Vanderbilt Children's Hospital
Pediatric Severe TBI Management Algorithm

V2.2 11/2022

Check
- Patient position: head neutral, HOB 30°
- Cervical collar: appropriate size, fit
- Equipment functioning: good waveform
- No recent interventions
- Exclude seizure activity: EEG as indicated

Fluid therapy, Vasopressors
- CPP should be maintained > 40 mmHg at all times, or above higher age-based targets while receiving ICP-targeted interventions
- Bolus with NS as needed to achieve euvolemia
- Once euvolemic, use inotropic/vasopressor support as indicated

CPP Targets by Age

Age (yrs)	CPP (mmHg)
< 1 year	45
1-4 years	50
5-7	55
> 7 years	60

CSF Drainage Options
- Not possible if ICP monitor used and not EVD
- EVD management per Peds NSGY

Sedation/Analgesia/Sz Prophylaxis
- First 24 hours: remifentanil infusion
- After first 24 hours: fentanyl, hydromorphone, or morphine infusion titrated for exam. Add dexmedetomidine, ketamine, and/or midazolam infusion as needed
- Avoid hypotension
- Once sedation/analgesia is adequate, minimize boluses of fentanyl or midazolam
- Consider neuromuscular blockade for ICP > 20 mmHg refractory to other therapies

Hyperosmolar Therapy
- **3% Saline** 5-10 cc/kg bolus over 5-10 min.
  - If needed, start 0.5 mEq/kg/hr (1 ml/kg/hr), titrate as needed for goal Na 150-160
- **23.4% Saline**, 0.5cc/kg bolus over 10 min.
  - *Must be infused through central line.*
- **Mannitol** 0.25-0.5 g/kg for rescue therapy only when Na 150-160, serum osmolarity < 320, and ICP > 20 mmHg for 5 min

Treatment-Refractory Intracranial Hypertension
- Is salvage therapy appropriate? (Assess mechanism of injury, best GCS, age, pupil reactivity, CT scans)

- Consider:
1. Barbiturate therapy (burst suppression)
2. Hyperventilation (pCO_2 28-34mmHg)
3. Decompressive craniectomy

GCS < 9 → Surgery as indicated

Art line, $EtCO_2$, CVP, ICP monitor, core temp

Goals of Management:
1. Maintain adequate MAP/CPP
2. Fluids to maintain CVP 5-10 mmHg (if available)
3. Na^+ > 140
4. Hct > 21%
5. Adequate sedation and analgesia
6. Brain/core temp 36-37.5°C (cooling blanket to bedside)
   a. See Neuroprotective Targeted Temperature Management SOP
7. O_2 sat > 93%, pCO_2 35-40mmHg (tolerate higher if normal ICP)
8. Glucose control 80-180
9. Levetiracetam x 7 days for early post-traumatic seizure prophylaxis (see accompanying document)
10. Early enteral nutrition via feeding tube unless contraindicated

ICP ≤ 20 mmHg? → Fluid therapy, vasopressors to maintain normotension

ICP > 20 mmHg for 5 min? → Ensure adequate sedation/analgesia → Persistent ICP > 20 mmHg? → Hyperosmolar therapy *(3% saline preferred vs. mannitol)* → CPP deficit? → Fluid therapy, vasopressors → Persistent ICP > 20 mmHg? → Neuromuscular blockade, additional hyperosmolar therapy, Consider repeat CT scan → Persistent ICP > 20 mmHg?

Seizure Prophylaxis in Pediatric Severe Traumatic Brain Injury

Division of Pediatric Critical Care Medicine
Department of Pediatric Surgery
Department of Neurological Surgery
Division of Pediatric Neurology

Rationale

Prophylactic anti-epileptic drugs are suggested in the 3rd Edition of the Guidelines for the Management of Pediatric Severe Traumatic Brain Injury (TBI) for the prevention of early posttraumatic seizures (PTS) within 7 days of injury[1]. This guideline is based on 2 retrospective studies. The first study from 1993 noted that children with severe TBI who were placed on prophylactic phenytoin had a 15% incidence of early PTS compared to 53% in children who received no seizure prophylaxis[2]. In 2011, a second retrospective study demonstrated that seizure prophylaxis administration in their cohort was associated with a significantly decreased odds ratio of developing early PTS[3]. Two subsequent studies have studied the use of levetiracetam for the prevention of early PTS[4,5]. Neither of these studies provided sufficient evidence to support a recommendation for a specific prophylactic agent. However, the effect of phenytoin on cognitive recovery following brain injury has been questioned. Levetiracetam does not appear to interfere with cognitive recovery, requires no therapeutic monitoring, and has a favorable side effect profile.

Practice Management Guideline

Indications

Pediatric patients with severe traumatic brain injury (post-resuscitation Glasgow Coma Score 3-8) should receive levetiracetam for early PTS prophylaxis.

- Therapy should not continue beyond 7 days unless documented seizure activity, Neurology has been consulted, or continuing home medications for a known seizure disorder.

Exception

- Hypersensitivity or previous adverse reaction to levetiracetam
- Pre-existing seizure disorder

If seizure prophylaxis is omitted based on an Exception, please document on the inpatient problem list and/or daily progress notes.

Prophylaxis dosing

- Levetiracetam 20mg/kg (max 1g) IV/enteral load → 10mg/kg (max 500mg) IV/enteral q12h x 7 days
- Levetiracetam can be converted to the enteral route at the same dose as the IV route
- Please consult Pharmacy for dosing recommendations in the setting of decreased renal function

Follow-up

- If seizure activity is documented at any point in the continuum of care, a Neurology consult should be placed to ensure long-term management.

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Last revision: November 2, 2022

References

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3 Liesemer, K., Bratton, S. L., Zebrack, C. M., Brockmeyer, D. & Statler, K. D. Early post-traumatic seizures in moderate to severe pediatric traumatic brain injury: rates, risk factors, and clinical features. *J Neurotrauma* **28**, 755-762, doi:10.1089/neu.2010.1518 (2011).

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5 Pearl, P. L. *et al.* Results of phase II levetiracetam trial following acute head injury in children at risk for posttraumatic epilepsy. *Epilepsia* **54**, e135-137, doi:10.1111/epi.12326 (2013).