Guidelines for Prehospital Management of Traumatic Brain Injury

Protocol Example & Patient Case Study

Brain Trauma Foundation
Prehospital Care
Epidemiology

• Traumatic Brain Injury (TBI) is the leading cause of death and disability in children & young adults during their productive years.

• Research estimates there are 1.6 million head injuries each year in the United States.

• Approximately 60,000 of these head injured people die from TBI, and 70,000 - 90,000 are left with permanent neurological disabilities.
Epidemiology

- The cost to society is over 40 billion dollars annually.
- EMS personnel are often the first health providers to assess, treat and determine the destination of patients with severe head injury.
- Most emergency medical practices for TBI are not based on the results of scientific evidence.
Secondary Brain Injury

- Not all brain injury occurs at the moment of impact (immediate primary injury).
- Secondary injury is brain cell death due to lack of oxygen and blood flow to the brain (ischemia).
- Secondary brain injury occurs most often in severe TBI (comatose) patients.
Secondary Brain Injury

- Secondary brain injury evolves over time after the primary brain injury.
- Secondary brain injury increases mortality and worsens disability.
- The receiving hospital for severe TBI patients should have immediate diagnostic and interventional capability. The hospital should be compliant with the Guidelines for the Management of Severe Head Injury.
Priorities

• Assessment / Treatment
  – Airway
  – Breathing
  – Circulation
  – Cervical Spine
  – Disability
  – Exposure
TBI Assessment

• TBI assessment always follows the ABC’s of assessment and treatment.
• Identifying TBI in the prehospital setting is critical.
• The determination of TBI impacts assessment, treatment and transport decisions.
Oxygenation

- Early post-injury episodes of hypoxemia greatly increases mortality and morbidity.
- Evidence defines hypoxemia as apnea or cyanosis in the field or an oxygen saturation (SaO₂) < 90%.
- Intubation of the unconscious and unresponsive TBI patient improves outcome.
Oxygenation

- Monitor SaO2 continuously
- Provide supplemental O2
- Keep SaO2 saturation > 90%
- If available intubate patients with:
  - Persistent hypoxemia (SaO2 < 90%) with oxygen
  - Apnea
  - Airway compromise
  - Unconsciousness (comatose) or unresponsiveness with a (GCS < 9)
Blood Pressure

- Evidence defines hypotension as a single observation of SBP < 90mm Hg (in adults).
- A single episode of hypotension doubles mortality and increases morbidity.
- Evidence suggests that raising blood pressure in hypotensive patients with TBI improves outcome.
Blood Pressure

- Blood pressure
  - Monitor Q 5 min
  - Prevent hypotension
  - Administer isotonic fluid to reverse hypotension (SBP <90 mmHg)
- Pediatric SBP is considered hypotension by age groups:
  - <65 mmHg (0-1 year)
  - <75 mmHg (1-5 years)
  - <80 mmHg (5-12 years)
  - <90 mmHg (>12 years)
# Glasgow Coma Scale

## Eye opening
- Spontaneous: 4
- To Speech: 3
- To Pain: 2
- None: 1

## Motor Responses
- Obeys commands: 6
- Localizes: 5
- Withdraws: 4
- Abnormal flexion: 3
- Extension: 2
- None: 1

## Verbal Response
- Oriented: 5
- Confused: 4
- Inappropriate: 3
- Incomprehensible: 2
- None: 1

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**Total**: 3 - 15
Glasgow Coma Scale

- Perform after resuscitation & before administering sedatives or paralytics
  - 13-15 Mild TBI
  - 9-12 Moderate TBI
  - 3-8 Severe TBI
- Serial examinations
- Change in GCS > 2 is a significant prognosticator
Glasgow Coma Scale
Motor Exam

6- Follows commands
5- Localizes to axillary pinch
4- Withdrawal to nailbed pressure
3- Flexor to nailbed pressure (decorticate)
2- Extension to nailbed pressure (decerebrate)
1- Flaccid to nailbed pressure
Neurological Exam
Localization Test
Pupils

- The initial pupil exam, with the GCS score establishes a neurological baseline.
- The pupil exam in conjunction with the GCS score aids in determining treatment.
- The pupillary exam should be performed:
  - after resuscitation
  - before administration of sedatives or paralytics
Pupillary Exam

- Pupil reactivity to light
  - positive reaction $> 1$mm constriction
- Pupil asymmetry
  - significant asymmetry $> 1$mm difference
- Fixed/Dilated Pupils
  - pupils that are $\geq 4$mm and react $< 1$mm
Significant Pupillary Findings

Pupil Asymmetry

Pupils that are greater than 1mm difference in size are considered asymmetric.
Significant Pupillary Findings

Fixed & Dilated Pupils

Pupils that are greater than or equal to 4mm in diameter and constrict less than 1mm in reaction to bright, direct light are considered fixed and dilated.
Pupillary Exam
Signs of Cerebral Herniation

In an unconscious and unresponsive patient:

- Patient with dilated and unreactive pupil(s)
- Patient with asymmetric pupils
- Patient non-responsive to painful stimuli
- Patient displaying extensor posturing
Hyperventilation

- In severe TBI patients, the following are signs of cerebral herniation:
  - Asymmetric pupils (size > 1 mm difference)
  - Pupils fixed & dilated (≥ 4 mm)
  - GCS Motor
    - 1 Flaccid
    - 2 Extension (decerebrate posturing)
- Requires emergency intervention, i.e. hyperventilation, to lower intracranial pressure.
Ventilation Parameters

- Normal ventilation rates are defined as approximately:
  - 10 breaths per minute (bpm) for adults
  - 20 bpm for children
  - 25 bpm for infants

- Hyperventilation is defined as approximately:
  - 20 breaths per minute (bpm) for adults
  - 30 bpm for children
  - 35 bpm for infants
Minimum facility requirements:

Mild TBI
- GCS 14, 15
Transport to Emergency Department

Moderate TBI
- GCS 9-13
Transport to Trauma Center
Transport Decisions

Severe TBI GCS 3-8
Level I Trauma Center with the following capabilities:

- 24 hour CT scan availability
- 24 hour operating room availability
- Prompt neurosurgical care
- Ability to monitor intracranial pressure
- Ability to treat intracranial hypertension as delineated in the Guidelines for the Management of Severe Head Injury
PREHOSPITAL TRIAGE FOR THE TBI PATIENT

Mild, Moderate TBI

Score GCS Eyes
- Eyes Open, Open to Voice or Open to Pain

Score GCS Verbal
- Says at Least Words

Score GCS Motor
- Any Motor Response

Assess Pupils
- Any Pupil Exam

Treatment
- Oxygenate

Transport
- Transport to Emergency Room (GCS 14, 15)
- Trauma Center (GCS 9-13)

Severe TBI (Comatose)

Score GCS Eyes
- Eyes Do Not Open To Pain

Incomprehensible Sounds or None

Localization, Withdrawal of Flexor Response

Localization, Extensor or Flaccid Response

Pupils Equally Reactive

Pupils Asymmetric or Fixed and Dilated

Intubate †/ Normoventilate

Intubate †/ Hyperventilate

First Priority Keep

Airway † Sep < 90 mm Hg
Breathing SaO₂ > 90%
Circulation

Transport to Trauma Center with TBI Resources
- (GCS < 9) †

† Ventilate and oxygenate if intubation not available

† Trauma Center with 24-hour scanning capability, 24-hour available operating room, prompt neurosurgical care and the ability to monitor intracranial pressure and treat intracranial hypertension as delineated in the Guidelines for the Management of Severe Head Injury (www.braintrauma.org)

† See table for pediatric values

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Overview

• Initial assessment
• ABC’s
• Neurologic Evaluation
• Treatment & Interventions
• Neurologic Deterioration
• Transport Considerations
Case Presentation

- 21 year old male
- Unrestrained driver, single vehicle MVC
- 20mph; sedan vs. concrete barrier
- No airbag
- Starred windshield
- + LOC
Initial Assessment

- Patient has clear airway
- Bilateral breath sounds
- Strong radial pulse of 100
- Blood Pressure 120/80
- Speaking spontaneously
Physical & Neurologic Evaluation

- Found out of vehicle walking near the accident scene.
- 3X5 Hematoma/ contusion left forehead
- Opens eyes spontaneously
- Alert to person & place, but confused to month and year.
- Follows motor commands
- GCS = ___
Treatment & Interventions

- Reassess vital signs & neuro exam Q5 minutes and more often as needed
- Assess oxygenation via SaO2 if available
- Establish IV access
- Administer supplemental oxygen as needed to maintain SaO2 > 90%
- Immobilization with cervical collar and/or backboard
- Rule out other causes of altered mental status
Causes of Altered Mental Status

- Hypovolemia
- Hypoxemia
- Drugs
- Alcohol
- Hypoglycemia
- Pain/Discomfort
- Traumatic Brain Injury
Transport Decisions

• Destination
  – Mild TBI
  – GCS 14

→ Emergency Department
Reassessment: ABC’s

• Vital signs remain stable
  – patent airway
  – bilateral breath sounds
  – Pulse 96
  – BP 116/76
Reassessment: Neuro Exam

- Eyes open to painful stimuli
- Speech is incomprehensible
- Localizes to painful stimuli
- Pupils 3mm with brisk reaction to light
- GCS = ___
Treatment & Interventions

- $O_2$ administered via NRM
- IV access established with NS infusing
- Cervical spine immobilized
- Backboard in place
Transport Decisions

- Destination
  - Moderate TBI
  - GCS 9

→ Trauma Center
Reassessment: ABC’s

• Changes in vital signs
  – respiratory rate 8
  – poor air exchange
  – SaO2 98% on NRM
  – Pulse 112
  – BP 80/56
Reassessment: Neuro Exam

- Patient is unresponsive
  - eyes - no response
  - motor - bilateral extensor posturing
  - verbal - no response

- Pupils
  - Right 4mm & reactive
  - Left 3mm & reactive

- GCS = ___
Treatment Interventions

- Establish a patent airway
- Vigorous IV fluid administration (Keep SBP > 90mm Hg)
- Supplemental oxygen
- Hyperventilation @ 20 breaths/minute
Transport Decisions

- Destination
  - Severe TBI
  - GCS 4

Level I Trauma Center with TBI capabilities
Transport Decisions

• Level I Trauma Center with TBI capabilities:
  – 24 hour available CT scan
  – 24 hour available operating room
  – prompt neurosurgical care
  – ability to monitor intracranial pressure
  – ability to treat intracranial hypertension as delineated in the *Guidelines for the Management of Severe Head Injury*
Summary

- Provide oxygen and ventilation to maintain oxygen saturation >90%
- Provide adequate fluid to maintain SBP >90mm Hg
- Continually reassess and document the GCS exam
- Assess and note changes in pupillary response
- Select the most appropriate facility for admission of the TBI patient
Guidelines for the Prehospital Management of Traumatic Brain Injury

To place an order call:
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