Surgical or Percutaneous Treatment of Aortic Valve Disease

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Bichat Hospital
University Paris VII, Paris, France
Disclosures

- Relationship with companies who manufacture products used in the treatment of the subjects under discussion

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Manufacturer(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speaker's Honoraria</td>
<td>Edwards Lifesciences</td>
</tr>
<tr>
<td>Consultant (Advisory Board)</td>
<td>Medtronic, Saint Jude Medical</td>
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</tbody>
</table>
Background

- Aortic stenosis is frequent and carries a poor prognosis in symptomatic patients with severe AS

- Patients are mostly elderly with several comorbidities

- Surgery may be high risk or even contraindicated

- In practice, many patients are denied surgery
Current results and indications of TAVI

What is next?

The «essentials»
First in man
Alain Cribier - 16 April 2002
Cardiogenic shock, patient not amenable to surgical treatment
The Devices for TAVI

Medtronic CoreValve® TAV  Edwards SAPIEN™ THV

CE mark 2007  CE mark 2007

> 50000 patients treated in > 500 centers
## Demographics of TAVI patients

<table>
<thead>
<tr>
<th></th>
<th>ADVANCE (\text{(n=1015)})</th>
<th>SOURCE (\text{(n=2706)})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>81</td>
<td>82</td>
</tr>
<tr>
<td>Log Euroscore</td>
<td>19.2</td>
<td>23.9</td>
</tr>
<tr>
<td>CAD</td>
<td>57.6</td>
<td>48.4</td>
</tr>
<tr>
<td>PVD</td>
<td>19.5</td>
<td>10.2</td>
</tr>
<tr>
<td>Prior MI</td>
<td>16</td>
<td>12.7</td>
</tr>
<tr>
<td>Prior PCI</td>
<td>31.1</td>
<td>24.5</td>
</tr>
<tr>
<td>Prior CABG</td>
<td>21.4</td>
<td>15.4</td>
</tr>
<tr>
<td>COPD</td>
<td>22.6</td>
<td>18.2</td>
</tr>
<tr>
<td>Renal insufficiency</td>
<td>14.6</td>
<td>24.9</td>
</tr>
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</table>
## Procedural Success in European TAVI Registries

<table>
<thead>
<tr>
<th></th>
<th>French</th>
<th>UK</th>
<th>Belgian</th>
<th>German</th>
<th>Italian</th>
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<tbody>
<tr>
<td>n</td>
<td>3195</td>
<td>870</td>
<td>800</td>
<td>697</td>
<td>633</td>
</tr>
<tr>
<td>Procedural success (%)</td>
<td>97</td>
<td>99</td>
<td>98</td>
<td>98.7</td>
<td>98</td>
</tr>
</tbody>
</table>

**References**

Gilard NEJM 2012;366:1705-11  
Moat J Am Coll Cardiol 2011;58:2130-8  
Zahn Eur Heart J 2011;32:198-204  
Tamborino C Circulation 2011;123:299-308
Efficacy of TAVI

Echocardiographic Findings in PARTNER A

Gradient (mmHg)

- Peak Gradient - TAVR
- Mean Gradient - TAVR
- Peak Gradient - AVR
- Mean Gradient - AVR

Numbers at Risk

<table>
<thead>
<tr>
<th></th>
<th>TAVR</th>
<th>AVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>307</td>
<td>295</td>
</tr>
<tr>
<td>30 Day</td>
<td>275</td>
<td>228</td>
</tr>
<tr>
<td>6 Month</td>
<td>233</td>
<td>168</td>
</tr>
<tr>
<td>1 Year</td>
<td>218</td>
<td>155</td>
</tr>
<tr>
<td>2 Year</td>
<td>144</td>
<td>112</td>
</tr>
</tbody>
</table>

(Kodali, NEJM, 2012;366:1686-95)
# Procedural Complications in SOURCE XT

<table>
<thead>
<tr>
<th>Events</th>
<th>Results (N = 2706)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aborted Procedures - %</td>
<td>0.6</td>
</tr>
<tr>
<td>Unable to Cross Native Valve - %</td>
<td>0.04</td>
</tr>
<tr>
<td>Conversion to Surgery - %</td>
<td>0.4</td>
</tr>
<tr>
<td>Annular Dissection - %</td>
<td>0.4</td>
</tr>
<tr>
<td>Coronary Occlusion - %</td>
<td>0.4</td>
</tr>
<tr>
<td>SAPIEN-in-SAPIEN (Bailout) - %</td>
<td>1.1</td>
</tr>
<tr>
<td>Valve Embolization - %</td>
<td>0.7</td>
</tr>
<tr>
<td>Cardiac Tamponade - %</td>
<td>0.5</td>
</tr>
</tbody>
</table>
### Clinical Outcome at 30 Days

<table>
<thead>
<tr>
<th></th>
<th>ADVANCE Transfemoral N=1015</th>
<th>SOURCE Transfemoral N = 1694</th>
<th>SOURCE Transapical N = 906</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause Mortality (%)</td>
<td>4.5</td>
<td>4.3</td>
<td>9.9</td>
</tr>
<tr>
<td>Any Stroke (%)</td>
<td>2.9</td>
<td>2.3</td>
<td>2.1</td>
</tr>
<tr>
<td>Myocardial Infarction (%)</td>
<td>0.2</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>New Pacemaker (%)</td>
<td>26.3</td>
<td>8.0</td>
<td>10.9</td>
</tr>
<tr>
<td>Vascular Complication – Major (%)</td>
<td>10.7</td>
<td>7.3</td>
<td>3.6</td>
</tr>
<tr>
<td>Renal Failure with Temporary Dialysis (%)</td>
<td>5.7</td>
<td>1.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Major Bleeding (%)</td>
<td>9.7</td>
<td>5.0</td>
<td>11.4</td>
</tr>
</tbody>
</table>

(Bauernschmidt; Wendler EuroPCR 2012)
Strokes in PARTNER A

HR [95% CI] = 1.22 [0.67, 2.23]
p (log rank) = 0.517

30 Day Stroke Rate
TAVR – 4.6%
AVR – 2.4%

Months Post Procedure

0 6 12 18 24 30 36

Stroke

0% 10% 20% 30% 40% 50% 60% 70%
Paravalvular Aortic Regurgitation
in PARTNER A

TAVI vs AVR

p < 0.0001

Percent of evaluable echoes

Severe
Moderate
Mild
Trace
None

TAVR 30 Day
N = 277

TAVR 6 Month
N = 230

TAVR 1 Year
N = 216

TAVR 2 Year
N = 145

AVR
N = 226

N = 172

N = 155

N = 112
Follow-up after TAVI in the UK Registry

(Moat J Am Coll Cardiol 2011;58:2130-8)
All Cause Mortality in PARTNER B
TAVI vs Medical Treatment

HR [95% CI] = 0.57 [0.44, 0.75]  
p (log rank) < 0.0001

Δ at 1 yr = 20.0%  
NNT = 5.0 pts

Δ at 2 yr = 24.3%  
NNT = 4.1 pts

(Makkar, NEJM 2012;366:1696-704)
All Cause Mortality in PARTNER A

TAVI vs AVR

HR [95% CI] = 0.88 [0.70, 1.12]

p (log rank) = 0.310

Numbers at Risk:

<table>
<thead>
<tr>
<th></th>
<th>TAVR</th>
<th>AVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>36 months</td>
<td>348</td>
<td>351</td>
</tr>
<tr>
<td>30 months</td>
<td>298</td>
<td>252</td>
</tr>
<tr>
<td>24 months</td>
<td>288</td>
<td>236</td>
</tr>
<tr>
<td>18 months</td>
<td>260</td>
<td>217</td>
</tr>
<tr>
<td>12 months</td>
<td>234</td>
<td>165</td>
</tr>
<tr>
<td>6 months</td>
<td>172</td>
<td>65</td>
</tr>
<tr>
<td>0 months</td>
<td>70</td>
<td>65</td>
</tr>
</tbody>
</table>

(Kodali, NEJM 2012; 366:1686-95)
Predictors of 1-year Death after TAVI

Non–cardiac
- Age
- Logistic Euroscore
- STS Score
- COPD
- Chronic Kidney D.
- Diabetes
- Prior stroke
- Carotid stenosis
- Dyslipidemia
- HTN

Cardiac
- PHT
- NYHA Class IV
- Acute pulm.oedema
- CAD
- Severe MR
- M Valvuloplasty

Procedural
- Moderate/ severe AR
- Major vascular compl
- Stroke
- Kidney injury
- Experience
- Transapical
Functional Results in PARTNER B
TAVI vs Medical Treatment

- Baseline: TAVR 92.2%, Standard Rx 93.9%
- 1 Year: TAVR 23.7%, Standard Rx 60.8%
- 2 Year: TAVR 16.9%, Standard Rx 57.5%

(p = 0.61, p < 0.0001, p < 0.0001)

(Makkar, NEJM 2012;366:1696-704)
Functional Results in PARTNER A

TAVI vs AVR

<table>
<thead>
<tr>
<th></th>
<th>IV</th>
<th>III</th>
<th>II</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>94%</td>
<td>23%</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>30 Days</td>
<td>94%</td>
<td>15%</td>
<td>35%</td>
<td>13%</td>
</tr>
<tr>
<td>1 Year</td>
<td>94%</td>
<td>16%</td>
<td>13%</td>
<td>15%</td>
</tr>
<tr>
<td>2 Year</td>
<td>94%</td>
<td>16%</td>
<td>13%</td>
<td>15%</td>
</tr>
</tbody>
</table>

(Kodali, NEJM 2012; 366:1686-95)
Quality of Life after TAVI in Inoperable Patients

Primary Endpoint: KCCQ Overall Summary

Δ = 13.9
P<0.001

Δ = 20.7
P<0.001

Δ = 24.5
P<0.001

MCID = minimum clinically important difference
PARTNER: Quality of Life in Operable Patients
TF Subgroup / AVR

![Graph showing quality of life differences between TAVR and AVR over time.]

- 1 month: Δ = 9.9, P < 0.001
- 6 months: Δ = -0.5, P = NS
- 12 months: Δ = -1.2, P = NS
PARTNER: Quality of Life in Operable Patients
TA Subgroup / AVR

Treatment Difference (TAVR - AVR)

1 month 6 months 12 months

Δ = -5.8
P = NS

Δ = -7.9
P = 0.04

Δ = 0.8
P = NS
Cost-Effectiveness Estimates from PARTNER B (Inoperable patients)

Aspirin MI prevention, rosuvastatin high-CRP, ICD prim prev, CRT-D v. medical Rx, dabigatran AF, PARTNER Cohort B, AF ablation vs. AAD, dialysis, PCI stable CAD, LVAD destination Rx

(Dollars per Life Year or QALY ($thousands))

(Reynolds. Circulation 2012;125:1102-9)
Cost-Effectiveness of TAVI/SAVR in High Risk Patients in PARTNER A

- In TF TAVR /SAVR:
  Comparable Costs
  Minor number of life-years and QALYs gained
  Cost < 50,000 USD per QALY in 74.7% of times

(Reynolds, ACC 2012)
Current Indications for TAVI

Transcatheter valve implantation for patients with aortic stenosis: a position statement from the European Association of Cardio-Thoracic Surgery (EACTS) and the European Society of Cardiology (ESC), in collaboration with the European Association of Percutaneous Cardiovascular Interventions (EAPCI)

Alec Vahanian1*, Ottavio Alfieri2*, Nawwar Al-Attar3, Manuel Antunes3, Jeroen Bax4, Bertrand Cormier5, Alain Cribier4, Peter De Jaegere7, Gerard Fournel1, Arie Pieter Kappetein7, Jan Kovac9, Susanne Ludgate10, Francesco Maisano2, Neil Moat11, Friedrich Mohr12, Patrick Nataf1, Luc Piéard13, José Luis Pomar14, Joachim Schofer15, Pilar Tornos16, Murat Tuzcu17, Ben van Hout18, Ludwig K. Von Segesser19, and Thomas Walther12

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Received 2 April 2008; accepted 10 April 2008, online publish-ahead-of-print 13 May 2008

**Aims**

To critically review the available transcatheter aortic valve implantation techniques and their results, as well as propose recommendations for their use and development.
Current Indications for TAVI

After assessment by the ‘Team’

- Severe AS
- Symptomatic
- Life expectancy >1 year
- Contra indication for surgery, or
  High Risk for Surgery:
   ✓ Clinical judgment +
     - EuroScore (logistic) > 20%; STS Score>10%

AND/OR
- Porcelain aorta
- History of thoracic irradiation
- Severe thoracic deformity
- Patent coronary by pass
- .....................

Conclusions from PARTNER:

- “TAVI is already the standard-of-care for inoperable patients with severe aortic stenosis.”
- “TAVI is an acceptable alternative to AVR in selected high-risk operable patients.”

TAVI Reimbursement in Europe

- United Kingdom: Local negotiation
- Denmark: DRG covers all costs
- Germany: DRG covers all costs
- Poland: Special Funds for 230 implants in 2012
- The Netherlands: DRG covers all costs
- Austria: DRG covers all costs
- Spain: DRG covers all costs
- Restricted to 33 centers
- Switzerland: DRG covers all costs
- Italy: Lombardia, Veneto, Sicily: DRG covers all costs, Emilia Romagna: Special Funds for 120 implants in 2012

(Piazza EuroPCR 2012)
TAVI and AVR in Germany

29% in 2011

Quelle: DGTHG Statistik 2010
Impact of TAVI on Patient Referral

Patients referred for severe and symptomatic aortic stenosis
- Median age 78 years
- **10% increase in surgical referral and interventions**

Current results and indications of TAVI

What is next?

The «essentials»
Multi Modality Screening before Transcatheter Aortic Valve Implantation

Measurement of aortic annulus

Echo/CT/MRI?

Evaluation of calcium distribution

Distance coronary – aortic valve

Peripheral arterial disease
“The Model” for the Prediction of the Risk of AVR @ TAVI

- Simple score based on a limited number of variables
- Specific evaluation in valve patients
- Elaborated from a broad spectrum of operative risks
- External validation in high- and low-volume centers
- Updated on a regular basis
- Inclusion of indices of functional and/or cognitive capacities
- Consider specific model for high-risk patients?

Future Indications for TAVI
Causes of Death 30 Days to 1 Year
SOURCE Registry

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac</td>
<td>45</td>
<td>25.1%</td>
</tr>
<tr>
<td>Heart Failure</td>
<td>28</td>
<td>62.2%</td>
</tr>
<tr>
<td>Myocardial Infarction</td>
<td>6</td>
<td>13.3%</td>
</tr>
<tr>
<td>Endocarditis</td>
<td>3</td>
<td>6.7%</td>
</tr>
<tr>
<td>Other*</td>
<td>8</td>
<td>17.8%</td>
</tr>
<tr>
<td>Non Cardiac</td>
<td>88</td>
<td>49.2%</td>
</tr>
<tr>
<td>Pulmonary***</td>
<td>21</td>
<td>23.9%</td>
</tr>
<tr>
<td>Renal Failure</td>
<td>11</td>
<td>12.5%</td>
</tr>
<tr>
<td>Cancer</td>
<td>10</td>
<td>11.4%</td>
</tr>
<tr>
<td>Stroke</td>
<td>9</td>
<td>10.2%</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>5</td>
<td>5.6%</td>
</tr>
<tr>
<td>Other**</td>
<td>32</td>
<td>36.4%</td>
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<tr>
<td>Unknown</td>
<td>46</td>
<td>25.7%</td>
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<tr>
<td>Sudden Death</td>
<td>18</td>
<td>39.1%</td>
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<tr>
<td>Unknown</td>
<td>18</td>
<td>39.1%</td>
</tr>
<tr>
<td>Other</td>
<td>10</td>
<td>21.7%</td>
</tr>
<tr>
<td>Total</td>
<td>179</td>
<td></td>
</tr>
</tbody>
</table>

(Thomas et al. Circulation 2011;124:425-33)
Screening in Bichat among 603 High-risk Patients Referred for TAVI

EuroSCORE ≥ 20% - STS PROM ≥ 10% / CI to AVR

Medical Rx 195 (32%)

TAVI 354 (59%)

AVR 54 (9%)

« Futility > Utility »
Future Indications for TAVI

- # Patients
- Surgery
- TAVI
- Risk

?
« German TAVI Registry: The 13% patient decision rate as a reason to perform TAVI is alarming »
Zahn et al. Eur Heart J 2011,32;198-204

« If you don’t come up with good evidence people will still continue to expand the indication »
P Kappetein Eur Heart J ,Jan 2011
Follow-up after TAVI

We need a longer follow-up to know the timing and mode of valve failure

(Gurvitch R et al. Circulation 2010;122:1319-1327)
Early Calcific Degeneration of a CoreValve Bioprosthesis (5 years)

(Ong Eur Heart J Online August 2011)
SURTAVI

Patient referred for severe aortic stenosis with indication for aortic valve replacement

‘All-comers’ trial

1. Documentation of risk scores (STS 4 to 8 )

2. Clinical judgment based on ‘State of the Art’ by the Heart Team

SURTAVI

Moderate-High risk
Randomise (1100pts)
TAVI (transfemoral, subclavian, retroperitoneal, transapical) vs. SAVR

Primary end-point: All cause death and major stroke at 24 months

Surgical AVR registry

Low risk

TAVI registry

Inoperable
Revisiting Exclusion Criteria

Coronary Artery Disease

Decision based on
- Symptoms, clinical presentation
- Location of lesions
- Myocardium at risk
- Suitability for PCI

Options
- TAVI + medical Rx
- PCI pre > per TAVI
- Reconsideration of surgery
- Give up any intervention

ACTIVATION Trial will start soon
< « Revisiting Exclusion Criteria » 

Bicuspid valve

Case by case decision
• annulus: shape/diameter
• amount/distribution of Ca
• specific valve design?
« Revisiting Exclusion Criteria »

Left Ventricular Dysfunction

- BAV as a Bridge?
- TAVI?
- Cardiac assist for pts in Shock?

(Clavel. Circulation 2010;122:1928-36.)
## Trends towards Procedural Simplification

<table>
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<tr>
<th></th>
<th>2002</th>
<th>2012</th>
<th>In the Future</th>
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<tbody>
<tr>
<td>Delivery Cath</td>
<td>25/24/22F</td>
<td>16F</td>
<td>Down</td>
</tr>
<tr>
<td>Surgical cut-down</td>
<td>Yes</td>
<td>No</td>
<td>Full percutaneous</td>
</tr>
<tr>
<td>Balloon dilatation</td>
<td>yes</td>
<td>yes</td>
<td>No with MCV?</td>
</tr>
<tr>
<td>Cardiac Support</td>
<td>Yes</td>
<td>No</td>
<td>But available</td>
</tr>
<tr>
<td>Anesthesia</td>
<td>Full</td>
<td>Local</td>
<td>But present</td>
</tr>
</tbody>
</table>
Improvement in Safety

- **Stroke**: Protection devices; antithrombotic/antiarrhythmic therapy

- **Aortic Regurgitation**: Valve sizing and positionning; quantification; valve design

- **Vascular complications**: Assessment of peripheral vasculature; tailoring the approach; devices profile
New Systems for Navigation and Positioning during TAVI
New Prosthesis Design

N=27
Current results and indications of TAVI

What is next?

The « essentials »
The « Heart Team »

SURGEONS
CARDIOLOGISTS
Anesthesiologists
Imaging specialists (Echo, CT, MRI)

Management of Aortic Stenosis

Other specialists: Geriatricians ……

Imaging specialists (Echo, CT, MRI)

With expertise in the treatment of valve disease

EACTS/ESC/EAPCI Position Statement, Eur Heart J, 2008; 29: 1463-1470,
“When surgery and medicine collaborate rather than compete, patients are the ultimate winners”

S.E. Nissen. J Am Coll Cardiol 2006
Careful Training for Percutaneous Interventions

- Procedural success in registries: TAVI > 95%
- Training for individuals and teams
- Firstly disease - then technique - finally device-oriented
- Simulators - proctoring - post graduate courses
- By companies – scientific societies
**Evaluation is Key**

**Long-Term Outcomes After Transcatheter Aortic Valve Implantation in High-Risk Patients With Severe Aortic Stenosis**

**The UK TAVI (United Kingdom Transcatheter Aortic Valve Implantation) Registry**

Neil E. Moat, MBBS, MSc, Peter Lockwood, MA, MD, Mark A. de Belder, MA, MD, Ben Bridgewater, PhD, Andrew D. Cunningham, PhD, Christopher P. Young, MD, Martyn Thomas, MD, Jan Kovac, MD, Tom Sprot, MD, Philip A. McCarthy, BS, PhD, Olaf Wendler, MD, PhD, David Hildick-Smith, MD, Simon W. Davies, MBBS, MD, Uday Trivedi, MBBS, MD, David J. Blackstone, MD, Richard D. Levy, MD, Stephen J. D. Brecker, MD, Andreas Baumhackl, MD, Tim Daniel, MB, CHB, Huong G. Duong, MD, Michael J. Mullen, MBBS, MD

London, Birmingham, Bristol, Middlesbrough, Manchester, Leicester, Brighton, Leeds, and Southampton, United Kingdom

**Objectives**

The objective was to define the characteristics of a real-world patient population treated with transcatheter aortic valve implantation (TAVI), regardless of technology or access route, and to evaluate their clinical outcome over the cold to be long term.

**Background**

Although a substantial body of data exists in relation to early clinical outcomes after TAVI, there are few data on outcomes beyond 1 year in any notable number of patients.

**Methods**

The UK TAVI (United Kingdom Transcatheter Aortic Valve Implantation) Registry was established to report outcomes of all TAVI procedures performed within the United Kingdom. Data were collected prospectively on 870 patients undergoing TAVI procedures up to December 31, 2009. Mortality tracking was achieved in 100% of patients with mortality data on record as of December 31, 2009.

**Results**

Survival at 30 days was 92.9%, and it was 78.6% and 73.7% at 1 year and 2 years, respectively. There was a marked attrition in survival between 30 days and 1 year. In a univariate model, survival was significantly affected by renal dysfunction, the presence of coronary artery disease, and a nontransfemoral approach whereas levell ventricle function (fraction < 30%), the presence of moderate/severe aortic regurgitation, and chronic obstructive pulmonary disease remained the only independent predictors of mortality in the multivariate model.

**Conclusions**

Midterm to long-term survival after TAVI was encouraging in this high-risk patient population, although a substantial proportion of patients died within the first year.

From the "Royal Brompton and Harefield National Health Service (NHS) Foundation Trust, London, United Kingdom; University Hospital Birmingham NHS Foundation Trust, Birmingham, United Kingdom; James Cook University Hospital, Middlesbrough; University Hospital Foundation Trust, Manchester, United Kingdom; Brighton Heart Institute, Brighton, United Kingdom; West Midlands Specialised Commissioning Group, Birmingham, United Kingdom; York Teaching Hospital Foundation, York, United Kingdom; University Hospitals Leiceste NHS Trust, Leicester, United Kingdom; "The Kings College Hospital” (KGH), Health Services, London, United Kingdom; "Hammersmith Hospital”, London, United Kingdom;

United Kingdom; "Leeds General Infirmary, Leeds, United Kingdom; "St. George" Hospital London, London, United Kingdom; "U.C.C. Cataract Audit Unit”, London, United Kingdom, "Medical College Specialised Commissioning Group London, United Kingdom; "Southend University Hospital, Southend, United Kingdom; and the "University College Hospital" NHS Foundation Trust, London, United Kingdom). Dr. Pichard is a consultant and provide for Edwards Lifesciences; Dr. Kovesi is a consultant and provide for Edwards Lifesciences; Dr. Kovesi is a consultant and provide for St Jude Medical; and has received honoraria from Edwards Lifesciences and Abbott. Dr. Kovesi is a consultant and provide for Edwards Lifesciences; Dr. Kovesi is a consultant and provide for Edwards Lifesciences; and has received honoraria from Edwards Lifesciences and Abbott.

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Conclusions

- Expert centers in VHD, team approach, careful training, good imaging, and careful evaluation, are, and will remain, essential.

- Today, TAVI is only indicated in inoperable or high risk patients with severe AS and severe symptoms. Further research is needed on risk stratification models for AVR and TAVI - improvement of safety and ease of the procedure - technology - evaluation in comparison with surgery.

  Then indications will be expanded to lower risk patients.
“We are still learning a lot, but I can see a great potential”

adapted from Andreas Gruntzig

“Transcatheter valve interventions are the natural evolution of surgery”

Michael Mack
STOP
« Revisiting Exclusion Criteria »

Left Ventricular Dysfunction

- BAV as a Bridge ?
- TAVI ?
- Cardiac assist for pts in Shock ?

(Clavel. Circulation 2010;122:1928-36.)
Figure 2. Normal aortic root (A) and dilated aortic root (B) characteristic of patients with BAV.

**Conclusion**

- *Percutaneous mitral commissurotomy* is here to stay for as long as MS and rheumatic valve disease.
- The current results of *the Edge to Edge technique* suggest that it may be useful in selected high risk patients. Long-term FU and RCT in secondary MR are needed.
- The results with *coronary sinus annuloplasty* are disappointing.
- In the future a combination of techniques for percutaneous mitral valve repair, and evaluation of new devices aimed at reproducing surgical techniques is expected.
- Preliminary data on *transcatheter treatment after surgical failure* show that it is feasible. This new option may have important clinical implications.
« We need to be sure that we do not sacrifice proven long-term effectiveness for short-term issues, such as convenience, invasiveness, or irreversible procedural complications »

Catherine Otto  NEJM 2011
In centres performing TAVI, multidisciplinary meetings should be held to discuss indications, procedural techniques, and case outcomes. Hospitals should keep proof of close medico-surgical collaboration and maintain a log of all patients referred to TAVI for continuous evaluation of the programme.

Surgery and Interventional Cardiology are Complementary

A patient’s story...

- C....47 years old
- 1986  Percutaneous Mitral Commissurotomy
- 1998  re –PMC
- 2001 AVR (Stentless valve) for AS
- 2010 Severe AR; MVA= 1.8cm²
cerebral tumor requiring surgery :
  « Valve in a Valve «

During 25 years she had 3 pregnancies
and never took Coumadin ....
Combining Interventions
Randomized = 699 patients

**Transfemoral**
- n = 492
  - TAVR (244)
    - 2 Years
      - Alive = 157
      - Dead = 74
      - LTFU = 2
      - Withdrawal = 2
      - Censored* = 9
      - 95.4% follow-up at 2 years
  - AVR (248)
    - 2 Years
      - Alive = 143
      - Dead = 80
      - LTFU = 2
      - Withdrawal = 16
      - Censored* = 7
      - 96.1% follow-up at 2 years

**Transapical**
- n = 207
  - TAVR (104)
    - 2 Years
      - Alive = 59
      - Dead = 42
      - LTFU = 1
      - Withdrawal = 0
      - Censored* = 2
      - 97.1% follow-up at 2 years
  - AVR (103)
    - 2 Years
      - Alive = 57
      - Dead = 34
      - LTFU = 1
      - Withdrawal = 8
      - Censored* = 3
      - 95.8% follow-up at 2 years

*Censored = Patient is alive at last contact but no information available within follow-up window
## Baseline Patient Characteristics
### Demographics (ITT)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>TAVR (n = 348)</th>
<th>AVR (n = 351)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age – years (Mean ± SD)</td>
<td>348 83.6 ± 6.8</td>
<td>349 84.5 ± 6.4</td>
<td>0.07</td>
</tr>
<tr>
<td>Male</td>
<td>201 57.8%</td>
<td>198 56.7%</td>
<td>0.82</td>
</tr>
<tr>
<td>STS Score (Mean ± SD)</td>
<td>347 11.8 ± 3.3</td>
<td>349 11.7 ± 3.5</td>
<td>0.61</td>
</tr>
<tr>
<td>NYHA Class III or IV</td>
<td>328 94.3%</td>
<td>328 94.0%</td>
<td>0.79</td>
</tr>
</tbody>
</table>
## Baseline Patient Characteristics

### Vasculopathy (ITT)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>TAVR (n = 348)</th>
<th></th>
<th>AVR (n = 351)</th>
<th></th>
<th>p-value</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>CAD</td>
<td>260</td>
<td>74.7</td>
<td>266</td>
<td>76.2</td>
<td>0.66</td>
</tr>
<tr>
<td>Previous MI</td>
<td>92</td>
<td>26.5</td>
<td>103</td>
<td>29.8</td>
<td>0.35</td>
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<tr>
<td>Previous CABG</td>
<td>148</td>
<td>42.5</td>
<td>152</td>
<td>43.6</td>
<td>0.82</td>
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<tr>
<td>Previous PCI</td>
<td>116</td>
<td>33.5</td>
<td>110</td>
<td>31.6</td>
<td>0.63</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>96</td>
<td>29.4</td>
<td>87</td>
<td>26.8</td>
<td>0.49</td>
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<tr>
<td>Peripheral vascular disease</td>
<td>149</td>
<td>43.2</td>
<td>142</td>
<td>41.6</td>
<td>0.70</td>
</tr>
</tbody>
</table>
## Baseline Patient Characteristics

### Other Co-morbidities (ITT)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>TAVR (n = 348)</th>
<th>AVR (n = 351)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>n</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td><strong>COPD – Any</strong></td>
<td><strong>152</strong></td>
<td><strong>151</strong></td>
<td><strong>0.88</strong></td>
</tr>
<tr>
<td><strong>COPD – O₂ dependent</strong></td>
<td><strong>38</strong></td>
<td><strong>38</strong></td>
<td><strong>0.90</strong></td>
</tr>
<tr>
<td><strong>Creatinine &gt;2mg/dL</strong></td>
<td><strong>37</strong></td>
<td><strong>22</strong></td>
<td><strong>0.04</strong></td>
</tr>
<tr>
<td><strong>Atrial fibrillation</strong></td>
<td><strong>81</strong></td>
<td><strong>75</strong></td>
<td><strong>0.60</strong></td>
</tr>
<tr>
<td><strong>Pacemaker implant</strong></td>
<td><strong>69</strong></td>
<td><strong>76</strong></td>
<td><strong>0.58</strong></td>
</tr>
<tr>
<td><strong>Pulmonary hypertension</strong></td>
<td><strong>126</strong></td>
<td><strong>111</strong></td>
<td><strong>0.15</strong></td>
</tr>
</tbody>
</table>
All-Cause Mortality (ITT)

HR [95% CI] = 0.88 [0.70, 1.12]
p (log rank) = 0.310
All-Cause Mortality (AT)

HR [95% CI] = 0.95 [0.74, 1.22]

p (log rank) = 0.692

<table>
<thead>
<tr>
<th>Months Post Procedure</th>
<th>TAVR</th>
<th>AVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>344</td>
<td>313</td>
</tr>
<tr>
<td>6</td>
<td>291</td>
<td>243</td>
</tr>
<tr>
<td>12</td>
<td>259</td>
<td>229</td>
</tr>
<tr>
<td>18</td>
<td>232</td>
<td>211</td>
</tr>
<tr>
<td>24</td>
<td>155</td>
<td>143</td>
</tr>
<tr>
<td>30</td>
<td>70</td>
<td>63</td>
</tr>
<tr>
<td>36</td>
<td>29</td>
<td>26</td>
</tr>
</tbody>
</table>
## All-Cause Mortality at 1 and 2 Years

### Patient Subgroups

<table>
<thead>
<tr>
<th>Source</th>
<th>All Patients</th>
<th>TF Patients</th>
<th>TA Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>no. of patients (%)</td>
<td>no. of patients (%)</td>
<td>no. of patients (%)</td>
</tr>
<tr>
<td></td>
<td>TAVR</td>
<td>AVR</td>
<td>p-value</td>
</tr>
<tr>
<td><strong>ITT</strong></td>
<td>84 (24.3)</td>
<td>89 (26.8)</td>
<td>0.45</td>
</tr>
<tr>
<td><strong>AT</strong></td>
<td>81 (23.7)</td>
<td>78 (25.2)</td>
<td>0.65</td>
</tr>
<tr>
<td><strong>ITT</strong></td>
<td>116 (33.9)</td>
<td>114 (35.0)</td>
<td>0.78</td>
</tr>
<tr>
<td><strong>AT</strong></td>
<td>114 (33.9)</td>
<td>99 (32.7)</td>
<td>0.75</td>
</tr>
</tbody>
</table>
Cardiovascular Mortality (ITT)

HR [95% CI] = 0.89 [0.65, 1.22]

p (log rank) = 0.481

Cardiovascular Mortality

<table>
<thead>
<tr>
<th>Months</th>
<th>TAVR</th>
<th>AVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>348</td>
<td>351</td>
</tr>
<tr>
<td>6</td>
<td>298</td>
<td>252</td>
</tr>
<tr>
<td>12</td>
<td>260</td>
<td>236</td>
</tr>
<tr>
<td>18</td>
<td>234</td>
<td>217</td>
</tr>
<tr>
<td>24</td>
<td>172</td>
<td>165</td>
</tr>
<tr>
<td>30</td>
<td>70</td>
<td>65</td>
</tr>
<tr>
<td>36</td>
<td>31</td>
<td>32</td>
</tr>
</tbody>
</table>
## Multivariate Baseline Predictors of Mortality - Pooled Cohort

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Hazard Ratio [95% CI]</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TAVR Arm</strong></td>
<td>0.89 [0.70-1.13]</td>
<td>0.34</td>
</tr>
<tr>
<td><strong>Body Mass Index (kg/m²)</strong></td>
<td>0.96 [0.94-0.98]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Liver Disease</strong></td>
<td>2.24 [1.30-4.00]</td>
<td>0.006</td>
</tr>
<tr>
<td><strong>Mean Gradient (mmHg/10)</strong></td>
<td>0.89 [0.81-0.98]</td>
<td>0.020</td>
</tr>
<tr>
<td><strong>STS Risk Score</strong></td>
<td>1.04 [1.01-1.08]</td>
<td>0.018</td>
</tr>
<tr>
<td><strong>Moderate/Severe MR</strong></td>
<td>1.36 [1.02-1.82]</td>
<td>0.036</td>
</tr>
</tbody>
</table>
## Multivariate Baseline Predictors of Mortality - By Treatment Arm

<table>
<thead>
<tr>
<th>TAVR</th>
<th>Hazard Ratio [95% CI]</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Mass Index (kg/m²)</td>
<td>0.93 [0.90-0.97]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean Gradient (mmHg/10)</td>
<td>0.82 [0.72-0.94]</td>
<td>0.003</td>
</tr>
<tr>
<td>Baseline Creatinine</td>
<td>1.06 [1.00-1.13]</td>
<td>0.044</td>
</tr>
<tr>
<td>Prior Vascular Surgery or Stent</td>
<td>1.85 [1.01-3.39]</td>
<td>0.045</td>
</tr>
<tr>
<td>AVR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior CABG</td>
<td>0.57 [0.40-0.82]</td>
<td>0.002</td>
</tr>
<tr>
<td>STS Risk Score</td>
<td>1.07 [1.02-1.12]</td>
<td>0.004</td>
</tr>
<tr>
<td>Liver Disease</td>
<td>2.59 [1.16-5.43]</td>
<td>0.020</td>
</tr>
<tr>
<td>Moderate/Severe MR</td>
<td>1.77 [1.17-2.68]</td>
<td>0.006</td>
</tr>
</tbody>
</table>
Feasibility of BMC Derived Autologous Heart Valve Implantation

Study Design:
Adult Sheep (n = 4)
acute Study (24hrs)
Hufnagel Procedure

Results:
✓ Systemic pressure accepted
✓ Good motion and co-aptation
✓ dp mean: 12 mmHg
✓ No regurgitation

(Emmert et al, JACC Cardiovasc Interv. 2011,7;822)
NYHA Class Survivors (ITT)

<table>
<thead>
<tr>
<th>NYHA Class</th>
<th>Survivors</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>23%</td>
</tr>
<tr>
<td>III</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>13%</td>
</tr>
</tbody>
</table>

- **Baseline**: NYHA Class I: 94%, NYHA Class II: 94%, NYHA Class III: 35%, NYHA Class IV: 15%
- **30 Days**: NYHA Class I: 23%, NYHA Class II: 15%, NYHA Class III: 35%, NYHA Class IV: 16%
- **1 Year**: NYHA Class I: 16%, NYHA Class II: 13%, NYHA Class III: 15%, NYHA Class IV: 15%
- **2 Year**: NYHA Class I: 15%, NYHA Class II: 15%, NYHA Class III: 15%, NYHA Class IV: 15%
All-Cause Mortality or Rehospitalization (ITT)

HR [95% CI] =
0.98 [0.79, 1.21]
p (log rank) = 0.836

Numbers at Risk

<table>
<thead>
<tr>
<th></th>
<th>TAVR</th>
<th>AVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>348</td>
<td>351</td>
</tr>
<tr>
<td>6</td>
<td>257</td>
<td>222</td>
</tr>
<tr>
<td>12</td>
<td>223</td>
<td>200</td>
</tr>
<tr>
<td>18</td>
<td>194</td>
<td>183</td>
</tr>
<tr>
<td>24</td>
<td>139</td>
<td>130</td>
</tr>
<tr>
<td>30</td>
<td>48</td>
<td>53</td>
</tr>
<tr>
<td>36</td>
<td>18</td>
<td>26</td>
</tr>
</tbody>
</table>
Strokes (ITT)

HR [95% CI] = 1.22 [0.67, 2.23]
p (log rank) = 0.517

30 Day Stroke Rate
TAVR – 4.6%
AVR – 2.4%

Months Post Procedure

<table>
<thead>
<tr>
<th>Months Post Procedure</th>
<th>Numbers at Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TAVR</td>
</tr>
<tr>
<td>0</td>
<td>348</td>
</tr>
<tr>
<td>6</td>
<td>287</td>
</tr>
<tr>
<td>12</td>
<td>249</td>
</tr>
<tr>
<td>18</td>
<td>224</td>
</tr>
<tr>
<td>24</td>
<td>162</td>
</tr>
<tr>
<td>30</td>
<td>65</td>
</tr>
<tr>
<td>36</td>
<td>28</td>
</tr>
</tbody>
</table>
Strokes (ITT Population)

<table>
<thead>
<tr>
<th></th>
<th>≤ 30 Days</th>
<th>&gt; 30 days</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAVR ≤ 30 Days</td>
<td>16</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>AVR ≤ 30 Days</td>
<td>8</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>TAVR &gt; 30 days</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVR &gt; 30 days</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAVR Total</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVR Total</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
All Neurologic Events (ITT)

<table>
<thead>
<tr>
<th></th>
<th>≤ 30 Days</th>
<th>&gt; 30 Days</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAVR - TIA</td>
<td>16</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>TAVR - Stroke</td>
<td>7</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>AVR - TIA</td>
<td>8</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>AVR - Stroke</td>
<td>1</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

Number of Events
All-Cause Mortality or Strokes (ITT)

HR [95% CI] = 0.96 [0.76, 1.21]

p (log rank) = 0.700

<table>
<thead>
<tr>
<th>Months Post Procedure</th>
<th>All-Cause Mortality or Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>28.6%</td>
</tr>
<tr>
<td>6</td>
<td>27.4%</td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>37.1%</td>
</tr>
<tr>
<td>36</td>
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</tr>
</tbody>
</table>

Numbers at Risk

<table>
<thead>
<tr>
<th></th>
<th>TAVR</th>
<th>AVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>348</td>
<td>351</td>
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<tr>
<td>6</td>
<td>287</td>
<td>246</td>
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<td>62</td>
</tr>
<tr>
<td>36</td>
<td>28</td>
<td>31</td>
</tr>
</tbody>
</table>
# Clinical Outcomes at 1 and 2 Years

## All Patients (N = 699)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>1 Year</th>
<th>2 Years</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AVR (N = 351)</td>
<td>TAVR (N = 348)</td>
<td></td>
</tr>
<tr>
<td>Major Vascular complications</td>
<td>13 (3.8)</td>
<td>39 (11.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>88 (26.7)</td>
<td>52 (15.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Major bleeding – no. (%)</td>
<td>16 (5.0)</td>
<td>21 (6.4)</td>
<td>0.44</td>
</tr>
<tr>
<td>New PM – no. (%)</td>
<td>3 (1.0)</td>
<td>2 (0.6)</td>
<td>0.63</td>
</tr>
<tr>
<td>Endocarditis – no. (%)</td>
<td>2 (0.6)</td>
<td>0</td>
<td>0.16</td>
</tr>
<tr>
<td>SVD§ requiring AVR</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MI – no. (%)</td>
<td>2 (0.6)</td>
<td>0</td>
<td>0.16</td>
</tr>
<tr>
<td>Acute kidney inj* – no. (%)</td>
<td>20 (6.5)</td>
<td>18 (5.4)</td>
<td>0.57</td>
</tr>
</tbody>
</table>

Abbreviations: 
- AVR: Aortic Valve Replacement
- TAVR: Transcatheter Aortic Valve Replacement
- SVD: Structural Valve Deterioration

* Renal replacement therapy

---

$^*$SVD = Structural Valve Deterioration
---
**Echocardiographic Findings**

**AVA (AT)**

<table>
<thead>
<tr>
<th></th>
<th>TAVR</th>
<th>AVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers at Risk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAVR</td>
<td>301</td>
<td>290</td>
</tr>
<tr>
<td>30 Day</td>
<td>269</td>
<td>224</td>
</tr>
<tr>
<td>6 Month</td>
<td>223</td>
<td>162</td>
</tr>
<tr>
<td>1 Year</td>
<td>210</td>
<td>151</td>
</tr>
<tr>
<td>2 Year</td>
<td>139</td>
<td>110</td>
</tr>
</tbody>
</table>

Valve Area (cm²)

- **TAVR**: p = 0.001, p = 0.002, p = 0.003, p = 0.16
- **AVR**: p = 0.32, p = 0.53, p = 0.54
**Echocardiographic Findings**

**Mean and Peak Gradients (AT)**

<table>
<thead>
<tr>
<th>Gradient (mmHg)</th>
<th>TAVR</th>
<th>AVR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Peak Gradient</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Mean Gradient</strong></td>
<td>307</td>
<td>295</td>
</tr>
</tbody>
</table>

**Numbers at Risk**

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>30 Day</th>
<th>6 Month</th>
<th>1 Year</th>
<th>2 Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAVR</td>
<td>307</td>
<td>275</td>
<td>233</td>
<td>218</td>
<td>144</td>
</tr>
<tr>
<td>AVR</td>
<td>295</td>
<td>228</td>
<td>168</td>
<td>155</td>
<td>112</td>
</tr>
</tbody>
</table>
PARTNER Grading Criteria for Paravalvular AR

Circumference = 6"
AR = 0.1+0.35 = 0.45"
Ratio = 8%
Severity = Mild (< 10%)

Circumference = 6"
AR = 0.5+0.5 = 1.0"
Ratio = 17%
Severity = Moderate (10 – 20%)
(Trans AR also present)

Circumference = 6"
AR = 0.6+1.1 = 1.7"
Ratio = 28%
Severity = Severe (> 20%)

Images courtesy of Pamela Douglas, MD, FASE
Paravalvular Aortic Regurgitation (AT)

- p < 0.0001

Percent of evaluable echos:
- Severe
- Moderate
- Mild
- Trace
- None

- TAVR 30 Day: N = 277
- AVR: N = 226
- TAVR 6 Month: N = 230
- AVR: N = 172
- TAVR 1 Year: N = 216
- AVR: N = 155
- TAVR 2 Year: N = 145
- AVR: N = 112
Aortic Regurgitation (AT)

N = 279  N = 228  N = 231  N = 173  N = 217  N = 156  N = 145  N = 113

Percent of evaluable echos

TAVR 30 Day  AVR  
N = 279  N = 228

TAVR 6 Month  AVR  
N = 231  N = 173

TAVR 1 Year  AVR  
N = 217  N = 156

TAVR 2 Year  AVR  
N = 145  N = 113

- Severe
- Moderate
- Mild
- Trace
- None
Paravalvular AR and Mortality
TAVR Patients (AT)

HR [95% CI] = 2.01 [1.38, 2.92]
p (log rank) = 0.0002

Numbers at Risk

<table>
<thead>
<tr>
<th></th>
<th>None-Tr</th>
<th>Mild-Mod-Sev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>167</td>
<td>160</td>
</tr>
<tr>
<td>6</td>
<td>149</td>
<td>134</td>
</tr>
<tr>
<td>12</td>
<td>140</td>
<td>112</td>
</tr>
<tr>
<td>18</td>
<td>126</td>
<td>101</td>
</tr>
<tr>
<td>24</td>
<td>87</td>
<td>64</td>
</tr>
<tr>
<td>30</td>
<td>41</td>
<td>26</td>
</tr>
<tr>
<td>36</td>
<td>16</td>
<td>12</td>
</tr>
</tbody>
</table>

Mortality

- None - Trace
- Mild - Moderate - Severe
Paravalvular AR and Mortality

TAVR Patients (AT)

Mortality

None - Trace
Mild
Moderate - Severe

p (log rank) < 0.001

Numbers at Risk

<table>
<thead>
<tr>
<th></th>
<th>None-Tr</th>
<th>Mild</th>
<th>Mod-Sev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Months Post Procedure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>167</td>
<td>136</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>149</td>
<td>115</td>
<td>19</td>
</tr>
<tr>
<td>12</td>
<td>140</td>
<td>95</td>
<td>17</td>
</tr>
<tr>
<td>18</td>
<td>126</td>
<td>86</td>
<td>15</td>
</tr>
<tr>
<td>24</td>
<td>87</td>
<td>51</td>
<td>13</td>
</tr>
<tr>
<td>30</td>
<td>41</td>
<td>21</td>
<td>5</td>
</tr>
<tr>
<td>36</td>
<td>16</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>
**Total AR and Mortality**

**TAVR Patients (AT)**

- None - Trace
- Mild - Moderate - Severe

HR [95% CI] = 1.66 [1.13, 2.44]

p (log rank) = 0.0087

<table>
<thead>
<tr>
<th>Numbers at Risk</th>
<th>Months Post Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>None-Tr</td>
<td>135</td>
</tr>
<tr>
<td>Mild-Mod-Sev</td>
<td>199</td>
</tr>
</tbody>
</table>

- Mortality

<table>
<thead>
<tr>
<th>Months Post Procedure</th>
<th>0%</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>12.7%</td>
<td>27.8%</td>
<td>36.3%</td>
<td>26.3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Total AR and Mortality
TAVR Patients (AT)

Numbers at Risk

<table>
<thead>
<tr>
<th>Type</th>
<th>0</th>
<th>6</th>
<th>12</th>
<th>18</th>
<th>24</th>
<th>30</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>None-Tr</td>
<td>135</td>
<td>125</td>
<td>115</td>
<td>101</td>
<td>68</td>
<td>31</td>
<td>11</td>
</tr>
<tr>
<td>Mild</td>
<td>165</td>
<td>139</td>
<td>121</td>
<td>111</td>
<td>71</td>
<td>33</td>
<td>16</td>
</tr>
<tr>
<td>Mod-Sev</td>
<td>34</td>
<td>25</td>
<td>22</td>
<td>19</td>
<td>15</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

Mortality

- None - Trace
- Mild
- Moderate - Severe

$p$ (log rank) < 0.001

Months Post Procedure

- 0%
- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
Mortality in Patients with None-Trace AR

TAVR vs AVR

HR [95% CI] = 0.72 [0.49, 1.05]

p (log rank) = 0.090

<table>
<thead>
<tr>
<th>Months Post Procedure</th>
<th>TAVR</th>
<th>AVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>135</td>
<td>252</td>
</tr>
<tr>
<td>10%</td>
<td>125</td>
<td>201</td>
</tr>
<tr>
<td>20%</td>
<td>115</td>
<td>189</td>
</tr>
<tr>
<td>30%</td>
<td>101</td>
<td>176</td>
</tr>
<tr>
<td>40%</td>
<td>68</td>
<td>118</td>
</tr>
<tr>
<td>50%</td>
<td>31</td>
<td>52</td>
</tr>
<tr>
<td>60%</td>
<td>11</td>
<td>22</td>
</tr>
</tbody>
</table>

Numbers at Risk

TAVR | 135 | 125 | 115 | 101 | 68 | 31 | 11
AVR  | 252 | 201 | 189 | 176 | 118| 52 | 22
Conclusions (1)

- At 2 years, in patients with symptomatic severe AS who were high-risk candidates for surgical AVR...
- TAVR remained equivalent to surgical AVR with similar rates of all-cause and cardiovascular mortality
- Symptom improvement was similar in both groups and maintained thru two years
- TAVR hemodynamic performance was maintained with similar valve gradients and areas compared with surgery; there was no evidence of structural valve deterioration.
Conclusions (2)

- Baseline predictors of mortality were different for TAVR (e.g. BMI, PVD) and surgery (e.g. STS score, mod/severe MR)
- Adverse procedural events had a significant impact on subsequent mortality, including stroke and major bleeding (for TAVR and AVR) and major vascular complications (for TAVR)
- Strokes were similar in TAVR and surgery patients, despite increased peri-procedural events after TAVR; there was no late (after 30 days) stroke hazard in TAVR patients
Conclusions (3)

- Post-procedural AR, was more common after TAVR (mild-mod-severe ~50%) and did not change significantly during follow-up.
- Even mild post-procedural AR (paravalvular and total AR) was associated with increased subsequent mortality.
Implications

2-year results from the high-risk operable PARTNER cohort indicate…

- TAVR should be considered an option for patients with severe symptomatic aortic stenosis who are high risk for AVR
- Peri-procedural stroke concerns after TAVR have diminished with longer follow-up
- TAVR valve hemodynamics have remained stable, although peri-procedural AR (even mild) has emerged as a predictor of late mortality
Two-Year Outcomes after Transcatheter or Surgical Aortic-Valve Replacement


Thank you to the dedicated study teams at all the PARTNER Sites!
- **General comments**
- Natural history
- Medical treatment / Surgery/ TAVI
- Guidelines
- Real life
- What is next?
Prevalence of Aortic Stenosis

- 11,911 patients (Nkomo et al. Lancet 2006;368:1005-11)
- 5,201 patients ≥ 65 years (Stewart et al. J Am Coll Cardiol 1997;29:630-4)
- 577 patients ≥ 55 years (Lindroos et al. J Am Coll Cardiol 1993;21:1220-5)

(lung, Nat Rev Cardiol 2011;8:162-72)
The Graying of the World
Population by Age, Sex

Age
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
10-14
5-9
0-4

Population in millions

1975
2030

Male
Female
Baby boom
### Patient Characteristics in the Euro Heart Survey

<table>
<thead>
<tr>
<th></th>
<th>Age (years)</th>
<th>≥ 70 years (%)</th>
<th>≥ 1 comorbidity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>69±12</td>
<td>56</td>
<td>36</td>
</tr>
<tr>
<td>AR</td>
<td>58±16</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>MS</td>
<td>58±13</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>MR</td>
<td>65±14</td>
<td>44</td>
<td>42</td>
</tr>
</tbody>
</table>

*(Iung. Eur Heart J 2003;24:1244-53)*
Frailty, Co-morbidity, and Disability

(Fried LP et al, J Gerontology 2001;56A:M146-56)
- General comments
- *Natural history*
- Medical treatment / Surgery / TAVI
- Guidelines
- Real life
- What is next?
Patients aged ≥ 70 yrs (median 78)

Stratification of spontaneous prognosis
- LV dysfunction (RR=4.8)
- Mitral regurgitation (RR=2.0)
- Class III or IV (RR=1.6) 3 risks groups

Natural History of AS

(Bouma et al. Heart 1999;82:143-8)
Natural History of AS in High-Risk Patients

274 patients screened for TAVI but non-eligible, treated medically ± BAV
- Age 81 ± 9 years
- Mean Euroscore 42%
- Mean STS score 13%

1-year mortality: 40%

(Ben-Dor et al. Circulation 2010;122(suppl.1):S37-S42)
- General comments.
- Natural history
- Medical treatment / Surgery / TAVI
- Guidelines
- Real Life
- What is next?
Medical Therapy
SEAS Trial

355 Placebo / 333 Simvastatine + Ezetimibe

Hazard ratio: 0.96, P=0.59

Placebo

EZ/Simva 10/40 mg

Percentage of Patients

Year

0 1 2 3 4 5

0 10 20 30 40 50

Percentage of Patients

Hazard ratio: 0.96, P=0.59

355 Placebo / 333 Simvastatine + Ezetimibe
Survival after Surgical AVR

Relative survival

Observed survival

Survival after TAVI in Inoperable Patients

The PARTNER US trial: B cohort
- 358 patients randomised to TAVI or standard therapy
- Age 83 ± 8 years
- Mean Euroscore 28%
- Mean STS score 12%

The PARTNER US trial: A cohort
- 699 patients randomised to surgical AVR (n=351) or TAVI (transfemoral: n=244, transapical: n=104)
- Age 84 ± 7 years
- Mean Euroscore 29%
- Mean STS score 12%

Survival after TAVI in High-Risk Patients

- General comments.
- Natural history
- Medical treatment / Surgery / TAVI
- *Guidelines*
- Real life
- What is next?
Severe AS (< 1 cm² or < 0.6 cm²/m² BSA) → Symptoms → No → LV EF < 50% → No → Markedly calcified valve and increase in peak jet velocity ≥ 0.3 m/sec within 1 year → Yes → Patient physically active → No → Re-evaluate in 6 to 12 months or when symptoms occur → Exercise test → Normal → No → Abnormal → Yes → Surgery

surgery. Age, per se, should not be considered a contra-indication for surgery. Decisions should be made on an individual basis, taking into account patients’ wishes and cardiac and non-cardiac factors (see also General com-
Modalities of Follow up

- In cases of moderate to severe calcification of the valve and peak aortic jet velocity > 4 m/s at initial evaluation patients **should be re-evaluated every 6 months** for the occurrence of symptoms, change in exercise tolerance or in echo-parameters:

  - If peak aortic jet velocity has increased since the last visit
    - (> 0.3 m/sec. per year) or if other evidence of haemodynamic progression is present, surgery should be considered.

Inclusion Criteria for TAVI

After assessment by the ‘Team’

- Severe AS
- Symptomatic
- Life expectancy >1 year
- Contra indication for surgery, or
  - High Risk for Surgery:
    - Clinical judgment +
    - EuroScore (logistic) > 20%; STS Score > 10%

AND/OR
- Porcelain aorta
- History of thoracic irradiation
- Severe thoracic deformity
- Patent coronary by pass
- ......................

Conclusions from PARTNER:

- “TAVI is already the standard-of-care for inoperable patients with severe aortic stenosis.”

- “TAVI is an acceptable alternative to AVR in selected high-risk operable patients.”

- General comments.
- Natural history
- Medical treatment / Surgery / TAVI
- Guidelines
  - *Real life*
  - What is next?
> 30% of patients are not referred for surgery

(Bouma et al. Heart 1999;82:143-8
Iung et al. Eur Heart J 2005;26:2414-20
Charlson et al. J Heart Valve Dis 2006;15:312-21
## Factors Associated with a Decision not to Operate in the Elderly with AS

<table>
<thead>
<tr>
<th></th>
<th>$X_2$</th>
<th>$p$</th>
<th>OR [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV dysfunction (EF &lt; 50%)</td>
<td>12</td>
<td>0.0005</td>
<td>3.78 [1.79-8.12]</td>
</tr>
<tr>
<td>Age (1-year increase)</td>
<td>10.7</td>
<td>0.001</td>
<td>1.15 [1.06-1.25]</td>
</tr>
<tr>
<td>Charlson comorbidity index</td>
<td>2.65</td>
<td>0.75</td>
<td>1.72 [0.83-3.50]</td>
</tr>
</tbody>
</table>

*(Iung et al. Eur Heart J 2005;26:2714-20)*
AS with LV Dysfunction and No Contractile Reserve on Dobutamine Echo

(Tribouilloy et al. JACC 2009;53:1865-73.)
Many Asymptomatic Patients will not be Operated when they become Symptomatic....

(Pellikka et al. Circulation 2005;111:3290-5)

(Kang et al. Circulation. 2010; doi: 10.1161/CIRCULATIONAHA.109.909903)
Patients referred for severe and symptomatic aortic stenosis

- Median age 78 years
- 10% increase in surgical referral and interventions

Germany
TAVI a Game Changer in AVR

% Patients undergoing conventional AVR vs TAVI

(Quelle: DGTHG Statistik 2010)
Growing TAVI Experience in Europe

<table>
<thead>
<tr>
<th>Year</th>
<th># of procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>49450</td>
</tr>
<tr>
<td>2008</td>
<td>56100</td>
</tr>
<tr>
<td>2009</td>
<td>53200</td>
</tr>
<tr>
<td>2010</td>
<td>71000</td>
</tr>
</tbody>
</table>
- General comments.
- Natural history
- Medical treatment / Surgery/ TAVI
- Guidelines
- Real life
- *What is next?*
The « Heart Team »

- **Surgeons**
- **Cardiologists**
- **Anesthesiologists**
- Imaging specialists (Echo, CT, MRI)
- Other specialists: Geriatricians …

**Treatment of Aortic Stenosis**

With expertise in the treatment of valve disease

EACTS/ESC/EAPCI Position Statement, Eur Heart J, 2008; 29: 1463-1470,
Risk-Benefit Assessment

- Decision-making for intervention is multifactorial:
  - Prognosis according to severity and consequences of valvular disease
  - Risks and late consequences of intervention
  - Patient life expectancy and quality of life
  - Patient wishes after information
  - Local resources, in particular results of surgery
The “Ideal” Model for the Prediction of the Risk of AVR @ TAVI

- Specific evaluation in valve patients
- Tested in a subset representative of the global patient population and practices
- Prospective and external validation
- Easy to use
- Prediction of long-term outcome, morbidity, costs
- “Use-by-date”
Currently available risk scores should not be used as an isolated decision tool but as part of an integrated approach, which includes complete clinical evaluation, reference to local resources and surgical results, and the preferences of the patient and their family. Risk scores are not a substitute for clinical experience in the management of patients with VHD.
Causes of Death 30 Days to 1 Year
SOURCE Registry

ALL 179

Cardiac 45 (25.1%)

Heart Failure 28 (62.2%)
Myocardial Infarction 6 (13.3%)
Endocarditis 3 (6.7%)
Other* 8 (17.8%)

Non Cardiac 88 (49.2%)

Pulmonary*** 21 (23.9%)
Renal Failure 11 (12.5%)
Cancer 10 (11.4%)
Stroke 9 (10.2%)
Gastrointestinal 5 (5.6%)
Other** 32 (36.4%)

Unknown 46 (25.7%)
Sudden Death 18 (39.1%)
Unknown 18 (39.1%)
Other 10 (21.7%)

(Thomas et al. Circulation 2011;124:425-33)

Avoid Cohort C!
Screening in Bichat among 603 High-risk Patients Referred for TAVI

EuroSCORE ≥ 20% - STS PROM ≥ 10% / CI to AVR

Medical Rx
195 (32%)

TAVI
354 (59%)

AVR
54 (9%)
Risk Score for Predicting Outcome in Asymptomatic AS

Score = (peak velocity (m/s) x 2) + (logarithm of BNP x 1.5) + 1.5 (if female)

(Monin, Circulation, 2009; 120; 69-75)
Good Evaluation

Percutaneous Transcatheter Aortic Valve Replacement in Selected High-Risk Patients With Aortic Stenosis
John G. Webb, Sunjeetan Poyapati, Karan Humphries, Christopher Thompson, Lukas Althoeve, Robert Moss, Ajay Sinhal, Ronald G. Cuere, Brad Munt, Donald Ricci, Jian Ye, Anson Cheung and Sumi V. Lichtenstein

Circulation 2007, 116:755-763; originally published online July 23, 2007
doi: 10.1161/CIRCULATIONAHA.107.698258
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N. Anderson, Ph.D., Duolao Wang, Ph.D.,
RTNER Trial Investigators

One-Year Outcomes of Cohort 1 in the Edwards SAPIEN Aortic Bioprosthesis European Outcome (SOURCE) Registry: The European Registry of Transcatheter Aortic Valve Implantation Using the Edwards SAPIEN Valve
Marty Stein, Gerhard Schymaik, Thomas Wallner, Dominique Humbert, Tabea Leifer, Henri Thiede, Holger Eggbercht, Paolo Rabino, Antonio Colombo, Rudiger Lange, Rebecca R. Schwarz, and Odal Wendler

Circulation 2011, 124:425-433; originally published online July 11, 2011
doi: 10.1161/CIRCULATIONAHA.110.015843
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N. Anderson, Ph.D., Duolao Wang, Ph.D.,
RTNER Trial Investigators
Cost-Effectiveness Assessment

TAVI: Estimates from PARTNER B

(Reynolds. ACC 2011)
Conclusions (I)

- The prevalence of AS increases sharply with age and represents an important burden, which is expected to increase in the near future.

- AS carries a poor prognosis when severe and symptomatic.

- The benefit of surgery has been largely demonstrated.

- Guidelines do not provide explicit age limitations to aortic valve replacement in severe symptomatic AS.
Conclusions (II)

- However, current experience shows that a high percentage of patients are denied surgery.

- The reasons for denying surgery are not always consistent with risk-benefit analysis.

- TAVI enables a higher number of patients to be effectively treated.

- Initial experience suggests that the availability of TAVI increases patient referral, not only for less invasive procedures, but also for conventional surgery.
Conclusions (III)

Further research is needed on:

- Impact of medical therapy on aortic valve sclerosis and new therapeutic pathways
- Early detection of LV dysfunction in asymptomatic patients
- Risk stratification models and implementation of their use in conjunction with the other elements in decision-making
- Evaluation of the role of TAVI in randomized trials and comprehensive registries
- Newer trials for better evidence…….
“We may have all come in different ships, but we’re in the same boat now”

Martin Luther King, Jr.
stop
## European TAVI Registries

<table>
<thead>
<tr>
<th></th>
<th>French</th>
<th>UK</th>
<th>Belgian</th>
<th>German</th>
<th>Italian</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (yr)</strong></td>
<td>82±6</td>
<td>83±7</td>
<td>83±6</td>
<td>81±6</td>
<td>81±7</td>
</tr>
<tr>
<td><strong>LogEuroscore (%)</strong></td>
<td>22±14</td>
<td>21±6</td>
<td>26±16</td>
<td>21±13</td>
<td>23±14</td>
</tr>
<tr>
<td><strong>Procedural success (%)</strong></td>
<td>97</td>
<td>99</td>
<td>98</td>
<td>98.7</td>
<td>98</td>
</tr>
<tr>
<td><strong>1-month Survival (%)</strong></td>
<td>90</td>
<td>93</td>
<td>92</td>
<td>88</td>
<td>94</td>
</tr>
</tbody>
</table>

Zahn et al Eur Heart J 2011;32:198-204  
Moat In Press J Am Coll Cardiol 2011  
Tamburino C et al Circulation 2011;123:299-308  
European TAVI Registries

French registry
  33 centers,
  4042 consecutive pts

Belgian registry
  18 centers,
  600 consecutive pts

United Kingdom registry
  26 centers
  872 consecutive pts

German registry
  22 centers
  833 consecutive pts

Italian registry
  14 centres
  663 pts CoreValve
AR after TAVI and Mortality in PARTNER A

- None - Trace
- Mild
- Moderate - Severe

$p$ (log rank) < 0.001

<table>
<thead>
<tr>
<th>Months Post Procedure</th>
<th>Numbers at Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None-Tr</td>
</tr>
<tr>
<td>0</td>
<td>135</td>
</tr>
<tr>
<td>6</td>
<td>125</td>
</tr>
<tr>
<td>12</td>
<td>115</td>
</tr>
<tr>
<td>18</td>
<td>101</td>
</tr>
<tr>
<td>24</td>
<td>68</td>
</tr>
<tr>
<td>30</td>
<td>31</td>
</tr>
<tr>
<td>36</td>
<td>11</td>
</tr>
</tbody>
</table>
Current Indications for TAVI

Transcatheter valve implantation for patients with aortic stenosis: a position statement from the European Association of Cardio-Thoracic Surgery (EACTS) and the European Society of Cardiology (ESC), in collaboration with the European Association of Percutaneous Cardiovascular Interventions (EAPCI)

Alec Yahanian1*, Ottavio Alfieri2*, Nawwar Al-Attar1, Manuel Antunes3, Jeroen Bax4, Bertrand Cormier5, Alain Cribier6, Peter De Jaegere7, Gerard Fournia8, Arie Pieter Kappetein7, Jan Kovacs9, Susanne Ludgate10, Francesco Maisano2, Neil Moat11, Friedrich Mohr12, Patrick Natal13, Luc Piérard13, José Luis Pomar14, Joachim Schofer15, Pilar Tornos16, Murat Tuzcu17, Ben van Hout18, Ludwig K. Von Segesser19, and Thomas Walther12

1 Hôpital Bichat, Paris, France; 2Chiesi SA, Raffaello, Milan, Italy; 3University Hospital, Coimbra, Portugal; 4Leiden University Medical Center, Leiden, The Netherlands; 5Institut Hopitalier Jacques Cartier, Massy, France; 6CHU de Rouen—Hôpitaux de Rouen—Hôpital Charles Nicolle, Rouen Cedex, France; 7Thoraxcenter, Erasmus Medical Center, Rotterdam, Netherlands; 8CHU—Centre Hospitalier de Rennes, Rennes, France; 9University Hospitals of Leicester, Leicester, UK; 10Department of Health, Medical and Healthcare Products Regulatory Agency, London, UK; 11Royal Brompton Hospital, London, UK; 12Heart Center Leipzig, University of Leipzig, Leipzig, Germany; 13University Hospital Saint-Tiimen, Liege, Belgium; 14Hospital Clinic de Barcelona, University of Barcelona, Barcelona, Spain; 15Hamburg University Cardiovascular Center, Hamburg, Germany; 16Hospital Universitari Vall d’Hebron, Barcelona, Spain; 17Cleveland Clinic, Cleveland, Ohio, USA; 18Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, Utrecht, The Netherlands; and 19CHUV, Lausanne, Switzerland

Received 2 April 2008; accepted 16 April 2008; online publish-ahead-of-print 13 May 2008

Aims

To critically review the available transcatheter aortic valve implantation techniques and their results, as well as propose recommendations for their use and development.
Paravalvular Aortic Regurgitation

(Kodali, NEJM, on line 2012)
Prevalence of Valvular Heart Disease in US

- 11,911 randomly selected patients with echo
  Age-adjusted prevalence of valvular disease: **2.5%**
- Prevalence: **1.8%** in a community-based study

*(Nkomo et al. Lancet 2006;368:1005-11)*
The Graying of the World
Population by Age, Sex

2030

1975

Population in millions

Age

Male

Female

Baby boom
Patient Characteristics in the Euro Heart Survey

<table>
<thead>
<tr>
<th></th>
<th>Age (years)</th>
<th>≥ 70 years (%)</th>
<th>≥ 1 comorbidity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>69±12</td>
<td>56</td>
<td>36</td>
</tr>
<tr>
<td>AR</td>
<td>58±16</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>MS</td>
<td>58±13</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>MR</td>
<td>65±14</td>
<td>44</td>
<td>42</td>
</tr>
</tbody>
</table>

Frailty, Co-morbidity, and Disability

(Fried LP et al, J Gerontology 2001;56A:M146-56)
Where Shall we Perform?

In cardiology and cardiac surgery centers
FRANCE 2 (n=3195)

Procedural characteristics

- Operative room: 74.7% (67%)
- Cath-lab: 9.9% (21%)
- Hybrid room: 15.3% (12%)
The “Heart Team”

- A group of valve specialists who collaborate to:

  ✓ Select the most appropriate procedure
  ✓ Perform the procedures
  ✓ Evaluate the results

Decision-making for intervention

✓ Prognosis according to severity and consequences of valvular disease
✓ Risks and late consequences of intervention
✓ Patient life expectancy and quality of life
✓ Patient wishes after information
✓ Local resources, in particular results of surgery
FRANCE 2 (n=3195)
Approaches used

- Trans apical (TA): 5%
- Trans femoral (TF): 29%
- Subclavian (SC): 74%

(66%)
Severe symptomatic AS
Agreed high surgical risk

Annular sizing Echo/CT/both
Coronary sinus/LVOT suitable

18-20 mm 20-25 mm 25-27 mm

Re-evaluate surgical options

Proximal ascending aorta
≤ 40 mm (20-23 mm annuli)
≤ 43 mm (23-27 mm annuli)

Femoral sizing angio/CT/both
Femoral > 6 mm

yes or no

Femoral sizing angio/CT/both
Fem ≥ 6 mm

yes or no

Edwards Transapical
Edwards Transfemoral

CoreValve Transfemoral
Direct Aortic Access

CoreValve Transaxilllary

(Jilaihawi. JACC: Cardiovasc Int 2010;3:859-66.)
FRANCE 2 (n=3195)
Approaches used

- Trans apical: 5% (5%)
- Trans femoral: 19% (29%)
- Subclavian: 74% (66%)

Legend:
- Green: Trans apical
- Blue: Trans femoral
- Yellow: Subclavian
Cost – effectiveness acceptability curves for Medical Management and TAVI

Assuming a cost–effectiveness threshold of £12000 per QALY gained, the probability that TAVI is a cost effective intervention in inoperable patients is 1.

TAVI is highly likely to be a cost effective treatment for patients with severe AS who are currently ineligible for SAVR.

Follow-up after TAVI

(Webb. Circulation 2009;119;3009-3016)
Transfemoral Approach
(74% in France 2)

Percutaneous access + surgical closure

Surgical access and closure

Percutaneous access and closure (closure device)
Alternatives to the TF approach

Transapical (Edwards Sapien) (17% in France 2)

Subclavian (Medtronic CoreValve) (5% in France 2)

Transaortic (Both) (2% in France 2)
Procedural Predictors of Mortality in PARTNER

<table>
<thead>
<tr>
<th></th>
<th>HR</th>
<th>[95% CI]</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stroke</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAVR</td>
<td>2.76</td>
<td>[1.58-4.82]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>AVR</td>
<td>4.99</td>
<td>[2.85-8.75]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Major Bleeding</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAVR</td>
<td>2.14</td>
<td>[1.42-3.20]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>AVR</td>
<td>2.88</td>
<td>[1.99-4.14]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Major Vascular</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAVR</td>
<td>1.67</td>
<td>[1.04-2.70]</td>
<td>0.03</td>
</tr>
<tr>
<td>AVR</td>
<td>1.40</td>
<td>[0.57-3.44]</td>
<td>0.46</td>
</tr>
</tbody>
</table>
Decision-making for intervention

✓ Prognosis according to the severity and consequences of valvular disease
✓ Risks and late consequences of intervention
✓ Patient life expectancy and quality of life
✓ Patient wishes after information:

Self referral!

✓ Local resources, in particular results of surgery

(ESC Guidelines, Eur Heart J 2007;28:230-68)