

MANAGEMENT OF PATIENTS WITH SEVERE HEAD TRAUMA

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Supersedes:	Management of Patients with Severe Head Trauma, no date		
<input type="checkbox"/> Minor Changes (or)	<input checked="" type="checkbox"/> <i>Changes are substantial and require a thorough reading of this CPG (or)</i>		
<input type="checkbox"/> Significant Changes			

1. Goal. To provide guidelines and recommendations for the treatment and management of combat casualties with severe head injuries.

2. Background.

- a. Severely head injured patients are those comatose patients with Glasgow Coma Scores (GCS) of < 9.
- b. Currently, definitive neurosurgical care is available at Level III facilities in both Iraq and Afghanistan.
- c. Multiple trends have been observed since 2003, warranting the standardization of care for these casualties.
 - 1) The mortality of American service members with severe head injuries is 65% for GCS from 3 to 5 and 10% for GCS from 6 to 8.
 - 2) Of the survivors, progression to independent stateside living is <10% for GCS from 3 to 5 and 60% for GCS from 6 to 8.
 - 3) Positive outcomes are achieved through rapid evacuation from the battlefield, timely neurosurgical intervention, meticulous critical care, and a dedicative rehabilitative effort that often continues for months.
 - 4) In the CENTCOM AOR, a large percentage of patients who present with severe head injury are Host Nationals.
 - 5) Following Level III theater hospital treatment and transfer to a local host nation hospital, Host Nationals in Iraq and Afghanistan who fail to quickly recover to independent or minimally assisted living will typically not be aggressively treated thereafter.
- d. All Coalition casualties with a head injury more serious than a concussion and/or GCS <15, and Host Nationals with a GCS from 6 to 13 should be referred to Level III facilities with neurosurgical capability for definitive care. Transfer of Host Nationals with a GCS from 3 to 5 is optional and must be preceded by direct communication and discussion with the neurosurgeon, as these casualties will almost inevitably be treated expectantly. Host National patients with GCS of 14 or 15 should be managed locally and should not be transferred to Level III facilities unless transfer is first discussed and coordinated with the receiving neurosurgeon or Trauma Chief/Czar.

3. Evaluation and Treatment.

- a. Address life-threatening injuries and begin resuscitation using ATLS protocols.

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- 1) Normal saline is the preferred crystalloid solution for resuscitation of patients who do not require massive transfusion.
 - 2) Blood products are preferred over albumin and Hespan if colloids are necessary.
 - 3) Consider recombinant Factor VIIa for life threatening intracranial bleeding.
 - 4) Consider hyperventilation with goal PaCO₂ 30-35 mm Hg to decrease ICP (starting respiratory rate of 20 bpm).
 - 5) Antibiotics are unnecessary for isolated closed head injuries. Casualties with open head injuries should receive one gram (children 50 mg/kg) cefazolin (Ancef) IV on admission and then every 8 hours until wounds are closed.
 - 6) **Do not use steroids.** Steroids provide no benefit to head injured patients and have been proven to worsen outcomes in patients with severe head injury.
- b. Manage hypotension and hypoxemia.
- 1) Keep SBP > 90 mm Hg.
 - 2) Keep SaO₂ > 93%.
- c. Document serial neurological examinations.
- 1) GCS
 - 2) Pupil size and reactivity
 - 3) Presence of gross unilateral weakness, paraplegia, or quadriplegia
- d. If possible, for casualties transferring to Level III facilities with neurosurgical capability, avoid medications that cause long-lasting sedation or paralysis. Neurosurgeons at these sites will examine the casualty upon arrival. However, at no time should medication selection override the need to safely transport the casualty.
- 1) Vecuronium is preferred for paralysis.
 - 2) Propofol is preferred for sedation.
 - 3) **Intermittent administration of narcotics is preferred over continuous infusions.**
- e. If treatment for intracranial hypertension is needed prior to transfer:
- 1) Typical signs of severe intracranial hypertension: asymmetric motor posturing, unilateral or bilateral fixed, dilated pupil, decreasing level of consciousness
 - 2) Initiate 3% Saline Protocol (see Appendix B).
 - 3) Optimize pO₂/pCO₂ (pO₂ > 80 mm Hg, pCO₂ 30-35 mm Hg)
 - 4) Avoid/rapidly treat hypotension
 - 5) Elevate head of bed (may keep patient flat in the setting of suspected spine injury and use reverse trendelenberg position)
 - 6) If signs of herniation or severe edema are present, consider Mannitol 1g/kg bolus IV, followed by 0.5g/kg rapid IV push q4hrs. **Note: Do not use Mannitol in hypotensive or under-resuscitated casualties.**

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- f. Antiepileptic medications for seizure prophylaxis:
 - 1) Consider for all patients with intracranial hemorrhage, penetrating brain injury, and seizure activity following the injury, or a GCS < 9.
 - 2) Phenytoin or fosphenytoin are the preferred parenteral (IV or IM) medications.
 - 3) Discontinue after seven days if there is no penetrating brain injury, no prior seizure history, and no development of seizures following the injury.
- g. See attached tables for a concise description of salient points for the management of severe head trauma patients.

4. Responsibilities. It is the trauma team leader's responsibility to ensure he or she is familiar with this CPG and expeditiously coordinates transfer of severe head injury patients to one of the theaters' neurosurgical centers

5. References.

- ¹ *Guidelines for Field Management of Combat-related head trauma, Emergency War Surgery Handbook, 2004*
- ² Brain Trauma Foundation Guidelines for Management of head injury, 2005
http://www.braintrauma.org/site/DocServer/btf_field_management_guidelines.pdf?docID=121

Approved by CENTCOM JTTS Director, JTS Director
and Deputy Director and CENTCOM SG

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APPENDIX A

MONITORING & LABS	GENERAL INDICATIONS*
INTRACRANIAL PRESSURE (ICP)	Glasgow Coma Score of 3-8 with an abnormal CT scan (hematomas, contusions, edema, or compressed basal cisterns) <i>or</i> 2 or more of the following adverse features are present in a patient with severe head injury and a normal head CT scan: (Age > 40 yrs, Unilateral or bilateral motor posturing, systolic blood pressure, < 90 mmHg)
ARTERIAL LINE	Any head trauma that requires tracheal intubation and/or for other medical indications.
CENTRAL VENOUS PRESSURE	When ICP or CPP management requires anything beyond simple measures and/or for other medical indications. <i>Trendelenberg position will raise ICP. Line site of choice is SCV.</i>
EXHALED CO2	Desirable when active measures are required to control ICP. Correlate to PaCO2 initially/periodically.
NEUROIMAGING	Non-contrast head CT upon admission then within 24 hours after admission (or earlier to document stability of the bleed). Additional scans obtained as indicated (e.g.; clinical deterioration).
LABS	ABG, CBC, Chem 10, TEG, PT, PTT, and INR <i>at least</i> q8 hrs during the acute phase.
GENERAL MANAGEMENT PRINCIPLES*	
PHILOSOPHY	<ul style="list-style-type: none"> • Maintain continuous communication between the care teams. • Maintain the patient in a “hyperosmolar-but-euvolemic” state with adequate oxygen carrying capacity and a constant substrate delivery via adequate cerebral perfusion pressure (CPP) of 50-70 mm Hg. • Aggressively avoid hypotension, hypoxemia, fever (>99 F), hyponatremia and other CNS insults. • The longer the ICP is ↑, and the MAP & CPP are ↓, the worse the outcome! • Brain injury is heterogeneous amongst patients and the process is dynamic: Treatment and management goals must be tailored accordingly
RESUCITATION FLUID	Normal saline.
MAINTENANCE FLUID	D ₅ Normal saline (Dextrose in maintenance fluids mandatory if insulin is utilized)
SEDATION	Propofol 1 st choice up to 72°. Other short-acting agents (fentanyl, versed) upon discretion of SICU or neurosurgical staff. Typical ICU Propofol sedation dose range: 20-75 ugm/kg/min
ULCER PROPHYLAXIS	All patients.
DVT PROPHYLAXIS	Recognize high DVT risk in traumatic brain injury patients. Intracranial neurosurgical procedures: Sequential Compression Device (SCD) with or without Graduated Compression Stocking (GCS); High Risk neurosurgery patients: SCD and/or GCS; OK to use Lovenox following stable CT scan in consultation with neurosurgeon.

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SEIZURE PROPHYLAXIS		For acute post-traumatic seizure treatment /prophylaxis. Neurosurgeon discretion. Usually for 7 days only. Phenytoin or Fosphenytoin. (Dose: 1 gm IVPB or 15-20 mg/kg infused at a rate of 150 mg/min IV. Use the higher dose-range for children. Maintenance is ~ 100mg TID or 300 mg qHS or 4-7 mg/kg/day divided TID)	
ANTIBIOTICS		If using antibiotic impregnated ventriculostomy, then no IV prophylactic antibiotics required. Otherwise, Ancef 1 gm IV tid while ventriculostomy in place only (neurosurgeons' discretion). For all penetrating head trauma, use Ancef 1 gm IV tid.	
NURSING		Hourly neurologic assessments. Document ICP/ CPP and ventriculostomy output. Notify physician of all pertinent changes.	
STEROIDS		Steroids are <i>not</i> recommended for head or spine trauma and should not be used.	
NUTRITION		Enteral feeding should be begun as soon as it is safe to do so. <i>Avoid agitation/↑ICP during nasal or oral tube placement.</i> Full enteral nutritional goal ≤ 7 days.	
General management goals (Goals may be individualized / altered by faculty according to specific patient requirements)*			
NEUROLOGIC	ICP	< 20 mm Hg	See page 2
	CPP	At least 50-70 mm Hg	
HEMODYNAMIC	Mean BP	Maintain to avoid ↓BP	<ul style="list-style-type: none">• Hypotension (SBP < 90mmHg) worsens mortality• Provide a rapid physiologic resuscitation
	CVP	> 5 mm Hg	
PULMONARY	SpO2%	> 93%	Aggressive avoidance of hypoxemia
	PaCO2	35 – 40 mmHg in first 24 hrs/ 30-35 24 hrs to 7 days	Avoid <i>routine</i> hyperventilation
HEMATOLOGIC	INR	≤ 1.3	Fresh frozen plasma
	Platelets	≥ 100,000/mm ³	Platelets
	Hemoglobin	≥ 10 g/dL	Packed red blood cells
	TEG	Normalized values	As indicated by results
METABOLIC	Glucose	> 80 < 150 mg/dl	Have low threshold for insulin drip
RENAL	Serum Osmolarity	> 280 & < 320 mOsm	See sodium disorders on next page
	Serum Sodium	> 138 & < 165 meq/L	
INTRACRANIAL PRESSURE MANAGEMENT*			
GENERAL MEASURES		Head in midline position, avoidance of tight cervical collars and tight circumferential ETT ties; elevate the head of the bed to 30 degrees. (Consider reverse Trendelenberg)	
SEDATION		Propofol 1 st choice up to 72°. Other short-acting agents (fentanyl, versed) upon discretion of SICU or neurosurgical staff. Typical ICU Propofol sedation dose range: 20-75 ugm/kg/min.	

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TEMPERATURE		Aggressive temperature management. Consider cooling measures (Tylenol, cooling blanket) even for <i>modest</i> temperature elevations (>98.6° F).		
INTRACRANIAL DYNAMICS		<ul style="list-style-type: none">• Treat sustained ICP elevations >20• Always consider an expanding mass lesion with ICP elevations refractory to therapy.		
Treatment Paradigm for the Traumatic Brain Injury Patient*				
TITRATE TO EFFECT Goal of ICP < 20	Ensure sedation and analgesia are adequate	Titrate lowest possible dose to achieve desired RASS score and/or BIS 60-80. Avoid routine over sedation.		
	Initiate CSF drainage via ventriculostomy	Consider ventriculostomy drainage to control ICP to <20 mm Hg		
	Initiate osmotic therapy Hold if [Na+] is >159 and/or the Sosm is >329	Hypertonic Saline (3%): Infuse between 30-50 cc/hour or at the discretion of the neurosurgeon (see Appendix B). As optional or adjunctive therapy consider Mannitol: 0.25–1 gm/kg over < 20 minutes then ≈ 0.25 gm/kg q 6 h.		
	Initiate paralysis	Vecuronium: 10 mg IVP or 0.1 mg/kg. Cisatracurium (if available): Loading dose 0.2 mg/kg/Maint infusion rates: 1-3 mcg/kg/min		
	Titrate EtCO2	PaCO2 >= 35 for 1st 24°-always keep >25		
CEREBRAL PERFUSION PRESSURE MANAGEMENT (CPP = MAP – ICP)*				
CPP GOAL 50-70 mm Hg	1. Ensure euvolemia	Utilize endpoints of resuscitation (exam, vitals, Art. Line, CVP, PAC)		
	2. Control the ICP/PbtO2	First line: 3% saline; Second line: mannitol. Do Not use mannitol in hypovolemic patients.		
	3. Consider vasoactive drugs	Consider patient physiology. Levophed / dopamine are reasonable choices.		
ACUTE CLINICAL DETERIORATION (e.g.; Acute mental status change, blown pupil or other obvious signs of cerebral herniation, new focal neurological symptoms, progressive and refractory ICP elevation)*				
1. Verify oxygenation and ventilation		UNCAL HERNIATION SYNDROME <ul style="list-style-type: none">• Unilaterally dilating pupil → progression to fixed and dilated• Progressive impairment of consciousness → comatose• Contralateral babinski → contralateral weakness → bilateral decerebrate rigidity		
2. Hyperventilate (PaCO2 30-35 mmHg) to temporize only				
3. Re-dose osmotic agent				
4. Call Neurosurgery				
5. Arrange for emergent CT scan				
GLASGOW COMA SCORE		Eye Opening	Best Verbal Effort	Best Motor Effort
1		None	None	Flaccid
2		To Pain	Nonspecific sounds	Decerebrates to pain
3		To verbal stimuli	Inappropriate words	Decorticates to pain
4		Spontaneous	Confused	Withdraws to pain
5		-	Oriented	Localizes to pain
6		-	-	Follows commands

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COMMON SODIUM DISORDERS SEEN IN HEAD TRAUMA (Discuss therapy with staff prior to initiation)			
Disorder	Na+	Diagnostic clues	Treatment
SIADH	↓	Low Sosm, <u>usually euvolemic</u> , ↑ Uosm	Free water restriction, hypertonic saline if severe
Cerebral salt wasting	↓	Sosm may be nl, ↑ uop, <u>signs of volume depletion & hemoconcentration</u> , very high U _{Na}	Volume replacement with NS or hypertonic saline. Oral sodium. Beware of rapid Na+ correction.
Mannitol use	↑	Polyuria, ↑ [Na ⁺] & Sosm	Hold mannitol if Sosm > 329 mosm / [Na+] > 159
Diabetes Insipidus	↑	Polyuria (>250cc/hr), ↑ [Na ⁺] & Sosm, U _{SpGr} <1.005	DDAVP 2-4 mcg SQ/IV bid as permitted by staff neurosurgeon

* Individualized patient management in consultation with Neurosurgeon

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APPENDIX B

3% Saline Protocol

Hypertonic (3% saline) may be delivered via peripheral IV or intraosseous access

1. Give 200cc 3% NaCl bolus IV (children 5 cc/kg) over 10-15 minutes
2. Follow bolus with infusion of 3% NaCl at 50 cc/hour
3. If awaiting transport; check serum Na⁺ levels every hour:
 - a. If Na < 150 mEq/L re-bolus 150 cc over 1 hour then resume previous rate
 - b. If Na 150-154, increase NaCl infusion 10 cc/hr
 - c. If Na 155-160, continue infusion at current rate
 - d. If Na >160, hold infusion, recheck in 1 hour