Objectives

• Understand the terms and the clinical characteristics of birth depression.
• Be familiar with the evidence behind therapeutic hypothermia, aka “cooling”.
• Stabilize and manage the birth depressed infant until transport can occur.
• Introduce our new transport cooling blanket, Tecotherm Neo, and review our outcomes.

Birth Depression Terms

• “birth depression”, “respiratory depression at birth”, “perinatal asphyxia”, “hypoxic ischemic encephalopathy”, “neonatal encephalopathy”
• Do all these terms mean the same thing?

Prolonged Hypoxia

Asphyxia

Ischemia

Lactic Acid Production

Hypoxic Ischemic Encephalopathy
Hypoxic Ischemic Encephalopathy

- History of an intrapartum event
- Apgar score of <5 at 5 minutes, or
- Continued need for resuscitation, including ventilation, at ten minutes after birth, or
- Acidosis defined as either umbilical cord pH or any arterial or venous pH within 60 minutes of birth <7, or
- Base deficit ≥ 16 mmol/L in umbilical cord blood sample or any blood sample within 60 minutes of birth
- Evidence of moderate to severe encephalopathy
- Multiorgan dysfunction within 72 hours
- Exclusion of other identifiable etiologies

Why do we cool?

Therapeutic Hypothermia is the Standard of Care for HIE

<table>
<thead>
<tr>
<th>Study</th>
<th>Number of babies</th>
<th>Cooling type</th>
<th>Mortality</th>
<th>Poor Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hypothermic</td>
<td>Normothermic</td>
</tr>
<tr>
<td>Cool Cap</td>
<td>235</td>
<td>Selective Head</td>
<td>33%</td>
<td>38%</td>
</tr>
<tr>
<td>TOBY Trial</td>
<td>325</td>
<td>Whole body</td>
<td>26%</td>
<td>27%</td>
</tr>
<tr>
<td>NICHD Trial</td>
<td>208</td>
<td>Whole body</td>
<td>24%</td>
<td>37%</td>
</tr>
</tbody>
</table>

All infants studied were >36 wks gestation, cooling initiated at 5.5-6hrs of life, and inclusion criteria of 1 out of 4: Apgars at 10 min<5, pH<7, base def>16, vented or resusc at 10 min of life; depressed consciousness and 1 of 3: hypotonia, abnormal reflexes, abnormal suck; clinical seizures or abnormal EEG (except for NICHD trial). Poor outcomes (severe disability) were based on 18-22 month Bayley II <70 and GMFCS 3-5 and/or severe visual or hearing loss. NICHD trial looked at moderate disability as well.
To cool or not to cool?

- ≥ 36 weeks gestation
- ≤ 6 hours of age at initiation of therapy
- Assess for evidence of hypoxia-ischemia by using discussed biochemical criteria AND
- Assess for moderate to severe encephalopathy
  - Must have one or more: hypotonia, abnormal reflexes, absent or weak suck, clinical seizures
- Amplitude EEG will be performed at the Regional Perinatal Center to evaluate brain activity background

What can you do to be prepared?

- Have equipment ready for the delivery room.
  - Intubation equipment
  - Umbilical venous line kit
  - Epinephrine and Volume expansion
- ABC’s and Temperature!
- Request a cord pH!
- Call the RPC ASAP for transport and consider passive cooling.

What you can do before transport

- ABC’s
- Establish IV access and check glucose frequently.
- Initiate passive cooling
- Treat for sepsis if appropriate
- Treat for seizures if present
- Discuss the diagnosis with the infant’s family

Airway, Breathing, Circulation

- Intubate and ventilate as needed
- Document ETT position and lung volumes by CXR
- Obtain ABG or VBG to document any acidosis
- Goal of ventilation is a normal pCO2
- Use blended oxygen if available
- Monitor blood pressure and perfusion closely
  - Anticipate a lower heart rate
  - Treat hypotension with volume expansion
  - Normal Saline 10ml/kg bolus IV over 10 minutes, or consider O neg packed red blood cells in the case of acute hemorrhage
IV Access and Glucose

- Establish IV access quickly
- Low Umbilical Venous Catheters
  - 3.5 or 5 French catheter, inserted to 5 cm
  - Great because you can quickly place for access and draw labwork (VBG, CBC, Blood Culture)
- IV fluid: D10W at 60 ml/kg/day
- Monitor glucose frequently and maintain glucose per STABLE (50-110 mg/dL)
- Treat hypoglycemia: D10W 2ml/kg IV push

Monitor and Treat Seizures

- Seizures may be subtle:
  - Rhythmic jerks: unifocal or multifocal
  - Bicycling/ swimming
  - Posturing
  - Nystagmus/ blinking/ fluttering
  - Sucking/ tongue protrusion
  - Apnea
- Treat with Phenobarbital 20 mg/kg IV

Initiation of passive cooling

- Do not apply hat
- Avoid hyperthermia but don’t overcool either!
- Monitor and document temperatures q15 minutes.
- The radiant warmer may be used in manual mode and the skin probe can be inserted rectally 6 cm, or rectal temps may be checked.
  - If using the warmer you must shield the head with cloth diapers or foil
- Maintain passive cooling to target core temperatures of 34-35°C

Cooling on Transport

- To initiate and maintain therapy, we now have the latest equipment, the Tecotherm Neo, for therapeutic hypothermia on transport.
Cooling on Transport

Cooling Protocol at Crouse

- Whole body cooling blanket servo-controlled to an esophageal temperature of 33.5° for 72hrs with aEEG monitoring
- Intubated and sedated on morphine drip
- Monitored closely for complications:
  - Polycythemia
  - Coagulopathy
  - Fat necrosis
  - Hypotension
  - Bradycardia

After the cooling period

- MRI of the brain (usually around 7-10 days of life) and conventional EEG when off cooling blanket.
- Withdrawal of support remains an option for those who continue to manifest signs of a devastating insult.
- Neurodevelopmental follow-up at 6 and 24 months because of the vast developmental milestones that occur between 6-24 months.

Total Body Cooling Data 5/28/09 – 4/22/15

- Total Cooled 46
- Died 9 (19.6%)
- Survival 37 (80.4%)
- NICU followup clinic
  - 37 scheduled
  - 33 seen
  - 4 lost to follow-up
Total Body Cooling Characteristics
May 28, 2009 – April 22, 2015
N=37

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender- Male</td>
<td>Male 21 (57%)</td>
</tr>
<tr>
<td>Birth Weight</td>
<td>3.38kg ± 0.64 (1.87-5kg)</td>
</tr>
<tr>
<td>Apgar 1 min (n=36)</td>
<td>1.6 ± 1.5 (0-5)</td>
</tr>
<tr>
<td>Apgar 5 min (n=36)</td>
<td>3.1 ± 1.8 (0-7)</td>
</tr>
<tr>
<td>Apgar 10 min (n=34)</td>
<td>4.6 ± 1.9 (0-8)</td>
</tr>
<tr>
<td>Cord pH (n=34)</td>
<td>6.9 ± 0.2 (6.5-7.3)</td>
</tr>
<tr>
<td>Inborn</td>
<td>15 (41%)</td>
</tr>
<tr>
<td>Seizures (yes)</td>
<td>25 (68%)</td>
</tr>
</tbody>
</table>

6 Month Follow-up
N=33 (4 lost to follow-up)
89% follow-up rate

<table>
<thead>
<tr>
<th>Scores with Mean, std dev, range</th>
<th>Normal</th>
<th>Mild-Moderate Delay</th>
<th>Severe Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive</td>
<td>93 ± 25 (55-120)</td>
<td>25 (76%)</td>
<td>3 (9%)</td>
</tr>
<tr>
<td>Language</td>
<td>90 ± 16 (47-112)</td>
<td>26 (79%)</td>
<td>4 (12%)</td>
</tr>
<tr>
<td>Motor</td>
<td>89 ± 22 (46-124)</td>
<td>22 (67%)</td>
<td>5 (15%)</td>
</tr>
</tbody>
</table>

Cerebral Palsy in 3 (9%) and 2 possible (6%)

24 Month Follow-up
Total to date N=27 (5 no show/1 moved out of state)
N=21 (data available) 78% follow-up rate

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<th>Severe Delay</th>
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</thead>
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<tr>
<td>Cognitive</td>
<td>92 ± 23 (50-135)</td>
<td>15 (71%)</td>
<td>3 (14%)</td>
</tr>
<tr>
<td>Language</td>
<td>89 ± 22 (50-144)</td>
<td>14 (67%)</td>
<td>4 (19%)</td>
</tr>
<tr>
<td>Motor</td>
<td>90 ± 27 (50-115)</td>
<td>15 (71%)</td>
<td>4 (19%)</td>
</tr>
</tbody>
</table>

Autism Spectrum: 1 child
Cerebral Palsy: 2 (10%) with severe CP

Questions?
References