SPINAL CORD ISCHEMIA AFTER THORACIC ANEURYSM REPAIR:
RISK STRATIFICATION & PREVENTION

DISCLOSURES

> INDIVIDUAL
None

> INSTITUTIONAL
Cook, Inc
W. L. Gore, Inc

SPINAL CORD ISCHEMIA

OPEN TAA(A) REPAIR
Intraoperative Adjuncts

- Oversew intercostals immediately
- Reimplant intercostals
- Hypogastric preservation
- Left subclavian artery preservation
- Shorten aortic crossclamp time
  - Sew fast
  - Crawford reimplantation technique
  - Left heart bypass/distal aortic perfusion
- Epidural cooling (4°C)
- CSF drainage
- Hemodynamic stability/permissive hypertension
- Neuromonitoring

Acher, J Vasc Surg, 2010

OPEN TAA(A) REPAIR

O/E ratio of SCI has declined from 1 to 0.25 or less (range 0.05—0.71) over last decade

- Spinal fluid drainage
- Hypothermia
- Induced/permissive hypertension
- Neuroprotection
  - Steroids
  - Naloxone
  - Barbiturates
- Dedicated/experienced team
- Protocol for patient management

Acher, J Vasc Surg, 2010
OPEN TAA(A) REPAIR

Most important factors for SCI

Table IV. Paraplegia factors

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crawford type 2 (Y)</td>
<td>12.45</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>SFDN (Y)</td>
<td>0.251</td>
<td>.0834</td>
</tr>
<tr>
<td>Caudal index (pre-angioplasty)</td>
<td>0.490</td>
<td>.0272</td>
</tr>
<tr>
<td>Acute (Y)</td>
<td>2.736</td>
<td>.0175</td>
</tr>
<tr>
<td>Dissection (Y)</td>
<td>4.567</td>
<td>.0012</td>
</tr>
</tbody>
</table>

OR, Odds ratio; SFDN, spinal fluid drainage; SFDN, and nulvencare.
*Higher caudal index and use of our spinal cord protection protocol were protective from paraplegia, whereas extent of replacement (Crawford type C1), dissection, and acute presentation were associated with increased paralytic risk.

Acher, J Vase Surg, 2010

OPEN TAA(A) REPAIR

Not important factors for SCI

- Age
- Renal function
- Aortic occlusion time
- Core temperature
- Intercostal reimplantation
  - Crawford type II and dissection

Acher, J Vase Surg, 2010

ENDOVASCULAR TAA REPAIR

Data Limitations

- Reports mix acuity
- Reports mix pathology
- TAAA results often included
- Outcomes for TAA alone not always presented

<table>
<thead>
<tr>
<th>YEAR</th>
<th>TEVAR/OPEN</th>
<th>PATHOLOGY</th>
<th>TEVAR</th>
<th>OPEN</th>
<th>P</th>
<th>COMMENT</th>
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</thead>
<tbody>
<tr>
<td>DTAA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bath</td>
<td>2007</td>
<td>207</td>
<td>DTAA</td>
<td>4.1%</td>
<td>Single center</td>
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<tr>
<td>Ultery</td>
<td>2011</td>
<td>287</td>
<td>DTAA</td>
<td>2.8%</td>
<td>Single center</td>
<td></td>
</tr>
<tr>
<td>DISSECTION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bath</td>
<td>2007</td>
<td>206</td>
<td>dissection</td>
<td>1.5%</td>
<td>EUROSTAR</td>
<td></td>
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<tr>
<td>Nienaber</td>
<td>INSTEAD</td>
<td>2009</td>
<td>72</td>
<td>dissection</td>
<td>2.8%</td>
<td>Prospective, Randomized, best med rx</td>
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<tr>
<td>Ultery</td>
<td>2011</td>
<td>80</td>
<td>dissection</td>
<td>5.0%</td>
<td>Single center</td>
<td></td>
</tr>
<tr>
<td>Lauhke</td>
<td>2010</td>
<td>1951</td>
<td>dissection</td>
<td>acute</td>
<td>4.9%</td>
<td>Meta-analysis</td>
</tr>
<tr>
<td>Thrumurthy</td>
<td>2011</td>
<td>567</td>
<td>dissection</td>
<td>0.4%</td>
<td>0.001 OR 0.26</td>
<td>review</td>
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</table>

UCSF Vascular & Endovascular Symposium 2012
TAA & SCI

UCSF Vascular & Endovascular Symposium 2012
TAA & SCI

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TAA & SCI

UCSF Vascular & Endovascular Symposium 2012
TAA & SCI
### Endovascular TAA Repair

#### Important factors for SCI

- **Length of aorta excluded**
  - Exclusion of distal thoracic aorta
  - $>20$ cm
  - $>25$ cm
  - $>30$ cm
  - $3-4$ stent grafts

- **Coverage of two collateral routes**
  - L subclavian coverage
  - Hypogastric coverage

- **Infrarenal aortic replacement**

- **History of prior aortic surgery**

#### Meta-analysis

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients</th>
<th>Distal Exclusion</th>
<th>Pathology</th>
<th>Operative</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>Tang 2008</td>
<td>370 / 329</td>
<td>&gt;20 cm, &gt;25 cm, &gt;30 cm</td>
<td>BAI</td>
<td>8% 5.6%</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Xenos 2011</td>
<td>121 / 875</td>
<td>All TA rupture</td>
<td>BAI</td>
<td>3.5% 1.6%</td>
<td>0.359</td>
</tr>
<tr>
<td>Xenos 2008</td>
<td>215 / 333</td>
<td>Trauma rupture</td>
<td>BAI</td>
<td>0.5% 6.6%</td>
<td>0.37</td>
</tr>
</tbody>
</table>

#### Adjuncts

- Oversew intercostals immediately
- Reimplant intercostals
- Hypogastric preservation
- Left subclavian artery preservation
- Shorten aortic crossclamp time
  - Sew fast
  - Crawford reimplantation technique
  - Left heart bypass / distal aortic perfusion
- Epidural cooling ($4^\circ C$)
- CSF drainage
- Hemodynamic stability / permissive hypertension
- Neuromonitoring
**ENDOVASCULAR TAA REPAIR**

**Adjuncts**

- Preserve collateral spinal cord perfusion
  - Carotid subclavian bypass
  - Hypogastric artery bypass (? Left more important)
- Hemodynamic stability / permissive hypertension
  - Reduce or stop antihypertensive medications preop
  - Stage procedures to avoid hypotension
  - Use pressors
  - Gradual reintroduction of antihypertensives over several weeks
- CSF drainage to effect, not to a specific pressure
  - Routine lumbar drain insertion

**SPINAL CORD ISCHEMIA**

**OPEN TAA REPAIR**

- Raise the blood pressure
  - Volume
  - Pressors
- Steroids
  - Bolus
  - Continuous infusion
- Naloxone

**TEVAR**

- Raise the blood pressure
  - Volume
  - Pressors
- Steroids
  - Bolus
  - Continuous infusion
- Induce endoleak

**SPINAL CORD ISCHEMIA**

**OPEN TAA REPAIR**

- Early onset
- More profound deficit
- Paraplegia
- Less likely to resolve

**TEVAR**

- Delayed onset
- Less profound deficit
- Paraparesis
- More likely to resolve
SPINAL CORD ISCHEMIA

Harrison, J Vasc Surg, 2012
We must beware of needless innovation, especially when guided by logic.

Winston Churchill