Extra-anatomic Bypass for Complex Aortic Arch Obstruction

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AATS
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Disclosure

Mayo Clinic Division of Cardiovascular Surgery

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CryoLife

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Medtronic
St. Jude Medical
Thoratec Corporation
TransTech Pharma
W.L. Gore and Associates

No personal equity, patents, licensing, or consulting agreements with the medical device or pharmaceutical industry to disclose
Freedom from reoperation (%) vs. Follow-up (yr) for Coarctation Repair (n=819).

Burkhart, Connolly et al, ACC 2009
Freedom from reintervention on the descending aorta (%)

Follow-up (yr)

- End-end
- Bypass graft
- Interposition graft
- Patch
- Subclavian flap or other

P<0.001

Repair type

Follow-up (yr)

- 616 516 422 344 270 210
- 30 19 14 12 9 5
- 49 30 24 19 13 7
- 72 31 19 9 5 3
- 35 26 20 13 10 4

Burkhart, Connolly et al, ACC 2009
Freedom from reintervention on the descending aorta (%)

Follow-up (yr)

Age
- ≤1
- 2-5
- 6-10
- 11-20
- ≥21

P<0.001

<table>
<thead>
<tr>
<th>Follow-up (yr)</th>
<th>≤1</th>
<th>2-5</th>
<th>6-10</th>
<th>11-20</th>
<th>≥21</th>
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<tbody>
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<td>0</td>
<td>114</td>
<td>75</td>
<td>122</td>
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<td>84</td>
<td>56</td>
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<tr>
<td>30</td>
<td>11</td>
<td>10</td>
<td>16</td>
<td>47</td>
<td>60</td>
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</table>
Reoarctation Intervention

Indications

- Gradient $\geq 20$ mmHg with HTN, LVH or exercise related HTN
  - Underestimated with collaterals
- $\geq 50\%$ narrowing of the aorta vs diaphragm
- Severe AS or AR
- Ascending or descending aneurysm
Aortic Recoarctation
Management - Intervention

Angioplasty ± stent preferred
Recurrent Coarctation Surgical Intervention

- Arch hypoplasia/involvement
- Long segment coarctation
- Calcified
- Aneurysmal disease
- Concomitant cardiac disease
- Cath intervention unsuitable
Recurrent Coarctation
Surgical Options

- Resection, interposition graft
- Patch aortoplasty
- Extra-anatomic bypass
- Re-resection, end-to-end anastomosis
- Subclavian flap angioplasty
Reintervention after Coarctation

n=130

Mean age (y) 32 ± 24
Female (%) 28
Mean interval to reintervention (y) 17 ± 13
Asymptomatic presentation 58%
HTN 74%
Recoarctation 92%

Brown, Burkhart et al, AHA 2009
## Reintervention after Coarctation Sx

Surgery 73%, Endo 27%

<table>
<thead>
<tr>
<th>Procedure</th>
<th>N</th>
<th>%</th>
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<tbody>
<tr>
<td>Thoracotomy</td>
<td>52</td>
<td>55</td>
</tr>
<tr>
<td>CPB</td>
<td>52</td>
<td>55</td>
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<td><strong>Operative procedures</strong></td>
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<td></td>
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<tr>
<td>Extra-anatomic conduit</td>
<td>41</td>
<td>43</td>
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<tr>
<td>Patch repair</td>
<td>32</td>
<td>37</td>
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<tr>
<td>Balloon</td>
<td>22</td>
<td>63</td>
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<tr>
<td>Stent</td>
<td>13</td>
<td>37</td>
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</tbody>
</table>
Ascending Descending Bypass

Indications

- Complex coarctation
- Complex aneurysmal disease
- Concomitant cardiac pathology

Connolly, Circ. 2001
Izhar, Ann Thorac Surg 2000
Intermediate-term results of ascending–descending posterior pericardial bypass of complex aortic coarctation

Stephen H. McKellar, MD, a,b Hartzell V. Schaff, MD, b Joseph A. Dearani, MD, b Richard C. Daly, MD, b Charles J. Mullany, MBMS, b Thomas A. Orszulak, MD, b Thoralf M. Sundt III, MD, b Heidi M. Connolly, MD, c Carole A. Wannes, MD, c and Francisco J. Puga, MD b

Experience 1985-2005
• 53 pt
• Mean age 42 yr (15-75)

% Male 54
Preoperative HTN 94
Previous operations 66
**Ascending Descending Bypass**

**Concomitant Operations n=28**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>AVR</td>
<td>28%</td>
</tr>
<tr>
<td>Aneurysm repair</td>
<td>15%</td>
</tr>
<tr>
<td>CABG</td>
<td>15%</td>
</tr>
<tr>
<td>Septal myectomy</td>
<td>15%</td>
</tr>
<tr>
<td>MV replace/repair</td>
<td>8%</td>
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</table>

**Operative Mortality 0%**
Ascending Descending Bypass

- Median sternotomy
- Bicaval cannulation
- LV vent
- Rt pleural space
- TEE
- Femoral art line
Ascending Descending Bypass

- Limit AoCx
- Pericardium interposed
- 18-20 mm Hemashield
SURGICAL RECORD
MAYO CLINIC — ROCHESTER, MINNESOTA

No. .........................................................................................................................
Age...5 weeks M...Section...Kennedy...Date...1956

Name......................................................................................................................
Address.................................................................................................................

OLDEHAM, SOUTH DAKOTA

Name of Dr. W.H. Patt Dr’s. Address..................................................Brookings, South Dakota

Not Referred Accompanied Patient Sends Letter to.................................Referred Only Wishes to be notified date of operation

Name of Relative: Father: Patient accompanied by: parents

Operation advised by, Consultant Medical Mills Surgical Consultant Kirklin

Preoperative Diagnosis..........................................................................................

COARCTATION OF THE AORTA

Operation Indicated..................................................REPAIR..........................Meth. 5B1

Date opr. 8-11-56 Opr. Room I-1 Sur. Kirklin 1st Harshbarger 2nd Phalen


Oper. Diag.: Coarctation of the aorta with cardiac failure in infancy.
Oper.: Resection of coarctate area; end-to-end anastomosis.
Institution of temporary closed intercostal drainage.
Transfusion of 90 c.c. of blood.

Drainage 1 No. 18 catheter.

Add. cond. to index:
Detail: Skin antiseptic: ether and merthiolate.

A primary posterolateral incision was made on the left entering the chest through the fourth interspace. There were already at this young age, definite enlarged collaterals. There were no thrills over the base of the heart which was very large. The mediastinal pleura was incised over the coarctate area. The distal aortic arch, left subclavian artery, coarctate area and upper 3 cm. of thoracic aorta were dissected out. There was a typical coarctation of the aorta at the level of the attachment of the ligamentum arteriosum which was closed. It was about 5 mm. distal to the take-off of the left subclavian artery. The aorta proximal to the stricture was of normal size. There was poststenotic dilatation of the distal aorta. The ligamentum arteriosum was ligated and divided. Appropriate fine tooth clamps were placed without sacrificing any intercostal arteries. The coarctate area was excised and an end-to-end anastomosis made with one row of interrupted everting and simple mattress sutures of 0000 silk. The anastomosis was the size of the aortic arch measuring approximately 4 to 5 mm. in diameter. There was an excellent pulsatile flow into the distal aorta and I think the patient should have a good result. The mediastinal pleura was loosely closed. The
Recurrent Aortic Coarctation

51 yr male

- Shortness of breath
- Decreases exercise capacity
- PMHx: Coarctation repair 1956 (Kirklin)
- Echo: bicuspid AoV
calcified cusps
moderate stenosis (1.3 cm²)
moderate regurgitation
Ascending Descending Bypass
Extra-anatomic Bypass

- 17 YOWM
- Severe HTN
- Intestinal angina
- PSH: Left subclavian flap/coarctation repair age 4, angioplasty of aorta age 7
- Meds: Labetalol 400 mg tid, Spironolactone/HCTZ 25/25 mg bid, Digoxin 0.125 mg qd, Nexium 40mg qd
Chest MRI/MRA
Extra-anatomic Bypass
Extra-anatomic Bypass
Extra-anatomic Bypass

Summary

• Long-term reoperation for coarctation is significant
• Extra-anatomic bypass safe and reproducible
• Extended to more complex procedures
  • Abdominal aorta bypass
  • Valve sparing root
Coarctation Repair (n=819)

Survival (%)

Follow-up (yr)

P<0.001

- All patients
- Age and gender matched

Burkhart, Connolly et al, ACC 2009