Traumatic Brain Injury- Initial Management Guideline

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PURPOSE: To provide guidelines to help standardize the diagnosis and early management of traumatic brain injury.

DEFINITION(s):

Traumatic Brain Injury: An injury to the brain resulting in disorders of motor, sensory, and/or cognitive function.

GUIDELINE:

1) Procedure:
    a. Perform primary survey according to Advanced Trauma Life Support (ATLS) guidelines:
        i. Provide urgent airway for Glasgow Coma Score (GCS) ≤ 8
        ii. Hypoxia can be devastating to the injured brain
            1. Low threshold for surgical airway in the setting of severe TBI
        iii. If sedative and paralytics are to be used, conduct a rapid, but thorough neurologic exam including:
            1. Level of consciousness, including GCS
            2. Presence of rectal tone, if unable to move lower extremities
            3. Pupillary response
            4. Brain stem reflexes if appropriate (eg corneal and gag reflex)
            5. Note presence of bruises, Battle's signs, raccoon eyes, lacerations, etc.
            6. CSF otorrhea or rhinorrhea or presence of cerebral tissue
            7. Penetrating injury or palpable skull fracture in scalp laceration
        iv. Maintain C- Spine precautions, including rigid collar.
    b. Assess for and treat chest injury (pneumo/hemothorax), ventilate to maintain PaCO2 between 35 – 40mmHg.
        i. Arterial Blood Gas (ABG) should be obtained early in the resuscitation to prevent hypercarbia.
    c. Determine hemodynamic status; resuscitate from shock, maintain normovolemia and normal hemodynamics.
    d. If patient is not sedated, perform neurologic exam (see below)
    e. Expose patient, when able to look for any obvious injury
        i. Keep patient covered once assessment is complete
2) Hemodynamic Goals
    a. Generally, clinical parameters should be maintained within NORMAL parameters
    b. Advanced monitors (ICP, CPP, PbO2) not typically available in the ED setting
    c. Empiric SBP and MAP goals based on National Best Practice Guidelines

i. SBP > 110
ii. MAP > 80
iii. SpO2 > 94%
iv. Core Temp 36-38oC
v. PaO2 80-100 (avoid hyperoxia)
vi. PaCO2 35-45mmHg
vii. pH 7.35-7.45

3) Initial Hematologic and Electrolyte Goals (these will serve as baseline, may be adjusted in the ICU)
   a. Hemoglobin > 7g/dL
   b. Platelet Ct > 75,000 /mm^3
   c. Serum Sodium 135-145 mEq/L
   d. Serum Osmolality < 320mOsm
   e. Glucose 100-180mg/dL
4) Anticoagulant Reversal
   a. Patients with moderate and severe TBI should be considered for rapid reversal of anticoagulant therapy.
   b. Thromboelastography with platelet mapping should be ordered for anyone on a P2Y12 inhibitor (clopidogrel, ticlopidine, ticagrelor, prasugrel) or Aspirin
      i. See FH Guideline (internal link to Pharmacy Medication Guidelines page): Management of Anticoagulation Associated Bleeding and Reversal of Anticoagulation governing this.
   c. Patients with minor TBI may not require immediate reversal
      i. Risk of reversal must be weighed against risk of further intracranial bleeding
      ii. Coordinated decision between Trauma/EM and Neurosurgery
         1. Decision will be DOCUMENTED in the patients EMR
5) Basic neurologic assessment
   a. Assess and report each component of GCS (eye, verbal, and motor)
      i. Observe and record spontaneous patient activities and responses prior to the application of any stimulus.
      ii. Provide verbal stimuli while observing for eye opening, verbal, or upper extremity motor responses. Note: Document the best upper extremity response for calculation of GCS motor.
      iii. Use another stimulus to elicit a response (e.g., fingertip pressure, supra-orbital pressure, trapezius pinch) if the patient has no response to verbal stimuli.
      iv. Document the type of stimulus applied (i.e., central or peripheral), and then use this stimulus as a standard for future assessments.
   b. Other neurologic symptoms should be documented
      i. Lateralization
      ii. Sensory and motor deficits
      iii. Abnormal eye movements
   c. Pupillary light response should be captured and documented

d. Quantitative pupillometry can be useful, but not necessary during initial phases of resuscitation
    i. If measured, the following should be documented:
        1. Starting diameter (mm)
        2. Ending diameter (mm)
        3. % Change Latency (s)
        4. Average constriction velocity (mm/s)
        5. Average dilation velocity (mm/s)

6) Imaging
    a. A non-contrast head CT should be obtained for anyone ≥16y/o with LOC or post-traumatic amnesia if the following are also present: *(Significant active scalp hemorrhage should be stopped with rapid wound closure prior to going to CT scanner)*

        i. GCS < 15

        ii. Suspected open or depressed skull fracture

        iii. Signs of basilar skull fracture (e.g., raccoon eyes, Battle's sign)

        iv. Age 60 years or older

        v. Post-traumatic seizure

        vi. Coagulopathy

        vii. Drug or alcohol intoxication

        viii. Two or more episodes of vomiting

        ix. Amnesia before impact lasting more than 30 minutes

        x. Dangerous mechanism of injury (e.g., pedestrian struck by vehicle, ejection from vehicle, fall from > 3 feet or 5 steps)

    b. CT Should be abandoned if the patient requires an emergent operation to stop hemorrhage or immediately repair a life – threatening injury.
        i. Notify neurosurgery immediately of this situation
    c. Further imaging can be obtained for ongoing suspicion of other neurologic injuries
        i. See Management of Blunt Extra-Cranial Carotid and Vertebral Artery Injury Guideline
        ii. MRI or other CT studies as recommended by neurosurgery

7) Neurosurgical EMERGENCY: A 30-minute response from time of page to presence at the patient bedside is required for neurosurgery.
    a. CT evidence of TBI with GCS < 9

   b. Intracranial mass lesion w/ GCS 9-12
      i. EDH/SDH with midline shift
   c. Penetrating intracranial injury
   d. Open, depressed skull fracture
   e. Neurologic deficit as a result of a potential spinal cord injury
   f. Trauma surgeon discretion
8) If neurosurgery capabilities are encumbered or overwhelmed the faculty neurosurgeon will contact the physician covering call as neurosurgery trauma backup.
9) Seizures:
   a. Acute Seizure
      i. Administer benzodiazepine (ie: lorazepam 4mg IV) repeatedly, until seizure breaks.
      ii. Loading and maintenance doses of anti-epileptic agent (levetiracetam, phenytoin, or valproate)
   b. Seizure Prophylaxis-
      i. Patients with TBI and any of the following findings should receive prophylactic antiseizure medication for 7 days; longer term treatment may be required for ongoing seizure activity.
         1. GCS ≤ 10
         2. Immediate post-traumatic seizure
         3. Post-traumatic amnesia > 30 minutes
         4. Subdural hematoma
         5. Epidural hematoma
         6. Intraparenchymal hematoma/contusion
         7. Penetrating brain injury
         8. Linear or Depressed skull fracture
         9. Age ≤ 65 y/o
         10. Chronic alcoholism
         11. Empiric ICP treatment
      ii. Patients with the following findings (in the absence of above) do not require seizure prophylaxis:
         1. Isolated traumatic SAH or IVH (or a combination of both)
         2. Negative head CT
   c. All patients
      i. Patient's head of bed should be elevated while maintaining spine precautions.
      ii. Neck maintained midline and C-collar should snug enough to immobilize the spine in neutral position but not be so tight as to compress jugular veins / impede venous drainage.
      iii. Appropriate analgesia and sedation should be administered.
      iv. Normothermia should be maintained.
   d. Concern for elevated ICP
      i. Either Mannitol or Hypertonic saline may be utilized
         1. *Mannitol may cause hypotension in hypovolemic patients*

ii. Patients with impending herniation may be hyperventilated as a bridge to further therapy
iii. Neurosurgery should be IMMEDIATELY alerted to the above scenarios

10) Scalp Laceration:
    a. Exsanguinating hemorrhage can occur from scalp laceration
    b. Raney clips, suture, and skin staples are all available in the Trauma Room and may be used to temporarily control bleeding from large scalp avulsions.
11) Special situations
    a. Life threatening hemorrhage and operable TBI
        i. A craniotomy may be performed at the same time as other operative procedures. This should be coordinated at the faculty level. Consider all possibilities if patient is to be taken to the operating room.
    b. Non-survivable Traumatic Brain Injuries
        i. Confirmation of magnitude of brain injury should be made with the Neurosurgery team.
        ii. Versiti organ donation team should be made aware of the situation per hospital policy.
        iii. Family members should be updated as quickly as possible and, if possible, allowed into the resuscitation bay
        iv. After assessment and confirmation of non-survivable prognosis patient should be admitted to the Trauma Service and rapidly transported to the ICU
        v. A consult to Palliative Care may be made if assistance is necessary.
        vi. For further guidance, please reference Severe Traumatic Brain Injury Management Guidelines
    c. Direct admissions (to neurosurgery or neurology/critical care from referring hospitals)
        i. The trauma team should be consulted as soon as possible but no later than 12h of admission to perform a tertiary survey.

RELATED POLICIES/GUIDELINES:

Management of Blunt Extra-Cranial Carotid and Vertebral Artery Injury Guideline (link available externally)

Severe Traumatic Brain Injury Management Guidelines (link available externally)

Management of Anticoagulation Associated Bleeding and Reversal of Anticoagulation (internal link only)

REFERENCES:

Best Practice Guidelines: The Management of Traumatic Brain Injury. *American College of Surgeons.* (2024). https://www.facs.org/media/vgfgjpfk/best-practices-guidelines-traumatic-brain-injury.pdf

Resources for optimal care of the injured patient. American College of Surgeons. (2025, July). https://www.facs.org/quality-programs/trauma/quality/verification-review-and-consultation-program/standards/

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