



Guidelines for the Management of Severe Traumatic Brain Injury, 4th Edition

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The *Guidelines for the Management of Severe Traumatic Brain Injury* was updated from its previous publication in 2007. Concurrently, we initiated a transition from the model of performing intermittent updates of the entire Guidelines, to a model of performing real-time literature searches and continual updates of specific topics as new evidence becomes available – the Living Guidelines model.

Topics for investigation were categorized as Treatments, Monitoring, and Thresholds. Eleven treatment topics, three monitoring topics, and four thresholds topics were specified for investigation. MEDLINE was searched from 2006 through November 2013. Relevant studies referred to us that were published after November 2013 were also reviewed. Two members of the methods team independently evaluated each study for potential for bias. Studies rated Class 1, 2, or 3 were used to derive treatment recommendations.

Included in this edition are 191publications – 5 Class 1, 48 Class 2, 135 Class 3 studies, and 3 meta-analyses. During the seven years between the 3rd and 4th Editions of this work, 95 new studies were added to the library of evidence. One Level I, eight Level IIA, nine Level IIB, and eleven Level III recommendations were made.

4 <sup>th</sup> Edition Recommendations	
LEVEL I	
Steroids	The use of steroids is not recommended for improving outcome or reducing intracranial pressure (ICP). In patients with severe traumatic brain injury (TBI), high dose methylprednisolone is associated with increased mortality and is contraindicated.
LEVEL IIA	
Decompressive Craniectomy	Bifrontal decompressive craniectomy (DC) is not recommended to improve outcomes as measured by the Glasgow Outcome Scale – Extended (GOS-E) score at 6 months post-injury in severe TBI patients with diffuse injury (without mass lesions), and with ICP elevation to values >20mmHg for more than 15 minutes within a 1-hour period that are refractory to first tier therapies. However, this procedure has been demonstrated to reduce ICP and to minimize days in the intensive care unit (ICU). A large frontotemporoparietal DC (not less than 12 x 15 cm or 15 cm diameter) is recommended over a small frontotemporoparietal DC for reduced mortality and improved neurologic outcomes in patients with severe TBI.
Nutrition	Patients should be fed to attain basal caloric replacement at least by the 5 <sup>th</sup> day and at most by the 7 <sup>th</sup> day post-injury to decrease mortality.
Infection Prophylaxis	Early tracheostomy is indicated to reduce mechanical ventilation days when the overall benefit is felt to outweigh the complications associated with such a procedure. However, there is no evidence that early tracheostomy reduces mortality or the rate of nosocomial pneumonia. The use of povidone-iodine oral care is not recommended to reduce ventilator associated pneumonia and may cause an increased risk of acute respiratory distress syndrome.
Anti-Seizure Prophylaxis	Prophylactic use of phenytoin or valproate is not recommended for preventing late posttraumatic seizures (PTS). Phenytoin is indicated to decrease the incidence of early PTS (within seven days of injury), when the overall benefit is felt to outweigh the complications associated with such treatment. However, early PTS have not been associated with worse outcomes.
Cerebral Perfusion Pressure Monitoring	Management of severe TBI patients using guidelines-based recommendations for CPP monitoring is recommended to decrease 2-week mortality.
LEVEL IIB	
Prophylactic Hypothermia	Early (within 2.5 hours), short term (48 hours post injury) prophylactic hypothermia is not recommended to improve outcomes in patients with diffuse injury.
Ventilation Therapies	Prolonged prophylactic hyperventilation with partial pressure of carbon dioxide in arterial blood (PaCO <sub>2</sub> ) of 25 mmHg or less is not recommended.
Anesthetics, Analgesics, and Sedatives	Prophylactic administration of barbiturates to induce burst suppression measured by electroencephalography (EEG) is not recommended. High dose barbiturate administration is recommended to control elevated ICP refractory to maximum standard medical and surgical treatment. Hemodynamic stability is essential before and during barbiturate therapy. Although propofol is recommended for the control of ICP, it is not recommended for improvement in mortality or 6 month outcomes, and caution is required as high dose propofol can produce significant morbidity.
Nutrition	Transgastric jejunal feeding is recommended to reduce the incidence of ventilator-associated pneumonia.
Intracranial Pressure (ICP) Monitoring	Management of severe TBI patients using information from ICP monitoring is recommended to reduce in-hospital and 2-week post-injury mortality.
ICP Monitoring Thresholds	ICP above 22 mm Hg should be treated because values above this level are associated with increased mortality.
Cerebral Perfusion Pressure (CPP) Thresholds	The target cerebral perfusion pressure (CPP) value for improved outcomes is between 60 and 70 mm Hg. Whether 60 or 70 mm Hg is the minimum optimal CPP threshold is unclear and may depend upon the patient’s autoregulatory status.

LEVEL III	
Cerebral Spinal Fluid Drainage	An external ventricular drainage (EVD) system zeroed at the midbrain with continuous drainage of cerebral spinal fluid (CSF) may be considered to ICP more effectively than intermittent use. Use of CSF drainage to lower ICP in patients with an initial GCS < 6 during the first 12 hours after injury may be considered.
Infection Prophylaxis	Antimicrobial-impregnated catheters may be considered to prevent catheter-related infections during external ventricular drainage (EVD).
Deep Vein Thrombosis Prophylaxis	Low molecular weight heparin (LMWH) or low dose unfractionated heparin may be used in combination with mechanical prophylaxis. However, there is an increased risk for expansion of intracranial hemorrhage. In addition to compression stockings, pharmacologic prophylaxis may be considered if the brain injury is stable and the benefit is considered to outweigh the risk of increased intracranial hemorrhage.
Advanced Cerebral Monitoring	Jugular bulb monitoring of arteriovenous oxygen content difference (AVDO <sub>2</sub> ), as a source of information for management decisions, may be considered to reduce mortality and improve outcomes at 3 and 6 months post-injury.
Blood Pressure Thresholds	Maintaining systolic blood pressure (SBP) above 100 mm Hg may decrease mortality and improve outcomes.
ICP Thresholds	A combination of ICP values and clinical and brain CT findings may be used to make management decisions.
CPP Thresholds	Avoiding aggressive attempts to maintain CPP above 70 mm Hg with fluids and pressers may be considered because of the risk of adult respiratory failure. CPP <50 mm HG should be avoided.
ACM Thresholds	Jugular venous saturation of < 50% may be a threshold to avoid in order to reduce mortality and improve outcomes.