Brain Hypoxia is associated with short-term outcome after severe traumatic brain injury independently of intracranial hypertension and low cerebral perfusion pressure (2011)

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### Objectives/Rationale

**Hypothesis:** Brain hypoxia (BH) is associated with worse short-term outcome after severe traumatic brain injury (TBI)

**Objective:** Examine the origin of secondary BH insults and the relationships among reduced PbtO2, elevated intracranial pressure (ICP), and low cerebral perfusion pressure (CPP)

### Methods/Patients

- Retrospective study of 103 severe, non-penetrating TBI patients who underwent both PbtO2 and ICP monitoring
- ICP, brain temperature, and PbtO2 measured using Licox®
- Short-term outcome using the Glasgow Outcome Score (GOS) was assessed within 30 days of injury

### Results

1. CPP decrease was frequently associated with BH; wide inter-individual ranges suggest that individual CPP thresholds vary among patients

2. Patients with elevated ICP and low CPP were more likely to have BH; hypoxia in the presence of elevated ICP was associated with fewer favorable outcomes. Similarly, hypoxia in the presence of low CPP was associated with fewer favorable outcomes

### Conclusions

1. Brain hypoxia is common in severe TBI and may be caused by an increased ICP or decreased CPP; BH also occurs in patients with normal ICP and CPP

2. BH was associated with unfavorable short-term outcomes, independent of elevated ICP, low CPP, and severity of injury

3. PbtO2 is an important complement of ICP and CPP to improve management of TBI patients

### Key Messages

1. Longer periods of BH results in worse patient outcomes

2. Patients with elevated ICP and BH have fewer favorable outcomes as compared to patients with elevated ICP alone

3. Patients with low CPP and BH were less likely to have favorable outcomes than those with low CPP but without BH

4. BH is associated with poor short-term outcome after severe traumatic brain injury independently of elevated ICP, low CPP, and injury severity
FAQs

1. This study examines the short term outcomes (30 days) of patients based on ICP, CPP, and PbtO2, among other factors. Have there been any studies that examine long term patient outcomes using similar factors as this study?

   The authors note that previous observational studies have demonstrated an association between brain hypoxia and outcome after TBI. The studies suggested that brain hypoxia might be an independent factor associated with poor outcome. A large, multi-centered, randomized controlled trial is needed to determine if PbtO2 directed therapy improves outcome in patients with severe TBI.

2. What is the significance of instances where CPP was normal (>60mmHg) and PbtO2 was low (<15mmHg)?

   Although the authors note that high ICP and low CPP are associated with an increased likelihood of brain hypoxia, they also note that an elevated ICP or decreased CPP are not the only causes of brain hypoxia. Arterial oxygenation (PaO2), hyperthermia, induced cooling, and low hemoglobin were also associated with brain hypoxia in this study, suggesting that ICP/CPP monitoring alone may not be surrogates for PbtO2 monitoring in detecting brain hypoxia.

3. What was the “local” treatment protocol that was used in this study?

   This study was conducted in the neurointensive care unit at the Hospital at the University of Pennsylvania (HUP). This institution has published numerous articles on the use of PbtO2-guided therapy and utilizes an evidence-based treatment protocol to guide this care.