AORTIC VALVE SPARING OPERATION: TECHINQUE AND LONG TERM RESULTS

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The concept that aortic insufficiency can occur in patients with normal aortic cusps is not new but...
...for many years we have been replacing a normal valve and preserving a diseased tissue!
Pathology of the aortic root

With diseased cusps

Composite root replacement (Bentall)

With normal cusps

1983 remodeling
1992 reimplantation

Valve-sparing procedure
How to assess aortic valve reparaibility?

Use of a standardized functional classification is important because it will assist in the interpretation of TEE studies with specific reference to anatomical lesions and description of the pathology, but also in identifying optimal candidates for surgical repair.
Concept of functional anatomy

*the native stent*

- Functional aortic annulus (FAA) = annulus + STJ
- Valve Leaflets
- Sinus of Valsalva
# Functional classification (G. El Khouri)

<table>
<thead>
<tr>
<th>Functional type</th>
<th>Lesions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>1a: ST junction dilation</td>
</tr>
<tr>
<td>normal cusp motion</td>
<td>1b: ST junction + sinuses dilation</td>
</tr>
<tr>
<td></td>
<td>FAA</td>
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<tr>
<td></td>
<td>1c: annular dilation</td>
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<tr>
<td></td>
<td>1d: cuspal defect</td>
</tr>
<tr>
<td>Type 2</td>
<td>Excess of cuspal tissue</td>
</tr>
<tr>
<td>cusp prolapse</td>
<td>Commissure flailed or distorted</td>
</tr>
<tr>
<td>Type 3</td>
<td>Fibrous thickening</td>
</tr>
<tr>
<td>restricted cusp motion</td>
<td>Calcifications</td>
</tr>
</tbody>
</table>
Causes of aortic regurgitation (with normal leaflets)

- FAA pathology (dilatation)
Type Ia (ST dilatation)
Type Ia (ST dilatation)

Dilatazione giunzione ST
Type Ic (annular dilatation)
Type Ic (annular dilatation)

Dilatazione anulare
Sub-commissural annuloplasty
Type Ib (aneurism of the root and sinuses)
Tipo Ib (aneurisma radice e seni di Valsalva)

Aneurisma seni di Valsalva

DX: 69%
NC: 26%
SX: 5%
VALVE-SPARING OPERATIONS
Global root dilatation

Remodeling

Reimplantation

Circulation 1983;68(Suppl):III321

The choice of valve sparing procedure “REIMPLANTATION”

- Annulus stabilization
- Support of the aortic wall
- Less risk of suture bleeding
- Long-term results
Leyh RG et al. Circulation 1999;100:2153-2160
Modifications of the reimplantation for a better root reconstruction

Cochran 1995
David V 2003
Stanford mod. 2004
Lansac 2005
Gleason 2005
Hess 2005
Takamoto 2006
Rama 2007
“T. David IV” (2001)

1. Oversize: 38 mm graft

2. Plicate the ST junction
1. Oversize: 38 mm graft

2. Pinch down the annulus: 25 mm valve-sizer

3. Plicate the ST junction
“T. David V” or Miller I (2004)
The Valsalva graft

February 2000: 1st use in a **Bentall** procedure
March 2000: 1st use in a **Remodeling** procedure
May 2000: 1st use in a **Reimplantation** procedure
Anatomical design

Two fixed rings: the skeleton of the root

An expandable portion: the pseudosinuses
Anatomical comparison over other surgical approach

Standard straight graft

Arched commissures

Valsalva graft
Simple reconstruction of three independent sinuses
SURGICAL APPROACH
1. Accurate root dissection
2. Testing the leaflets
3. Conduit sizing

Size the annulus then add 5 mm to choose the conduit optimal size (e.g. for a 25 mm choose a 30 mm Valsalva graft)
4. Placing the first row of sutures

Following the crescent shape of the annulus
5. Preparing the selected graft
6. Measuring the commissures

Lenght of commissures = 25 mm
After choosing the proper conduit size just adapt the patient’s valve to the skirt of the graft.
How to adapt the selected graft?

Height of aortic commissures < length of skirt

Height of aortic commissures = length of skirt
7. Matching with the Valsalva graft
8. Placing the sutures on the graft
9. Parachuting the graft down
10. Suturing the valve remnants to the Valsalva graft

Attaching the commissures at the level of the new ST junctio
11. Coronary ostia preparation
For a long-lasting aortic leaflet function

- Maintain or reconstruct the sinuses
  - Natural shape of the sinuses
  - Normal proportion of the components
  - Large leaflet coaptation

- Elasticity of the wall
Angiographic and MRI results

Optimal proportion of the various root components
Echocardiographic postop. findings

Perfect sinus shape and optimal sinus-leaflet assembly

ST junction re-established

Individual Sinus expansion
Measure of stress at the coronary ostia anastomoses

LONG-TERM RESULTS
# Reimplantation long-term results

<table>
<thead>
<tr>
<th>Study</th>
<th>No. pts</th>
<th>Mortality</th>
<th>Freedom from AI &gt;2</th>
<th>Freedom from AVR</th>
<th>Survival (follow-up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>David et al. 2007</td>
<td>167</td>
<td>1.2%</td>
<td>94±4%</td>
<td>95±4%</td>
<td>92±3% (10 y)</td>
</tr>
<tr>
<td>(38% Marfan)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Kallenbach et al. 2005</td>
<td>284</td>
<td>3.2%</td>
<td>/</td>
<td>87.1±4.5%</td>
<td>80±5.7% (10 y)</td>
</tr>
<tr>
<td>(19% Marfan)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>David et al. 2009</td>
<td>103</td>
<td>1%</td>
<td>94.7±5%</td>
<td>87.6±7.7%</td>
<td>87.2% (15 y)</td>
</tr>
<tr>
<td>Marfan</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Patel et al. 2008</td>
<td>children</td>
<td></td>
<td>100 %</td>
<td></td>
<td>4.5 y</td>
</tr>
</tbody>
</table>

Patel et al., 2008; Marfan
Patients and methods

From May 2000 to September 2010

278 consecutive patients

(55.6 ± 14.7 years)

European Hospital, Rome
Tor Vergata University, Rome
Bologna University, Bologna
Institute Humanitas, Milan
Preoperative data

**ROOT PATHOLOGY**
- Aortic root aneurysm: 52% (144 pts)
- Type A acute dissection: 5% (13 pts)

**ASSOCIATED PATHOLOGY**
- Marfan: 15% (42 pts)
- Bicuspid valve: 11% (31 pts)
**Preoperative data**

- **Root diameter**: 48.9 ± 8.2 mm
- **Average EF**: 58 ± 8%
- **NYHA I or II**: 80% pts

![Degree of aortic regurgitation](attachment:image.png)
Operative data

- Additional cusp repair: 9% (25 pts)
- Concomitant procedure: 28% (78 pts)
- Average graft size: 30 ± 2 mm
- X-clamp time: 120 ± 27 min (range 67 to 271)
- CPB time: 144 ± 38 min (range 90 to 373)
## Results

### Operative mortality 30 days

<table>
<thead>
<tr>
<th>Cause</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiorgan Failure</td>
<td>2 pts</td>
</tr>
<tr>
<td>Cardiac Failure</td>
<td>2 pts</td>
</tr>
<tr>
<td>Intestinal Ischemia</td>
<td>1 pts</td>
</tr>
</tbody>
</table>

5 pts (1.8%)

(3 with type A aortic dissection)
Results
Late mortality

Average follow-up  52 ± 28 (2 to 112 months)

5 pts (1.8%)
- Stroke 1 pt
- Heart Failure 1 pt
- Pulmonary Embolism 1 pt
- Cancer 2 pts
Overall survival

Acute aortic dissection predicted mortality
HR=2.1; p=0.003
Freedom from AVR

Reoperations 17 patients: mean 27.3 ± 23.6 months (range 3-78)
Freedom from AVR

Additional cusp repair predicted the need for AVR
HR=1.67; p=0.0036
Freedom from residual AI

No factors were found predictive of residual AI

There was a tendency toward a lower incidence of residual AI in the last 5 years of experience (7% vs. 14%)
Freedom from adverse events (AVR or residual AI) in patients with good or imperfect results

![Graph showing actuarial freedom (%) over duration of follow-up (years)]

- **AI ≤ 1**
- **AI ≥ 2**
- **P = 0.001**

Patients at risk:
- 213
- 115
- 22

Duration of follow-up (years):
- 0.00
- 5.00
- 10.00
Conclusions

- The operation is safe and carries a low mortality
- The operation works equally well in Marfans or in patients with bicuspid valves
- Patients should not leave the OR with > 1 residual AI
Conclusions

- Additional leaflet plasty might require an increased experience

- The operation can be standardized and easily reproduced by an increased number of surgeons

- A perfect root reconstruction is likely to positively influence a longer follow-up