Intracranial pressure monitoring: Fundamental considerations and rationale for monitoring (2014)

**Authors:** Chesnut, *et al.*
**Journal:** *Neurocritical Care, 21*(2), 64-84.

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<tr>
<th>Objectives/Rationale</th>
<th>Methods/Patients</th>
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<td><strong>Background:</strong> Traumatic brain injury (TBI) is a major cause of death and disability worldwide; associated neuromonitoring has traditionally focused on intracranial pressure (ICP)</td>
<td>• Systematic review searching PubMed, Embase, and Cochrane databases; total of 244 articles reviewed in detail (dates between 1980 and September 2013)</td>
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<td><strong>Objective:</strong> Review the fundamental literature relative to the clinical application of ICP monitoring in TBI critical care and provide recommendations on how the technique may be applied to help patient management and enhance outcomes</td>
<td>• Randomized controlled trials (RCTs), cohort studies, case-control studies, case series, databases, or registries</td>
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<td>• Outcomes were required to address human clinical recovery (including mortality)</td>
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**Results**

1. Risks associated with ICP monitoring are generally low, and more complications exist with ventriculostomy than parenchymal monitoring; safety can be enhanced through using specific protocols and bundles

2. Generally, successful treatment of intracranial hypertension is associated with better outcome than observed in patients who do not respond to treatment

3. The crisis threshold for ICP monitoring is unclear, but patients who respond to efforts to keep ICP < 15-25 mmHg generally do better

**Conclusions**

1. Intracranial pressure and its management is a fundamental concept in TBI care

2. An ICP monitor, per se, makes little difference to outcome; it is how the data from the monitor is used and whether effective treatment exists

3. There is an association between using an ICP monitor and adhering to guideline recommendations and “better outcomes” (usually, reduced mortality)

4. Future ICP management should be based on ICP waveform analysis, autoregulation, and other variables

**Key Messages**

1. ICP and cerebral perfusion pressure (CPP) monitoring is recommended to guide medical and surgical interventions and to detect life-threatening imminent herniation; absolute thresholds are uncertain

2. Indications and method for ICP monitoring should be tailored to the specific diagnosis (e.g. TBI vs. stroke)

3. Continuous assessment of ICP and CPP, including waveform quality using a structured protocol, is strongly recommended

The Integra® Camino® ICP Monitor is indicated for use by qualified neurosurgeons or neurointensivists for measurement of intracranial pressure and temperature.
Monitoring of Brain and Systemic Oxygenation in Neurocritical Care Patients (2014)

Authors: Oddo, et al.
Journal: *Neurocritical Care*, 21(2), 103-120.

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<td><strong>Background:</strong> Maintenance of adequate oxygenation is a mainstay of intensive care, however, recommendations on the safety, accuracy, and the potential clinical utility of invasive and non-invasive tools to monitor brain and systemic oxygenation are lacking</td>
<td>• Systematic review searching PubMed database; total of 281 articles reviewed in detail, 161 of those specifically discuss PbtO2 (dates between 1980 and August 2013)</td>
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<td><strong>Objective:</strong> Examine the safety and accuracy of systemic, brain oxygen (PbtO2), and CO2 monitoring; evaluate its utility to guide therapy, and analyze whether oxygen or CO2 monitoring-guided therapy improves patient outcome after acute brain injuries</td>
<td>• Randomized controlled trials (RCTs), cohort studies, case-control studies, case series, databases, or registries</td>
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**Results & Conclusions**

1. **The PbtO2 Safety & Accuracy**
   - No PbtO2 catheter-related infections found
   - 0-3% local bleeding around the catheter (with no clinical consequence)
   - 6-14% technical complications (deflect or dislocation)
   - Factors such as PaCO2, PaO2, cerebral metabolic rate (fever/shivering) can alter PbtO2
   - “Normal” PbtO2 is 25-35mmHg and depends on probe depth; values < 20mmHg are considered abnormal and are associated with cerebral ischemia and energy dysfunction
   - Probe location can influence how PbtO2 responds to therapeutic interventions

2. **PbtO2 Helps Guide Management**
   - Most studies include comatose traumatic brain injury (TBI) patients and less frequently subarachnoid hemorrhage (SAH) patients
   - PbtO2 monitoring helps guide optimal cerebral perfusion pressure (CPP) levels to prevent/treat hypoxia in individual patients
   - Effect of treatments such as osmotherapy, hypothermia, barbiturates, or decompressive craniectomy can be guided by PbtO2 monitoring
   - PbtO2 levels may help guide ventilator management

3. **PbtO2-Guided Care Influence on Outcome**
   - In TBI, reduced PbtO2 is associated with mortality, lower Glasgow Outcome Score, and increased neuropsychological deficits
   - A physiologic response to therapy to correct PbtO2 is associated with better outcomes in TBI and SAH
   - A tendency towards better outcomes with combined PbtO2 and ICP/CPP therapy compared to ICP/CPP therapy alone was found in the majority of studies

**Key Messages**

- PbtO2 monitoring is safe and accurate
- PbtO2 monitoring helps guide management of TBI/SAH patients
- PbtO2 monitoring guided-care can have a positive impact on outcome