The Dilemma of Tricuspid Valve Repair

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• Other
  – I am a cardiac surgeon, not a cardiologist
  – Generic tricuspid regurgitation in adults

The Forgotten Valve

• Aortic valve
  STS 2009 Report
  44,500 procedures
• Mitral valve
  21,000 procedures
• Tricuspid valve
  7,133 procedures
• Pulmonic valve
  522 procedures

STS National Adult Cardiac Database 2009

The Forgotten Valve

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Tricuspid Valve Remembered

• If untreated at the time of MV repair, tricuspid regurgitation negatively impacts:
  – perioperative outcomes
  – functional class
  – survival

Tricuspid Valve Anatomy

• Tricuspid valve complex
  – Trileaflet valve
    • Anterior, posterior, and septal
  – Chordae tendinae
  – Anterior and posterior papillary muscles
  – Fibrous annulus
  – Right atrial and ventricular myocardium

Tricuspid Valve Remembered

• Overview
  Anatomy
  Pathophysiology
  Indications for tricuspid valve repair
  Surgery
  Cases

Tricuspid Valve Remembered

Tricuspid Valve Remembered
Tricuspid Valve Anatomy

- Successful function depends on the integrity and coordination of all components

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Tricuspid Valve Anatomy

- Surgeon’s view

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Tricuspid Valve Anatomy

- Surgeon’s view

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Tricuspid Valve Anatomy

- Special considerations
  - Septal leaflet smallest and relatively fixed
  - Tricuspid annulus dilates in the A-P dimension
  - Annuloplasty sizing based on septal annulus dimension
  - Complex 3 dimensional structure

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Tricuspid Valve Remembered

- Overview
  - Anatomy
  - Pathophysiology
  - Indications for tricuspid valve repair
  - Surgery
  - Cases

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Pathophysiology

- Cause of tricuspid regurgitation
  - Primary causes: 25%
  - Less common causes include rheumatic, congenital, endocarditis, chordal or papillary muscle rupture, iatrogenic from transvenous leads
Pathophysiology
• Secondary causes of tricuspid regurgitation
• Left and right ventricular interdependence
  – Share interventricular septum
  – LV contraction augments RV free wall contraction
  – 20-40% of RV contraction results from LV work
  – Shared neurohormonal milieu
  – Left sided chamber enlargement and valve dysfunction can lead to right sided pressure and volume overload, tricuspid annular dilation, and tricuspid regurgitation

Pathophysiology
• Secondary causes of tricuspid regurgitation
  – Most often secondary to left heart failure from myocardial or valvular causes: 75%
  – Annular dilation and right ventricular enlargement

Pathophysiology
• Secondary tricuspid regurgitation is common in surgery populations
  – 30% of patients undergoing mitral valve repair for functional MR have at least moderate tricuspid regurgitation

Pathophysiology
• Implications of tricuspid regurgitation
  – Tricuspid regurgitation persists in patients undergoing mitral valve repair without tricuspid valve repair (TR Grade 0.4 vs 2.1; improved functional class)
  – Short term, in-hospital mortality higher in patients with unrepaired TR
  – Long term, actuarial mortality higher in patients with unrepaired TR
  – Patients with significant TR should have tricuspid valve repair at the time of mitral valve surgery

Pathophysiology
• Presentation of tricuspid regurgitation
  – Fatigue, decreased exercise tolerance
  – Classic symptoms of right heart failure
    • Ascites, congestive hepatopathy, peripheral edema, decreased appetite, abdominal fullness
    • Atrial fibrillation
  – Assessment of volume status difficult because of pulsatile jugular venous pressure on exam

Pathophysiology
• Echocardiography routinely used to assess severity
  – Color Doppler flow mapping in 2 orthogonal planes
  – Vena contracta width, flow convergence calculation, direction and size of jet
  – Morphology of continuous wave Doppler across the valve, pulsed wave Doppler of the hepatic veins
• Clinical context important
  – Volume status, afterload
Imaging

• Echocardiography

![](image)

Tricuspid Valve Remembered

• Overview
  Anatomy
  Pathophysiology
  *Indications for tricuspid valve repair*
  Surgery
  Cases

Indications for Tricuspid Valve Repair

• 2008 ACC/AHA Indications

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


Indications for Tricuspid Valve Repair

• 2008 ACC/AHA Indications

  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 diseased/abnormal tricuspid valve leaflets not amenable to annuloplasty or repair. *(Level of Evidence: C)*


Indications for Tricuspid Valve Repair

• 2008 ACC/AHA Indications

  Class IIb
  1. 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)*

Tricuspid Valve Remembered

- Overview
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  Pathophysiology
  Indications for tricuspid valve repair

Surgery

Cases

Surgery for Tricuspid Regurgitation

- Approaches
  - Reduce the tricuspid valve annulus size
    - Annuloplasty
    - Posterior annular bicuspidalization


Surgery for Tricuspid Regurgitation

- Approaches
  - Reduce the tricuspid valve annulus size
  - Annuloplasty

Surgery for Tricuspid Regurgitation

- Approaches
  - Leaflet augmentation
  - Chordal replacement
  - Tricuspid valve replacement
    - Reserved for cases where leaflet tissue or chordae are deficient

Surgery for Tricuspid Regurgitation

- Outcomes
  - Operative mortality associated with tricuspid valve repair or replacement varies greatly with the surgery population
  - Addition of tricuspid valve repair to mitral valve surgery does not substantially increase operative mortality (0.7%)
  - Tricuspid valve repair is durable in these populations (2% failure rate at long-term follow up)

Tricuspid Valve Remembered

- Overview
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  - Pathophysiology
  - Indications for tricuspid valve repair
  - Surgery
- Cases

Case #1

- 70 year old man referred for CABG

Case #1

- HPI: progressive shortness of breath and lower extremity swelling. Functional Class III.
  - Physical exam: 2+ LE edema, ascites

Case #1

- Echo

Case #1

- Operation: High CVP (25 mm Hg), V wave on CVP trace
  - CABG x 3, TV repair with a 30 mm annuloplasty ring
  - Ultrafiltrated 6 L using cardiopulmonary bypass machine
Case #1

- Echo

Case #1

- Postoperative course significant for delerium which resolved with conservative measures
- Discharged POD #10
- Functional Class I after recovery 3 months postop

Case #2

- 70 year old woman referred for re-do AVR
- s/p mechanical AVR 19 years ago
- Increased velocities across aortic valve, related to pannus?

Case #2

- HPI: fatigue, dyspnea on exertion. Functional Class II
- GI bleeding on warfarin

Case #2

- Echo

Case #2

- Operation: High CVP
- Re-do AVR with bioprostheses
- TV repair with 28 mm annuloplasty
Case #2

- Uncomplicated hospital course
- Doing well at short term follow up

Conclusions

- Tricuspid valve comprised of a complex of components including leaflets, fibrous annulus, chordae, papillary muscles, myocardium
- Function depends on integrity and coordination of all these components

Conclusions

- Secondary tricuspid regurgitation is common, especially in surgery populations (30% of mitral valve repair patients)
- Tricuspid valve repair does not add substantial morbidity to left-sided operations
- Patients with unrepaired tricuspid regurgitation have worse functional status and short- and long-term survival

Conclusions

- Evaluation of the tricuspid valve should be part of the evaluation of any patient presenting with heart failure or reduced cardiovascular functional status, especially those being prepared for cardiac surgery for left-sided lesions
- Don’t forget to remember the forgotten valve!

Thank you!