Head Injuries/TBI

Source of Information/Pittsburgh EMS Pre Hospital Monograph
Definitions:

Closed Head Injury

Penetrating Head Injury

Closed Head Injuries
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.
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 Comatose TBI Patients.

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.
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Closed Head Injuries
Anatomy and Physiology:

Definitions:

Cranium

Meninges

Brain

Cerebral Spinal Fluid

Skin/Skull

Dura Mater

Arachnoid

Pia

Brain

Closed Head Injuries
Anatomy and Physiology:

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Closed Head Injuries
Types of Injuries:

- Concussion
- Contusion
- Intracranial Hemorrhage
- Epidural Hematoma

Closed Head Injuries
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Concussion

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Intracranial Hemorrhage

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Types of Injuries:

Epidural Hematoma

Closed Head Injuries
Types of Injuries:

Subdural Hematoma

Closed Head Injuries
Pathophysiology

Intracranial Pressure (ICP) Build Up

Closed Head Injuries
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.
Blood pressure (contd)
  – 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)
Assessment And Treatment- cont d

Physical

  Pupils
  Posturing
  Battle Signs

Periorbital Ecchymosis

Glasgow Coma Scale

Closed Head Injuries
• In severe TBI patients, the following are signs of cerebral herniation:
  Brain herniation, also known as cistern obliteration, is a deadly side effect of very high intracranial pressure that occurs when the brain shifts
  – Asymmetric pupils (size > 1mm difference)
  – Pupils fixed & dilated (≥ 4 mm)
  – GCS Motor
    1 Flaccid (soft and limp; not firm;)
  • 2 Extension (decerebrate posturing)
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

Closed Head Injuries
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
Total 3 -15
Causes of Altered Mental Status

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

Closed Head Injuries
**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

**Closed Head Injuries**
Neurological Exam Localization Test

Closed Head Injuries
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

Pupil Asymmetry
Pupils that are greater than 1mm difference in size are considered asymmetric.
**Significant Pupil 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.

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**Closed Head Injuries**
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

Closed Head Injuries
Lord Fairfax 2009 Guideline for CNS Injury

Closed Head Injuries

**Adult – Trauma: Central Nervous System (CNS) Injuries**

**EMT – Basic**
1. Spinal immobilization, if indicated.
3. Patient assessment including vital signs, initiate pulse oximetry monitoring, and apply oxygen based on patient condition / need.
4. Manage airway appropriately.
5. Elevate head of stretcher at 30 degrees.
6. Record Glasgow Coma Scale.

**EMT – Enhanced / Intermediate / Paramedic**
1. Establish IV access.
2. If patient is hypotensive (SBP <90 mmHg), consider IV bolus of 500 ml 0.9% Sodium Chloride and reassess, may be repeated up to 1 liter 0.9% Sodium Chloride.
3. Manage airway appropriately.

**Key Points / Considerations**
- Difficulty breathing or moving? Loss of sensation? Any penetrating trauma in or around spinal cord? Any bruising noted around neck and back?
- Keep the patient warm unless already hyperthermic.
How about drugs??
**Solumedrol**- can be used to decrease fluid retention and swelling in the brain (cerebral edema) due to a brain tumor. It is also used to suppress the immune system in organ transplantation?

**Mannitol for acute traumatic brain injury**
Mannitol is a sugar alcohol solution which is sometimes effective in reducing brain swelling after head injury. However, its effectiveness in the ongoing treatment of severe head injury remains unclear. There is evidence that excessive
Contraindicated Drugs:

D50- Due to Known Intracranial Hemorrhage

Morphine- Due to hypotension or Head Injury

Nitro- Due to ICH

Closed Head Injuries
Post Injury

What to do if Discharged from ER

What to do if EMS is called subsequent to discharge

Documentation

Closed Head Injuries
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

Closed Head Injuries
Conclusion:

Head Injury not a definitive Field Diagnosis until CT Scan is done