Moderate/Severe Traumatic Brain Injury (TBI) Care Guideline

Acute ED Management (within 30 mins of arrival)

Patients presenting following any mechanism of injury that impacts the brain will be considered candidates for this care guideline if they meet **one** of the following criteria:

Inclusion Criteria:
- Moderate traumatic brain injury (GCS 9-12) or
- Severe traumatic brain injury (GCS 3-8)

Exclusion Criteria:
- Neurodegenerative or congenital insult to the brain;
- Mild traumatic brain injury (GCS ≥13)

Goals: Prevent Secondary Injury
- Airway protection
- Avoid hypoxemia
- Avoid hypotension
- Optimize MAP per age related norms (as indicated in table below)
- Evaluate and treat elevated ICP
- CT within 30 minutes
- Assist with timely neurosurgical intervention as necessary

Assessment and Interventions

Initiate appropriate tier trauma response

- **Acute trauma evaluation by the ED physician and trauma/neuro surgeon**

- **Airway and Breathing**
  ATLS protocol- RSI for GCS ≤10 or unable to protect airway
  Keep Sao2 100%
  EtCO2 35-40 mmHg

Age in years	Goal CPP	Normal BP Range	Normal MAP
0 – 1	40-50	75/40 – 105/66	52-80
2 – 4	50-60	87/53 – 105/66	64-80
5 - 8	50-60	97/57 – 112/71	70-85
>8	50-70	112/80 – 128/80	90-96

- **Circulation**
  Establish 2 large bore IVs
  IVF with NS
  Place arterial line and central IV catheter (severe TBI)
  Optimize MAP per age related norms
  Place OG and Foley
  Assess for signs and symptoms of shock and/or any unidentified injuries
  Labs: Panel 18, Type and Cross, CBC with platelets, PT, PTT

- **Neurologic**
  Frequent neuro assessment, including pupil exam. Report any pupillary changes, changes in LOC, worsening of GCS, or worsening neurological symptoms to provider immediately
  Monitor for s/sx of acute elevated ICP
  Focal neurological exam deficit (e.g. unilateral dilated pupil) and/or
  Cushing's Triad (hypertension, bradycardia, abnormal breathing).

  If symptomatic consider:
  Sedation
  Hyperosmolar therapy: Mannitol 0.5-1 gram/kg – may consider the use of hypertonic saline
  Hyperventilation to transiently lower EtCO2 to <35 –caution AVOID prolonged duration due to cerebral ischemia

- **Radiology/OR**
  STAT head CT
  Immediate neurosurgical management, as indicated
  Consider: EVD, LICOX, Craniectomy

For LICOX:
Refer to *Policy F870: Cerebral Tissue Oxygenation/LICOX® Monitoring: Assisting with Insertion, Monitoring and Care* for more information.

Admit to PICU
Refer to PICU Care Guidelines on Next Page

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6-28-2017

Reassess the appropriateness of Care Guidelines as condition changes and 24 hrs after admission. This guideline is a tool to aid clinical decision making. It is not a standard of care. The physician should deviate from the guideline when clinical judgment so indicates.

Moderate/Severe Traumatic Brain Injury (TBI) Care Guideline

PICU Stabilization Phase "Getting in the Zone"

Goal: Prevent Secondary Injury

- SaO2 100%
- PaCO2 35-40 mmHg
- Avoid hypotension
- Optimize MAP per age related norms (as indicated in table below)
- Maintain ICP< 20 mmHg and if LICOX, PbtO2 ≥ 20 mmHg (titrate PaCO2)

Assessment and Interventions

Within 1-2 hours of PICU Admit

- Neuro assessment hourly, including pupil checks with pupillometer
- Report any pupillary changes, changes in LOC, worsening of GCS, or worsening neurological symptoms to provider immediately
- Airway Management (intubation)
- Place patient on temperature regulating blanket w/ rectal temp probe
- Maintain normothermia (36-37)
- Avoid shivering
- Set-up/monitor arterial line and CVP
- Insert OG and Foley
- Administer fluids to keep CVP 4-8
- Optimize MAP per age related norms with fluids/vasopressors
- ICP Monitoring - Drain CSF for ICP > 20 mm Hg for > 5 minutes
- Sedate- the early use of Propofol is only indicated when primary analgesic and sedation agents fail to keep ICP<20. The Pediatric Intensivist, in consultation with the neurosurgeon, will make the decision to begin Propofol in patients with refractory ICP
- Use BIS monitor to titrate level of sedation.
- Monitor triglycerides and pH daily.
- If Propofol infusion is required > 48 hours, consider pentobarbital
- Consider vecuronium drip
- Cognitive Rest

Age in years	Goal CPP	Normal BP Range	Normal MAP
0 – 1	40-50	75/40 – 105/66	52-80
2 – 4	50-60	87/53 – 105/66	64-80
5 - 8	50-60	97/57 – 112/71	70-85
>8	50-70	112/80 – 128/80	90-96

If using LICOX

Determine optimal CPP for patient (Maintain CPP in range to maintain PbtO2>20 and/or ICP < 20)
If LICOX and PbtO2 <15, place on increased FiO2 with goal to titrate as soon as possible (up to 24 hours)
Note: this is a temporary intervention only until PbtO2 ≥ 20 then titrate to maintain PbtO2
**Note: The individual patient's optimal CPP must be determined using the Goal CPP, a Pbt02 >20mm Hg and an ICP <20mm Hg.

Refer to Policy F870: Cerebral Tissue Oxygenation/LICOX® Monitoring: Assisting with Insertion, Monitoring and Care for more information.

Cognitive Rest

1. Dim lights in room.
2. Promote rest and periods of uninterrupted sleep. Ensure that the room remains quiet and calm.
3. No TV, cell phone, computer, iPad, or other electronic devices-including video games.
4. Avoid activities that cause mental exertion (reading, homework).
5. Limit visitors and length of visit based on the patient's condition.
6. Only one person should speak at a time, use short sentences and normal tone. Keep topics simple.
7. Assess social dynamics of visitors and refer to social services, as needed.
8. Avoid caffeine, concentrated sugar/sweets, and junk food.

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Moderate/Severe Traumatic Brain Injury (TBI) Care Guideline

PICU Maintenance Phase "Staying in the Zone"

CHOC Children's

Goal: Prevent Secondary Injury

Maintain ICP< 20 mmHg and optimize CPP (per table);
If LICOX, maintain PbtO2 ≥ 20 mmHg

Assessment and Interventions

- Neuro assessment hourly, including pupil checks with pupillometer
- Report any pupillary changes, changes in LOC, worsening of GCS, or worsening neurological symptoms to provider immediately
- Determine optimal CPP for patient, Maintain CVP 4-8
- Maintain FiO2 per pulmonary needs
- Use vasopressors to optimize MAP once euvolemic
- Monitor I & O closely, with goal balance I=O with 48-72 hours of admission
- Sedate via continuous Midazolam or Precedex, adjust with BIS (if using)
- Deliver pain control with continuous Morphine or Fentanyl
- Provide chemical paralysis with paralytic of choice only if needed for ventilator management; Use BIS monitoring and adjust paralytic with Train of Four
- Seizure prophylaxis
- Keep temperature 36-37 degrees for first 7 days, avoid shivering
- Cognitive Rest (refer to previous page for detailed interventions)
- HOB at 30 degrees (unless otherwise indicated) with head/neck midline
- Begin nutrition via appropriate route as soon as possible. If enteral route established, attempt post pyloric feeding.
- Monitor pH, base deficit, and lactate levels q 6 hours x 48 hours.
- Monitor serum electrolytes especially Na+, glucose, serum osmolarity keep <320, K+, Ca+, and Mg+
- PT, OT and Speech consults for cognitive evaluation and recommendations for treatment

Age in years	Goal CPP	Normal BP Range	Normal MAP
0 – 1	40-50	75/40 – 105/66	52-80
2 – 4	50-60	87/53 – 105/66	64-80
5 - 8	50-60	97/57 – 112/71	70-85
>8	50-70	112/80 – 128/80	90-96

Acute ICP and/or PbtO2 Management

Optimize Nursing Interventions
- First check monitors, troubleshoot to ensure valid readings
- HOB at 30, unless otherwise ordered, neck midline
- Drain CSF
- Administer FIO2 100% x 15 minutes
- Optimize PaCO2 35-40
- Check labs: CBC and ABG

Optimize CPP, CVP and MAP
- Give IV NS or 5% albumin to increase CVP
- Consider packed RBCs if Hgb <11 or Hematocrit < 33
- Start vasopressors: Dopamine, Phenylephrine, Epinephrine, and/or Norephinephrine

Sedate
- Increase versed/precedex and/or fentanyl drips

Give Osmotics
- Mannitol 0.5 g/kg bolus or 3% Saline 2.5mL/kg (up to max of 200mL) IV over 20 minutes.
- Keep serum osmo <320; Provide fluid replacement to maintain euvolemia.
- Monitor sodium; If sodium approaches 155, hold mannitol and contact provider.

Paralyze
- Consider vec drip, use train of four monitoring to achieve 0-1/4

Start/Titrate Propofol or Barbiturates
- The intensivist, in consultation with the neurosurgeon, will make the decision to begin propofol in patients with refractoru ICP. Monitor triglycerides and pH daily. If propofol infusion is required > 48 hours, consider use of pentobarbital for ICP control
- Titrate to maintain BIS <20 and SR > 60%
- Consider EEG

Hypothermia
- Consider hypothermia, goal of 35 degrees C
- Avoid shivering

Decompressive Craniectomy
- Consider aggressive decompressive craniectomy if ICP refractory to interventions

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Moderate/Severe Traumatic Brain Injury (TBI) Care Guideline
PICU Weaning Phase

CHOC Children's

Goal: Prevent Secondary Injury
Maintain ICP< 20 mmHg
If LICOX, maintain PbtO2 ≥ 20 mmHg

Assessment and Interventions

- Discontinue paralytics
- Normalize CPP/CVP
- Discontinue EVD and LICOX
- Decrease sedation/analgesia-wean and start methadone, if needed
- Assess for pre-existing physical, cognitive, emotional, and sleep pattern symptoms to identify baseline assessment for concussion symptoms
- Ensure PT, OT and Speech consults are completed
- Prior to mobilizing patient, assess patient's fall risk and provide assistance with mobility to ensure safety
- Assess for pre-existing physical, cognitive, emotional, and sleep pattern symptoms to identify baseline assessment for concussion symptoms.

Discharge Criteria

- Ensure cognitive evaluation/concussion screen by speech therapy has been completed prior to discharge
- Tolerating regular diet
- Ambulating without difficulty/appropriate supportive equipment
- Pain controlled with oral pain medications

Patient Education

- Provide family with Head Injury handout which includes common post-concussive symptoms and direction on when to call the doctor immediately (available on Clinical Education page under Patient-Family Handouts)

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