The therapeutic effects of hyperoxia during CPB

Alison M. Lancaster
North Shore – LIU Post
Great Neck, NY, State
Disclosures

- I have no disclosures
Overview

• Two Key reasons why hyperoxia may possibly improve the clinical outcome of the CPB patient:
  
• 1) Effects on GMEs:
    Nitrogen vs oxygen containing GMEs
  
• 2) Neuroprotective qualities
Hyperoxia effects on GMEs

- Change of GME composition
- Decrease the size of GMEs present
- Decrease number of GMEs
GMEs are space occupying lesions; the brain is at greatest risk for damage.
Neuroprotection Strategies

• 1) Decrease excitotoxicity
• 2) Maintenance of BBB
• 3) Enhance neural plasticity
Hyperoxia Effects

- Decrease VEGF
- Decrease neuronally derived NO
- Decrease MMP formation
- Decrease NADPH $\rightarrow$ Reduces ROS

- Increase cerebral blood flow and oxygenation
The case of Diabetics

- Predisposed to cognitive deficits
- SCADs
- Impaired pathways preventing free radical generation
What about the generation of free radicals?

- Hyperoxia may cause free radical generation
- Further evaluation may determine correlation with increased post-operative time of ventilator use and prolonged hospital stays
We can Counteract Free Radicals

- Mannitol
- Other medications

- Inhibit radical producing reactions

- Reduced inflammation
Study Design

• 150 consecutive cases from 2 hospitals
  “Normoxia”

• Control Group: FIO2 = Variable
  – pO2 250-350 mmHg
  “Hyperoxia”

• Test Group: FIO2 = 1.0
  – pO2 >400 mmHg
Factors Analyzed

- O2 transfer at highest flow and lowest flow
- Calculated delivery of oxygen
- Hct, temperature, time of sample
- Total bypass time, cross clamp time
- Gender, age, and BSA
Results

- No significances between groups in demographics

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Test</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₂ transfer at low flow</td>
<td>93.6+/-.47</td>
<td>65.1+/-.34</td>
<td>*5.26W-09</td>
</tr>
<tr>
<td>O₂ transfer at high flow</td>
<td>112.3+/-.45</td>
<td>71.9+/-.40</td>
<td>*0.00000000000000105</td>
</tr>
<tr>
<td>BTW Sample Time Low Flow</td>
<td>28+/-.19</td>
<td>65+/-.38</td>
<td>*8.95E-23</td>
</tr>
</tbody>
</table>
Results

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Test</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculated O2 Consumption &lt; Expected at High Flow</td>
<td>5%</td>
<td>0%</td>
<td>*0.004</td>
</tr>
<tr>
<td>Calculated DO2 &lt; Expected O2 Consumption at Low Flow</td>
<td>24.70%</td>
<td>0%</td>
<td>*1.86E-11</td>
</tr>
</tbody>
</table>
Take Home Points

- Hyperoxia may facilitate removal of GMEs
- Hyperoxia potentially enhances neural protection
- Hyperoxia is a reasonably safe technique
- More research is necessary to confirm the post-operative effects on the patient