

# EmergencyKT: TRAUMATIC BRAIN INJURY

## Clinical Assessment

1. Glasgow Coma Scale (Table 1)
2. Level of consciousness
3. Cranial nerve exam (pupillary response, extraocular movements, facial symmetry, corneal and gag reflexes)
4. Motor strength
5. Motor tone
6. Sensory assessment
7. Vital signs
8. Note any seizure activity.

**Definition of severe head injury includes: Post resuscitation GCS of 3-8 with or without an abnormality noted on a head CT scan.**

## Diagnostic Assessment

Standard diagnostic assessment of brain injury may include:

1. Brain imaging: CT, MRI, MRS
2. Cerebral vascular imaging: CTA, MRA, MRV, angio
3. Cerebral perfusion imaging and Diamox Study
4. Intracranial pressure (ICP) monitor
5. Cerebral brain tissue oxygen monitor (PbtO<sub>2</sub>; Licox®)
6. EEG
7. Cerebral blood flow (CBF) monitor
8. Transcranial dopplers
9. Somatosensory evoked potentials (SSEP)

## Implement Resuscitation Protocols to Minimize Secondary Injury

Resuscitation is an urgent process that may require hours of intensive medical and surgical interventions. This process should be performed simultaneously with neurosurgical / neurological stabilization. Non-emergent invasive procedures may be delayed until all resuscitation and life-saving procedure are completed, especially in those patients with normal or nearly normal head CT.

**General ED Guidelines: Do not try to predict outcome early.**

**General goals: SaO<sub>2</sub> = 100%; PaCo<sub>2</sub> 35 – 40 mm Hg; MAP > 70 mm Hg**

## Airway Management

1. Supplemental O<sub>2</sub> to maintain SaO<sub>2</sub> = 100%
2. Intubate for GCS 3 – 8 or an inability to protect airway. A rapid sequence intubation is recommended. Intubation based solely on imaging findings is not recommended although air transfer or diagnostic testing of patient may dictate intubation for patient safety issues in cases of agitation or combativensess.
3. Titrate ventilator to maintain PaO<sub>2</sub> ≥ 100 mm Hg, and PaCO<sub>2</sub> = 35 – 40 mmHg. May hyperventilate to PaCO<sub>2</sub> of less than 35 mm Hg if there are concerns of herniation (otherwise, prophylactic hyperventilation is not indicated).

## Circulation

1. Establish minimum of 2 large bore IV's
2. Place NG/Foley if indicated
3. Draw initial assessment labs (CBC, renal profile and Coags)
4. Place central intravenous catheter and arterial line if able during initial care

## Diagnosis

Arrange for urgent diagnostic imaging (CT head / spine)

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**Table 1: Glasgow Coma Score**

	1	2	3	4	5	6
<b>Eye</b>	No response	Pain	Voice	Spontaneous		
<b>Verbal</b>	No response	Moans	Inappropriate	Disoriented	Oriented x 4	
<b>Motor</b>	No response	Extends	Flexor	Withdrawal	Localizes	Follows

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## Hemodynamic Management

1. Fluid resuscitation with Normal Saline (NS) or 3% Hypertonic Saline (HTS)
2. Avoid hypotension (ie, goal SBP less than 90 mm Hg)
3. Goal MAP  $\geq$  70 mm Hg or SBP  $>$  120 mm Hg, especially if there are any signs of increased intracranial pressure (See Management options below)

## Sedatives and Analgesics

As indicated for diagnostic procedures with preferred agents based on desired goal:

1. For Sedation: use propofol
2. For Analgesia: use fentanyl
3. Avoid paralytics until after initial assessment by the trauma/neurosurgery team. If paralytics are necessary for patient safety, short acting agents (eg, cisatracurium, vecuronium) should be used and treatment time should be clearly documented.

## Management Options for Intracranial Hypertension or Herniation Prior to Placement of ICP Monitor

(Signs such as posturing or unequal / non-reactive pupils)

1. Maintain neck in neutral position with cervical collar
2. HOB 30 degrees in reverse trendelenberg position
3. 3% HTS 250 ml bolus
4. Hyperventilation (temporary)
5. Mannitol 0.25 – 1 gram/kg (round to the nearest 25 gm dose) as the final measure once patient is euvolemic

## Consider Placement of an ICP and PbtO2 as Indicated

*The recommended device for ICP monitoring is an external ventricular drain (EVD; aka ventricuostomy). An intraparenchymal fiberoptic ICP monitor should be used only after failure to place and EVD (i.e., 3 passes with EVD) or in patients with abnormal coagulation studies*

1. Coagulation abnormalities should be corrected prior to placement of any invasive monitor. Although the optimal INR is normal (i.e.,  $\leq$ 1.2), active correction can stop once the INR is  $\leq$ 1.5.
2. Emergent resuscitation and stabilization should be complete prior to placement of intracranial neuromonitors. All intracranial neuromonitors should be placed in either the ICU or OR setting.
3. Indications for placement of intracranial neuromonitors are:
  - a. GCS  $\leq$ 8 with an abnormal admission head CT
  - b. GCS  $\leq$ 8 with normal head CT if  $\geq$ 2 complicating variables:
    - 1) Age greater than 40
    - 2) Unilateral or bilateral posturing
    - 3) Systolic BP less than 90
    - 4) Patients with indications for ICP / PbtO2 monitoring should also be considered for CBF and continuous EEG (cEEG) monitoring. Indications for cEEG monitoring are found in Appendix A

## Seizure Prophylaxis

See seizure monitoring and management guidelines (Appendix A)