Head Injury

Aliases

None noted

Patient Care Goals

1. Limit disability and mortality from head injury by:
    a. Promoting adequate oxygenation (avoid hypoxia and hyperventilation).
    b. Promoting adequate cerebral perfusion (avoid hypotension).
    c. Limiting development of increased intracranial pressure.
    d. Limiting secondary brain injury.

Patient Presentation

Inclusion Criteria

Adult or pediatric patient with blunt or penetrating head injury—LOC or amnesia not required

Exclusion Criteria

No recommendations

Patient Management

Assessment

1. Maintain cervical stabilization [See Spinal Care Guideline].
2. Primary survey per the General Trauma Management Guideline.
3. Monitoring:
    a. Conduct continuous pulse oximetry
    b. Conduct frequent systolic and diastolic blood pressure measurement.
    c. Conduct initial neurologic status assessment and reassessment with any change in mentation.
    d. Apply continuous waveform ETCO2, if available, in moderate to severe head injury.
4. Secondary survey pertinent to isolated head injury:
    a. Head: Gently palpate skull to evaluate for depressed or open skull fracture.
    b. Eyes:
        i. Evaluate pupil size and reaction to light to establish baseline.
        ii. Reassess pupils if decrease in mentation.
    c. Nose, mouth, and ears: Evaluate for blood or other fluid drainage.
    d. Face: Evaluate for bony stability.
    e. Neck: Palpate for cervical spine tenderness or deformity.
    f. Neurologic:
        i. Perform neurologic status assessment (GCS or AVPU).
        ii. Evaluate for focal neurologic deficit: motor and sensory.

Treatment and Interventions

Note: These are not necessarily listed in the order they are to be performed, but are grouped by conceptual areas.

1. Airway:
    a. Administer high-flow oxygen via NRB (non-rebreather) as a precaution against unanticipated deterioration. Goal is to maintain blood oxygen saturation 94-98% and prevent any desaturations below 90%
    b. If patient unable to maintain airway, consider oral airway (nasal airway should not be used with significant facial injury or possible basilar skull fracture) [EMR].
    c. BVM (bag-valve-mask) ventilation if high flow oxygen (HFO)/nonrebreather (NRB)

inadequate to maintain good airway and/or oxygenation [EMR].
    d. Place supraglottic airway [EMR/EMT] or perform endotracheal intubation [PARA] or if BVM ventilation ineffective in maintaining oxygenation or if airway is continually compromised.
2. Breathing:
    a. For patients who cannot maintain adequate oxygenation with NRB, start BVM ventilation:
        a. 15 years old or older: 10 breaths per minute
        b. 2–14 years old: 20 breaths per minute;
        c. Less than 2 years old: 25 breaths per minute
    b. SGA placement or ETI should only be performed if BVM ventilation fails to maintain adequate oxygenation. With advanced airways, manage with a target EtCO2 of 40 (normal range 35–45 mmHg).
    c. Do not induce hypocapnia through hyper-/overventilation unless directed by medical consultation.
3. Circulation:
    a. Wound care
        a. Control bleeding with direct pressure if no suspected open skull injury.
        b. Apply moist sterile dressing to any potential open skull wound.
        c. Cover an injured eye with moist saline dressing and place cup over it.
    b. Moderate or severe closed head injury
        a. Blood pressure: Hypotension
            1. Avoid hypotension and low cerebral perfusion by administering normal saline bolus 20 mg/kg ***[AEMT]*** to achieve the following goals (Do not wait until after the patient is already hypotensive—prevent hypotension):
            2. Adult (age greater than 10 yo): Maintain SBP greater than or equal to 110 mmHg.
            3. Pediatric: Maintain SBP:
                a. Less than 1 month old: greater than 70 mmHg
                b. 1–12 months old: greater than 84 mmHg
                c. 1-5 years old: greater than 90mmHg
                d. 6 -10 years old: greater than 100mmHg
        b. Blood Pressure: Hypertension
            1. In case of suspected or confirmed traumatic intracranial hemorrhage, maintain SBP less than 160 unless given different parameters by the receiving facility/medical control.
            2. Preferred agents
                a. Labetalol [PARA]
                b. Nicardipine [PARA]
                c. Hydralazine [PARA]
                d. **Nitroglycerin infusion [PARA]:** only if no other option or being used to treat concurrent cardiac event
    c. Do not delay transport to initiate IV access.
4. Disability:
    a. Evaluate for other causes of altered mental status; check blood glucose.
    b. Conduct spinal assessment and management, per Spinal Care guideline.
    c. Perform and trend neurologic status assessment (moderate/severe: GCS 3-13, P {pain} or U {unresponsive} on AVPU scale).
        a. Early signs of deterioration:
            1. Confusion
            2. Agitation
            3. Drowsiness
            4. Vomiting
            5. Severe headache
        b. Monitor for signs of herniation.
    d. Severe head injury: Elevate head of bed 30 degrees.
5. Use transport destination specific to head trauma.

a. Preferential transport to highest level of care within regional trauma system:
    a. GCS 3–13, P (pain) or U (unresponsive) on AVPU scale
    b. Penetrating head trauma
    c. Open or depressed skull fracture

6. Interfacility Considerations
    a. Continue medications for reduction of intracranial pressures primarily in cases of suspected impending herniation
        a. Hypertonic Saline (Sodium Chloride 3%) **[PARA/Interfacility]**
            1. BOLUS: 250mL IV over 30 min. Rate = 500mL/hr x 30 min
                a. Infusion: Start after bolus is complete if needed. Rate = 30mL/hr
            2. Mannitol [PARA/Interfacility]
                a. 0.25 to 1g/kg over 5 minute for adults
                b. 0.25 to 1g/kg over 30 minutes for pediatrics

Patient Safety Considerations

1. Do not hyperventilate patients: Maintain all patients in EtCO2 range of 35–45 mmHg.
2. Assume concomitant cervical spine injury in patients with moderate/severe head injury.
3. Geriatric consideration: Elderly patients with ankylosing spondylitis or severe kyphosis should be padded and immobilized in a position of comfort and may not tolerate a cervical collar.
4. Pediatric consideration: Children have disproportionately larger heads. When securing pediatric patients to a spine board, the board should have a recess for the head, or the body should be elevated approximately 1–2 cm to accommodate the larger head size and avoid neck flexion when immobilized.

Notes and Educational Pearls Key Considerations

- Head injury severity guideline:
    - Mild: GCS 13–15 / AVPU = (A)
    - Moderate: GCS 9-12 / AVPU = (V)
    - Severe: GCS 3-8 / AVPU = (P) or (U)
- If endotracheal intubation or invasive airways are used, continuous waveform capnography is required to document proper tube placement and assure proper ventilation rate and minute volume (preventing both hyperventilation [too fast] and overventilation [too much]).
- Herniation is difficult to diagnose in the prehospital setting. Hyperventilation results in vasoconstriction which further decreases blood flow to the brain and worsens the secondary brain injury
- Signs of herniation:
    - Decreasing mental status
    - Abnormal respiratory pattern
    - Asymmetric or unreactive pupils
    - Decorticate posturing
    - Cushing's response (bradycardia and hypertension)
    - Decerebrate posturing

Pertinent Assessment Findings

1. Neurologic status assessment findings
2. Pupils
3. Trauma findings on physical exam

Quality Improvement

Associated NEMSIS Protocol(s) (eProtocol.01)

- 9914101—Injury-Head

Key Documentation Elements

- Adequate oxygenation
- Airway status and management
- ETCO2 monitored and documented for moderate or severe head injury (avoidance of inappropriate hyperventilation)
- Neurological status with vitals: AVPU, GCS
- Exams: Neurological and Mental Status Assessment

Performance Measures

- No oxygen desaturation ***less than*** 90%
- No hypotension:
    - Adults: ***less than*** 90 mmHg
    - Pediatrics:
        - ***Less than*** 1 month: ***less than*** 60 mmHg
        - 1–12 months: ***less than*** 70 mmHg
        - 1–10 yo: ***less than*** 70 + 2x age in years
- No EtCO2 lower than 35 for mild head injury, 30 if severe head injury with signs of herniation
- Appropriate triage to trauma center
- ***EMS Compass® Measures*** *(for additional information, see www.emscompass.org)*
    - *PEDS-03: Documentation of estimated weight in kilograms.* Frequency that weight or length-based estimate are documented in kilograms
    - *Trauma-01: Pain assessment of injured patients.* Recognizing that pain is undertreated in injured patients, it is important to assess whether a patient is experiencing pain
    - *Trauma-02: Pain re-assessment of injured patients.* Recognizing that pain is undertreated in injured patients, it is important to assess whether a patient is experiencing pain
    - *Trauma-04: Trauma patients transported to trauma center.* Trauma patients meeting Step 1 or 2* or 3** of the *CDC Guidelines for Field Triage of Injured Patients* are transported to a trauma center
        - Any value documented in NEMSIS eInjury.03 - Trauma Center Criteria * 8 of 14 values under eInjury.04 - Vehicular, Pedestrian, or Other Injury Risk Factor match Step 3, the remaining 6 value options match Step 4

References

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