Head Injury – Moderate & Severe TBI

Purpose: Reduction of morbidity and mortality associated with Traumatic Brain Injury (TBI). The treatment of a patient with suspected TBI should focus on four important clinically identifiable conditions: hypoxia, hyperventilation, hypotension, and hemorrhage. Overall approach: Continuous monitoring of O2 saturation with high-flow oxygen regardless of O2 saturation, avoidance of positive pressure ventilation (PPV) whenever possible and use of continuous quantitative end-tidal CO2 (ETCO2) monitoring in patients requiring positive pressure ventilation, blood pressure monitoring every 3-5 minutes and using IV fluids to maintain BP above target, and assessment for signs of hemorrhage or hemorrhagic shock with use of applicable bleeding control interventions.

I. TBI Criteria (moderate or severe TBI)
   1. Anyone with physical trauma and a mechanism consistent for a brain injury AND one or more of the following:
      a. Any loss of consciousness OR any altered mental status (e.g., GCS <15)
      b. Multisystem trauma requiring PPV, whether the primary need for PPV was from TBI or from other injuries.
      c. Seizures: pre-traumatic or post-traumatic seizures whether continuing or not.
      d. In infants (where mental status may be difficult to interpret): any decreased level of consciousness or decreased responsiveness.

II. Procedure:
   1. Follow **General Pre-hospital Care Protocol**
   2. Transport according to **Adult and Pediatric Trauma Triage-Treatment Protocol** and MCA Transport Protocol.
   3. Manage Airway & Oxygenation (Prevent Hypoxemia)
      a. All patients identified with moderate or severe head injury should receive continuous high-flow oxygen immediately by non-rebreather mask.
      b. Monitor and maintain SpO2 equal to or greater than 90%.
      c. If hypoxia is present despite high-flow oxygen, basic maneuvers for airway repositioning should be attempted, followed by reevaluation.
      d. If this does not restore SpO2 to 90% or greater, or if there is inadequate ventilatory effort, bag-valve-mask (BVM) ventilation should be performed, 2-person with supplemental oxygen and basic airway adjuncts.
      e. Advanced airway placement only when BVM ventilation ineffective or other conditions warrant advanced airway (e.g., long transport time) refer to **Airway Management-Procedure Protocol**
   4. Manage Ventilation (Prevent Hyperventilation)
      Note: Identify and treat hypoventilation as well as prevent hyperventilation when assisting ventilation. As much as possible maintain normal ventilation. Hyper-ventilation decreases cerebral blood flow and worsens secondary brain injury. Strict attention on avoiding hypo- and hyper- ventilation is critical. It has been shown that repeatedly that inadvertent hyperventilation happens reliably if not

meticulously prevented. Use Pressure-Controlled Bags (PCBs) and Ventilation Rate Timers (VRTs) when available.

a. Utilize basic airway adjuncts (OPA, NPA).
b. Ventilate at the following rates:
   i. Adults (>14 years of age) ventilate at 10 breaths per minute.
   ii. Children (≥ 2 years of age - ≤ 14 years of age) ventilate at 20 breaths per minute.
   iii. Infants (< 2 years of age) ventilate at 25 breaths per minute.
c. Continuously monitor SpO2 and maintain ≥ 90%
d. Continuously monitor end tidal carbon dioxide per **End Tidal Carbon Dioxide Monitoring-Procedure Protocol**.
   i. Maintain ETCO2 35-45 mmHG (ideal target is 40 mmHG)
e. If hypoventilation or hypoxia persists after these interventions, consider advanced airway options, go to **Airway Management-Treatment Protocol.**

5. Manage Hemorrhage
   a. See **Bleeding Control (BCON)-Treatment Protocol**
   b. Consider **TXA**, if available, per the **Hemorrhagic Shock-Treatment Protocol**
      i. Consider contacting medical control for patients who may not meet clinical criteria for **TXA** administration, but hemorrhage is suspected.

6. Manage Blood Pressure (Prevent Hypotension)

Note: Do not wait for the patient to become hypotensive.

a. Obtain vascular access per **Vascular Access & IV Fluid Therapy-Procedure Protocol** for all patients.
   i. Consider IO placement per **Vascular Access and IV Therapy-Procedure Protocol** in the presence of hypotension or other signs of shock when an IV cannot be established quickly.
b. Do not wait for patient to become hypotensive. Decreasing SBP or other signs of compensated shock (increasing heart rate, increasing respiratory rate) require proactive fluid administration.
c. Target blood pressures:
   i. Adults (>14 years of age) SBP ≥ 110 mmHG
   ii. Pediatrics (11-14 years of age) SBP ≥ 110mmHG
   iii. Pediatrics (> 1 year-≤ 10 years of age) SBP > 70 + (age in years x2)
   iv. Pediatrics (1-12 months) SBP > 70 mmHG
   v. Pediatrics (< 1 month) SBP > 60 mmHG
d. Administer **LR** or **NS**
   i. Frequent blood pressure evaluation is required for immediate responsiveness to blood pressures that have fallen below target.
   ii. Adults (> 14 years of age) up to 1L wide open for immediate correction.
   iii. Pediatrics (≤ 14 years of age) 20 ml/kg wide open for immediate correction.
   iv. Once target blood pressures are achieved, fluids should be stopped.
   v. Subsequent fluid bolus may be required to maintain blood pressures above target

e. Check blood glucose (may be MFR skill), see **Blood Glucose Testing-Procedure Protocol** and treat hypoglycemia per **Adult or Pediatric Altered Mental Status-Treatment Protocol**

Protocol Source/References: Excellence in Prehospital Injury Care (EPIC) | Excellence in Prehospital Injury Care - Traumatic Brain Injury (arizona.edu); NASEMSO National Model EMS Clinical Guidelines Version 3.0