

Severe Traumatic Brain Injury

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Objectives Severe Traumatic Brain Injury (TBI)

- Review the neurologic examination
- Present the controversy surrounding prehospital airway management
- Discuss the indications for ICP monitoring
- Discuss management of increased ICP



Case

- 18 year-old male assaulted with a lead pipe and beaten several times on the back of the head. Unconscious upon EMS arrival, and now intermittently agitated.
- GCS score 8: Eyes open to pain (2), verbal inappropriate words (3), motor flexion abnormal (3). Pupils equal and reactive.
- The on-scene paramedic calls in requesting orders for sedative-assisted intubation. Their anticipated transport time to your ED is 15-20 minutes.



EMS Airway Management

- Prospective study of adult trauma patients:
 - GCS \leq 8
 - Transport time > 10 minutes, and
 - Inability to intubate without RSI
- Midazolam and succinylcholine were used for RSI, and rocuronium was given after ETT placement confirmation.

Davis DP. *J Trauma* 2003; 54:444



EMS Airway Management

- 209 patients were enrolled and compared to 627 controls.
- The two groups were similar.

	Mortality	Good Outcome
Field RSI group	33%	45%
ED RSI group	24%	57%

Davis DP. *J Trauma* 2003; 54:444



Case continued

- Patient was given lorazepam 2 mg in the field; arrives in the ED backboarded and collared with bag-valve-mask assisted ventilations
- BP is 90 / 60, P 110, RR 24, Pulse Ox 92%, blood glucose 100.
- GCS score 5 (nonverbal 1, eyes open to pain 2, extension posturing 2)
- Right pupil dilated and fixed



Clinical Indicators of Increased ICP/ Herniation

- Unilateral or bilateral unreactive, dilated pupil
- Extensor posturing (decerebrate)
- In patients with a GCS score <9, a 2 point decrease in GCS score



Airway Management in Severe TBI

- Premedicate:
 - Minimize reflex sympathetic response
 - Lidocaine, fentanyl, defasciculating dose of ndp
- Induction:
 - Avoid hypotension
 - Etomidate
- Paralyze:
 - Succinylcholine



Severe TBI Guidelines (BTF / AANS)

- Standards
 - Prophylactic hyperventilation should be avoided
 - Use of glucocorticoids is not recommended
 - Prophylactic phenytoin is not recommended for preventing late sz



Severe TBI Guidelines (BTF / AANS)

- Guidelines:
 - Hypotension and hypoxia must be avoided
 - ICP monitoring is appropriate
 - Mannitol is effective for controlling raised ICP

Severe TBI Guidelines (BTF / AANS)

- Options
 - Hyperventilation may be necessary for brief periods when there is acute neurologic deterioration
 - AEDs may be used to prevent early posttraumatic sz

ICP Management



CPP = MAP - ICP

ICP : < 20 mm Hg

MAP: 100 - 110

CPP: near 70 mm Hg



Hyperventilation

- Aggressive hyperventilation has been the cornerstone of ICP management for the past 20 years
- Hyperventilation reduces ICP by causing cerebral vasoconstriction
- Focal/regional reduction in cerebral perfusion the consequence



Hyperventilation

- Hyperventilation [PCO₂ from 36 to 29 mmHg]
N = 33 patients with severe TBI
Increased the volume of severely hypoperfused tissue despite improvements in cerebral perfusion pressure and intracranial pressure.
- Hypoperfusion associated with accumulation of cytotoxic byproducts including glutamate, pyruvate, and lactate

Marion DW. *CCM* 2002; 30:2774 Muizelaar



Hyperventilation

- Prospective, randomized trial
 - N= 77 patients with severe TBI
 - 5 days of prophylactic hyperventilation [versus eucapnea]
 - 3 and 6 month follow up – outcome was significantly better in the control group

JP. J Neurosurg 2001; 75:731

BTF Recommendations

- Endpoint = 30 mmHg with careful end-tidal PCO₂ monitoring
- In conjunction with other measures, for:
 - Asymmetric pupil response
 - Unilateral or bilateral pupil dilatation
 - Motor posturing
 - Rapid neurologic decline



Mannitol

- Immediate plasma-expanding effect
 - Benefits CPP
 - Decreases hematocrit and blood viscosity
- Delayed osmotic effect, with onset in 15-30 minutes and duration from 1 to 6 hours
(The latter is responsible for ICP reduction)



Hypertonic Saline

- Plasma volume expander
- Improves CPP by increasing MAP without increasing ICP
- Dehydrates tissue simultaneously leading to decreasing edema and improved perfusion
- Does not cause osmotic diuresis
- Human studies using 7.5% - 29% concentrations report 20 – 50% decreases in ICP
- Not first line at this time



Hypertonic Saline

- Prospective, randomized, double-blind trial
N = 229 patients with severe TBI and hypotension in the field
- Hypertonic saline 250 ml 7.5% LR vs LR
- Results
(No differences between groups at baseline)
 - Mean GCS = 4, ISS = 38, Fluid = 1250
 - No difference in BP on ED arrival
 - No difference in survival or outcomes

Cooper DJ. *JAMA* 2004; 291:1350.

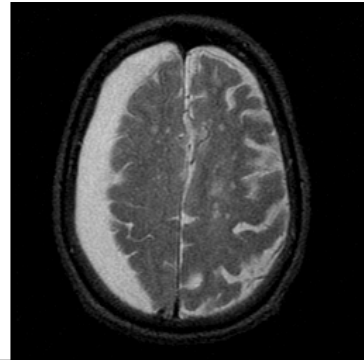


TBI: Future Directions

- Induced hypothermia
- Neuroprotectants
- Neurogenesis



Case Continued



Conclusions

- Hypoxia and hypotension must be carefully assessed for and corrected in patients with severe TBI
- Prehospital intubation has been associated with worse outcomes in severe TBI patients and its indications must be reassessed
- Patients with severe TBI should have an ICP monitor placed in the emergency department / trauma center
- Hyperventilation is a temporizing measure in the management of elevated ICP
- Mannitol is the first line agent for managing elevated ICP
- Hypertonic saline indications are yet to be defined



Questions??

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