The Value of Hyperbaric Oxygen as a Rescue Treatment for SCI after Open, F/B EVAR for TAAAA

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Disclosures

- Consultant for Bayer

Spinal Cord Injury After TAAA

- Spinal Cord blood supply can be interrupted by all types of TAAA repair
- Injury can be immediate or delayed
- Rate of SCI varies by procedure and series
- **Open** 9.6% deficit
  - 2.9% permanent paraplegia,
  - 2.6% permanent paraparesis (Coselli)
- **FEVAR or BEVAR**
  - 8-13% depending on series

Spinal Cord Blood Supply

- Spinal Cord blood supply is a network
- Anterior Spinal Artery supplies anterior 2/3rd of cord supply where motor tracts travel
- Segmental arteries play a significant role such as Artery of Adamkiewicz at T10-L1 on the left
- Segmental vessels interrupted by TAAA repair

Etiology of Spinal Cord Injury After TAAA

- Direct blood flow interruption leading to infarction
- Systematic Hypoperfusion
- Atheromatous Embolic Infarction
- Thrombosis of radicular arteries
- Ischemia/Reperfusion that progresses to infarction

Conventional Therapy for Post Operative Spinal Cord Injury After TAAA

- Maximize Blood Pressure MBP >90 mmHg
- Optimize Hb >10 g/L
- CSF drainage
- No proven drug therapy (naloxone, papaverine)
- No proven adjuncts
HBOT in Spinal Cord Injury

• Many animal models of spinal injury and ischemia demonstrate benefits of HBOT

Hyperbaric Oxygen Therapy
Mechanisms of Action

• Based on breathing 100 % Oxygen at elevated atmospheric pressure
• Marked increases the dissolved oxygen content of blood in HBOT therapy
• Enhanced diffusion of oxygen into ischemic areas
• Longer lasting effects
  Affects oxidant/anti oxidant mechanisms (Nitric oxide, secretion of growth factors, modifies inflammation and I/R injury)

HBOT Therapy After TAAA

• Begin at 2.8 ATA first 2 -3 treatments, then 2.4 ATA
• Main risk is oxygen induced seizures/lung toxicity
• Treatments are stopped when the patient reaches neurological plateau
• Oxygen supplied through ETT or hood.
• Treatments are in the multipurpose chamber which is pressurized with air.
• Goal achieve supra physiological concentration of Oxygen soluble in plasma.
• Post treatment is to keep Sat >92% normobaric condition to prevent lung oxygen toxicity

Initial Results of HBOT After TAAA

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Sex</th>
<th>Initial Status</th>
<th>Spinal Cord Blood Supply</th>
<th>TAAA Repair</th>
<th>HBOT Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>56</td>
<td>M</td>
<td>Paraplegia</td>
<td>Interrupted</td>
<td>Endovascular</td>
<td>5 treatments</td>
<td>Died</td>
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<tr>
<td>2</td>
<td>34</td>
<td>M</td>
<td>Paraplegia</td>
<td>Interrupted</td>
<td>Surgery</td>
<td>4 treatments</td>
<td>Died</td>
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<td>Interrupted</td>
<td>Endovascular</td>
<td>3 treatments</td>
<td>Died</td>
</tr>
<tr>
<td>4</td>
<td>55</td>
<td>M</td>
<td>Paraplegia</td>
<td>Interrupted</td>
<td>Surgery</td>
<td>2 treatments</td>
<td>Died</td>
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<tr>
<td>5</td>
<td>41</td>
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<td>Interrupted</td>
<td>Surgery</td>
<td>1 treatment</td>
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<tr>
<td>6</td>
<td>38</td>
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<td>Surgery</td>
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<tr>
<td>7</td>
<td>52</td>
<td>M</td>
<td>Paraplegia</td>
<td>Interrupted</td>
<td>Surgery</td>
<td>6 treatments</td>
<td>Died</td>
</tr>
<tr>
<td>8</td>
<td>49</td>
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<td>Paraplegia</td>
<td>Interrupted</td>
<td>Surgery</td>
<td>4 treatments</td>
<td>Died</td>
</tr>
<tr>
<td>9</td>
<td>53</td>
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<td>Paraplegia</td>
<td>Interrupted</td>
<td>Surgery</td>
<td>3 treatments</td>
<td>Died</td>
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<tr>
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<td>60</td>
<td>M</td>
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<td>Interrupted</td>
<td>Surgery</td>
<td>2 treatments</td>
<td>Died</td>
</tr>
<tr>
<td>11</td>
<td>58</td>
<td>M</td>
<td>Paraplegia</td>
<td>Interrupted</td>
<td>Surgery</td>
<td>1 treatment</td>
<td>Died</td>
</tr>
<tr>
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<td>Surgery</td>
<td>0 treatments</td>
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</tr>
<tr>
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<td>51</td>
<td>M</td>
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<tr>
<td>14</td>
<td>62</td>
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</tbody>
</table>

Data Since Publication to June 2018

• 18 patients treated, total 89 HBOTs (on average 5 treatments/patient BID (range 1-14 treatments))
• 6 patients did not survive hospitalization but one of the non-survivors recovered from paraplegia completely and expired due to ruptured aneurysm
• 9 patients recovered from paraplegia and can ambulate.
• 3 patients did not respond.
Conclusions
Role of HBOT in Spinal Cord Injury Post Aortic Surgery

- HBOT is experimental therapy
- Raises the level of dissolved oxygen in blood
- Approximately 50% response rate after unresponsive to conventional therapy
- Limited supportive animal mechanistic data
- Requires larger numbers and randomized studies to determine effectiveness