The Münster strategy
to avoid spinal cord ischemia during F/BEVAR

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Disclosure
Speaker name:

I have the following potential conflicts of interest to report:

- [x] Receipt of grants/research support
- [ ] Receipt of honoraria and travel support
- [ ] Participation in a company-sponsored speaker bureau
- [ ] Employment in industry
- [ ] Shareholder in a healthcare company
- [ ] Owner of a healthcare company
- [ ] I do not have any potential conflict of interest
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Fenestrations

Branches
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CMD-FEVAR for TAAA:

CMD-FEVAR in Dissection:
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CMD-BEVAR:

T-Branch:
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Arch-Branch-Device:
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The spinal perfusion
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Frequency of SCI before 2014:

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>N=</th>
<th>30-d-SCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Münster 2014</td>
<td>2010-2014</td>
<td>136</td>
<td>16.2%</td>
</tr>
<tr>
<td>Reilly 2012</td>
<td>2006-2012</td>
<td>81</td>
<td>7.8%</td>
</tr>
<tr>
<td>Greenberg 2009</td>
<td>2001-2006</td>
<td>189</td>
<td>7.4%</td>
</tr>
<tr>
<td>Verhoeven 2009</td>
<td>2009-2009</td>
<td>30</td>
<td>16.7%</td>
</tr>
<tr>
<td>Haulon 2012</td>
<td>2006-2012</td>
<td>89</td>
<td>7.8%</td>
</tr>
<tr>
<td>Greenberg 2008</td>
<td>2001-2006</td>
<td>189</td>
<td>7.4%</td>
</tr>
<tr>
<td>Reilly 2009 review</td>
<td>2006-2013</td>
<td>61</td>
<td>14.7%</td>
</tr>
<tr>
<td>Reilly 2014</td>
<td>2006-2012</td>
<td>287</td>
<td>14.9%</td>
</tr>
</tbody>
</table>

30-d-SCI up to 16.7%
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St. Franziskus Hospital Münster experience 2010 - TAAA

SCI and 30d-Mortality after BEVAR/FEVAR for TAAA
Challenge: SCI/paraparesis

Risk factor for SCI during endovascular TAAA-repair:

- Amount of covered aorta.
- Circulatory instability (blood transfusion, need of catecholamines)

Prophylactic spinal cord drainage without impact on SCI, but 6% complications!

Fig 2. Aortic coverage in percentage in patients treated endovascularly for thoracoabdominal aortic aneurysms (TAAAs). The aorta is normalized in percentage from the subclavian artery (100% coverage) to the aortic bifurcation (0% coverage). Each bar represents the aortic coverage of each patient (green, no spinal cord ischemia [SCI]; red, SCI) correlated also to the Crawford classification of the respective aneurysm.
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Solution 1: Staging

Thoraco-abdominal Typ B Dissection with false lumen aneurysm
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Solution 1: Staging

Staged repair (Open surgery)

Etz et al. J Thorac Cardiovasc Surg 2010;139:1464-72
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**Solution 1: Staging**

Staged repair (Endo repair)

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**Editor's Choice — Temporary Aneurysm Sac Perfusion as an Adjunct for Prevention of Spinal Cord Ischemia After Branched Endovascular Repair of Thoracoabdominal Aneurysms (CME)**


Department of Surgery, Vascular and Endovascular Surgery, University Hospital, University of Regensburg, Franz-Josef-Strauss-Allee 11, 93053 Regensburg, Germany

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**Table 5. Neurological complications.**

<table>
<thead>
<tr>
<th>Neurological complications</th>
<th>Non-TASP (n = 43)</th>
<th>TASP (all patients) (n = 40)</th>
<th>( p^a )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute cerebrovascular events</td>
<td>0 (0)</td>
<td>3 (1)</td>
<td></td>
</tr>
<tr>
<td>Paraesthesia</td>
<td>1 (2)</td>
<td>5 (13)</td>
<td></td>
</tr>
<tr>
<td>Temporary paraparesis ( b )</td>
<td>1 (2)</td>
<td>5 (13)</td>
<td>NS</td>
</tr>
<tr>
<td>Paraplegia (day 30 or discharge) ( b )</td>
<td>9 (21)</td>
<td>2 (5)</td>
<td>.03</td>
</tr>
<tr>
<td>Subgroup of aneurysm type I–III ( n = 24 )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paraplegia (d 30 or discharge) ( b )</td>
<td>7 (29)</td>
<td>1 (3)</td>
<td>.01</td>
</tr>
</tbody>
</table>

*Note. Values are \( n (%) \) unless otherwise indicated. TASP = temporary aneurysm sac perfusion; NS = all in comparison to the non-TASP group. \( p^a \) = comparison to the non-TASP group.*

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**Muscle strength 0–2 according to the modified Tarlov scale.**
A systematic review and meta-analysis of the occurrence of spinal cord ischemia after endovascular repair of thoracoabdominal aortic aneurysms

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Metaanalysis 27 Studies 2333 patients:

Lower pooled SCI rate after staged (20 studies) than after non staged (8 studies) approach (9% vs 18%, p=0.02)

Method of staging, timing > or < one month without effect.

30d Mortality similar staged vs non-staged 6% vs 9%

Interstage mortality reported in 9 studies pooled estimate rate 1.6%

Symptomatic vs prophylactic CSFD with similar pooled SCI rates (10% vs 10%, p=0.99)
Solution 2: Early reperfusion of the iliacs

Place the Graft

Close the groins

Attach the target vessels to the cuffs

Reduction of SCI below 2%.
Solution 2: Early reperfusion of the iliacs
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Solution 3: Communication

Operator – Anästhesiologiest – Intensiv care unit

About:

Amount of aortic coverage
Blood loss
Special risks: Occlusion of the hypogastric arteries
Subclavian occlusion
Amount of intercostals

Post-operative visit of the operation on the ICU!
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**Solution 4: Standardized perioperative management**

For 48h:

Middle RR > 80mmHg, HB > 10 g/dl monitored on ICU

Bedrest.

Circulatory stability:

Avoid blood loss or substitute.
Ideal volume therapy.

Avoid catecholamines if possible.

Spinal cord fluid drainage (CSFD) only on demand.
**OPEN REPAIR**

<table>
<thead>
<tr>
<th>Authors, year</th>
<th>Study</th>
<th>Type of monitor</th>
<th>CSFD benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crawford et al, 1991</td>
<td>RCT*</td>
<td>50ml CSF</td>
<td>none</td>
</tr>
<tr>
<td>Svennson et al, 1998</td>
<td>RCT</td>
<td>Volume-based</td>
<td>Favors CSFD</td>
</tr>
<tr>
<td>Coselli et al, 2002</td>
<td>RCT</td>
<td>Pressure-based</td>
<td>Favors CSFD</td>
</tr>
</tbody>
</table>

*Randomised controlled trial

- **1177 papers about CSFD during open TAAA repair:**
  CSF drainage does offer a neuroprotective benefit
  (CSFD <10 mmHg)


**CSFD-related adverse events:**
- Intracranial hematoma: 3-11%
- Postdural puncture headache: 10%

Youngblood et al, J Thorac Cardiovasc Surg 2013;146:166-71
### CSF-drainage (CSFD)?

#### ENDOVASCULAR REPAIR

<table>
<thead>
<tr>
<th>Authors, year</th>
<th>Journal</th>
<th>Study</th>
<th>Preoperative CSFD benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ullery et al, 2011</td>
<td>Sem Cardiothor Vasc Anesth</td>
<td>Meta-analysis</td>
<td>none</td>
</tr>
<tr>
<td>Wong et al, 2013</td>
<td>J Vasc Surg</td>
<td>Meta-analysis</td>
<td>none</td>
</tr>
<tr>
<td>Zipfel et al, 2013</td>
<td>Ann Thorac Surg</td>
<td>Retrospective cohort analysis</td>
<td>none</td>
</tr>
<tr>
<td>Bisdas et al, 2015</td>
<td>J Vasc Surg</td>
<td>Retrospective cohort analysis</td>
<td>none</td>
</tr>
<tr>
<td>Spanos et al, 2019</td>
<td>J Vasc Surg</td>
<td>Meta-analysis</td>
<td>none</td>
</tr>
<tr>
<td>Kitpanit et al, 2021</td>
<td>Circulation</td>
<td>Propensity-score matched</td>
<td>none</td>
</tr>
<tr>
<td>Greenberg et al, 2008</td>
<td>Circulation</td>
<td>Propensity-score matched</td>
<td>87%</td>
</tr>
<tr>
<td>Sobel et al, 2013</td>
<td>J Vasc Surg</td>
<td>Retrospective cohort analysis</td>
<td>79%</td>
</tr>
<tr>
<td>Bisdas et al, 2015</td>
<td>J Vasc Surg</td>
<td>Retrospective cohort analysis</td>
<td>57%</td>
</tr>
<tr>
<td>Spanos et al, 2019</td>
<td>J Vasc Surg</td>
<td>Retrospective cohort analysis</td>
<td>28%</td>
</tr>
</tbody>
</table>

**SFH – Münster:**

Since 2015 **no** prophylactic CSF-drainage.
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Prophylactic CSFD 78 pt (73,6%), No CSFD 28 pt (26,4%)

SCI 4 pt with CSFD (2 permanent, 2 paraparesis)

Extent and blood loss independent risk factors for SCI.

6 pt (7,6%) with major CSFD complications (subarachnoidal bleeding 2,6%, spinal hematoma 2,6%, Cerebellar hemorrhage 1,3%, Laminektomy 1,3%)

20 pt (25,6%) with minor CSFD complications

Conclusions: The incidence of SCI after F/B-EVAR with selective CSFD was low, and risk factors for SCI were greater with extent of thoracic aortic coverage and intraoperative blood loss. However, the incidence of major CSFD-related complications exceeded the incidence of SCI, and CSFD significantly increased both intensive care unit and total hospital length of stay. Therefore, routine prophylactic CSFD may not be justified, and a prospective randomized trial of CSFD in patients undergoing F/B-EVAR seems appropriate.
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Multicenter Study to Evaluate Endovascular Repair of Extent I–III Thoracoabdominal Aneurysms Without Prophylactic Cerebrospinal Fluid Drainage

Giuliana B Marcondes 1, Nolan C Cirillo-Penn 2, Emanuel R Tenorio 1 2, Donald J Adam 3, Carlos Timaran 4, Martin J Austermann 6, Luca Bertoglio 6, Tomasz Jakimowicz 7, Michele Piazza 8, Maciej T Juszczak 3, Carla K Scott 4, Bärbel Berekoven 8, Roberto Chiesa 6, Guilherme B B Lima 1, Katarzyna JAMA 7, Francesco Squizzato 8, Martin Claridge 3, Bernardo C Mendes 2, Gustavo S Oderich 1,
Trans-Atlantic Aortic Research Consortium Investigators

N=541


30d Mortality 3%

SCI 8%
Paraparesis 4% Paraplegia 4%, permanent 2%
Extent 1 and 2: 12% SCI, Extent 3: 5% SCI

Rescue treatment incl hypertension and CSFD improved symptoms in 73%

Risc factors for SCI:
Length of covered aorta, impaired collateral network, Perioperativ hypotension.
Lessons learned: St. Franziskus Hospital Münster

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Long term iliac Occlusion</td>
<td>Longer iliac Occlusion Proph. CSFD 50%</td>
<td>Short iliac Occlusion No proph. CFSD</td>
</tr>
<tr>
<td>30 d mortality</td>
<td>4 (2,9%)</td>
<td>15 (2,8 %)</td>
</tr>
<tr>
<td>SCI</td>
<td>22 (16,2%)</td>
<td>30 (5,7%)</td>
</tr>
<tr>
<td>Permanent paraplegiyn</td>
<td>11 (8 %)</td>
<td>14 (2,6 %)</td>
</tr>
</tbody>
</table>
Conclusion:

Staging...

Early restauration of the iliac perfusion...

Communication Operator-Anesthesiology...

Standardized perioperative management...

....reduce the risk for SCI below 3%
Clinic for Vascular Surgery and Phlebology
Institute for Vascular Research
Director: PD Dr. M. J. Austermann

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48145 Münster

master class
endoVASCULAR and OPEN

SAVE THE DATE
13.– 14. Mai 2024 | Münster
Thank you!
The Münster strategy
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M. J. Austermann
Director
Clinic for Vascular Surgery and Phlebology
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