<table>
<thead>
<tr>
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<th>ICP &lt; 20</th>
<th>ICP ≥ 20</th>
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<tbody>
<tr>
<td>( \text{PbtO}_2 \geq 20 )</td>
<td>A</td>
<td>B</td>
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<tr>
<td>( \text{PbtO}_2 &lt; 20 )</td>
<td>C</td>
<td>D</td>
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</tbody>
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Notes:

1. Treatment is triggered by an “episode”
2. An “episode” is ICP > 20 mmHg and/or PbtO2 < 20 mmHg for > 5 min
3. Choose at least 1 intervention from a tier before progressing toward the subsequent tier

Scenario A

- No intervention necessary – continue to monitor
- Once peak swelling has passed (usually 5 days post-ictus) and neurological exam has stabilized consider removal of monitors after 24-36 hours of stable ICP, PbtO2 (i.e. not requiring treatment), and GCS ≥ 9.
- Devices may be kept in place for no more than 9 days. If devices are still required after that time, then they should be replaced.

Scenario B

- Tier 1 (begin within 15 minutes of episode)
  - Increase angle of HOB, straighten neck, loosen ETT tape, C-collar
  - Ensure core temp < 38°C
  - Treat agitation and pain with lowest necessary dose of sedative and analgesic to achieve pain/agitation control (do not titrate to ICP)
  - Adjust minute ventilation for target PaCO\textsubscript{2} 35 – 45 mmHg
  - CSF drainage
  - Mannitol per protocol
- Tier 2 (begin within 60 minutes of episode)
  - Consider repeat HCT to look for increased size of intracranial mass lesions
  - Adjust minute ventilation for target PaCO\textsubscript{2} 30 – 35 mmHg (\textit{monitor PbtO2 for evidence of ischemia})
  - Hypertonic saline per protocol
  - Treat surgically remediable lesions
  - Lower core temp to 35 – 37°C while treating rigors
  - Monitor EEG and treat seizures if present
- Tier 3 (Obtain repeat HCT prior to initiation of Tier 3 therapies)
Decompressive craniectomy
- Therapeutic hypothermia (32 – 34°C) per protocol
- Consider decompressive laparotomy (with or without intraabdominal hypertension)
- Consider Xenon CT or jugular bulb catheter to assess for hyperemia as cause of refractory intracranial hypertension
- Trial of neuromuscular blockade
- Barbiturate (pentobarbital) coma if ICP responds to test dose of thiopental. Consider Propofol. Titrate sedative to lowest dose necessary to achieve ICP < 20, or to achieve isoelectric activity on EEG, or until side-effects occur - whichever comes first.

Scenario C (if PbtO2 < 20 after 60-120 minutes post insertion)

- Tier 1 (begin within 15 minutes of episode)
  - Troubleshoot monitor with oxygen challenge (see below)
  - Check HCT to confirm catheter is in appropriate location
  - Ensure core temp < 38°C
  - Increase CPP to maximum of 70 mmHg with fluid boluses (goal euvoolemia)
  - Correct hypoxemia by increasing FiO2 and/or PEEP

- Tier 2 (begin within 60 minutes of episode)
  - Increase CPP to maximum of 70 mmHg with pressor
  - Decrease ICP to < 10 mmHg through CSF drainage and/or increased sedation
  - Add EEG monitoring and treat seizures if present
  - If anemic, transfuse 1 unit RBC and re-assess

Scenario D

- Tier 1 (begin within 15 minutes of episode)
  - Increase angle of HOB, straighten neck, loosen ETT tape, C-collar
  - Troubleshoot monitor with oxygen challenge (see below)
  - Ensure core temp < 38°C
  - Treat agitation and pain with lowest necessary dose of sedative and analgesic to achieve pain/agitation control (do not titrate to ICP)
  - Mannitol per protocol
  - Correct systemic hypoxemia by increasing FiO2 and/or PEEP

- Tier 2 (begin within 60 minutes of episode)
  - Hypertonic Saline per protocol
  - Increase CPP to maximum of 70 mmHg with pressor – however, consider evaluating for hyperemia as cause of intracranial hypertension and brain tissue hypoxia
  - Repeat HCT – look for increased size of intracranial mass lesions
  - Treat surgically remediable lesions
Lower core temp to 35 – 37°C while treating rigors
Add EEG monitoring and treat seizures if present
If anemic, transfuse 1 unit RBC and re-assess

- Tier 3
  - Decompressive craniectomy
  - Treat surgically remediable lesions
  - Lower core temp to 32 – 34°C while treating rigors
  - Consider Xenon CT or jugular bulb catheter to assess for hyperemia as cause of refractory intracranial hypertension and brain tissue hypoxia
  - Consider decompressive laparotomy (with or without intraabdominal hypertension)
  - Trial of neuromuscular blockade
  - Barbiturate (pentobarbital) coma if ICP responds to test dose of thiopental. Consider propofol. Titrate sedative to lowest dose necessary to achieve ICP < 20, or to achieve isoelectric activity on EEG, or until side-effects occur - whichever comes first.

Oxygen Challenge Test:
After brain tissue has had time to settle from the initial insertion, place the ventilator FIO2 on 100% for 2 to 5 minutes. A properly functioning probe will demonstrate an increase in PbtO2. If there is no response to increased FIO2, a head CT should be obtained to confirm correct probe placement.

Hospital Policy References:
1. Brain Tissue Oxygen Monitoring  
   CCC-05-04 09/2010
2. Intracranial Pressure Monitoring Using the Camino Fiber-Optic Monitor  
   CCC-05-03 06/2010
3. Ventriculostomy: Placement, Monitoring, Patient Care  
   CCC-05-02 06/2010
4. Jugular Venous Oxygen Saturation (SjvO2) Monitoring  
   CCC-05-07 08/2006
5. Normothermia in the Brain-Injured Patient  
   CCC-05-09 12/2007

HUP Traumatic Brain Injury Guidelines:
1. Overview: Osmotherapy for the Treatment of Severe Intracranial Hypertension
2. Algorithm for the Use of Mannitol in the Management of Intracranial Hypertension.
3. Osmotherapy for Treatment of Intracranial Hypertension: 20% Mannitol
4. Algorithm for the Use of 3% NaCl in the Management of Intracranial Hypertension
5. Algorithm for the Use of 5% NaCl in the Management of Intracranial Hypertension