwards, 8.7%; Cosgrove-Edwards, 0.9%; P < .001), almost exclusively at the septal leaflet portion of the annulus. Multivariate analysis identified annuloplasty type as independently predicting ring dehiscence (odds ratio, 10.7; 95% confidence interval, 3.2–36.5; P < .001). Patients with annuloplasty dehiscence had more residual tricuspid regurgitation on predischarge echocardiography than did patients without dehiscence (4.4 ± 0.63 vs 0.7 ± 0.6; P < .001). Ten patients underwent reoperation for recurrent tricuspid regurgitation, 4 with ring dehiscence. Five-year freedom from reoperation was 95.3% (Cosgrove-Edwards, 97.7%; Carpentier-Edwards, 92.3%).

Conclusions: Although both rigid and flexible systems provide acceptable early tricuspid valve repair results, use of a rigid ring increases risk of subsequent ring dehiscence. (J Thorac Cardiovasc Surg 2012;143:1050-5)
Annuloplasty Rings may not be forever...

Detachment
Infection
TR recurrence

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Isolated Tricuspid surgery

Primary Tricuspid Valve Incompetence or Stenosis

Secondary late Tricuspid Incompetence
In the absence of left sided pathology, the decision to perform an ITV operation is more controversial. The literature on isolated TV operations is sparse and historically associated with high mortality rates. This is especially true in the setting of right ventricular failure. While some studies have questioned if TV replacement is ever indicated, there is increasing interest in TV pathology and interventions reflected in recent publications.
Rheumatic Tricuspid stenosis

STS and EACTS meet in Latin América
The primary indications for operative intervention

TV endocarditis 25%
Traumatic biopsies and iatrogenic injury from pacing leads 19%
Orthotopic heart transplant (OHT) in 16%
Carcinoid syndrome 5%
Congenital malformations 5%
Idiopathic TV insufficiency in 9%
Persistent TV insufficiency after left sided surgery 21%
The presence of significant tricuspid regurgitation, whether in the context of mitral valve disease or heart failure, should no longer be treated with 'surgical abstention'.

Sean P. Pinney, 2012

Mount Sinai Medical Center, New York, New York 10029, USA.
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Concomitant tricuspid repair rates

4%

Mayo Clinic

4% 62.5%

Mount Sinai

Yilmaz O et al 2011; JTCVS 142: 608-13

Castillo JG, Anyanwu AC, Fuster VF et al, 2012; JTCVS 144: 308

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In patients with **primary TV disease**, TV repair is associated with better early, mid-term, and event-free survival than TV replacement (5 years at 90% vs 63%; 10 years at 76% vs 55%; \( P < 0.001 \)). Moderate to severe RV dysfunction was significantly lower in the TV repair group (repair, 9%; replacement, 28%).

However, in patients with **combined TV and MV disease**, Moraca et al. found no difference in survival benefits between TV repair and replacement. In the propensity-matched study, operative mortality was similar (both high) for TV repair and replacement (18% vs 13%), and late survival was similar (5 years at 72% vs 79%; 10 years at 66% vs 49%).

Other investigations also demonstrated no difference between procedures, despite a higher incidence of preoperative TR severity and risk factors in the TV replacement group. The incidence of redo TV surgeries was not significantly different between groups.

Why is so important to know the history ???

Determining which of the current repair procedures provide the best long-term outcomes are necessary, in particular for those patients with severe tricuspid tethering (RHF- dilatation).

Investigations of adjunctive or other repair techniques are warranted or the use of chord-sparing TV replacement.

Patrick M. McCarthy, 2010
Surgical treatment of tricuspid valve disease, regardless of the operative approach, is associated with significant early and late mortality. However, there is no difference favoring tricuspid valve repair over replacement. Thus, we should not hesitate to consider tricuspid valve replacement for patients in whom we believe there is a reasonable chance for recurrence of regurgitation after repair.

Repairing the mitral and the tricuspid is a good deal
Why Isolated TV surgery is less common?

**Primary (Organic) 20%**
- Rheumatic
- Myxomatous
- Endocarditis
- Carcinoid disease
- Ebstein anomaly
- Endomyocardial fibrosis
- Traumatic
- Iatrogenic

**Secondary (functional) 80%**
- Left heart valvular disease
- Pulmonary hypertension
- Primary RV dysfunction
- Volume overload due to intracardiac shunt

Current surgical volume of TV surgery in the STS Database represents only about one-tenth of the >40,000 mitral valve operations performed yearly in the United States.

Circulation.2009;119:2719-2725

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Severe secondary tricuspid regurgitation

End stage RV dilatation
Tricuspid leaflets severe tethering

Undersized Tricuspid Annuloplasty Rings Optimally Treat Functional Tricuspid Regurgitation

Mehrdad Ghoreishi, MD, Jamie M. Brown, MD, Craig E. Stauffer, BS, Cindi A. Young, Mary J. Byron, PA-C, Bartley P. Griffith, MD, and James S. Gammie, MD
Division of Cardiac Surgery, University of Maryland Medical Center, Baltimore, Maryland

Background. In contrast to mitral valve repair, residual and recurrent regurgitation after tricuspid valve (TV) repair for functional tricuspid regurgitation (TR) is common. We have systematically used undersized, rigid 3-dimensional annuloplasty rings to treat functional TR.

Methods. From March 2006 to October 2009, 101 consecutive patients with moderate or greater functional TR underwent TV repair with an undersized rigid 3-dimensional annuloplasty ring. All patients had a predischarge echocardiography evaluation in a core echocardiography laboratory. Follow-up echocardiography was available for 96% of surviving patients. Mean follow-up was 17 ± 9 months.

Results. Twenty-nine percent of patients had undergone previous cardiac operations, 74% were in New York Heart Association functional class III or IV, and 48% had atrial fibrillation. Mitral valve operations were performed in 95 patients, aortic valve operations in 17, coronary artery bypass grafting in 21, and CryoMaze procedures in 40. Size 26 or 28 rigid tricuspid annuloplasty rings were used in 88% of patients, and no ring larger than a 28 has been used since November 2008. The operative mortality rate was 6% (n = 6). Freedom from significant TR (TR > moderate) at hospital discharge, as assessed by the clinical core laboratory, was 97%. Only 3% of patients had TR greater than moderate during follow-up. No patient required TV reoperation. New postoperative permanent pacemakers were inserted in 3 patients.

Conclusions. Tricuspid valve repair with an undersized (size 26 or 28) rigid 3-dimensional annuloplasty ring is the method of choice for reliable and durable treatment of functional TR.

Severe secondary tricuspid regurgitation

End stage RV dilatation
Tricuspid leaflets severe tethering

How-to-do-it

Tricuspid leaflet augmentation to address severe tethering in functional tricuspid regurgitation

Gilles D. Dreyfus, Shahzad G. Raja, Kok Meng John Chan

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b Department of Cardiovascular Sciences, Imperial College London, United Kingdom

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Abstract

This paper describes a technique for treating severe tricuspid regurgitation due to severe tethering of the tricuspid valve leaflets. The anterior tricuspid leaflet is augmented by use of an autologous pericardial patch, which increases its size, and hence its surface area of coaptation, allowing increased leaflet coaptation to occur with reduced tension within the right ventricle. A Carpenter–Edwards annuloplasty ring is then implanted. We have successfully performed this operation in 15 patients with severe tricuspid regurgitation due to severe leaflet tethering and have achieved complete elimination of tricuspid regurgitation with good coaptation of the tricuspid leaflets. We describe this simple and easily reproducible technique to treat severe tricuspid regurgitation due to tethering of the tricuspid valve leaflets.

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Septalization of APM + annuloplasty to reverse the physiopatological FTR mechanism?

To reposition the APM
To reallign the subvalvular apparatus
In one plane

Functional Tricuspid Regurgitation

Area to Treat

Surgical remodelling of right ventricle

Jean-Paul Couetil, MD  Henri Mondor Hospital, Creteil, France

STS and EACTS meet in Latin América
Is repair always better?

Tricuspid Valve Replacement vs. Repair in Severe Tricuspid Regurgitation

Hyoung Woo Chang, MD, PhD; Dong Seop Jeong, MD, PhD;
Yang Hyun Cho, MD, PhD; Klick Sung, MD, PhD; Wook Sung Kim, MD, PhD;
Young Tak Lee, MD, PhD; Pyo Won Park, MD, PhD

Compared with TVr, TVR had acceptable early and late outcomes in patients with severe TR. TVR can be considered as a valid option with acceptable clinical outcomes in patients who are not suitable candidates for TVr.


STS and EACTS meet in Latin América
Compared with TVr, TVR was not a risk factor for early or long-term outcomes in patients with severe TR. Even with several disadvantageous preoperative characteristics such as longer CPB time, more complex concomitant procedures, and higher proportion of previous cardiac surgeries, TVR was equivalent to TVr in outcomes.

In order to prevent TR recurrence, ring annuloplasty is strongly recommended in TVr procedures. TVR is still a valid option when the tricuspid valve has hostile pathology or the patient is in a critical condition.

Why is so important to know the history ???

TVR is better option than inadequate TV repair

Dr. Karliova, Homburg

STS and EACTS meet in Latin América
Why TV Replacement is less common?

Primary (Organic) 20%
- Rheumatic
- Myxomatous
- Endocarditis
- Carcinoid disease
- Ebstein anomaly
- Endomyocardial fibrosis
- Traumatic
- Iatrogenic

Secondary (functional) 80%
- Left heart valvular disease
- Pulmonary hypertension
- Primary RV dysfunction
- Volume overload due to intracardiac shunt

Current surgical volume of TV surgery in the STS Database represents only about one-tenth of the >40,000 mitral valve operations performed yearly in the United States.

STS and EACTS meet in Latin América
Severe organic tricuspid regurgitation

STS and EACTS meet in Latin América
Rheumatic TR

Thickening and reduction of the tissue of the three leaflets
Fusion of the posterior and septal leaflets

STS and EACTS meet in Latin América
Infective Tricuspid Endocarditis

STS and EACTS meet in Latin América
Infective Tricuspid Endocarditis in Addicts to drugs

Tricuspid valve replacement using a mitral homograft: surgical technique and initial results.

Pomar JL, Mestres CA.

Tricuspid tumors

STS and EACTS meet in Latin América
Tricuspid traumatisms

Chordal rupture of the anterior and posterior leaflets

Prolapse of the anterior leaflet
Tricuspid traumatisms: chordal rupture
Carcinoid and obesity drugs

Callahan et al. Am Heart J. 1982;50:762

STS and EACTS meet in Latin América
Endomyocardial fibrosis

STS and EACTS meet in Latin América
Survival curves for the entire cohort. (A) Showing overall postoperative survival between isolated tricuspid valve repair and replacement; (B) composite proportion of patients without return of moderate/severe TR/RH failure or TV reoperation.

**Surgical outcomes of isolated tricuspid valve procedures: repair versus replacement** Julius I. Ejiofor, Robert C. Neely, Maroun Yammine, Siobhan McGurk, Tsuyoshi Kaneko, Marzia Leacche, Lawrence H. Cohn, and Prem S. Shekar

STS and EACTS meet in Latin América
Choosing the substitute

Provided we need to replace the tricuspid valve:

Is it better a bioprosthesis or a mechanical device?
Mechanical, porcine, bovine for T Valve Replacement?

Not a single manufacturer sells valve prostheses for tricuspid position.

STS and EACTS meet in Latin América.
The biological prostheses in tricuspid

Closing the pericardial leaflets with a central orifice. Better to use porcine???
Porcine vs bovine xenografts in the tricuspid?

Resistance of the tissue, closing central orifice of bovine?

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Dealing with the pacemaker’s electrodes: No electrodes

STS and EACTS meet in Latin América
Tricuspid replacement: bioprosthetic or mechanical valve?

There was no significant difference in performance so as to recommend one type over the other, but bioprosthetic valves may be more favorable as they failure is more predictable.

N.A. Solomon

The patients who require tricuspid valve replacement are usually high risk surgical candidates with early and long term mortality.

The findings of the current study showed no significant hemodynamic difference between mechanical and biological valves.
Isolated mechanical TVR still leads to increased early mortality. A mechanical valve can be considered in select situations when anticoagulation is necessary and in the presence of good right ventricular function.

J Thorac Cardiovasc Surg 2014;148:603-8
TVR with a mechanical prosthesis still has its place and indications. The long-term outcome is satisfactory, with good durability and excellent freedom from reoperation.

Our preference is a low profile bileaflet mechanical prosthesis.
Even in younger patients who need anticoagulation therapy irrespective of TVR, mechanical TVR is not superior because of increased occurrence of valve-related events, especially the composite of thrombosis, embolism, and bleeding, although there is no difference in overall survival between mechanical and bioprosthetic TVRs.

1. Isolated Tricuspid Valve surgery is getting lower hospital mortality and therefore, early indication is recommended.

2. Tricuspid pathology, severity (what de hell moderate TR is?) symptoms and RV Function will advice proper timing.

3. Appropriate repair is the ideal offer for most patients. However…

CONCLUSIONS AT THE END
Valve replacement is not a disaster: many TV patients evolve well after getting a prostheses.

If the repair will be imperfect, consider replacement.

Bioprostheses are my favourite if no OAC required.

Patients needing OAC may benefit of a mechanical device.

Intrinsic failure uses to be benign on bioprostheses. Elective vs emergency surgery makes a huge difference…

Forget the myths and what “every body says” and have your own opinion in those unusual cases.