The Optimal Treatment for Patients Under 50 with Aortic Valve Disease

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Disclosure

I do **NOT** have a financial interest, arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation.

I will **NOT** discuss investigational or off-label use of unapproved products or devices.
Key Points

Repair when Possible

Little or no difference in survival between mechanical and biological in middle-aged patients at 15 years

Mechanical have a higher risk of stroke or bleeding but biological suffer from SVD requiring reoperation

Ross provides greater freedom from morbidity but mortality is increased and most patients require a difficult reoperation
Why Do Young Patients Need AVR?

• Aortic Stenosis
  – Unlikely with tri-leaflet valves under 75 years-old
  – Bicuspid patients
    • Younger patients fail more often with AI than AS

• Endocarditis

• Aortic Insufficiency

• Primary Aortic Root Pathology
Causes of Pure Aortic Regurgitation in Patients Having Isolated AVR at Single US Tertiary Hospital (199-2005)

• 268 patients with AI greater than 20 years-old
  – 146 (54%) due to conditions affecting the root
  – 122 remaining patients
    • 66 (46%) due to endocarditis
    • 46 (38%) bicuspid valves without aneurysm
    • 10 miscellaneous

Roberts et al. Circ 2006;114:422-429
Primary Option for Aortic Regurgitation: Aortic Valve Repair

• Advantages:
  • Patients are reluctant to be on Warfarin
  • Potential for Curative Surgery
  • Biological alternatives have a limited lifespan
  • Safe and Reproducible Procedure
Considerations for Bicuspid AI

• Advantages:
  – Easy Repair due to one coaptation plane
  – Patients are usually under 50 years old
  – A perfectly repaired bicuspid can valve serve as a platform for TAVR
  – Often associated with root aneurysm
Sievers Classification of Bicuspid Valves

1. Number of Raphes (0, 1, 2)
2. Spatial Position of Raphe
3. Functional Status of Valve

J Thorac Cardiovasc Surg 2007;133:1226-1233
Case Presentation

49 year-old female from Greece who carries the diagnosis of a thoracic aneurysm associated with bicuspid aortic valve and moderate AI. She has been followed with serial imaging and has sought several opinions regarding definitive management. She denies any symptoms and is quite active. Her most recent CT scan reveals a 5.5 cm maximal increased from from 4.9 cm over 18 months.

PMHx, SH, and FH WNL
Physical Exam:
Vitals: HR: 72 BP: 111/50 RR: 16
Constitutional: In great physical shape.
Sternum: normal size and shape
Heart: S1, S2 loud diastolic murmur
Lungs; CTA B/L
Abd: soft NT/ND +BS
Ext: WNL
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Aortic Valve-Sparing Operations in 220 Patients

Figure 4. Freedom from aortic valve replacement after aortic valve-sparing operations in all patients.

David et al, J Thorac Cardiovasc Surg 2006;132:347-54
# Valve Repair Data Summary

- **Age (years)**  
  - 58.5±12.9  
  - 46.5±13.4

- **CPB (min)**  
  - 132.9±35.6  
  - 139.8±35.2

- **Ao X-Clamp (min)**  
  - 100.1±31.9  
  - 113.1±26.7

- **Post-op 2+AI (%)**  
  - 1.5 (5/335)  
  - 1.0 (1/97)

- **Reop bleeding (%)**  
  - 1.8 (6/335)  
  - 0 (0/97)

- **Periop CVA (%)**  
  - 0.9 (3/335)  
  - 0 (0/57)

- **30- day mortality (%)**  
  - 0.6 (2/335)  
  - 0 (0/57)

- **5-year mortality (%)**  
  - 2.4 (6/335)  
  - 0 (0/57)
Aortic Valve Repair: Notes for the Cardiologist

- Accomplished with under 1% mortality or morbidity
- Myriad techniques for leaflet adjustment

Viable alternative for:
- Young, active patients who wish to avoid Coumadin
- Patients with connective tissue disorders
- Patients with bicuspid valve disease
- Patients with normal tri-leaflet valves and root aneurysms

- 15 year freedom from repeat surgery >90%
- Freedom from re-op appears superior to bio-prostheses
What About Aortic Stenosis?

For patients <70 years old (n=324):
- Bicuspid: 50%
- Post-inflammator: 25%
- Degenerative: 18%
- Unicommissural: 3%
- Hypoplastic: 2%
- Indeterminate: 2%

For patients ≥70 years old (n=322):
- Bicuspid: 27%
- Degenerative: 48%
- Post-inflammator: 23%
- 2%
Choice of Prosthetic Heart Valve in Adults
An Update
Shahbudin H. Rahimtoola, MB, FRCP, DSc (HON)
Los Angeles, California

In the last 7 years, more data have reconfirmed that patients’ comorbid conditions are very important factors determining patient outcomes. Prosthetic heart valves (PHVs) that require aortic root replacement in the absence of aortic root disease are associated with poorer outcomes. For the vast majority of patients, the choice of PHV is between a mechanical valve and a stented bioprosthesi. The choice is largely dependent upon the age of the patient at the time of PHV implantation and on which complication the patient wants to avoid: specifically, anticoagulation therapy and its complications with the mechanical valve, and structural valve deterioration with a bioprosthesi. Data on the pros and cons of the choices and exceptions to the rules are discussed, and a new algorithm is developed. (J Am Coll Cardiol 2010;55:2413–26) © 2010 by the American College of Cardiology Foundation
Durability

37%  18%  8%
Quality of Life with a Mechanical Valve

Even with an INR above 3, most patients undergoing mechanical valve replacement at the age of 45 will suffer a stroke at the age of 75.
Original Investigation

Survival and Long-term Outcomes Following Bioprosthetic vs Mechanical Aortic Valve Replacement in Patients Aged 50 to 69 Years

Yuting P. Chiang, BA; Joanna Chikwe, MD; Alan J. Moskowitz, MD; Shinobu Itagaki, MD; David H. Adams, MD; Natalia N. Egorova, PhD

**IMPORTANCE** The choice between bioprosthetic and mechanical aortic valve replacement in younger patients is controversial because long-term survival and major morbidity are poorly characterized.

**OBJECTIVE** To quantify survival and major morbidity in patients aged 50 to 69 years undergoing aortic valve replacement.

**DESIGN, SETTING, AND PARTICIPANTS** Retrospective cohort analysis of 4253 patients aged 50 to 69 years who underwent primary isolated aortic valve replacement using bioprosthetic vs mechanical valves in New York State from 1997 through 2004, identified using the Statewide Planning and Research Cooperative System. Median follow-up time was 10.8 years (range, 0 to 16.9 years); the last follow-up date for mortality was November 30, 2013. Propensity matching yielded 1001 patient pairs.

**MAIN OUTCOMES AND MEASURES** Primary outcome was all-cause mortality; secondary outcomes were stroke, reoperation, and major bleeding.
Survival and Long-term Outcomes Following Bioprosthetic vs Mechanical Aortic Valve Replacement in Patients Aged 50 to 69 Years

Table 3. Outcomes Within 30 Days of Aortic Valve Replacement in Propensity Score-Matched Patients

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Prosthesis Type, No. (%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bioprosthetic (n = 1001)</td>
<td>Mechanical (n = 1001)</td>
</tr>
<tr>
<td>Mortality</td>
<td>25 (3)</td>
<td>30 (3)</td>
</tr>
<tr>
<td>Stroke</td>
<td>18 (2)</td>
<td>12 (1)</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>129 (12)</td>
<td>135 (13)</td>
</tr>
<tr>
<td>Acute kidney injury</td>
<td>18 (2)</td>
<td>16 (2)</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>101 (10)</td>
<td>86 (9)</td>
</tr>
<tr>
<td>Readmission</td>
<td>173 (17)</td>
<td>172 (17)</td>
</tr>
</tbody>
</table>
Survival and Long-term Outcomes Following Bioprosthetic vs Mechanical Aortic Valve Replacement in Patients Aged 50 to 69 Years

Overall survival

HR, 0.97 (95% CI, 0.83-1.14); Cox P = .74a

<table>
<thead>
<tr>
<th>No. at risk</th>
<th>Bioprosthetic</th>
<th>Mechanical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1001</td>
<td>1001</td>
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<tr>
<td>0</td>
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<td>10</td>
<td>589</td>
<td>611</td>
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<td>15</td>
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<td>89</td>
</tr>
</tbody>
</table>

Chiang et al JAMA 2014;312:1323-1329
Mechanical valves require reoperation (6% at 15y)

Biological valves require reoperation (12% at 15y)

HR, 0.52 (95% CI, 0.36-0.75); Gray P = .001
Survival and Long-term Outcomes Following Bioprosthetic vs Mechanical Aortic Valve Replacement in Patients Aged 50 to 69 Years

**Stroke**
- HR, 1.04 (95% CI, 0.75-1.43); Gray P = .84

**Major bleeding**
- HR, 1.75 (95% CI, 1.27-2.43); Gray P = .001

Being readmitted for bleeding carried a 10.9% mortality, not benign
Early single-center experience in sutureless aortic valve implantation in 120 patients

Harald C. Eichstaedt, MD, Jerry Easo, MD, Tobias Härle, MD, and Otto E. Dapunt, MD, PhD

Objective: The study objective was to evaluate the safety and efficacy of sutureless self-expanding nitinol stent-frame aortic valve prostheses made of equine pericardium implanted in patients with symptomatic aortic valve disease.

Methods: We performed a retrospective analysis of 120 patients (mean age, 76.7 ± 5.9 years) who underwent

LOW AND ZERO PRESSURE FIXATION ANTIMINERALIZATION TREATMENTS ANTICALCIFICATION?

At discharge, respectively, in 6 patients (0.7%), permanent pacemaker implantation was necessary. No thromboembolic events or bleedings related to the bioprosthesis were observed.

Conclusions: In this large single-center experience with sutureless aortic valve replacement, the surgical procedure is shown to be safe and time-saving. In view of the excellent hemodynamic results and shortening of aortic crossclamp and bypass times, we notice advantages especially in high-risk patients. Minimally invasive access seems to be facilitated. The long-term durability of this prosthesis has yet to be determined. (J Thorac Cardiovasc Surg 2014;147:370-5)
Aortic Valve Replacement

A Prospective Randomized Evaluation of Mechanical Versus Biological Valves in Patients Ages 55 to 70 Years

NO DIFFERENCE IN SURVIVAL INCLUDING REOPS

![Graph showing survival rates over time for BP and MP valves.](image-url)
Reoperation is not an independent predictor of mortality during aortic valve surgery

Piroze M. Davierwala, MD, Michael A. Borger, MD, PhD, Tirone E. David, MD, Vivek Rao, MD, PhD, Manjula Maganti, MSc, and Terrence M. Yau, MD, MSc

Objective: Reoperations on aortic valves are associated with increased mortality, which may affect valve prosthesis selection at the time of initial aortic valve replacement. We analyzed our experience to determine whether reoperation itself independently predicts mortality during aortic valve surgery.

Methods: Demographic, intraoperative, and outcome data were collected prospectively on patients undergoing primary or redo aortic valve replacement or Bentall procedures after previous aortic valve replacement with or without concomitant coronary bypass grafting at a single institution from 1990 through 2002. Logistic regression analyses validated by means of bootstrap methodology identified the predictors of hospital mortality and the independent effect of reoperation.

Results: Of 2673 patients undergoing aortic valve surgery, 2375 were primary operations, 216 were reoperations, and 82 were Bentall–after–aortic valve replacement procedures. Of 298 reoperations, 32 were third and 5 were fourth procedures. Mortality was 2.3% for primary operations, 4.6% for redo aortic valve replacement, and 2.4% for Bentall–after–aortic valve replacement procedures. Most patients underwent elective procedures, with mortalities of 1.6%, 1.7%, and 2.5%, respectively. Hospital mortality was independently predicted by peripheral vascular disease (odds ratio, 3.6), active endocarditis (odds ratio, 2.9), worsening New York Heart Association class (odds ratio, 2.3), and need for annular enlargement (odds...
Reoperation is not an independent predictor of mortality during aortic valve surgery

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Figure 3. Independent predictors of hospital mortality for primary or redo aortic valve replacement. NYHA, New York Heart Association.
What About the Ross Procedure?
Long-term results of the Ross operation: an 18-year single institutional experience†

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Abstract

OBJECTIVES: The purpose of the study was to assess the 18-year outcome of the Ross operation (RO), with emphasis on survival, reoperations, and late function of the pulmonary autografts (PAs) and the right-sided pulmonary allografts.

METHODS: Between May 1995 to July 2013, 414 patients with a mean age (mean ± standard deviation) of 30.8 ± 13.1 years were submitted to an RO with the root replacement (n = 356) or the inclusion (n = 58) technique. The most prevalent aetiology was bicuspid valve (n = 206, 49.8%). Patients were divided in four groups depending on the type of allograft used on the right side. The mean follow-up was 8.2 ± 5.2 years and was 97.7% complete. In addition to longitudinal outcomes determined by means of the Kaplan–Meier analysis, log-rank test and Cox regression analysis were used to identify predictors of valve failure.

RESULTS: The early mortality rate was 2.7% and the late survival rate was 89.3% at 15 years, similar to an age- and sex-matched population. There were 22 reoperations on the PA (90.7% freedom at 15 years) and 15 on the pulmonary allografts (92.5% freedom at 15 years). The freedom rate from more than mild aortic insufficiency (AI) was 73.1% at 15 years. Thirty-three patients presented with a late root diameter >45 mm, corresponding to a freedom rate of 72.4% at 15 years. Patients with AI and a dilated annulus, especially males, are at greater risk for these complications. Among the right-sided allografts, fresh decellularized allografts showed significantly superior freedom from structural valve dysfunction.
Long-term results of the Ross operation: an 18-year single institutional experience

The early mortality rate was 2.7% (11/414). Causes of early death were low cardiac output syndrome in 4 cases, uncontrollable

Unadjusted Aortic Valve Operative Mortality
Yearly over last 10 years
Long-term results of the Ross operation: an 18-year single institutional experience

Francisco Diniz Affonso da Costa, Johanna Josepha Maria Takkenberg, Daniele Fornazari

Survival comparison

Ross survival at 15 years: 89.3% (95% CI: 83.1–93.3)

Cumulative survival (%)

Follow-up (years)
How Do We Do Aortic Valve Surgery in Patients Under 50
Common Misconceptions

• Open Heart Surgery Is “Cracking the Chest”
• Open Heart Surgery Requires Long CPB
  – “Pump Head”
• All Open Heart Surgery Results in Bleeding
  – Need to be “given other peoples blood”
• Surgery Requires “months to recover”
Partial Sternotomy

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Outcomes of Minimally Invasive Valve Surgery: Personal Experience in a Teaching Program

208 consecutive Partial Sternotomy
103 aortic root replacements
105 AVR (18 Direct Aortic TAVR)

No sternal dehiscence
No mortality
No re-operation for bleeding

Average length of hospital stay 5.2 days
Average Cross-Clamp for AVR: 31 min
Average Cross-Clamp for VSRR: 102 minutes
Six Weeks Post-Op
Thoughts on Valve-in-Valve Rescue
70-year-old female with symptomatic severe AS (AVA 0.6cm², mean gradient 46mmHg, PV 4.3m/s). PMHx included HLD, DM, Prosthetic valve AS/AI. She is S/P AVR with an 21mm Edwards pericardial valve at 55 years-old Surgical Evaluation deemed patient high risk due to prior surgery and frailty.

**STS Score:** 5.33%

**Physical Exam:**

Constitutional: Frail appearing female who looks her stated age

HEENT: no signs of connective tissue disease

Sternum: Prior incision

Lungs: Rales at bases B/L

Heart; S1, S2 3/6 SEM

Abd: soft NT/ND +BS

Ext: +pedal edema
Left Subclavian Access
Device Placement (23mm Corevalve)
Can valve be repaired?  
Yes → Should it be repaired?  
Yes → Repair  
No → Future TAVR?  
Yes → Biological  
No → Mechanical  

Yes → Primary leaflet repair  
Valve sparing root  
Valve or BioRoot  
Ross Procedure
Thoughts on the Present

• Repair at any age When Repair is a Viable Option
  – Non-Thrombogenic Curative Surgery
  – Minimal Access Approach should be standard of care
  – Can be performed safely and reproducibly
  – Patients are appreciative of repair

• For Pure AI, the Ross Procedure is Rarely Indicated
  – Reasonable for endocarditis
  – Best Indication is Bicuspid AS
    • Metalloprotease issues in Autograft
Thoughts on Aortic MIS

• Minimally invasive AVR is feasible in most patients
  – Hemi- sternotomy and thoracotomy both options
  – Results appear to be superior to sternotomy

• Aortic Valve Repair can be performed by MIS
  – Inverted T gives equivalent exposure
  – Earlier Return to Function
  – Patients prefer smaller incision

• The Ross is feasible through partial sternotomy
Thoughts on the Future

• TAVR
  – Easily Implanted with Excellent Results
  – Will soon Supplant SAVR as treatment of choice for intermediate risk patients
  – Necessary to Educate Surgeons about valve size

• Mechanical valves are rapidly approaching extinction in US

• Patients under 50 years of age
  – Bio-prosthetic valve via sternal sparing approach
  – Valve-in-Valve rescue paradigm after deterioration
Thank You