Tricuspid Regurgitation
Prevalence-Treatment

Eurovalve-2017

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Mayo Clinic, Rochester, MN
Prevalence of Valve Diseases
VHD Olmsted County, MN

Prevalence per 100 adult residents

Total Left VHD 1.8%
Tricuspid Regurgitation 1.3%

In the USA adults affected by moderate or severe TR are >3 M
Prevalence of Valve Diseases
Olmsted County

Prevalence (%)

- Mitral
- Aortic
- Total Left VHD
- Tricuspid Regurgitation

Age Groups:
- 0-17
- 18-44
- 45-54
- 55-64
- 65-74
- 75+

CP980196-28
Guidelines for the management of Tricuspid Regurgitation

Tricuspid Regurgitation

- Progressive functional TR (stage B)
  - Mild
  - Moderate
    - At time of left-sided valve surgery
      - TA dilation*
      - PHTN without TA dilation
        - TV Repair (IIa)
        - TV Repair (IIb)
  - Moderate
    - At time of left-sided valve surgery
      - TV Repair or TVR (I)

- Asymptomatic severe TR (stage C)
  - Functional
    - At time of left-sided valve surgery
      - TV Repair or TVR (IIb)
  - Primary
    - Progressive RV dysfunction
      - TV Repair or TVR (IIb)

- Symptomatic severe TR (stage D)
  - Reoperation
    - Preserved RV function
      - PHTN not severe
        - TV Repair or TVR (I)
  - Functional
    - At time of left-sided valve surgery
      - TV Repair or TVR (IIa)
Tricuspid Regurgitation

Why is TR management so vague and poorly defined?

Reason #1: Heterogeneity

A smorgasbord of strange etiologies
Tricuspid Regurgitation
“Causal Disease”
1162 Quantified cases

- Congenital Disease 8.9%
- Organic T Valve diseases or pacemaker wire 11.9%
- Left valve disease 25.9%
- LV Dysfunction 12.2%
- Pulmonary HTN 28.9%
- Idiopathic 12.2%
Tricuspid Regurgitation
Rheumatic Valve Disease

Surgical Specimen
Tricuspid Regurgitation
Carcinoid Heart Disease

Autopsy Specimen (From RV Apex)
Tricuspid Regurgitation

Pulmonary Hypertension

Autopsy Specimens
Idiopathic Tricuspid Regurgitation
Dilated Annulus

Autopsy Specimen
Tricuspid Regurgitation
Uncertain management

Reason #1: Heterogeneity
Etiology and Mechanism should be comprehensively described by Doppler-Echo

Reason #2: Grading Uncertainty
Assessment of TR severity is difficult
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tricuspid valve</td>
<td>Usually normal</td>
<td>Normal or abnormal</td>
<td>Abnormal/Flail leaflet/Poor coaptation</td>
</tr>
<tr>
<td>RV/RA/IVC size</td>
<td>Normal*</td>
<td>Normal or dilated</td>
<td>Usually dilated**</td>
</tr>
<tr>
<td>Jet area-central jets (cm²)§</td>
<td>&lt; 5</td>
<td>5-10</td>
<td>&gt; 10</td>
</tr>
<tr>
<td>VC width (cm)§</td>
<td>Not defined</td>
<td>Not defined, but &lt; 0.7</td>
<td>&gt; 0.7</td>
</tr>
<tr>
<td>PISA radius (cm)§</td>
<td>≤ 0.5</td>
<td>0.6-0.9</td>
<td>&gt; 0.9</td>
</tr>
<tr>
<td>Jet density and contour—CW</td>
<td>Soft and parabolic</td>
<td>Dense, variable contour</td>
<td>Dense, triangular with early peaking</td>
</tr>
<tr>
<td>Hepatic vein flow†</td>
<td>Systolic dominance</td>
<td>Systolic blunting</td>
<td>Systolic reversal</td>
</tr>
</tbody>
</table>

CW, Continuous wave Doppler; IVC, inferior vena cava; RA, right atrium; RV, right ventricle; VC, vena contracta width.

* Unless there are other reasons for RA or RV dilatation. Normal 2D measurements from the apical 4-chamber view: RV medio-lateral end-diastolic dimension ≤ 4.3 cm, RV end-diastolic area ≤ 35.5 cm², maximal RA medio-lateral and supero-inferior dimensions ≤ 4.6 cm and 4.9 cm respectively, maximal RA volume ≤ 33 ml/m² (35;89).

** Exception: acute TR.

§ At a Nyquist limit of 50-60 cm/s. Not valid in eccentric jets. Jet area is not recommended as the sole parameter of TR severity due to its dependence on hemodynamic and technical factors.

† Other conditions may cause systolic blunting (e.g. atrial fibrillation, elevated RA pressure).
Tricuspid Regurgitation

ER0 = R flow

R Vel

R vol = ERO x RTVI
# Quantitation of Regurgitations

## Criteria for Severe Regurgitation

<table>
<thead>
<tr>
<th></th>
<th>AR</th>
<th>MR</th>
<th>TR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERO (mm²)</td>
<td>30</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Rvol (mL)</td>
<td>60</td>
<td>60</td>
<td>45</td>
</tr>
</tbody>
</table>
Tricuspid Regurgitation
Uncertain management

#2: TR assessment
Assessment of TR should be Comprehensive and Quantitative

Reason #3: Outcome Uncertainty
TR is often the consequence of another disease—Does it affect outcome?
TR Uncertain management

Reason #4: Outcome Uncertainty

Survival post-PBMV

Probability of survival (%)

0 20 40 60 80 100

0 6 12 18 24 30 36 42 48

Months after procedure

Mild TR
Moderate TR
Severe TR

Sagie et al JACC 1994; 24:696
Tricuspid Valvulpectomy without replacement

Drug-addict patients with intractable right-sided endocarditis

55 Valvulpectomy

6 early deaths

Tricuspid valve replacement for CHF N=6

4 deaths

No further tricuspid surgery N=43

10 deaths: All except 1 related to recurrent use of IV drugs

NYHA I-II: 95%

The independent effect of TR on Outcome under medical management remains unclear.

A serious problem

or

An unimportant color spot, surrogate of the causal condition
Impact of Tricuspid Regurgitation on Long-Term Survival

Jayant Nath, MD,* Elyse Foster, MD, FACC,† Paul A. Heidenreich, MD*

Palo Alto

Table 1. Clinical and Echocardiographic Features of Patients With Tricuspid Regurgitation

<table>
<thead>
<tr>
<th></th>
<th>No TR (n = 600)</th>
<th>Mild TR (n = 3,804)</th>
<th>Moderate TR (n = 620)</th>
<th>Severe TR (n = 199)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>62.2 ± 12.8</td>
<td>66.0 ± 12.6</td>
<td>71.9 ± 11.7</td>
<td>71.9 ± 12.4</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>LVEF (%)</td>
<td>57.3 ± 9.1</td>
<td>55.4 ± 11.6</td>
<td>47.1 ± 15.6</td>
<td>40.4 ± 17.2</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>RV dilation</td>
<td>8%</td>
<td>11%</td>
<td>35%</td>
<td>66%</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>RV dysfunction</td>
<td>3%</td>
<td>8%</td>
<td>30%</td>
<td>61%</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Dilated IVC</td>
<td>6%</td>
<td>11%</td>
<td>44%</td>
<td>76%</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>
Medical and surgical outcome of tricuspid regurgitation caused by flail leaflets

David Messika-Zeitoun, MD
Helen Thomson, MD
Michael Bellamy, MD
Christopher Scott, MS
Christophe Tribouilloy, MD
Joseph Dearani, MD
A. Jamil Tajik, MD
Hartzell Schaff, MD
Maurice Enriquez-Sarano, MD
TR due to Flail Leaflets

overall population

Survival (%)

P=0.001
Usefulness of Echocardiographic Determined Tricuspid Regurgitation in Predicting Event-Free Survival in Severe Heart Failure Secondary to Idiopathic-Dilated Cardiomyopathy or to Ischemic Cardiomyopathy

Judy Hung, MD, Todd Koelling, MD, Marc J. Semigran, MD, G. William Dec, MD, Robert A. Levine, MD, and Thomas G. Di Salvo, MD

FIGURE 1. Echocardiographic TR and event-free survival. The actuarial event-free survival of the patients without echocardiographic TR (diamonds) and the patients with echocardiographic TR (squares) is shown. Event-free survival was significantly better for patients without echocardiographic TR. Log-rank: p = 0.002. (Mean follow-up: 357 ± 428 days.)
Clinical Outcome of Isolated Tricuspid Regurgitation

Yan Topilsky, MD,* Vuyisile T. Nkomo, MD,† Ori Vatuty, MD,‡ Hector I. Michela, MD,† Thierry Letourneau, MD,† Rakesh M. Suri, MD, DPhil,‡ Sorin Pislaru, MD,† Soon Park, MD,† Douglas W. Mahoney, MSc,§ Simon Biner, MD,* Maurice Enriquez-Sarano, MD†
Idiopathic TR

Survival (%)

Years

ERO ≥ 0.40 cm²

87±2%
66±6%

ERO < 0.40 cm²

87±2%
66±6%
70±6%
38±7%

P<0.001
Idiopathic TR

Sinus Rhythm

Cardiac events (%)

Survival (%)

ERO <0.40 cm²

ERO ≥0.40 cm²

P<0.001

Atrial Fibrillation

Survival (%)

Cardiac events (%)

P<0.001

P<0.001

P<0.001

P<0.001

Idiopathic TR
Tricuspid Regurgitation
Uncertain management

#3: Outcome of TR
TR affects outcome and should be treated

Reason #3: Procedure Uncertainty
Should we advise Tricuspid valve repair or replacement?
Tricuspid Valve Tethering Predicts Residual Tricuspid Regurgitation After Tricuspid Annuloplasty

Shota Fukuda, MD; Jong-Min Song, MD; A. Marc Gillinov, MD; Patrick M. McCarthy, MD; Masao Daimon, MD; Vorachai Kongsaerepong, MD; James D. Thomas, MD; Takahiro Shiota, MD

TABLE 1. Effect of Characteristic and Echocardiographic Findings on Residual TR After TV Annuloplasty

<table>
<thead>
<tr>
<th></th>
<th>r</th>
<th>Univariate P</th>
<th>Multivariate P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.28</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LV ejection fraction</td>
<td>0.19</td>
<td>0.005</td>
<td>0.6</td>
</tr>
<tr>
<td>RV fractional area change</td>
<td>0.18</td>
<td>0.01</td>
<td>0.5</td>
</tr>
<tr>
<td>RA area</td>
<td>0.02</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>RV systolic pressure</td>
<td>0.02</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>TV annulus diameter</td>
<td>0.07</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>TV tethering distance</td>
<td>0.56</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>TV tethering area</td>
<td>0.52</td>
<td>&lt;0.001</td>
<td>0.4</td>
</tr>
<tr>
<td>Preoperative %TR</td>
<td>0.32</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

patients and 4 techniques of annuloplasty, we used 1-way ANOVA. We used logistic regression to correlate variables of interest. Multivariate stepwise regression analysis was performed to identify factors of severity of residual TR (measured continuously as %TR, %TI, and %D).
Tricuspid Regurgitation

- TR is poorly understood: comprehensive mechanistic assessment
- Severe TR adversely affects clinical outcome
- Surgical (interventional ?) treatment: Severe TR, even isolated, should be more often treated (repair if adequate)
TRICUSPID REGURGITATION
An imperious need for data
Thank you