

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 (SaO_2) $< 90\%$.
- 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

Verbal Response

Oriented	5
Confused	4
Inappropriate	3
Incomprehensible	2
None	1

Motor Responses

Obeys commands	6
Localizes	5
Withdraws	4
Abnormal flexion	3
Extension	2
None	1

Total	3 -15
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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

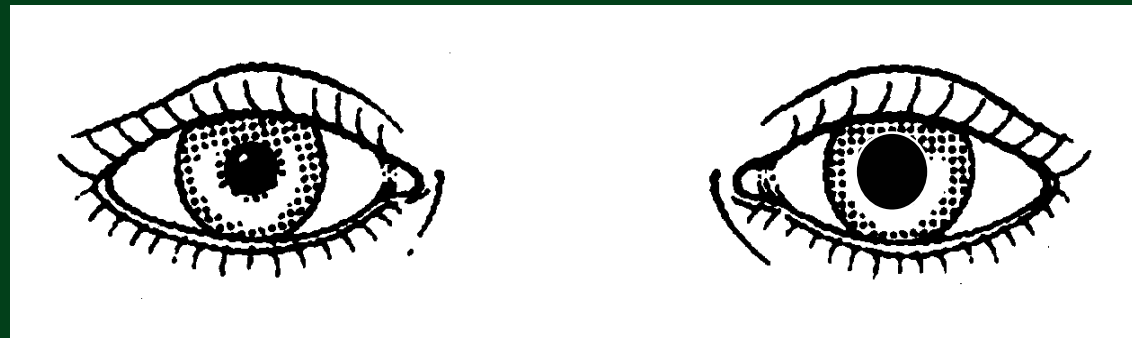
Pupillary Exam

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

Significant Pupillary Findings

Pupil Asymmetry

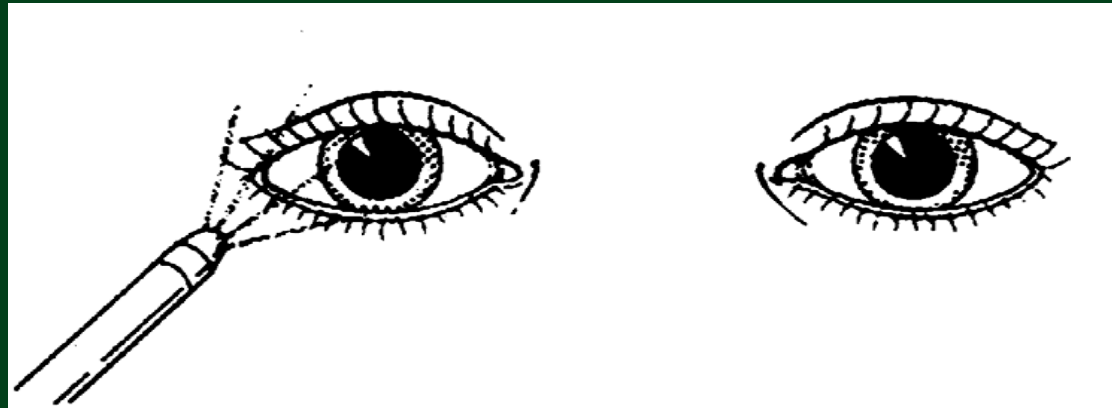
Pupils that are greater than 1mm difference in size are considered asymmetric.



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

Transport Decisions

Minimum facility requirements:

Mild TBI

– GCS 14, 15

→ Transport to Emergency Department

Moderate TBI

– GCS 9-13

→ Transport to Trauma Center

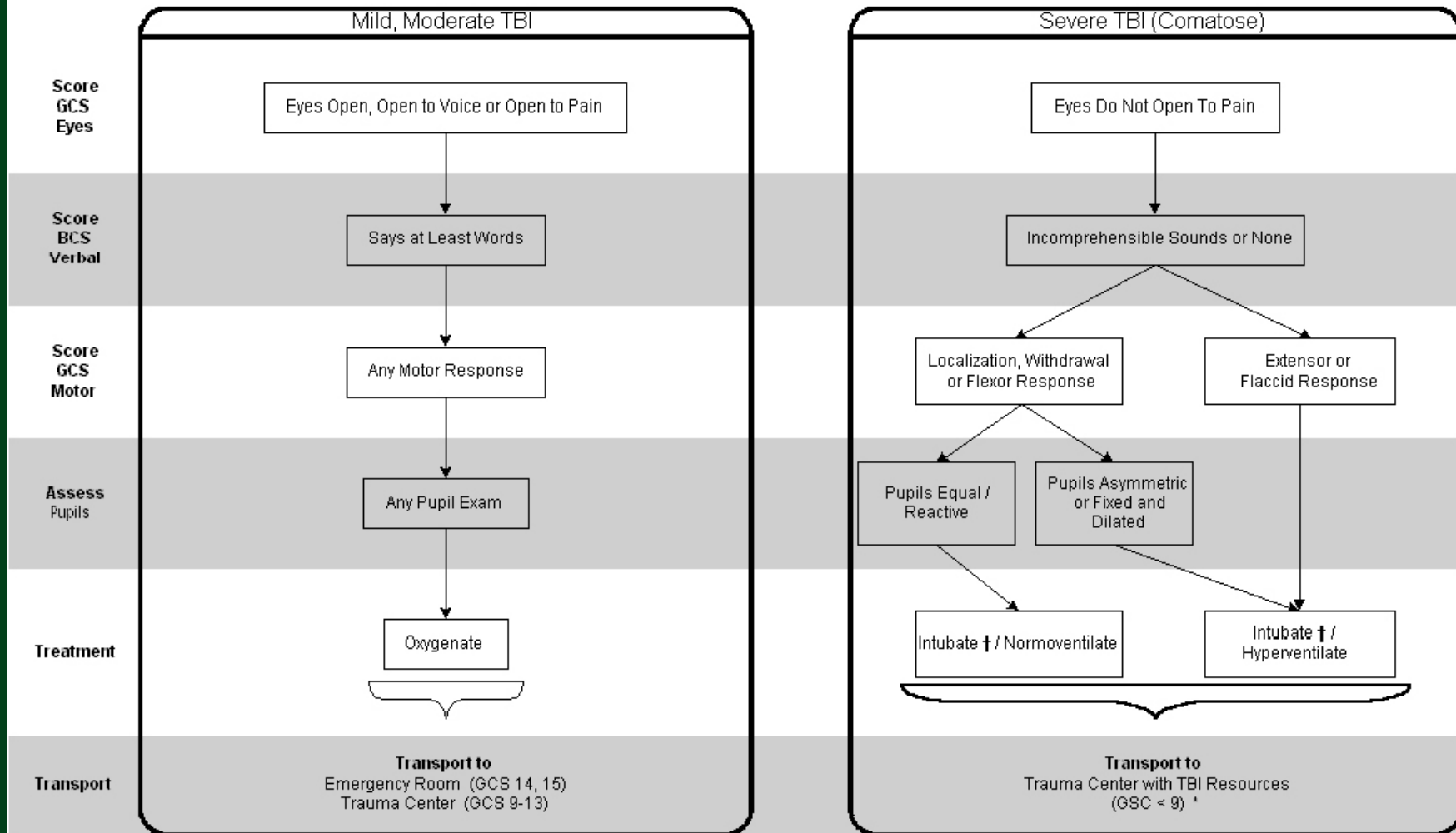
Transport Decisions

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



First Priority	Keep
Airway	‡ SBP >90 mm Hg
Breathing	SaO ₂ >90%
Circulation	

† 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

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

- O₂ 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 $>90\text{mm Hg}$
- 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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