ROSS PROCEDURE FOR AORTIC VALVE SURGERY

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- The Center was founded in 2008
- South region and North-Caucasus region
- 16,000,000 inhabitants
- 5100 cardiovascular procedures per year
- 2500 “open heart” operations per year

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Peculiarities of the region

• There were no cardiac surgery

• Far located districts

• Poor primary health care

• Impossibility of adequate INR control
“Gold-Standard” Substitute

Advantages

Limitations
Most surgeons have a clear preference for a particular prosthesis in young adult patients, and only a handful of surgeons are experienced with the Ross procedure.
Why the Ross procedure?

• Patient’s own living valve
• Superior hemodynamic characteristics of “neoaortic” valve
• Low rate of valve-related events (thrombogenicity, bleeding)
• Low risk of endocarditis
• Avoidance of anticoagulant therapy
• High Quality of Life!
• Potential growth of the autograft in children
Ross procedure: Unsolved problems

- Technically demanding operation
- Limited durability of the autograft and the valve substitute of pulmonary artery RVOT
- Risk of autograft reoperation and RVOT reintervention for valve deterioration (including minimally invasive technologies)
<table>
<thead>
<tr>
<th>Authors</th>
<th>n</th>
<th>Hospital mortality</th>
<th>Follow-up</th>
<th>Survival</th>
<th>Freedom from Valve-related Events</th>
<th>Reoperation</th>
<th>Autograft Failure</th>
<th>Pulmonary insufficiency/stenosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tirone E. David et al., Canada,</strong></td>
<td>212</td>
<td>0,5%</td>
<td>15 years</td>
<td>96.6±1.5%</td>
<td>87.0±2.8%</td>
<td>93.0±2.2%</td>
<td>90±3%</td>
<td>88.8±2.6%</td>
</tr>
<tr>
<td>Manuel Concha et al, Spain</td>
<td>169</td>
<td>2.36%</td>
<td>36.08 ± 31.09 months</td>
<td>95.99 ± 1.65%</td>
<td>92.4 ± 2.55%</td>
<td>95.6%</td>
<td>94.07%</td>
<td></td>
</tr>
<tr>
<td>Loes M.A. Klieverik, The Netherlands</td>
<td>146</td>
<td>2.7%</td>
<td>13 years</td>
<td>94 ± 2%</td>
<td>A 69±7% P 87±5%</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>John W. Brown, USA</strong></td>
<td>212</td>
<td>1%</td>
<td>7.9 ± 4.2 years</td>
<td>98% per 15 years</td>
<td>87%</td>
<td>89%</td>
<td>96%</td>
<td></td>
</tr>
<tr>
<td><strong>Ronald C. Elkins, Oklahoma City, USA</strong></td>
<td>487</td>
<td>3.9%</td>
<td>16 years</td>
<td>82 ± 6%</td>
<td>63 ± 6% P 82 ± 4%</td>
<td>74% ± 5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Laurent de Kerchove, Belgium</strong></td>
<td>218</td>
<td>94 ± 44 months</td>
<td>94 ± 4% per 10 years</td>
<td>A 81 ± 10%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Roberto R. Favalaro, Argentina</strong></td>
<td>249</td>
<td>3.3%</td>
<td>92% per 12 years</td>
<td>85% Endocarditis free 99%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Jürgen O. Böhm, Germany</strong></td>
<td>467</td>
<td>0.6%</td>
<td>11 years</td>
<td>94.4% 2.9% per 10 years</td>
<td>85.9% ± 6.3%</td>
<td>94.2 ± 2.8%</td>
<td>79.3 ± 7.3%</td>
<td></td>
</tr>
</tbody>
</table>
Long-term outcomes after autograft versus homograft aortic root replacement in adults with aortic valve disease: a randomised controlled trial

Ismail El-Hamamsy MD a b, Zeynep Eryigit MD b d, Louis-Mathieu Stevens MD c, Zubair Sarang BSc b, Robert George MD a b, Lucy Clark PhD b, Giovanni Melina MD a, Johanna JM Takkenberg MD d, Prof Magdi H Yacoub

Findings 228 patients were randomly assigned to receive an autograft or a homograft aortic root replacement. 12 patients were excluded because they were younger than 18 years; 108 in each group received the surgery they were assigned to and were analysed. There was one (<1%) perioperative death in the autograft group versus three (3%) in the homograft group (p=0.621). At 10 years, four patients died in the autograft group versus 15 in the homograft group. Actuarial survival at 10 years was 97% (SD 2) in the autograft group versus 83% (4) in the homograft group. Hazard ratio for death in the homograft group was 4.61 (95% CI 1.71—16.03; p=0.0060). Survival of patients in the autograft group was similar to that in an age-matched and sex-matched British population (96%).

Interpretation Our findings support the hypothesis that a living valve implanted in the aortic position can significantly improve the long-term outcomes in patients.
# The Ross Procedure: Outcomes at 20 Years

## Table 1: Freedom from morbid events after the Ross procedure

<table>
<thead>
<tr>
<th>Variable</th>
<th>10 years (95% CI)</th>
<th>15 years (95% CI)</th>
<th>20 years (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause mortality</td>
<td>97.5% (94.0 - 98.9)</td>
<td>93.6% (88.1 - 96.6)</td>
<td>93.6% (88.1 - 96.6)</td>
</tr>
<tr>
<td>Reoperation on the aortic valve</td>
<td>96.5% (93.2 - 97.7)</td>
<td>93.0% (87.5 - 95.9)</td>
<td>91.8% (82.2 - 94.8)</td>
</tr>
<tr>
<td>Aortic insufficiency</td>
<td>90.3% (85.2 - 93.7)</td>
<td>88.7% (83.1 - 92.6)</td>
<td>62.6% (28.6 - 89.3)</td>
</tr>
<tr>
<td>Pulmonary valve dysfunction</td>
<td>88.6% (83.1 - 92.3)</td>
<td>81.3% (73.9 - 86.8)</td>
<td>75.8% (64.2 - 84.0)</td>
</tr>
</tbody>
</table>

**Conclusions** – Patients who had the Ross procedure experienced excellent 20-year survival. Preoperative AI or mixed lesions and aortic annulus >27mm are associated with increased risk of failure of the pulmonary autograft.

Tirone E. David et al.  
AATS 93rd Annual Meeting 2013, Minneapolis, MN, USA
Guidelines on the management of valvular heart disease (version 2012)

The Joint Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

The transfer of the pulmonary autograft in the aortic position (Ross procedure) provides excellent haemodynamics but requires expertise and has several disadvantages: the risk of early stenosis of the pulmonary homograft, the risk of recurrence of AR due to subsequent dilatation of the native aortic root or the pulmonary autograft itself when used as a mini-root repair, and the risk of rheumatic involvement. Although the Ross operation is occasionally carried out in adults (professional athletes or women contemplating pregnancy), its main advantage is in children, as the valve and new aortic annulus appear to grow with the child, which is not the case with homografts. Potential candidates for a Ross procedure should be referred to centres that are experienced and successful in performing this operation.
Ross procedure: Indications?

Aortic Valve and Ascending Aorta Guidelines for Management and Quality Measures: Executive Summary

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The Society of Thoracic Surgeons Clinical Practice Guidelines are intended to assist physicians and other health care providers in clinical decision making by describing a range of generally acceptable approaches for the diagnosis, management, or prevention of specific diseases or conditions. These guidelines should not be considered inclusive of all proper methods of care or exclusive of other methods of care reasonably directed at obtaining the same results. Moreover, these guidelines are subject to change over time, without notice. The ultimate judgment regarding the care of a particular patient must be made by the physician in light of the individual circumstances presented by the patient.
Aortic Valve and Ascending Aorta Guidelines for Management and Quality Measures: Executive Summary

18. Pulmonary Autograft (Ross Procedure)— Recommendations

Class I
1. The Ross procedure is recommended in infants and small children for whom no satisfactory alternative valve substitute exists. (Level of evidence C)

Class IIb
1. The Ross procedure may be considered in older children and young adults because of low operative risk, but patients and their families must be informed of the possible need for reoperation which increases over time. (Level of evidence C)

Class III
1. The Ross procedure is not recommended for middle-aged or older adults when suitable alternatives to autograft replacement of the aortic valve are available with comparable results and without the need for replacement of the right ventricular outflow tract, because the latter adds the additional risk of pulmonary valve dysfunction and subsequent replacement. (Level of evidence C)
2. The Ross procedure is not recommended for patients with bicuspid valves and AR or aortic dilation if other alternatives are available. (Level of evidence C)

Aortic Valve Surgery in Astrakhan
FCCVS 2009-2012

Ross Procedure
- n=102 (15 children)
- Male – 71 (70%)
- Mean age 32.6±12.5 years
  (range 8-57)

Aortic Valve Replacement
- n=186
- Male – 107 (58%)
- Mean age 58.5±8.6 years
  (range 30-76)
Age distribution

AVR (n=186)
Mean age 58.5 ± 8.6 (range 30.8 - 76.3)

Ross procedure (n=102)
Mean age 32.6 ± 12.5 (range 8.1 - 57)

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ROSS PROCEDURE
Indications for Ross Procedure in Adults

- Infectious endocarditis
- Avoidance of anticoagulant therapy
- Young patient with active life-style
- Women which are planning pregnancy after surgery
- Impossibility of adequate INR control
Patient: Ross procedure

- n-102 (15 children)
- Male – 71 (70%)
- Mean age 32.6±12.5 years (range 8-57)

Causes of valvular disease:
- Congenital: 46%
- Connective tissue: 29%
- Rheumatic: 15%
- Endocarditis: 9%
- Other: 1%
Patient: Ross procedure

- Hemodynamic manifestation
  - Stenosis – 31 (30,4%)
  - Regurgitation – 52 (51,0%)
  - Mixed – 19 (18,6%)
Operative technique: Ross procedure

- Full Root Replacement technique
- Fresh pulmonary homograft for RVOT reconstruction
- Mild systemic hypothermia (32°C)
- Cold cardioplegia by Custodiol® solution
- Interrupted 4/0 simple sutures for proximal anastomosis
- Reinforcing of “neoaortic” annulus by prosthetic strip in case of aortic annulus dilatation
- Pre- and postoperative TEE in the operating room
Kind of surgery

Ross Procedure alone – 84 (82.4%)

Concomitant procedures – 18 (17.6%)
- RP + MV Replacement – 3 (2.94%)
- RP + MV Repair – 6 (5.88%)
- RP + ASD – 1 (0.98%)
- RP + CABG – 3 (2.94%)
- RP + Ascending Aorta Replacement – 2 (1.96%)
- Other combinations – 3 (2.94%)
Ross Procedure: Operative data

- Time of operation 245 ± 82 min
- CPB time 148,3 ± 34,4 min
- Cross-clamp time 120,6 ± 22 min
Complications Ross procedure

• Bleeding (reoperation) – 5 (4.9%)
• CABG for ischemia (proximal RCA deformation) after Ross procedure – 2 (1.96%)
• Acute heart failure (ECMO) – 2 (1.96%)
• Pacemaker implantation – 1 (0.98%)
• Multiorgan insufficiency – 2 (1.96%)
• Wound infection – 1 (0.98%)

30-day mortality – 1 (0.98%)
Follow-up: Ross procedure

- Follow-up completeness – 66.7% (68 patients)
- Follow-up duration – 12±6 (range 1 to 35) month

Major events during follow-up:
- Late death – 1 (0.98%) (Alcohol abuse disease)

Peak autograft gradient – 5.9 ± 2.4 (range 2 to 13) mm Hg
Peak homograft gradient – 7.4 ± 4.3 (range 6 to 14) mm Hg

Survival – 98%
Freedom from reintervention – 100%
Results: Ross Procedure

Hospital Period:
• 30-day mortality – 1 (0,98%)
• Morbidity – 13 (12,7%)

Follow-Up:
  Survival 98%
  - Freedom from reintervention – 100%
  - Freedom from recurrence endocarditis and valve-related events – 100%
  - Favourable hemodynamic characteristics
AORTIC VALVE REPLACEMENT
AVR: Patients

- n-186
- Male – 107 (58%)
- Mean age 58.5 ± 8.6 years (range 30-76)
AVR: Operative technique

• Midline sternotomy
• Standard CPB with bi-caval or two-staged venous cannulation
• Normothermia
• Cold cardioplegia by Custodiol solution (2000ml)
• Multiple mattressed sutures 2/0
• Biological or mechanical prothesis
AVR: Operative data

• Time of operation 179±42 min
• Cardiopulmonary bypass time 106,2±32,7 min
• Cross-clamp time 77±25,5 min
AVR: Complications

- Bleeding (reoperation) – 8
- Necessity of CABG – 1
- Pacemaker implantation – 8
- Multiorgan insufficiency – 2
- Acute renal failure (dialysis) - 4
- Stroke – 3
- Acute heart failure – 1
- Paravalvular leakage – 1
- Deep wound infection – 2

- 30-day mortality – 2 (1.1%)
Follow-up: AVR

- Follow-up completeness 63.9% (119 patients)
- Follow-up duration – 13.2±5.5 (range 2 to 38) month

Major events during follow-up:
- Aortic valve thrombosis – 3 (1.61%)
- Stroke – 1 (0.5%)
- Gastrointestinal bleeding – 1 (0.5%)
- Ablation due to Atrial flutter – 1 (0.5%)

Late death – 2 (1.1%) (Acute MI and Unknown)

Survival – 97.8%
Results: AVR

- 30-day mortality – 1.1%
- Morbidity – 30 (16.1%)

Follow-up results:
- Survival 97.8%
- Freedom from recurrence endocarditis – 100%
- Freedom from valve-related events – 95.4%
Conclusion

• Results from this study showed good outcomes in both groups.
• Significant difference in age disabled to make comparison of the groups.
• The Ross procedure can be performed with acceptable early- and short-term results with low mortality in children and young adults.
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FOR YOUR ATTENTION!
Welcome to Astrakhan!