Considering SAVR in the TAVR era: Surgical Implications of TAVR

Vinod H. Thourani, MD, FACC, FACS

Professor of Cardiothoracic Surgery and Medicine
Chief of Cardiothoracic Surgery, Emory Hospital Midtown
Co-Director, Structural Heart and Valve Center
Emory University School of Medicine

ACC Evolving Valve Management Strategies Roundtable
December 17, 2016
Disclosures

- **Edwards Lifesciences**
  - Emory Co-PI: PARTNER 1 and 2
  - National Co-PI: PARTNER 2 (SAPIEN 3 Trial) with Dr. Susheel Kodali
- **St. Jude Medical**
  - Emory PI Portico Trial, Structural Heart Advisory board
- **Boston Scientific**
  - Emory PI: REPRISE Trial
  - Advisory Board, Executive Comm (Lotus Valve Trial)
- **Medtronic**
  - Emory PI: SURTAVI Trial
- **Jenavalve**
  - National Co-PI with Drs. Martin Leon and Susheel Kodali
- **Abbott Medical**
  - Emory Co-PI: Coapt Trial
- **Apica Cardiovascular**
  - IP, co-founder
TAVR 2015

Operable AS patients

- SAVR, role of TAVR?
  - Low Risk: ~65%
- TAVR or SAVR
  - Intermed¹ Risk: ~25%
- TAVR
  - High Risk: ~10%
- Futile
  - Extr Risk
  - Too Sick

1. Open IDE studies for intermediate risk indication
Cumulative TVT Sites
2012 to September 2015

Q1 2012: 11
Q2 2012: 59
Q3 2012: 117
Q4 2012: 156
Q1 2013: 201
Q2 2013: 236
Q3 2013: 249
Q4 2013: 252
Q1 2014: 288
Q2 2014: 315
Q3 2014: 333
Q4 2014: 348
Q1 2015: 365
Q2 2015: 376
Q3 2015: 396

Q4 2015: 396
Effect of Availability of Transcatheter Aortic-Valve Replacement on Clinical Practice

Jochen Reinöhl, M.D., Klaus Kaier, Ph.D., Holger Reinecke, M.D., Claudia Schmoor, Ph.D., Lutz Frankenstein, M.D., Werner Vach, Ph.D., Alain Cribier, M.D., Friedhelm Beyersdorf, M.D., Christoph Bode, M.D., and Manfred Zehender, M.D., Ph.D.

Reinöhl J, et al. NEJM. 2015; 373:2438
**Table 1. Numbers of Surgical Aortic Valve Replacement (SAVR) and Transcatheter Aortic Valve Replacement (TAVR) Procedures, According to Year.***

<table>
<thead>
<tr>
<th>Procedure</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SAVR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total — no. (frequency)†</td>
<td>8622 (10.5)</td>
<td>8608 (10.5)</td>
<td>8259 (10.1)</td>
<td>8109 (9.9)</td>
<td>7899 (9.7)</td>
<td>7452 (9.1)</td>
<td>7048 (8.7)</td>
<td>55,992 (9.8)</td>
</tr>
<tr>
<td>Bioprostheses — no. (%)</td>
<td>6128 (71.1)</td>
<td>6196 (72.0)</td>
<td>6284 (75.1)</td>
<td>6266 (77.3)</td>
<td>6296 (79.7)</td>
<td>6050 (81.2)</td>
<td>5818 (82.8)</td>
<td>43,058 (75.9)</td>
</tr>
<tr>
<td>Mechanical prostheses — no. (%)</td>
<td>1810 (21.0)</td>
<td>1708 (19.8)</td>
<td>1333 (16.1)</td>
<td>1228 (15.1)</td>
<td>1104 (14.0)</td>
<td>1011 (13.6)</td>
<td>841 (12.0)</td>
<td>9,038 (15.1)</td>
</tr>
<tr>
<td>Other prostheses — no. (%) ‡</td>
<td>689 (8.0)</td>
<td>712 (8.3)</td>
<td>645 (7.8)</td>
<td>621 (7.7)</td>
<td>505 (6.4)</td>
<td>391 (5.2)</td>
<td>365 (5.2)</td>
<td>3,928 (7.0)</td>
</tr>
<tr>
<td><strong>TAVR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total — no. (frequency)†</td>
<td>144 (0.2)</td>
<td>1122 (1.4)</td>
<td>2599 (3.2)</td>
<td>4806 (5.9)</td>
<td>6523 (8.0)</td>
<td>8240 (10.1)</td>
<td>9147 (11.3)</td>
<td>32,581 (5.7)</td>
</tr>
<tr>
<td>Transfemoral — no. (%)</td>
<td>NA</td>
<td>825 (7.3)</td>
<td>1618 (62.3)</td>
<td>3051 (63.5)</td>
<td>4283 (65.7)</td>
<td>5881 (71.4)</td>
<td>6794 (74.3)</td>
<td>22,452 (68.9)</td>
</tr>
<tr>
<td>Transapical — no. (%)</td>
<td>NA</td>
<td>302 (26.9)</td>
<td>986 (37.9)</td>
<td>1772 (36.9)</td>
<td>2253 (34.5)</td>
<td>2363 (28.7)</td>
<td>2367 (25.9)</td>
<td>10,043 (30.8)</td>
</tr>
<tr>
<td>All procedures — no.</td>
<td>8766</td>
<td>9725</td>
<td>10,858</td>
<td>12,915</td>
<td>14,422</td>
<td>15,692</td>
<td>16,195</td>
<td>88,573</td>
</tr>
</tbody>
</table>
Evolution of the Treatment of Aortic Stenosis

1. Surgery is the only treatment
2. Surgery is the gold standard treatment
3. Surgery is the preferred treatment for low and intermediate risk patients
4. Transcatheter interventions are performed in intermediate risk patients
5. Surgery is performed in patients with contraindication to transcatheter approach
Mortality and Stroke: S3HR
At 30 Days (As Treated Patients)

Mortality

- All-Cause
- Cardiovascular

Stroke

- All Stroke
- Disabling

O:E = 0.26
(STS 8.6%)
Mortality and Stroke: S3i
At 30 Days (As Treated Patients)

**Mortality**

- All-Cause
- Cardiovascular

**Stroke**

- All Stroke
- Disabling

O:E = 0.21
(STS 5.3%)
### Impact on mortality of paravalvular leakage

Comprehensive literature review

#### Table 3: Outcomes Associated With Aortic and/or Paravalvular Regurgitation

<table>
<thead>
<tr>
<th>Author, Year (Ref. #)</th>
<th>n</th>
<th>Variable</th>
<th>Outcome</th>
<th>Univariate Analysis</th>
<th>Multivariate Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdel-Wahab, 2011 (3)</td>
<td>690</td>
<td>AR ≥2</td>
<td>In-hospital mortality</td>
<td>OR = 2.50 (1.37–4.55)</td>
<td>OR = 2.43 (1.22–4.85)</td>
</tr>
<tr>
<td>Gotzmann, 2011 (4)</td>
<td>122</td>
<td>AR ≥2</td>
<td>6-month mortality</td>
<td></td>
<td>OR = 4.26 (1.59–11.45)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No clinical improvement</td>
<td></td>
<td>OR = 10.1 (3.20–31.94)</td>
</tr>
<tr>
<td>Takagi, 2011 (15)</td>
<td>41</td>
<td>AR ≥2</td>
<td>6-month mortality</td>
<td>12.2% vs. 25.0% (p = 0.25)</td>
<td></td>
</tr>
<tr>
<td>Hayashida, 2012 (89)</td>
<td>260</td>
<td>AR ≥2</td>
<td>Median 217 days (IQR: 54–401)</td>
<td>HR = 1.97 (1.19–3.28)</td>
<td>[Not significant]</td>
</tr>
<tr>
<td>Leber, 2011 (90)</td>
<td>69</td>
<td>AR &gt;2</td>
<td>1-year mortality</td>
<td>9% vs. 37.5% (p = 0.07)</td>
<td></td>
</tr>
<tr>
<td>Moat, 2011 (5)</td>
<td>870</td>
<td>AR ≥2</td>
<td>1-year mortality</td>
<td>HR = 1.49 (1.00–2.21)</td>
<td>HR = 1.66 (1.10–2.51)</td>
</tr>
<tr>
<td>Sinning, 2012 (91)</td>
<td>152</td>
<td>PVL ≥2</td>
<td>1-year mortality</td>
<td>HR = 4.0 (2.1–7.5)</td>
<td>HR = 4.9 (2.5–9.6)</td>
</tr>
<tr>
<td>Tamburino, 2011 (6)</td>
<td>663</td>
<td>PVL ≥2</td>
<td>Late mortality</td>
<td>HR = 3.79 (1.57–9.10)</td>
<td>HR = 2.4 (1.0–5.4)</td>
</tr>
<tr>
<td>Sinning, 2012 (41)</td>
<td>146</td>
<td>Moderate/severe PVL</td>
<td>1-year survival</td>
<td>HR = 3.9 (2.0–7.5)</td>
<td></td>
</tr>
<tr>
<td>Unbehaun, 2012 (26)</td>
<td>358</td>
<td>No vs. trace vs. mild AR</td>
<td>2-year survival</td>
<td>66% vs. 72% vs. 67% (p = 0.77)</td>
<td>[Not significant]</td>
</tr>
<tr>
<td>Kodall, 2012 (8)</td>
<td>158</td>
<td>Mild to severe AR</td>
<td>2-year survival</td>
<td>HR = 1.75 (1.17–2.61)</td>
<td>HR = 2.11 (1.43–3.10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mild to severe PVL</td>
<td>2-year survival</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Genereux & Head et al. *JACC* 2013;61:1125-36
Heart Team

Comorbid Conditions
(not in scores)

Risk scores

Risk Estimation
Risk-Benefit ratio

Customized management decisions

Estimated QoL improvement

Life expectancy

Adapted from Dr. Kappetein
Risk Model Workgroup

- Develop a predictive tool to calculate in-hospital mortality at the patient level (a patient risk score similar to the online STS risk calculator).
Main issues
Aortic-valve-in-valve procedures

• Malpositioning
• Ostial coronary occlusion
• Residual stenosis
Bioprosthetic Valves

A. Stented
- Perimount (Edwards Lifesciences)
- Epic (St. Jude Medical)
- Hancock II (Medtronic)

B. Stented, Supraanular position
- Magna (Edwards Lifesciences)
- Mosaic (Medtronic)

C. Stented, Externally Mounted Leaflets
- Mitroflow (Sorin)
- Trifecta (St. Jude Medical)

D. Stentless
- Freedom (Sorin)
- Toronto SPV (St. Jude Medical)
- Freestyle (Medtronic)
Surgical Valve Label Size

Log-rank
P=0.001

≤ 21 mm
18.2%

> 21 mm & <25 mm
25.2%

≥ 25 mm
6.7%

No at risk:
133  176  139
81   116  89
68   103  82
61   95   76
57   92   73

Months
Possible Subclinical Leaflet Thrombosis in Bioprosthetic Aortic Valves

Volume rendered CT images of bioprosthetic valves

Normal leaflets

Thickened leaflets with thrombus

Systole

Diastole

Systole

Diastole
An All-comers Randomized Clinical Trial Comparing TAVR with SAVR in Patients with Aortic Valve Stenosis

Lars Søndergaard
The Heart Center, Rigshospitalet, Copenhagen, Denmark
- on behalf of the NOTION Investigators
Enrollment Criteria

Main inclusion criteria
- Severe AS
- Age ≥70 years
- Life expectancy ≥1 year
- Suitable for TAVR & SAVR

Main exclusion criteria
- Severe CAD
- Severe other valve disease
- Prior heart surgery
- Need for acute treatment
- Recent stroke or MI
- Severe lung disease
- Severe renal failure
## Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>TAVR n=145</th>
<th>SAVR n=135</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>79.2 ± 4.9</td>
<td>79.0 ± 4.7</td>
<td>0.71</td>
</tr>
<tr>
<td>Male</td>
<td>53.8</td>
<td>52.6</td>
<td>0.84</td>
</tr>
<tr>
<td>STS Score</td>
<td>2.9 ± 1.6</td>
<td>3.1 ± 1.7</td>
<td>0.30</td>
</tr>
<tr>
<td>STS Score &lt; 4%</td>
<td>83.4</td>
<td>80.0</td>
<td>0.46</td>
</tr>
<tr>
<td>Logistic EuroSCORE I</td>
<td>8.4 ± 4.0</td>
<td>8.9 ± 5.5</td>
<td>0.38</td>
</tr>
<tr>
<td>NYHA class III or IV</td>
<td>48.6</td>
<td>45.5</td>
<td>0.61</td>
</tr>
</tbody>
</table>
All-Cause Mortality at 2-years

- **P-value (log-rank)** = 0.54

- 3.7% at 2 years
- 7.5% at 12 months
- 9.8% at 24 months

- **SAVR**
- **TAVI**
## Secondary Outcomes at 2 Years

<table>
<thead>
<tr>
<th>Outcome, %</th>
<th>1 Year</th>
<th>2 Years</th>
<th>p-value</th>
<th>1 Year</th>
<th>2 Years</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TAVR</td>
<td>SAVR</td>
<td>p-value</td>
<td>TAVR</td>
<td>SAVR</td>
<td>p-value</td>
</tr>
<tr>
<td>Death, any cause</td>
<td>4.9</td>
<td>7.5</td>
<td>0.38</td>
<td>8.0</td>
<td>9.8</td>
<td>0.54</td>
</tr>
<tr>
<td>Death, cardiovascular</td>
<td>4.3</td>
<td>7.5</td>
<td>0.25</td>
<td>6.5</td>
<td>9.1</td>
<td>0.40</td>
</tr>
<tr>
<td>Stroke</td>
<td>2.9</td>
<td>4.6</td>
<td>0.44</td>
<td>3.6</td>
<td>5.4</td>
<td>0.46</td>
</tr>
<tr>
<td>TIA</td>
<td>2.1</td>
<td>1.6</td>
<td>0.71</td>
<td>6.0</td>
<td>3.3</td>
<td>0.30</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>3.5</td>
<td>6.0</td>
<td>0.33</td>
<td>5.1</td>
<td>6.0</td>
<td>0.69</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>21.2</td>
<td>59.4</td>
<td>&lt;0.001</td>
<td>22.7</td>
<td>60.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pacemaker</td>
<td>38.0</td>
<td>2.4</td>
<td>&lt;0.001</td>
<td>41.3</td>
<td>4.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Aortic valve re-intervention</td>
<td>0.0</td>
<td>0.0</td>
<td>N/A</td>
<td>0.0</td>
<td>0.0</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Aortic Valve Regurgitation

<table>
<thead>
<tr>
<th></th>
<th>0.8%</th>
<th>1.8%</th>
<th>0.8%</th>
<th>0.9%</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAVI</td>
<td>14.5%</td>
<td>19.8%</td>
<td>14.9%</td>
<td>16.8%</td>
</tr>
<tr>
<td>SAVR</td>
<td>61.3%</td>
<td>78.4%</td>
<td>55.4%</td>
<td>39.0%</td>
</tr>
</tbody>
</table>

p<0.001

<table>
<thead>
<tr>
<th></th>
<th>0.9%</th>
<th>0.9%</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAVI</td>
<td>23.4%</td>
<td>28.9%</td>
</tr>
<tr>
<td>SAVR</td>
<td>83.9%</td>
<td>83.9%</td>
</tr>
</tbody>
</table>

p<0.001

3 mo

1 year

2 years
Discussion Points

• How do we decide between SAVR or TAVR?
  – Heart Team, Scores (which score: EuroSCORE II, STS, TVT...)

• Are we ready for TAVR in low-risk pts, in light of PV leak, pacemaker rates, thrombosis… Should we mandate a randomized trial?

• Are we comfortable with the long-term durability data to implant in younger patients?

• Will TAVR in it’s current scheme, be cost-prohibitive?

• Should patient’s over 65 yrs always have a 23 valve implanted?

• Are certain pt populations better served with mini-AVR: bicuspid, low-risk, those with prior 21 valve, low-lying coronaries, etc…
Thanks

Vinod H. Thourani, MD

Emory University

vthoura@emory.edu