Transcatheter Aortic Valve Replacement (TAVR)
A less Invasive Treatment Option for Severe Aortic Stenosis.
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Interventional Cardiologist, Fairview Southdale Hospital
TAVR team UMP Heart

Disclosure
• Consultant Boston Scientific
• Speakers bureau Edwards Lifescience
• Sub PI – Reprise 3 trial
• I will discuss off label use of TAVR

Outline
• Background and Perspective
• TAVR Clinical Data
• Approved Commercial Devices
• Future of TAVR
• UMP Heart Valve team experience

Objectives
• Understand the pathophysiology of Aortic Stenosis
• Become familiar with trial data supporting the advent of TAVR.
• Become familiar with current TAVR platforms.
• Understand limitations of devices and future directions.
Prevalence

- Prevalence is estimated to be 4%
- Bicuspid AV present in 50% of the patients undergoing AVR

<table>
<thead>
<tr>
<th>Age Group (y)</th>
<th>Normal Aortic Valve (%)</th>
<th>Aortic Sclerosis (%)</th>
<th>Aortic Stenosis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Subjects</td>
<td>72</td>
<td>26</td>
<td>4</td>
</tr>
<tr>
<td>65 – 74</td>
<td>78</td>
<td>20</td>
<td>1.3</td>
</tr>
<tr>
<td>75 – 84</td>
<td>62</td>
<td>35</td>
<td>2.4</td>
</tr>
<tr>
<td>&gt; 84</td>
<td>48</td>
<td>48</td>
<td>4</td>
</tr>
</tbody>
</table>


2014 ACC/AHA Valve Guidelines

Concept of Valve Disease Stages

Age

Survival Percent

Worse Prognosis than Many Metastatic Cancers

5-Year Survival (Distant Metastasis)

- 5 year survival of breast cancer, lung cancer, prostate cancer, ovarian cancer and severe inoperable aortic stenosis


Worse Prognosis than Many Metastatic Cancers

<table>
<thead>
<tr>
<th>Cancer</th>
<th>Survival %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>23</td>
</tr>
<tr>
<td>Lung</td>
<td>13</td>
</tr>
<tr>
<td>Colorectal</td>
<td>20</td>
</tr>
<tr>
<td>Prostate</td>
<td>29</td>
</tr>
<tr>
<td>Ovarian</td>
<td>24</td>
</tr>
</tbody>
</table>

*Using constant hazard ratio. Data on file, Edwards Lifesciences LLC. Analysis courtesy of Murat Tuczu, MD, Cleveland Clinic

From Ross and Braunwald, Circulation 1968

“Surgical intervention should be performed promptly once even minor symptoms occur”
Symptoms of Aortic Stenosis:

- Shortness of breath
- Angina
- Fatigue
- Syncope or presyncope
- Other
  - Rapid or irregular heartbeat
  - Palpitations

The symptoms of aortic disease are commonly misunderstood by patients as "normal" signs of aging. Many patients initially appear asymptomatic, but on closer examination up to 37% exhibit symptoms.

Aortic Valve Replacement

- Current standard of care – open heart surgery.
- >200,000 Surgical AV replacements annually worldwide.
- Cardiac surgeon opens the heart, removes the diseased valve, and inserts a prosthetic valve.
- Recovery time: 1-3 months until normal activity
- Extended hospital stay (4-7 days).

Who Likes Surgery?

- Early Catheter-Based AV Designs
  - Dr. Henning Anderson "Father of "TAVR."
    - Cardiologist in Denmark
    - Concept conceived in 1989
    - Built device from materials at local hardware store
    - Performed first animal implantation
    - Company sold to Edwards Lifesciences

The Andersen valve (1992)
First-in-Man

Percutaneous Transcatheter Implantation of an Aortic Valve Prosthesis for Calcific Aortic Stenosis

First Human Case Description

Alain Cribier, MD; Helene Eltchaninoff, MD; Assaf Bash, PhD; Nicolas Borenstein, MD; Christophe Tron, MD; Fabrice Bauer, MD; Genevieve Derumeaux, MD; Frederic Anselme, MD; Francois Laborde, MD; Mario R. Leon, MD

AHA; Nov, 2002

Adopted from TCT presentation: Dr. Leon

Transcatheter AVR

“First” Generation Devices

Edwards
CoreValve

TAVR Clinical Data

Publications in NEJM

1-Year outcomes published on June 9, 2011

The NEW ENGLAND JOURNAL of MEDICINE

Two-Year Outcomes after Transcatheter or Surgical Aortic-Valve Replacement

1-Year outcomes published on March 28, 2013

@NEJM.org and print May 3, 2012
PARTNER Study Design

Symptomatic Severe Aortic Stenosis

N = 699

High Risk

Transfemoral (TF)

Transapical (TA)

Total = 1,057 patients

2 Parallel Trials: Individually Powered

Inoperable

N = 358

Transfemoral (TF)

Transapical (TA)

Randomized: All cause Mortality at 1 yr

NNT = 5.0 pts

Primary Endpoint: All Cause Mortality

All cause mortality

HR [95% CI] = 0.93 [0.74, 1.15]

p (log rank) = 0.483

Months post Randomization

AVR 448 382 366 359 348 332 317 308

TAVR 448 382 366 359 348 332 317 308

Strokes (ITT)

Strokes (ITT)

HR [95% CI] = 1.09 [0.62, 1.91]

p (log rank) = 0.763

Months Post Randomization

AVR 448 382 366 359 348 332 317 308

TAVR 448 382 366 359 348 332 317 308
Echocardiographic Findings (AT)

### Aortic Valve Area

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>30 Days</th>
<th>6 Months</th>
<th>1 Year</th>
<th>2 Years</th>
<th>3 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAVR</td>
<td>0</td>
<td>0.5</td>
<td>1</td>
<td>1.5</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>AVR</td>
<td>0</td>
<td>1.0</td>
<td>2.0</td>
<td>3.0</td>
<td>4.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Error bars</td>
<td>Baseline</td>
<td>30 Days</td>
<td>6 Months</td>
<td>1 Year</td>
<td>2 Years</td>
<td>3 Years</td>
</tr>
<tr>
<td>p = NS</td>
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<td>p = NS</td>
<td>p = NS</td>
<td></td>
</tr>
</tbody>
</table>

No. of Echos:
- TAVR: 304
- AVR: 271
- 30 Days: 223
- 6 Months: 211
- 1 Year: 150
- 2 Years: 88
- 3 Years: 294

### Mean & Peak Gradients

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>30 Days</th>
<th>6 Months</th>
<th>1 Year</th>
<th>2 Years</th>
<th>3 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradient - TAVR</td>
<td>30</td>
<td>25</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Gradient - AVR</td>
<td>40</td>
<td>35</td>
<td>30</td>
<td>25</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Mean Gradient - TAVR</td>
<td>10</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Mean Gradient - AVR</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

No. of Echos:
- TAVR: 310
- AVR: 277
- 30 Days: 233
- 6 Months: 219
- 1 Year: 155
- 2 Years: 88
- 3 Years: 299

**Edwards Lifesciences**

**SAPIEN/SAPIEN XT THV**

- Bovine Tissue
- ThermaFix Treatment
- Pericardial Mapping
- Leaflet Deflection
- Proprietary Processing

- Cobalt Alloy Frame
- New Leaflet Geometry

**New Skirt Height**

**NovoFlex Delivery System**

- Unidirectional tip-deflecting flex catheter facilitates negotiating the arch
- Balloon catheter tapered distal end for crossing calcified native valve

- Nasal cone: 4.5 cm

**New Sizes**

- (23, 26, 29mm)