Tricuspid Valve Surgery: Outcomes and Implications For Percutaneous Procedures

GREGORY PATTAKOS, MD, MS
CARDIOTHORACIC SURGEON
HYGEIA HOSPITAL
Anatomy and Pathophysiology
Anatomy and Pathophysiology
2017 - FTR is ignored!

STS Database

60,000

MR - 4,000,000
TR - 1,600,000

250,000

8,000

MR + TR
Annual New MR
Annual MR Surgeries
Annual TR Surgeries
Tricuspid “Lies”

TR not important… NO
Look for TR in OR… NO
Not much TR around… NO
Repair Mitral, TR goes away … NO
Adds operative mortality to do a TVr… NO
Don’t know how to… NO
RV will fail… NO
Will get TS… NO
Won’t make long-term difference… NO
Guidelines are vague… NO
heart failure during follow-up. The 2 groups had similar baseline clinical, echocardiographic, and operative characteristics, but operative mortality was significantly higher in the replacement group than in the repair group \((p = 0.008)\). During a median follow-up of 87 months, 19 patients (24%) in the repair group and 8 (47%) in the replacement group attained the composite end point, and TV replacement was independently associated with end points in the Cox proportional hazards analysis after adjustment with propensity score (hazard ratio 4.033, 95% CI 1.470 to 11.071; \(p = 0.007\)). In conclusion, compared with TV repair, replacement was associated with higher operative mortality and worse long-term clinical outcomes in patients with very severe functional TR. Repair should be the preferred surgical option even for severe TR associated with more advanced tethering and right ventricular dilatation. © 2017 Elsevier Inc. All rights reserved. (Am J Cardiol 2017;119:905–910)
Surgical Repair Options

**De Vega Annuloplasty**

**Kay Annuloplasty**

**Ring Annuloplasty**
Why We Choose Ring Annuloplasty

![Graph showing 3-4+ TR (%) for different ring types: Any ring, Rigid, Flexible, DeVega, Peri-Guard.]

**Functional Tricuspid Regurgitation and Ring Annuloplasty Repair**

William B. Weir, MD, Matthew A. Romano, MD and Steven F. Bolling, MD

1Department of Cardiac Surgery, University of Michigan, Ann Arbor, MI, USA
Why We Choose Ring Annuloplasty
926 tricuspid operations from 1977-2008 (out of total 11,077 total valve operations)

792 repairs and 134 replacements (118 bioprosthetic, 16 mechanical)

Concomitant operations: 78% also had mitral, 25% AVR, 15% CABG

Perioperative mortality: 14% (13% repair, 21% replacement, p=0.01)
At discharge >2+ TR in 13% repairs, 2% replacements

At long term follow-up (mdn 4 years) >2+ TR in 31% of repairs, 12% of replacements

Not using a ring associated with higher chance of >2+ TR (18% vs 12%)
Repair Type
Replacement type
Long-term Survival

![Graph showing long-term survival rates for repair and replacement After surgery (years)]
645 patients during 2003-2011 undergoing Tricuspid Repair during surgery for Mitral Repair
65% of patients had concomitant Tricuspid Repair for moderate or higher TR, or annulus over 40mm
Excluded patients with: prior sternotomy, need for AVR, severe 3v CAD
83% of patients received a ring sized 28mm or less
OPERATIVE MORTALITY 0.6%

7-year survival for the tricuspid annuloplasty group was 91% vs 97% for the isolated mitral repair group (p = 0.1).
Impact of Concomitant Tricuspid Annuloplasty on Tricuspid Regurgitation, Right Ventricular Function, and Pulmonary Artery Hypertension After Repair of Mitral Valve Prolapse

Joanna Chikwe, MD, Shinobu Itagaki, MD, Aneiechi Anyanwu, MD, David H. Adams, MD

**FIGURE 1** Freedom From Moderate or Greater TR

![Graph showing freedom from moderate or greater TR over years since surgery with HR=0.26 (95% CI 0.07-0.94), P=0.04]
Impact of Concomitant Tricuspid Annuloplasty on Tricuspid Regurgitation, Right Ventricular Function, and Pulmonary Artery Hypertension After Repair of Mitral Valve Prolapse

Joanna Chikwe, MD, Shinobu Itagaki, MD, Anelechi Anyanwu, MD, David H. Adams, MD

**FIGURE 2** Longitudinal Change in Pulmonary Artery Systolic Pressure

<table>
<thead>
<tr>
<th>Time Interval</th>
<th>Systolic Pulmonary Artery Pressure (mmHg)</th>
<th>Mitral only</th>
<th>MVR+TVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preop</td>
<td>30</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>Predis</td>
<td>25</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>&lt;1 y</td>
<td>25</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>1-3 y</td>
<td>25</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>3-5 y</td>
<td>25</td>
<td>25</td>
<td>30</td>
</tr>
</tbody>
</table>

P < 0.001

P = 0.97
Impact of Concomitant Tricuspid Annuloplasty on Tricuspid Regurgitation, Right Ventricular Function, and Pulmonary Artery Hypertension After Repair of Mitral Valve Prolapse

Joanna Chikwe, MD, Shinobu Itagaki, MD, Aneiechi Anyanwu, MD, David H. Adams, MD

FIGURE 3  Longitudinal Change in Right Atrium Area

![Graph showing longitudinal change in right atrium area with preop, predis, <1 y, 1-3 y, 3-5 y, with Mitral only and MVR+TVR groups, and statistical significance (P<0.001, P=0.50)]
Impact of Concomitant Tricuspid Annuloplasty on Tricuspid Regurgitation, Right Ventricular Function, and Pulmonary Artery Hypertension After Repair of Mitral Valve Prolapse

Joanna Chikwe, MD, Shinobu Itagaki, MD, Aneiechi Anyanwu, MD, David H. Adams, MD

**Figure 4** Longitudinal Change in the Proportion of Patients With RV Dysfunction
Impact of Concomitant Tricuspid Annuloplasty on Tricuspid Regurgitation, Right Ventricular Function, and Pulmonary Artery Hypertension After Repair of Mitral Valve Prolapse

Joanna Chikwe, MD, Shinobu Itagaki, MD, Anelechi Anyanwu, MD, David H. Adams, MD

**FIGURE 5** Recovery of RV Function

![Graph showing recovery of RV function](image-url)
23,685 patients, 1990-2014, at Brigham

- Increasing grade of preop TR associated with higher mortality rate postop
- Tricuspid repair associated with increased survival in multivariable analysis
Severity of tricuspid regurgitation is associated with long-term mortality

Brian J. Kelly, DO, a Jamahal Maeng Ho Luxford, MBBS, MPH, MCU, FANZCA, b Carolyn Goldberg Butler, MD, a Chuan-Chin Huang, MS, ScD, b Kerry Wilusz, BS, a Julius I. Ejiofor, MD, a James D. Rawn, MD, a John A. Fox, MD, a Stanton K. Shernan, MD, a and Jochen Daniel Muehlschlegel, MD, MMSc a
Severity of tricuspid regurgitation is associated with long-term mortality

Brian J. Kelly, DO, a Jamahal Maeng Ho Luxford, MBBS, MPH, MCU, FANZCA, b Carolyn Goldberg Butler, MD, a Chuan-Chin Huang, MS, ScD, a Kerry Wilusz, BS, a Julius I. Ejiofor, MD, c James D. Rawn, MD, c John A. Fox, MD, a Stanton K. Sherman, MD, a and Jochen Daniel Muehlschlegel, MD, MMSc a
Outcome of tricuspid valve surgery in the presence of permanent pacemaker

Nishant Saran, MBBS, Sameh M. Said, MD, Hartzell V. Schaff, MD, Simon Maltais, MD, John M. Stulak, MD, Kevin L. Greason, MD, Richard C. Daly, MD, Alberto Pochettino, MD, Katherine S. King, MS, and Joseph A. Dearani, MD
Treating these percutaneously?
Surgical Repair with Pacer Lead
Trends and Outcomes of Tricuspid Valve Surgery in North America: An Analysis of More Than 50,000 Patients From The Society of Thoracic Surgeons Database

Arman Kilic, MD, Paramita Saha-Chaudhuri, PhD, J. Scott Rankin, MD, and John V. Conte, MD

- 54,375 Tricuspid Operations from 2000-2010
- 89% were repairs, 86% were done as combined procedures
- Operative mortality 10.6% in 2000, 8.2% in 2010
<table>
<thead>
<tr>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAB Only</td>
</tr>
<tr>
<td>AV Replacement</td>
</tr>
<tr>
<td>MV Replacement Only</td>
</tr>
<tr>
<td>MV Repair</td>
</tr>
<tr>
<td>AV Replacement + CAB</td>
</tr>
<tr>
<td>MV Replacement + CAB</td>
</tr>
<tr>
<td>MV Repair + CAB</td>
</tr>
</tbody>
</table>

Where is the Tricuspid?
Development of a Risk Prediction Model and Clinical Risk Score for Isolated Tricuspid Valve Surgery

Damien J. LaPar, MD, MSc, Donald S. Likosky, PhD, Min Zhang, PhD, Patty Theurer, BSN, C. Edwin Fonner, John A. Kern, MD, Stephen F. Bolling, MD, Daniel H. Drake, MD, Alan M. Speir, MD, Jeffrey B. Rich, MD, Irving L. Kron, MD, Richard L. Prager, MD, Gorav Ailawadi, MD
Percutaneous Approaches

Transcatheter Therapies for Tricuspid Regurgitation

- Coaptation Device
- Heterotopic Caval Valve Implantation
- Annuloplasty Devices
TriAlign Percutaneous Annuloplasty Device

Early Feasibility Study of a Transcatheter Tricuspid Valve Annuloplasty

SCOUT Trial 30-Day Results

Rebecca T. Hahn, MD, a, b Christopher U. Meduri, MD, c Charles J. Davidson, MD, d Scott Lim, MD, e Tamim M. Nazif, MD, f Mark J. Ricciardi, MD, f Vivek Rajagopal, MD, f Gorav Ailawadi, MD, g Mani A. Vannan, MBBS, c James D. Thomas, MD, h Dale Fowler, MD, h Stuart Rich, MD, i Randy Martin, MD, j Geraldine Ong, MD, j Adam Groothuis, PhD, k Susheel Kodali, MD k

Wire Placement  Pledged Delivery  Plication and Lock
Toric Valve
Forma Repair System
TriCinch System

Step 1: Access via Inferior Vena Cava

Step 2: Aim at the anterior annulus

Step 3: Implant the anchor on the annulus

Step 4: Pull tension, check, secure.
Percutaneous Tricuspid Techniques

- What we have so far: Great high-tech ideas, some products that are safe
- What we don’t have: Hard clinical endpoints (mortality) and long-term data...
The International Multicenter TriValve Registry

Which Patients Are Undergoing Transcatheter Tricuspid Repair?

Maurizio Taramasso, MD, a Rebecca T. Hahn, MD, b Hannes Alessandrini, MD, c Azeem Latib, MD, d Adrian Attinger-Toller, MD, e Daniel Braun, MD, f Eric Brochet, MD, g Kim A. Connelly, MD, h Paolo Denti, MD, d Florian Deuschl, MD, i Andrea Englmaier, MD, f Neil Fam, MD, h Christian Frerker, MD, c Joerg Hausleiter, MD, f Jean-Michel Juliard, MD, g Ryan Kaple, MD, i Felix Kreidel, MD, c Karl Heinz Kuck, MD, c Shingo Kuwata, MD, PhD, a Marco Ancona, MD, d Margarita Malasa, MD, k Tamim Nazif, MD, b Georg Nickenig, MD, k Fabian Nielispach, MD, PhD, a Alberto Pozzoli, MD, a Ulrich Schafer, MD, i Joachim Schofer, MD, l Robert Schueler, MD, k Gilbert Tang, MD, m Alec Vahanian, MD, g John G. Webb, MD, e Ermela Yzeiraj, MD, l Francesco Maisano, MD, a Martin B. Leon, MD b
The Future Is (Always) Near