Antegrade Delivery of a Stent-Graft into the Descending Aorta During Open Repair of a Type A Aortic Dissection With Arch Involvement: A “Frozen Elephant Trunk”: How To Do It

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Disclosure

Medtronic, Inc PI Clinical Trials, Consultant
Vascutek Terumo Consultant, Royalties Coselli branched graft
WL Gore & Associates PI Clinical Trials, Consultant

Acute Aortic Dissection

The most common catastrophic event involving the aorta
3 cases per 100,000 patients
10,000 cases in US each year
IRAD open surg 24% mort

Klompas 2002 JAMA;287:2262-2272.
Acute DeBakey I Aortic Dissection

**Traditional Approach**

- Emergent open aortic repair
- Graft replacement of ascending aorta/proximal arch (hemiarch)
- Suspend, repair, spare, or replace aortic valve as needed
- **Limited repair of aortic arch in DeBakey Type I Dissection**

Substantial Differences in “Type A” DeBakey I vs DeBakey II Aortic Dissection

**GERAADA**

German Registry for Acute Aortic Dissection Type A

<table>
<thead>
<tr>
<th>Type of Proximal Dissection</th>
<th>30-day Death %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall “Type A” dissection</td>
<td>17%</td>
</tr>
<tr>
<td>DeBakey I (extensive with arch)</td>
<td>24%</td>
</tr>
<tr>
<td>DeBakey II (limited to ascending)</td>
<td>14%</td>
</tr>
</tbody>
</table>

Presented at the AATS Aortic Symposium 2014
Matthias Karck
GERAADA: Results and Implications 2006-2010 2137 patients

Metabolic Demands of the Brain

- **BRAIN IS 2% BODY WEIGHT**
- 15% CARDIAC OUTPUT
- CONSUMES 20% TOTAL BODY OXYGEN
- 25% OF BODY GLUCOSE

Survival After Type A Dissection

- **Patent**
- Partly thrombosed
- Thrombosed

P = 0.001
Hazard Risk 15.2

Fattouch Ann Thorac Surg 2009
Should We Do More?

**Total Arch**

**Hemi Arch + Frozen Elephant Trunk**

**Total Arch + Frozen Elephant Trunk**

- Extend repair beyond total arch + elephant trunk?
- Increased short-term risk of death?
- Acute malperfusion?
- Long-term risk of distal growth?
- Paraplegia?
- Increased late survival?

**FET: EVITA Multicenter**

**Comparison of Pathology Postoperative Outcomes**

- **Early Death** 17.1%
- **STROKE** 11.8%
- **Spinal Cord Injury** 6.5%
Wire in true lumen
femoral artery or
antegrade
IVUS
TEE
Direct vision

Confirm position
• Direct vision
• IVUS
• TEE
• Endoscopy
Early death Repair in Acute Type A Aortic Dissection

Fleck 2002 8 1 (13%) Hemiarch + Antegrade Stent-graft
Failed delivery in 1 due to kink

Hemiarch + Open Antegrade TEVAR
Believed to be 1st such use of this approach in acute aortic dissection

Frozen Elephant Trunk
Acute DeBakey I Type Dissection

Pochettino 2009 n=36
Roselli 2013 n=17
Vallabhajosyula 2014 n=62

Frozen Elephant Trunk
Acute DeBakey Type I Dissection

Author Year publ. n Early mortality Stroke Paraparesis/ Paraplegia
Vallabhajosyula 2014 62 6 (10%) 3 (5%) 0 permanent
Roselli 2013 17 0 2 (12%) 2 (12%)
Pochettino 2009 36 5 (14%) 1 (3%) 3 (8%)

Overlap possible between Vallabhajosyula and Pochettino:
U Penn Approach Cleveland Clinic Approach
Alternate Approach to FET: Hemiarch + Open Antegrade TEVAR

- 87 patients underwent traditional repair
  - In-hospital mortality 14.9%
  - 30-day mortality 13.8%
- 25 patients underwent hemiarch + TEVAR
  - In-hospital mortality 12.0%
  - 30-day mortality 12%
  - $P = 1.0$ for both

Prior to distal anastomosis

Gore TAG
Gentle curve

Pledget 3.0 prolene

Pledget to stabilize and affix stent-graft

Relative contraindications: connective tissue disorders, young age

Alternate Approach to FET: Hemiarch + Open Antegrade TEVAR

- 87 patients underwent traditional repair (group A)
  - 24 with malperfusion
  - In 13, malperfusion resolved
  - 54.2%
- 25 patients underwent hemiarch + TEVAR (group B)
  - 19 with malperfusion
  - In 16, malperfusion resolved
  - 84.2%
  - $P = 0.037$
**Hemiarch + Antegrade Open TEVAR (n=44)**

### Preoperative characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years), median (IQR)</td>
<td>67 (55-72)</td>
</tr>
<tr>
<td>Male</td>
<td>32 (72.7%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>41 (93.2%)</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>18 (40.9%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>5 (11.4%)</td>
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</table>

### Operative characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Median (IQR)</th>
</tr>
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<tbody>
<tr>
<td>CPB time (minutes)</td>
<td>113 (95-134)</td>
</tr>
<tr>
<td>Cardiac ischemia time (minutes)</td>
<td>92 (73-118)</td>
</tr>
<tr>
<td>Circulatory arrest time (minutes)</td>
<td>41 (35-51)</td>
</tr>
</tbody>
</table>

### Outcome characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative (early) death</td>
<td>5 (11.4%)</td>
</tr>
<tr>
<td>30-day death</td>
<td>4 (9.1%)</td>
</tr>
<tr>
<td>Permanent stroke</td>
<td>3 (6.8%)</td>
</tr>
<tr>
<td>Permanent paraplegia/paraparesis</td>
<td>1 (2.3%)</td>
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</tbody>
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**Conclusions:**

**FET and Acute Type I Aortic Dissection**

- The frozen elephant trunk is an intriguing approach that is widely used in Europe.
- Hemiarch plus antegrade open TEVAR is a twist on the FET, there may be some.
- Long term data needed.

**Thank you!**