Another View of Current Optimal Treatment of Aortic Arch Aneurysms: Total Endovascular, Hybrid, Open and Frozen Elephant Trunk: Which is Best When

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Disclosure Statement

- PI/Co-PI for several thoracic and abdominal aortic stent graft trials (Cook, Inc., Cordis® Corporation, Bolton Medical)
- Proctor and participated as a lecturer at symposia hosted by Cook, Inc., Bolton, W.L. Gore and Associates, Jotec and Medtronic, Inc.

2019 European Guidelines on Aortic Arch Surgery

Current Options and Recommendations for the Treatment of Thoracic Aortic Pathologies Involving the Aortic Arch: An Expert Consensus Document of the European Association for Cardio-Thoracic Surgery (EACTS) & the European Society for Vascular Surgery (ESVS)

- Concomitant aortic valve pathology
- Patients at high risk for retrograde type A dissection (ascending aorta > 38mm, bicuspid valve, arch abnormalities, lost sinotubular junction, extensive ascending aortic length)
- Symptomatic patients with floating aortic arch thrombi

Open aortic arch repair may be considered:
- Symptomatic patients with extensive mural aortic arch thrombus

A) Open surgery: today

Mortality < 5%

A) Open surgery recommendations

Open aortic arch repair should be considered:
- Concomitant aortic valve pathology
- Patients at high risk for retrograde type A dissection (ascending aorta > 38mm, bicuspid valve, arch abnormalities, lost sinotubular junction, extensive ascending aortic length)

Open aortic arch repair may be considered:
- Symptomatic patients with floating aortic arch thrombi

Open aortic arch repair should be considered:
- Symptomatic patients with extensive mural aortic arch thrombus

<table>
<thead>
<tr>
<th>Year</th>
<th>n pts</th>
<th>Mortality</th>
<th>Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>520</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>2013</td>
<td>65</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>2014</td>
<td>2595</td>
<td>12%</td>
<td>15%</td>
</tr>
<tr>
<td>2015</td>
<td>62</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>2016</td>
<td>58</td>
<td>4%</td>
<td>7%</td>
</tr>
<tr>
<td>2017</td>
<td>248</td>
<td>2%</td>
<td>11%</td>
</tr>
<tr>
<td>2018</td>
<td>50</td>
<td>6%</td>
<td>10%</td>
</tr>
</tbody>
</table>
B) “Frozen” Elephant trunk

Evolution of OR for patients who will need treatment for downstream aortic pathology

San Raffaele custom-made E-vita (in collaboration with Jotec)

Supraortic vessels branch

3.5 cm

Reperfusion branch

B) FET recommendations

The FET technique should be considered:

- To close the primary entry tear in TAD in the distal aortic arch
- In TBD when TEVAR is contraindicated
- In patients with concomitant distal TAA or TAAA

Frozen Elephant Trunk results

2016-2019 (San Raffaele custom-made E-vita)

<table>
<thead>
<tr>
<th></th>
<th>N = 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality (30-d)</td>
<td>4 (10%)</td>
</tr>
<tr>
<td>Stroke</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Paraplegia</td>
<td>2 (5%)</td>
</tr>
<tr>
<td>Renal failure</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>3 (7%)</td>
</tr>
</tbody>
</table>

SAT debranching (beating heart, bilateral axillary perfusion)

Stent-graft insertion and distal anastomosis (via axillary vessels)

Distal reperfusion (via dedicated branch) and proximal anastomosis

SAT bypass reimplantation (on dedicated branch, off-pump)
C) Hybrid Arch Surgery

Surgical supra-aortic vessels rerouting
Stent-graft repair of aortic arch aneurysm

1999 – 2019: 263 cases

Zone 0  Zone 1  Zone 2
73 cases  51 cases  139 cases

30-d mortality
7% 4% 2% 3.8%

Stroke
4% 2% 3% 3.0%

Paraplegia
0 0 1.5% 0.8%

Total
73 cases  51 cases  139 cases  263 cases

Hybrid arch surgery: OSR experience

C) Hybrid Arch Surgery Recommendations

- TEVAR in zone 0 after previous debranching may be considered in unfit pts and suitable anatomy
- TEVAR is not recommended in pts with a proximal landing zone of length < 25mm or maximum diameter > 38mm
- Not recommended in connective tissue disord.

D) Chimneys / Periscopes

Gutters
D) Chimneys / Periscopes / MFM Recommendations

- The **parallel graft** technique:
  - Should be considered in urgent TEVAR
  - Not first option in routine cases if other strategies are available

The **multilayer technique** is not recommended for the treatment of any kind of aortic arch pathology.

E) “Arch Total Endo” with custom-made devices

Inner branch arch repair results

<table>
<thead>
<tr>
<th>2012-2017</th>
<th>N = 54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical success</td>
<td>53 (98%)</td>
</tr>
<tr>
<td>In-hospital mortality</td>
<td>4 (7.4%)</td>
</tr>
<tr>
<td>Cerebrovascular events</td>
<td>6 (11%)</td>
</tr>
<tr>
<td>- Major stroke</td>
<td>3 (5.5%)</td>
</tr>
<tr>
<td>- Minor stroke</td>
<td>3 (5.5%)</td>
</tr>
</tbody>
</table>


Arch total endo: OSR experience

8 cases (Cook A-branch)

In-hospital mortality 12% (1 case of cerebral hemorrhage)

Stroke 0%

E) Arch Branched Recommendations

- Total endovascular aortic arch repair should be considered in unfit pts and with a suitable anatomy
Conclusions

• Open surgery: acceptable results in fit patients with Frozen Elephant trunk
• Hybrid: good option in high / moderate risk patients
• Total endo: improving results in anatomically suitable patients (costs?)