Evidence-Based Management of Pediatric Head Trauma

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Objectives

- Discuss the types and mechanisms of blunt head trauma in children
- Discuss the management of blunt head trauma in children
- Evaluate the evidence behind the management of pediatric blunt head trauma
Pediatric Head Trauma

- Trauma is the leading cause of death in children >1 year
- TBI is the leading cause of trauma-related death

- >600,000 ED visits annually
- 60,000 hospitalizations
- 6,000 deaths

Assessing and managing a patient with head trauma
# Glasgow Coma Scale

<table>
<thead>
<tr>
<th>Standard GCS</th>
<th>Pediatric GCS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eye Opening</strong></td>
<td><strong>Eye Opening</strong></td>
</tr>
<tr>
<td>4  Spontaneous</td>
<td>4  Spontaneous</td>
</tr>
<tr>
<td>3  To verbal stimuli</td>
<td>3  To speech</td>
</tr>
<tr>
<td>2  To pain</td>
<td>2  To pain</td>
</tr>
<tr>
<td>1  None</td>
<td>1  None</td>
</tr>
</tbody>
</table>

# Glasgow Coma Scale

<table>
<thead>
<tr>
<th>Standard GCS</th>
<th>Pediatric GCS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Best Verbal Response</strong></td>
<td><strong>Best Verbal Response</strong></td>
</tr>
<tr>
<td>5</td>
<td>Oriented</td>
</tr>
<tr>
<td>4</td>
<td>Confused</td>
</tr>
<tr>
<td>3</td>
<td>Inappropriate words</td>
</tr>
<tr>
<td>2</td>
<td>Incomprehensible sounds</td>
</tr>
<tr>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>Coos, babbles</td>
</tr>
<tr>
<td>4</td>
<td>Irritable, cries</td>
</tr>
<tr>
<td>3</td>
<td>Cries to pain</td>
</tr>
<tr>
<td>2</td>
<td>Moans to pain</td>
</tr>
<tr>
<td>1</td>
<td>None</td>
</tr>
</tbody>
</table>

# Glasgow Coma Scale

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<tbody>
<tr>
<td><strong>Best Motor Response</strong></td>
<td><strong>Best Motor Response</strong></td>
</tr>
<tr>
<td>6  Follows commands</td>
<td>6  Normal spontaneous moves</td>
</tr>
<tr>
<td>5  Localizes pain</td>
<td>5  withdraws to touch</td>
</tr>
<tr>
<td>4  withdraws to pain</td>
<td>4  withdraws to pain</td>
</tr>
<tr>
<td>3  Flexion to pain</td>
<td>3  Abnormal flexion</td>
</tr>
<tr>
<td>2  Extension to pain</td>
<td>2  Abnormal extension</td>
</tr>
<tr>
<td>1  None</td>
<td>1  None</td>
</tr>
</tbody>
</table>

Severe / Moderate Head Injury

Management:
- Airway
- Intracranial pressure
- Normal hemodynamic status
- Seizure prophylaxis
- Appropriate radiological investigations
- Hospitalization

GCS
Severe: 3
Moderate: 8, 9
Minor: 12, 13, 15

Trauma Handbook. Rhode Island Hospital, The Warren Alpert Medical School of Brown University, Department of Surgery, Division of Trauma and Surgical Critical Care. 2014.
97% of patients seen in ED with blunt head trauma

Risk of TBI 0-7% if GCS is 15

<1% require surgery

Classifications of Head Injuries

- Severe
- Moderate
- Minor

GCS

- 3
- 8
- 9
- 12
- 13
- 15

# Risk of TBI

<table>
<thead>
<tr>
<th>GCS</th>
<th>Risk of TBI</th>
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<tbody>
<tr>
<td>15</td>
<td>~2-3%</td>
</tr>
<tr>
<td>14</td>
<td>~7-8%</td>
</tr>
<tr>
<td>13</td>
<td>~25%</td>
</tr>
</tbody>
</table>

Indications of Head Imaging - Hasbro

Blunt Head Injury

GCS ≤14 or AMS, palpable skull fracture, focal neurologic findings

- Yes → CT Recommended
- No → History of LOC

History of LOC
History of vomiting
Significant headache
Concerning mechanism
Behavioral changes (esp <2 years)
Scalp hematoma (<2 years)

- Yes → Consider CT based on:
  - Worsening signs or symptoms
  - Clinical judgment
- No → CT not recommended
Clinically-important traumatic brain injury

Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study


**Goal:** Identify low-risk patients with GCS 15 who do not need to have head CT, not to identify patients for whom CT scans should be obtained.

Definition of clinically important TBI

- Death from TBI
- Neurosurgical intervention
- Intubation ≥24 hours for TBI
- Hospital admission ≥2 nights for TBI in association with TBI on CT

\[ \text{ciTBI: 0.9 \%} \]

Prediction Rule

<2 years
- Altered mental status
- Scalp hematoma
- Loss of consciousness
- Mechanism of injury
- Skull fracture
- Acting normally per parent

≥2 years
- Altered mental status
- Loss of consciousness
- Vomiting
- Basilar skull fracture
- Mechanism of injury
- Severe headache

Severe mechanism of injury

- MVC with patient ejection, death of another passenger, rollover
- Pedestrian or bicyclist without helmet struck by a motorized vehicle
- Falls more than 3 feet < 2 years or more than 5 feet ≥ 2 years
- Head struck by a high-impact object
< 2 years of age

≥ 2 years of age

B

GCS=14 or other signs of altered mental status†, or signs of basilar skull fracture

Yes
14.0% of population
4.3% risk of ciTBI

CT recommended

No

History of LOC, or history of vomiting, or severe mechanism of injury‡, or severe headache

Yes
28.8% of population
0.8% risk of ciTBI

Observation versus CT on the basis of other clinical factors including:
• Physician experience
• Multiple versus isolated§ findings
• Worsening symptoms or signs after emergency department observation
• Parental preference

No

57.2% of population
<0.05% risk of ciTBI

CT not recommended¶

Online Tool

PECARN Pediatric Head Injury/Trauma Algorithm

Provides the PECARN algorithm for evaluating pediatric head injury.

Note: This only applies to children with GCS scores of 14 or greater.

- Age
  - <2 Years +1
  - ≥2 Years +2

- GCS <14, Palpable Skull Fracture or Signs of AMS
  - Yes +1
  - No +2

- Occipital, parietal or temporal scalp hematoma; History of LOC ≥5 sec; Not acting normally per parent or Severe Mechanism of Injury?
  - Yes +1
  - No +2

PECARN recommends No CT; Risk <0.02%, "Exceedingly Low, generally lower than risk of CT-induced malignancies."
Prediction Rule

< 2 years

- Altered mental status
- Scalp hematoma
- Loss of consciousness
- Mechanism of injury
- Acting normally per parent

≥ 2 years

- Altered mental status
- Loss of consciousness
- Vomiting
- Basilar skull fracture
- Mechanism of injury
- Severe headache

Isolated vomiting

ciTBI with non-isolated vomiting: 2.5 %
ciTBI with isolated vomiting: 0.2 %
Isolated loss of consciousness

ciTBI with no LOC: 0.5 %
ciTBI with any LOC: 2.5 %
ciTBI with isolated LOC: 0.5 %
Isolated severe injury mechanism

ciTBI with isolated severe mechanism, <2 years: 0.3 %
ciTBI with isolated severe mechanism, ≥2 years: 0.5 %

Isolated scalp hematoma (<2 years)

ciTBI with isolated scalp hematoma: 0.4%

- <6 months more at risk
  - < 3 months with any scalp hematomas
  - Older infants with larger temporal or parietal scalp hematomas
Isolated headache

ciTBI with isolated headache: “very low”
Isolated basilar skull fracture

Intracranial pathology in patients with basilar skull fracture: 21 %
Summary

- TBI is the most common cause of death and disability among pediatric trauma patients
- Most children do not have a clinically-important traumatic brain injury
- Low-risk criteria have been validated to help manage patients and identify those who DO NOT need head CT
References

- Trauma Handbook. Rhode Island Hospital, The Warren Alpert Medical School of Brown University, Department of Surgery, Division of Trauma and Surgical Critical Care. 2014.