Head Injury in Children

Tina Kendrick
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Some Definitions

- Newborn < 28 days
- Infant < 1 year
- Child < 16th birthday (MoH)
Head Injury

- Leading cause of mortality & morbidity in children
  - Road trauma, falls, bicycle accidents, abuse and violence

- There are no “magic bullets” that have significantly changed outcome in the past decade

- Outcome still linked to severity of initial insult
Head Injury

- Children have increased survival but increased morbidity as diffuse brain injury prevalent

- Often associated with spinal injury but lower incidence in children

- Care is focused on:
  - Close observation
  - Prevention & minimisation of secondary injuries
  - Rehabilitation
Secondary Brain Injury

refers to the cascade of physiological and biochemical events that occur after primary injury and worsen outcome
Most Frequently Occurring

- Hypocapnia
- Hypotension
- Acidosis
Associated With Worse Outcome

- Hypocapnia
- Hypotension – occurred twice as often in non-survivors
- Acidosis
- Hypoxia
- Hyperglycaemia
- Hypothermia* in younger individuals
Infants and children: Acute management of Head Injury
second edition

CLINICAL PRACTICE GUIDELINES

NSW HEALTH

Tina Kendrick  Orange  May 2013
Patterns of Head Injury in children

- Some differences from adults that influence patterns include:
  - Developmental level and age of the child
  - Anatomic differences of the head
  - Frequency of inflicted injury in < 2 years
  - Response of the child’s brain to trauma
Developmental Considerations

- Unwitnessed/unobtainable history of loss of consciousness
- No LOC, especially in < 2s does not preclude intracranial injury
- GCS may not be reliable in young children; a modified scale should be used for infants and young children
- Parents generally provide most reliable & trustworthy information
Anatomic Differences

- Characteristics of child skull:
  - Thinner, provides less protection
  - Depressed skull # more prevalent
  - Pliability means underlying brain injury +/- bleeding in the absence of fracture
  - Head = 18% of TBSA in infants; 9% in adults
  - Intracranial and scalp haematomas can therefore represent significant blood loss
Anatomic Differences

- Blunt trauma can be followed rapidly by acute brain swelling
- Can occur despite:
  - no significant history
  - No visible abnormality of the head
- Children more disposed to developing oedema – higher brain H2O content
- This requires close monitoring of fluid balance
Inflicted Injury

- Have a high index of suspicion where:
  - History is inconsistent with physical findings
  - Infants present with serious head injury after reportedly minor fall
  - History changes over time
  - Another child is blamed
  - A delay in presentation to ED

- Most common cause of head injury in infants
Assessment of Conscious Level

AVPU Assessment Tool

A: Patient is Alert and Age-appropriate

V: Patient responds to Voice

P: Patient responds to Painful stimuli

U: Patient is Unresponsive
Five Assessment Parameters

- Level of consciousness
- Motor function
- Respiratory patterns
- Cranial nerve response
- Vital signs
Vital Signs

- Temperature
- SpO2
- Pulse and ECG
- Respirations
- Blood pressure
- Standard Paediatric Observation Charts (SPOC) should be used
Limitations of the Glasgow Coma Scale for Children

- Teasdale & Jennet did not report patient ages in their original work
- Recognised early on (late 70’s) that the GCS was limited in assessing children under 10 years of age
- Preverbal children (under 2 years) particularly challenging
Eye Opening Response

- Spontaneously (4)
- To speech (3)
- To pain (2)
- None (1)
Eye Opening Response

- No age-related modification necessary

- Best score is 4
Best Verbal Response <4 years

- Alert, babbles or coos, words or sentences to usual ability (5)
- Less than usual ability and/or spontaneous irritable cry (4)
- Cries inappropriately (3)
- Occasional whimpers/moans (2)
- None (1)
Best Verbal Response 4-15 years

- Orientated and converses (5)
- Disorientated and converses (4)
- Inappropriate words (3)
- Incomprehensible sounds (2)
- None (1)
Best Motor Response < 4 years

- Obeys verbal command or performs normal spontaneous movements (6)
- Localises pain or withdraws to touch (5)
- Withdraws from pain (4)
- Abnormal flexion to pain (3)
- Abnormal extension to pain (2)
- No response to pain (1)
Best Motor Response 4-15 years

- Obeys verbal command (6)
- Localises pain (5)
- Withdraws from pain (4)
- Abnormal flexion to pain (3)
- Abnormal extension to pain (2)
- No response to pain (1)
Classification

- Severity classification is traditionally used

- Is GCS-based

- Mild head injury (GCS 14 - 15)
- Moderate head injury (GCS 9 - 13)
- Severe head injury (GCS 3 - 8)
Severity

- In children, CHALICE criteria is generally used to guide management

- A more comprehensive system, using risk factors (including GCS) to more accurately detect intracranial injury

- Places children into Low, Intermediate or High risk groups, which determines management
CHALICE

- History
- Mechanism
- Examination
- Placement
- Observations
<table>
<thead>
<tr>
<th></th>
<th>LOW RISK (All features)</th>
<th>INTERMEDIATE RISK (Any feature / not low or high risk)</th>
<th>HIGH RISK (CHALICE Criteria) (Any feature)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HISTORY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Witnessed loss of consciousness</td>
<td>nil</td>
<td>&lt;5 minutes</td>
<td>&gt;5 minutes</td>
</tr>
<tr>
<td>Anterograde or retrograde amnesia</td>
<td>nil</td>
<td>possible</td>
<td>&gt;5 minutes</td>
</tr>
<tr>
<td>Behaviour</td>
<td>normal</td>
<td>mild agitation or altered behaviour</td>
<td>abnormal drowsiness</td>
</tr>
<tr>
<td>Episodes of vomiting without other cause</td>
<td>nil or 1</td>
<td>2 or persistent nausea</td>
<td>3 or more</td>
</tr>
<tr>
<td>Seizure in non-epileptic patient</td>
<td>nil</td>
<td>impact only</td>
<td>yes</td>
</tr>
<tr>
<td>Non accidental injury (NAI) suspected</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Headache</td>
<td>nil</td>
<td>persistent</td>
<td>persistent</td>
</tr>
<tr>
<td>Co-morbidities</td>
<td>nil</td>
<td>present</td>
<td>present</td>
</tr>
<tr>
<td>Age</td>
<td>&gt;1yr</td>
<td>&lt;1yr</td>
<td>Any</td>
</tr>
<tr>
<td>MECHANISM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Vehicle Accident (MVA) (pedestrian, cyclist or occupant)</td>
<td>low speed</td>
<td>&lt;60kmph</td>
<td>&gt;60kmph</td>
</tr>
<tr>
<td>Fall</td>
<td>&lt;1m</td>
<td>1-3m</td>
<td>&gt;3m</td>
</tr>
<tr>
<td>Force</td>
<td>low impact</td>
<td>moderate impact or unclear mechanism</td>
<td>high speed projectile or object</td>
</tr>
<tr>
<td>EXAMINATION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glasgow Coma Scale (GCS)</td>
<td>15</td>
<td>fluctuating 14 - 15</td>
<td>&lt;14 or &lt;15 if under 1 yr old</td>
</tr>
<tr>
<td>Focal neurological abnormality</td>
<td>nil</td>
<td>nil</td>
<td>present</td>
</tr>
<tr>
<td>Injury</td>
<td></td>
<td></td>
<td>*high risk features eg scalp haematoma in &lt;1yr of age (see below)</td>
</tr>
</tbody>
</table>

* High risk injury: a) penetrating injury, or suspected depressed skull fracture or base of skull fracture  
b) scalp bruise, swelling or laceration >5cm, or tense fontanelle in infants <1 yr of age
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<tr>
<td>PLACEMENT</td>
<td></td>
<td></td>
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<tr>
<td>Observation Area</td>
<td>Anywhere in ED</td>
<td>Acute area in ED</td>
<td>Acute or resuscitation bay</td>
</tr>
<tr>
<td>OBSERVATIONS</td>
<td></td>
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</tbody>
</table>
| • Respiratory rate, oxygen saturations | Hourly observations until discharge | Half-hourly observations for 4 to 6 hours until GCS 15 sustained for 2 hours, then hourly observations until discharge. **Revert to half hourly observations/continuous monitoring if signs of deterioration occur.** | • Continuous cardio-respiratory and oxygen saturation monitoring  
• BP and GCS every 15 to 30 minutes |
| • Pulse, blood pressure |                         |                                                        |                                            |
| • Temperature        |                         |                                                        |                                            |
| • GCS, pupillary response & size, limb strength |                         |                                                        |                                            |
| • Pain assessment    |                         |                                                        |                                            |
| • Sedation score as necessary |                         |                                                        |                                            |
Primary Survey and Resuscitation

Secondary Survey and Stabilisation

High Risk Group

Urgent head CT and consult paediatric expert

Abnormal head CT or persistent symptoms

Urgent admission/transfer to paediatric unit

Normal head CT

Deterioration or persistent symptoms

Intermediate Risk Group

Observe 4-6 hours until GCS 15 for 2 hours and consult paediatric expert

GCS 15, asymptomatic

Low Risk Group

At discharge, parents should:
- be educated on the detection and significance of changing signs and symptoms including when to seek urgent review;
- provided with details of follow-up arrangements; and
- receive a Head Injury fact-sheet and discharge summary
Low Risk

- Consider immediate discharge
Intermediate Risk

- Close observations for 4-6 hours post-injury until GCS is 15 for 2 hours
- May go home if GCS 15, asymptomatic, responsible carers and normal CT
- Any child not asymptomatic and neurologically normal at 6 hours needs discussion with paediatric expert or neurosurg
High Risk

- These children require urgent imaging, neurosurgical and Paed ICU consult via NETS - regarding transfer, CT decisions

- CT abnormalities need Neurosurg input

- Those with normal CT should still be observed for 6 hours min, may require admission
Figure 8  Lateral skull X ray demonstrating intracranial placement of an orogastric tube (arrow). Source: From Ref. 50.
Further Information

- Children’s Hospitals websites Fact Sheets for parents
- NSW Institute of Trauma and Injury
- Clinical Excellence Commission’s “Paediatric Between the Flags”
- ACCCN’s Critical Care Nursing (2012)
- DETECT Junior
- Frank Shann – DRUG DOSES
References

- Australian and New Zealand Paediatric Intensive Care Data Registry Report, 2010

- Brady, Cain & Johnston (2012) Justifying referrals for paediatric CT. MJA 197 (2) p95-98

Useful References
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ACCCN’s Critical Care Nursing

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