DENVER HEALTH TRAUMA
LEVEL ONE ADULT & LEVEL TWO PEDIATRIC
ERNEST E. MOORE SHOCK TRAUMA CENTER

PURPOSE

To provide guidelines and recommendations for the initial treatment and management of adult patients with severe TBI

SCOPE

Patient population: *Adult*

A. *Inclusion:* adult patients with severe TBI
B. *Exclusion:* pediatric patients

DHHA – All locations and departments.

DEFINITIONS

Severe TBI : Glasgow Coma Scale (GCS) of 3 to 8 without systemic sedation and after resuscitation
Moderate TBI : GCS of 9 to 12 without systemic sedation and after resuscitation

GUIDELINE

A. Intracranial Pressure Monitoring:

- ICP monitoring is performed based upon admission GCS. Admission GCS is determined after paralytics and sedation wear off.
- Consider ICP monitor placement when:
  - GCS 3-8 and traumatic brain injury, or
  - A patient with an abnormal CT Head in whom a neurologic exam will be unable to be obtained for any extended period (e.g. prolonged general anesthesia or neuromuscular blockade, hemodynamic instability with inability to obtain imaging), or
  - Unexplained decline in neurologic exam, acute clinical deterioration
  - Unilateral or bilateral motor posturing

If a patient has an above listed indication for ICP monitoring but does not receive an ICP monitor, please contact the Neurosurgery service. Know if a relative contraindication exists (coagulopathy, need for MRI, and presence of extra ventricular drain (EVD)).

B. Principles of Care:

- Neuro checks hourly and as needed by changing exam
- Urine output hourly
- Elevate HOB ≥30 degrees, unless contraindicated by spine fractures where reverse Trendelenburg may be used.
- Clear spine if possible, including thoracic and lumbar region
- Facilitate venous drainage
- Ensure adequate pain control with intermittent or continuous opiate infusion.

- Propofol should be the first choice for sedation in the acute phase. Transition to benzodiazepine if Propofol is not tolerated or if sedation remains necessary after day 3, in consultation with Neurosurgery.
- Maintain the patient in a euvolemic state.
- Maintain serum sodium > 140.
- Maintain normothermia. Consider cooling measures (acetaminophen, cooling blanket) for temperatures >37.7°C.
- Avoid tight cervical collars and endotracheal tube ties. Maintain the head and neck in a neutral position.
- If patient requires intervention for intracranial hypertension:
    - Obtain or verify recent BMP and serum osmolarity
    - Obtain q6 BMP and serum osmolarity; consider adding ABG, CBC, and/or r-TEG if clinically indicated or on continuous hypertonic therapy
    - Place a subclavian (preferentially) or jugular CVC for hyperosmolar infusions.
    - Place an arterial line for blood pressure measurement and frequent labs
        - Utilize FloTrac as indicated
    - Refer to Goals of Care for parameter targets.

- **Goals of Care:**

Neuro	ICP	<22 mmHg***
	(CPP)	>60 mmHg
	Seizure prophylaxis	Consider Levetiracetam x 7 days
	Head of bed	>30 degrees
CV	SBP	>90 mmHg
Pulmonary	PaO2	> 60 mmHg
	PaCO2	35-40 mmHg
Hematology	INR	≤1.5
	TEG	Normalized values, refer to MTP
	Platelets	≥100,000/mm
	Hgb	≥7 g/dL
	VTE prophylaxis	SCDs; start VTE meds 24-48hours after stable CT Head
Endocrine	Glucose	110-150 mg/dL
Electrolytes	Serum Osmolarity	<330 (OR gap>20)
	Serum Na	145-165
GI	Nutrition	Early enteral feeding; add ICU goal
	Stress ulcer prophylaxis	sucralfate

*** consider history and physical exam, CT scan, and all other available data

C. For Sustained (>5 min) ICP Elevations: Goal ICP<22.

- First Tier Therapies:
    - Non- invasive, non-pharmacological interventions
    - Ensure adequate sedation and analgesia
    - Hyperosmolar therapy:
        - Hold hypertonic saline if serum Na >165 and/or serum osmolarity >330
        - Hypertonic saline:

- ❖ 250cc of 3% NaCl infused over 20 minutes up to q4h prn OR
- ❖ 30cc of 23.4% NaCl infused over 15 minutes up to q4h prn (May be re-dosed if ICP remains elevated)

- Mannitol 1 g/kg over 20 minutes followed by 0.25 g/kg q6 hours.3
  - ❖ Hold mannitol if serum osmolarity is >330 or osmolar gap > 20

- Initiate CSF drainage via ventriculostomy if indicated; if ventriculostomy is present, ensure that it is patent and functioning (level and frequency to be determined by neurosurgery)

If unresponsive to first tier therapy- consider an expanding mass lesion with ICP elevations refractory to therapy and obtain a CT Head

- Second Tier Therapies
  - Verify patent airway, oxygenation, and ventilation.
  - Temporary hyperventilation to PaCO2 30-35 mmHg.
  - Continuous hypertonic saline infusion (3%) via central venous catheter
  - Paralysis:
    - Atracurium 0.5 mg/kg bolus followed by 5-15 mcg/kg/min continuous infusion
      - ❖ *Initiate infusion at 5 mcg/kg/min. Monitor depth of blockade using a train of 4 assessment and titrate by 1 mcg/kg/min every 10 min to achieve {1-2 twitches on train of 4}. Do not titrate if < 1 twitches on a train of 4. Do not exceed 15 mcg/kg/min. Once clinical goal achieved, monitor train of 4 every 2 hours. If <1 twitches on train of 4, decrease infusion by 1 mcg/kg/min every 30 mins to achieve 1-2 twitches on train of 4.*
    - Alternative: vecuronium
  - Craniectomy
- Third Tier Therapy
  - Barbiturate coma with continuous EEG monitoring

D. Goal Cerebral Perfusion Pressure >60 mmHg would love to see an algorithm given the interactions with ICP

1) Ensure ICP <22 (see previous)
2) Ensure euvolemia:
   - Urine output > 0.5cc/kg/hour
   - CVP > 5mmHg
   - SVV < 15
   - Place pulmonary artery catheter if volume status is unclear utilizing arterial line and CVC
3) Begin vasopressors and Alert Neurosurgery:
   - Phenylephrine or norepinephrine
   - Vasopressin

EXTERNAL REFERENCES

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DHHA RELATED DOCUMENTS

None

ATTACHMENTS

None

This Clinical Care Guideline is intended to assist care providers in the provision of patient care. This document serves as a guide, and is not a substitute for independent medical decision-making.