Percutaneous Aortic Valve Implantation

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Optimal therapy for valve disease…

It doesn’t take a genius to realize that we need better therapy solutions for elderly patients with end-stage aortic stenosis!!!
### Outcome of AVR in High Risk Patients with severe AS

<table>
<thead>
<tr>
<th>Study</th>
<th># pts</th>
<th>High risk features</th>
<th>In-Hosp mortality</th>
<th>Late mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brogan (1993)</td>
<td>18</td>
<td>LVEF + gradient</td>
<td>33%</td>
<td>na</td>
</tr>
<tr>
<td>Powell (2000)</td>
<td>55</td>
<td>LVEF ≤ 30%</td>
<td>18%</td>
<td>na</td>
</tr>
<tr>
<td>Jegaden (1986)</td>
<td>71</td>
<td>LVEF ≤ 40%</td>
<td>10%</td>
<td>5yr – 28%</td>
</tr>
<tr>
<td>Connolly (2000)</td>
<td>52</td>
<td>LVEF ≤ 35% + gradient</td>
<td>21%</td>
<td>3yr – 29%</td>
</tr>
<tr>
<td>Pereira (2002)</td>
<td>68</td>
<td>LVEF ≤ 35% + gradient</td>
<td>8%</td>
<td>1yr – 18%</td>
</tr>
<tr>
<td>Sundt (2000)</td>
<td>133</td>
<td>≥ 80 yo</td>
<td>11%</td>
<td>1yr – 20%</td>
</tr>
<tr>
<td>Mortasawi (2000)</td>
<td>105</td>
<td>≥ 80 yo</td>
<td>9%</td>
<td>1yr – 10%</td>
</tr>
<tr>
<td>Kohl (2001)</td>
<td>83</td>
<td>≥ 80 yo</td>
<td>13%</td>
<td>1yr – 14%</td>
</tr>
<tr>
<td>Bloomstein (2001)</td>
<td>180</td>
<td>≥ 70 yo</td>
<td>17%</td>
<td>na</td>
</tr>
<tr>
<td>Bernard (1992)</td>
<td>23</td>
<td>&gt; 75 yo</td>
<td>9%</td>
<td>17%</td>
</tr>
</tbody>
</table>
Surgical AVR - Mortality

Overall Operative Mortality (1994-2004)*

- **Isolated AVR**: 4.0%
- **AVR + CABG**: 6.8%

*Source: Society of Thoracic Surgeons National Cardiac Database*

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EuroSCORE and long-term survival**

<table>
<thead>
<tr>
<th>Risk Quartile</th>
<th>5yrs</th>
<th>10yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest risk quartile (&lt;5)</td>
<td>90%</td>
<td>78%</td>
</tr>
<tr>
<td>Highest risk quartile (&gt;11)</td>
<td>55%</td>
<td>35%</td>
</tr>
</tbody>
</table>

**Source: Toumpoulis et al**
Surgical AVR - Mortality
EuroSCORE - Example

76 y/o, female
Previous CABG
LVEF 38%

*Predicted operative mortality: 12.41%*
*(Logistic EuroSCORE)*
Balloon expandable AV Prosthesis

Percutaneous Valve Technologies, NJ – USA

First generation – polyurethane

Second generation – Bovine pericardium

Animal Implants

AVA
1.7 cm²
Cribier-Edwards Aortic Bioprosthesis
Balloon expandable AV Prosthesis
Percutaneous Valve Technologies, NJ – USA

Cribier et al.

Mean Gradient (mm Hg)

Pre: 43
Post: 8.5
p = .0076

AVA (cm²)

Pre: 0.56
Post: 1.69
p = .0076

n=11
Paravalvular leak

RCA

LM

Above

Below

Patient n° 3

Siegburg - Stanford
Postprocedural Outcome PVT (n=18 pts)  
(Follow-Up of 75 +/- 55 Days, range 4–179 Days)

<table>
<thead>
<tr>
<th>Event</th>
<th>Count (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death, 30 days</td>
<td>2 (11.1)</td>
</tr>
<tr>
<td>Alive at follow-up</td>
<td>16 (88.9)</td>
</tr>
<tr>
<td>Thromboembolism</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Disabling stroke</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Hemolysis</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Endocarditis</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Heart block</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Hospital readmission</td>
<td>2 (11.1)</td>
</tr>
<tr>
<td>Repeat valve procedure*</td>
<td>1 (5.5)</td>
</tr>
<tr>
<td>NYHA failure class, median (range)</td>
<td>2 (1–3)</td>
</tr>
</tbody>
</table>

NYHA indicates New York Heart Association.  

n=18. Values are n (%) unless otherwise stated.  
*Elective surgical aortic valve implantation as described in text.
Echocardiographic Outcome PVT (n=18 pts)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Baseline (n=18)</th>
<th>Postprocedure (n=13*)</th>
<th>One Month (n=8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradient, mm Hg, mean±SD</td>
<td>50±12</td>
<td>13±6</td>
<td>14±4</td>
</tr>
<tr>
<td>Valve area, cm²†, mean±SD</td>
<td>0.6±0.2</td>
<td>1.6±0.4</td>
<td>1.5±0.3</td>
</tr>
<tr>
<td>Calcification, grade</td>
<td>2 (n=5)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Annulus diameter, mm, mean±SD</td>
<td>23.0±1.5</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Ejection fraction, %, mean±SD</td>
<td>56±14</td>
<td>58±12</td>
<td>60±12</td>
</tr>
<tr>
<td>Mitral insufficiency, grade (range)</td>
<td>2+ (0-4+)</td>
<td>1+ (0-4+)</td>
<td>3+ (0-4+)</td>
</tr>
<tr>
<td>Prosthetic-mitral valve contact</td>
<td>N/A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mitral injury</td>
<td>N/A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aortic valvular insufficiency, grade (range)</td>
<td>2+ (1-2+)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aortic paravalvular insufficiency, grade (range)</td>
<td>0</td>
<td>2+ (0-3+)</td>
<td>2+ (0-3+)</td>
</tr>
<tr>
<td>Valve failure</td>
<td>N/A</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

N/A indicates not applicable.
*Does not include 4 patients in whom valve implantation was unsuccessful.
†Does not include 4 patients who had not yet reached 1-month follow-up.
‡Derived from continuity equation.

Webb et al. Circulation 2006;113:842-850
Selfexpanding AV Prosthesis

CoreValve

- A pericardium tissue valve
- Fixed to the frame in a surgical manner
- With PTFE sutures

AVA 1.7 cm²
Selfexpanding AV Prosthesis

CoreValve

- **HIGHER PART**: increases quality of fixation and axes the system
- **MIDDLE PART**: is constrained to avoid coronaries (no rotational positioning) and carries the valve
- **LOWER PART**: High radial force of the frame pushes aside the calcified leaflets and avoids recoil = no paravalvular leaks
Selfexpanding AV Prosthesis

CoreValve
CoreValve
Case Example

Visualization of coronary access
CoreValve Follow-up

Post-Implant Morphological Assessment by CT-scan
CoreValve Screening
CoreValve

Morphological Quantification

CT-Zentrum Siegburg
734/05 19.7.19 F/65y
31 May 2005 05:09:55.1
31 May 2005 05:09:55.1
2.70

33.7 mm
31.6 mm
2.18

Aorta asc. 3 cm post AKLE

Siegburg - Stanford
CoreValve – The Unsuitable Patient
Severe Calcifications of the Native Valve
CoreValve

Access Site Assessment
CoreValve
Results
CoreValve FIM

Phase 1: First Generation Device (24 F)
*India, South America, Siegburg; 14 patients*

Phase 2: Second Generation Device (21 F)
*Siegburg; 18 patients*
CoreValve Study

Inclusion criteria

- symptomatic AS, valve area < 1.0 cm²
- Age >80
  \[or\]
- Logistic EuroSCORE ≥ 20%
  \[or\]
- Age >65 yrs plus 1 or 2 of the following criteria:
  - Cirrhosis of liver, pulmonary insufficiency, previous cardiac surgery, pulmonary hypertension (>60mmHg), recurrent pulmonary embolus, right ventricular insufficiency, history of mediastinum radiotherapy, severe connective tissue disease

- Aorta-Annulus ≥ 20mm and ≤ 27mm
- Diameter ascending aorta ≤ 45mm
<table>
<thead>
<tr>
<th></th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>India, S. America, Siegburg</td>
<td>Siegburg</td>
</tr>
<tr>
<td></td>
<td>Gen 1</td>
<td>Gen 2</td>
</tr>
<tr>
<td>Number of patients (n)</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>Indication (n)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aortic valve stenosis</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Aortic valve regurgitation</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Combined</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Peak gradient (mmHg)</td>
<td>76.2 +/- 30.6</td>
<td>63.6 +/- 20.3</td>
</tr>
<tr>
<td>LV-EF (%)</td>
<td>53.8 +/- 9.6</td>
<td>55.9 +/- 18.9</td>
</tr>
<tr>
<td>Logistic EuroSCORE (%)</td>
<td>14.6 +/- 5.2*</td>
<td>22.0 +/- 17.4</td>
</tr>
</tbody>
</table>

*Only Siegburg patients
### CoreValve Study Results

<table>
<thead>
<tr>
<th>Category</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinchoff Method</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gen 1</td>
<td>India, S. America, Siegburg</td>
<td>Siegburg Gen 2</td>
</tr>
<tr>
<td>Acute Procedural Success</td>
<td>11/14</td>
<td>16/18</td>
</tr>
<tr>
<td>Peak Gradient (mmHg)</td>
<td>17.5 +/- 9.6</td>
<td>20.5 +/- 9.2</td>
</tr>
<tr>
<td>Conversion to Surgery</td>
<td>1/14</td>
<td>1/18</td>
</tr>
<tr>
<td>Conversion to Valvuloplasty</td>
<td>0</td>
<td>1/18</td>
</tr>
<tr>
<td>In-hospital Mortality</td>
<td>7/14</td>
<td>1/18</td>
</tr>
<tr>
<td>Out-of-hospital Mortality</td>
<td>0/14</td>
<td>0/18</td>
</tr>
</tbody>
</table>
CoreValve Study Results

Phase 1 (n=14) Phase 2 (n=21)

- Acute Success
- Hospital Death
- Conversion to AVR /Valvuloplasty

Phase 1 (14 pts)
- Acute Success: 11/14
- Hospital Death: 7/14
- Conversion: 1/14

Phase 2 (18 pts)
- Acute Success: 16/18
- Hospital Death: 1/18
- Conversion: 2/18
### CoreValve Study Results

#### Phase 1
- 1 procedural death
  - wire perforation (1) day 0
- 6 postprocedural deaths
  - pericardial tamponade (1) day 2
    - (due to delayed wire perforation)
  - pulmonary insufficiency (1) day 7
    - (lung cancer)
  - DIC (1) day 15
  - compartment syndrome (1) day 2
  - multi-organ failure (1) day 13
  - hemodynamic failure (1) day 9

#### Phase 2
- 1 postprocedural death
  - hemodynamic failure (1) day 1
    - (after conversion to valvuloplasty)
**CoreValve Study**

**Peak Pressure Gradients**

- **Pre**
  - Mean: 69.90 ± 22.96 mmHg
- **Post**
  - Mean: 22.23 ± 8.23 mmHg
- **30 Days**
  - Mean: 22.48 ± 8.40 mmHg

*p < 0.0001*
CoreValve Studie
Event-free survival (MACE-free)

Patients with x day FU:
32  24  20  16  9  2
### Clinical Follow-up (NYHA); n=22

<table>
<thead>
<tr>
<th>Clinical Status</th>
<th>Pre</th>
<th>30 day FU</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYHA IV</td>
<td>2 (9.1%)</td>
<td>0</td>
</tr>
<tr>
<td>NYHA III</td>
<td>19 (86.4%)</td>
<td>0</td>
</tr>
<tr>
<td>NYHA II</td>
<td>1 (4.5%)</td>
<td>17 (77.3%)</td>
</tr>
<tr>
<td>NYHA I</td>
<td>0</td>
<td>5 (22.7%)</td>
</tr>
</tbody>
</table>
CoreValve
Feasibility Study
(on going)
CoreValve Study

- Prospective, multi-center (≤ 7 Centers)
- Single arm
- n ≤ 35

Objective
Evaluation of feasibility and safety of the CoreValve Prosthesis
Study Centers

EUROPE
• Siegburg Heart Center, Germany, Prof Grube (PI)
• Leipzig, Germany, Prof Schuller
• Erasmus, Rotterdam, Holland, Prof Serruys
• Amphia, Breda, Holland, Dr den Haiyer
• University Hospital, Antwerp, Belgium, Dr Bosmans
• Heart Center, Hasselt, Belgium, Dr Benit

NORTH AMERICA
• Montreal Heart Center, Montreal, Canada, Dr. Bonan
Benefits of 2./3. Generation Device

Subinguinal access side with surgical cut-down (common femoral art. 7,5 – 8mm) possible

18 F Device 4.06 planned (subclavian access possible)
Phoenix Valve

- Percutaneous retrograde delivery
- Accurate positioning/repositioning
- Unique valve function during deployment
- Outer Adaptive™ Seal to minimize peri-prosthetic regurgitation
At this point the device can be fully retracted, back to step 1, and repositioned.

Phoenix Valve
Conclusion

First experience using a self-expanding aortic valve prosthesis for percutaneous treatment of AS

Demonstration of feasibility, safety and efficacy of this new technique with immediate improvement of the hemodynamic status and promising out-of-hospital outcome

Further studies are currently ongoing
Vielen Dank
Phoenix Valve

**Unique Valve Properties**

- Un-interrupted valve function and visualization throughout the procedure
- Novel membrane is designed to seal against irregular surface of native anatomy
- Valve is pre-assembled on delivery system