Spinal Cord Ischemia in EVAR for TAAA: Analysis of Risk Factors

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  - Consultant & Research grants
- Atrium
  - Consultant
- Siemens
  - Consultant
Lowering the Risk of SCI in Endovascular repair of TAAA

- **Preop**
  - Stent-graft planning
    - Preserve collaterals
    - Stage procedure/Perfusion branches
  - Cerebrospinal fluid drainage

- **Intraop**
  - Early pelvic and limb reperfusion
    - Surgical Access (Purse string sutures)
  - Proactive correction of blood pressure & Hb

- **Postop**
  - Proactive correction of blood pressure & Hb
  - Early & close neurological monitoring
Aim of Present Study

- Report the incidence and risk factors of SCI after endovascular TAAA repair with F & B stent-grafts
Patients and Methods

• Consecutive TAAA pts treated with F & B stent-grafts
  – 30d Mortality excluded

• 2004 - 2014

• Suprarenal aortic aneurysms excluded

• Data collected prospectively
Patients (N=201)*

- 78% Male
- Mean age 68.3 ± 7.6 years
- ASA score
  - 22.3% ASA II
  - 68.7% ASA III
  - 9.0% ASA IV
- 46.3% previous aortic procedures

* Excluding 30d Mortality (17 pts-7.8%)
TAAA Characteristics

- Mean Dmax: 68 ± 11mm
- Acute TAAA: N=17 (8.5%)
  - 10 Contained rupture TAAA
  - 7 Symptomatic TAAA
TAAA Extent

17 (8.5%)  55* (27.4%)  63 (31.3%)  54 (26.9%)

* 23 Chronic post-dissection TAAA
Stent-graft Design

- **Branches only**
  - $N=67$ (33.3%)

- **Fenestrations only**
  - $N=58$ (28.9%)

- **Branches + Fenestrations**
  - $N=76$ (37.8%)
Aorta Coverage with Stent-graft

- Mean: $76 \pm 17\%$ of total aortic length
  - (LSA to aortic bifurcation)
Spinal Cord Ischemia (SCI)

- N=21 (10.4%)

- Presentation & Evolution:
  - Transient limb weakness: N=13 (6.5%)
  - Persistent limb weakness: N=5 (2.5%)
  - Persistent paraplegia: N=3 (1.5%)
Spinal Cord Ischemia (SCI)

- Timing
  - Immediate symptoms: N=5/21 (23.8%)
  - Delayed symptoms: N=16/21 (76.2%)

  - <72 h postop: N=14
  - >72 h postop: N=2

  - Septic shock (pneumonia) → Hypotension
  - Bleeding (anticoagulation) → Hypotension
CSF Drainage (N=148)

- Preoperative: N=144 (71.6%)
- Postoperative: N=4 (2%)
  - Complete recovery: N=3
  - Persistent limb weakness: N=1

- Complications of drainage: N=3 (2%)
  - Bleeding at puncture site: N=2
  - Headache: N=1

- (Subdural hematoma: N=2*)

*30d Mortality
Risk Factors for SCI
## Univariate Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>SCI (N=21)</th>
<th>No SCI (N=180)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comorbidities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAD</td>
<td>16 (76.2%)</td>
<td>110 (61.1%)</td>
<td>0.24</td>
</tr>
<tr>
<td>Hypertension</td>
<td>17 (81%)</td>
<td>145 (80.6%)</td>
<td>1.0</td>
</tr>
<tr>
<td>PAD</td>
<td>17 (81%)</td>
<td>67 (37.2%)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>COPD</td>
<td>8 (38.1%)</td>
<td>99 (55%)</td>
<td>0.1</td>
</tr>
<tr>
<td>Smoking (current or past)</td>
<td>17 (81%)</td>
<td>111 (61.7%)</td>
<td>0.1</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1 (4.8%)</td>
<td>16 (8.9%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Renal (GFR&lt;30 ml/min)</td>
<td>5 (23.8%)</td>
<td>11 (6.1%)</td>
<td>0.016*</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>17 (81%)</td>
<td>127 (70.6%)</td>
<td>0.44</td>
</tr>
<tr>
<td>ASA≥3</td>
<td>19 (90.5%)</td>
<td>137 (76.1%)</td>
<td>0.17</td>
</tr>
</tbody>
</table>
## Univariate Analysis

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<tr>
<td>Previous aortic surgery</td>
<td>9 (42.9%)</td>
<td>84 (46.7%)</td>
<td>0.82</td>
</tr>
<tr>
<td>Acute repair</td>
<td>1 (4.8%)</td>
<td>16 (8.9%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Extent of repair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of stent-graft (mm)</td>
<td>328±81</td>
<td>301±75</td>
<td>0.175</td>
</tr>
<tr>
<td>Aortic coverage (%)</td>
<td>82%±17%</td>
<td>75%±17%</td>
<td>0.122</td>
</tr>
<tr>
<td>Operative data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation time &gt; 300 min</td>
<td>12 (57.1%)</td>
<td>28 (15.6%)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Fluoroscopy time, min</td>
<td>80 (35-240)</td>
<td>68 (15-160)</td>
<td>0.018*</td>
</tr>
<tr>
<td>Estimated blood loss, ml</td>
<td>500 (200-2000)</td>
<td>380 (80-2500)</td>
<td>0.001*</td>
</tr>
<tr>
<td>Contrast volume, ml</td>
<td>240 (120-400)</td>
<td>200 (80-500)</td>
<td>0.049*</td>
</tr>
</tbody>
</table>
Multivariate Analysis

• **Operation time > 300 min**
  – [OR], 7.4; 95% [CI], 2.6-21.1; p < 0.001

• **PAD**
  – [OR], 6.6; 95% [CI], 2-21.9; p = 0.002

• **Renal insufficiency (GFR<30 mL/min)**
  – [OR], 4.1; 95% [CI], 1.1-16.1, p = 0.04
Study Limitations

• Retrospective data analysis
• Non-uniform protocol over study period (11 yrs)
• No routine assessment from neurologist
  – Minor neurologic deficits missed?
• Low event rate (Type II statistical error?)
Conclusions

• Persistent paraplegia rare (1.5%)
• Rarely immediate, but within 72 h postop

• Risk factors for SCI
  – Long operation time (longer ischemia?)
  – PAD
  – Renal Insufficiency
Surgical Access for TAAA

- Surgical dissection
  - Purse string sutures
Surgical Access for TAAA

- Remove sheaths at first occasion
  - ↓ Iliac occlusion time
  - ↓ Immediate SCI time
  - ↓ Delayed spinal cord IRI
  - ↓ Risk for SCI

*but also...*