



ACUTE SYMPTOMATIC HEAD INJURIES – MILD AND MODERATE TBI

Aim

To provide clear criteria for categorizing head injuries.
To define criteria for imaging.
To define criteria for safe discharge home, and advice on discharge.
To educate clinical staff on concussion or 'mild traumatic brain injury'

Definition of terms

Head Injury Severity Scale (HISS)¹

Minimal Head Injury	=	GCS 15, no LOC, no amnesia, asymptomatic	
Mild TBI	=	GCS 14-15, amnesia or LOC <5mins, or impaired alertness	<u>AVPU</u>
Moderate TBI	=	GCS 9-13, LOC >5mins or focal deficit	<u>AVPU</u>
Severe TBI	=	GCS 5-8	<u>AVPU</u>
Critical TBI	=	GCS 3-4	<u>AVPU</u>

Minimal Head Injury = A Head Injury which does not affect the functioning of the brain, and therefore from which there are no symptoms.

Concussion = A force transmitted to the head which results in a short lived impairment of neurological function that resolves spontaneously.

Loss of consciousness is involved in 10% of cases. Recovery is typically over 7-10 days. Typically there are grossly normal neuroimaging studies.

Target Patient Population

This evidence summary applies to children aged 0-16 with mild/moderate head injuries. It does not deal with poly-trauma or severe head injury. There is a separate guideline for [minimal/trivial head injuries](#). There is a complementary guideline for [concussion/post concussive syndrome](#).

Target Users

This guide is directed at health-care professionals engaged in the care of children with mild and moderate head injuries in the acute setting. A separate guideline addresses the ongoing management of severe TBI GCS<8 from ED to the ICU setting. A separate guideline also deals with sub-acute symptoms from head injury in the emergency and outpatient department ([concussion and post concussive syndrome](#)).

Assessment

Introduction

The key aim in management of any head injury is detection of life threatening intracranial bleeding, and skull fracture and to prevent and minimise secondary brain injury from hypoxia, poor cerebral perfusion, cerebral bleeding, hypoglycaemia, seizures and fever.

This guideline will offer direction to treating clinicians to help establish when an injury is mild or moderate, which patients might require admission or imaging, It should provide the information to reassure those in which this is unlikely and manage the expectations of a symptomatic mild traumatic brain injury also known as a concussion.

History

History of presenting complaint	Time of and mechanism of injury Area of head hit and speed of impact
Differentiating factors in mild v moderate	GCS / AVPU at time of event, since, and now Loss of Consciousness and its duration Amnesia pre or post event, specifically ask to recall events and duration Seizure
History typical of concussion (Always consider need for CT brain separately as per head injury guideline)	Headache (early post traumatic) Disorientation/ Confusion Reported pallor/ 'dazed' look Nausea/ Vomiting including number of discreet episodes and timing Ataxia/ Dizziness Visual symptoms/ Blurring/ Light insensitivity Fatigue
Evolution of symptoms	Clinical course improving/deteriorating?
Special considerations in history	Consider seizure or arrhythmia as precedent to injury Circumstances- child protection concerns? Previous head injuries/ concussions Medical conditions / Medications/ pain relief Past hx of bleeding disorder /warfarin tx Other injuries

Factors in BOLD help assess whether imaging is necessary

Initial acute clinical assessment

Primary survey and resuscitation:

- **ABC:** ensure that the child's airway, **cervical spine**, breathing and circulation are assessed and managed as required.
- **D:** Rapidly assess the child's mental state using the **AVPU/GCS** scale. Use firm supraorbital pressure as the painful stimulus.
Remember a cervical spine **cannot** be cleared in the presence of a distracting injury or decreased mentation

AVPU

<u>A</u>VPU	Alert	GCS 14-15
<u>A</u>VPU	Responds to voice	GCS 9-13
<u>A</u>VPU	Responds to pain ⇒ Purposefully ⇒ Non-purposefully ⇒ Withdrawal/flexor response ⇒ Extensor response Unresponsive	GCS 3-8

Glasgow Coma Scale (GCS)

≥ 4 years		< 4 years	
Response	Score	Response	Score
Eye opening		Eye opening	
Spontaneously	4	Spontaneously	4
To verbal stimuli	3	To verbal stimuli	3
To painful stimuli	2	To painful stimuli	2
No response to pain	1	No response to pain	1
Best verbal response		Best verbal response	
Orientated and converses	5	Appropriate words or social smile, fixes, follows	5
Confused and converses	4	Cries but consolable; less than usual words	4
Inappropriate words	3	Persistently irritable	3
Incomprehensible sounds	2	Moans to pain	2
No response to pain	1	No response to pain	1
Best motor response		Best motor response	
Obeys verbal commands	6	Spontaneous or obeys verbal commands	6
Localises to stimuli	5	Localises to stimuli	5
Withdraws to stimuli	4	Withdraws to stimuli	4
Abnormal flexion to pain (decorticate)	3	Abnormal flexion to pain (decorticate)	3
Abnormal extension to pain (decerebrate)	2	Abnormal extension to pain (decerebrate)	2
No response to pain	1	No response to pain	1

Ongoing clinical assessment Secondary survey:

Eyes: Pupils symmetry prior to light reflex, light reflex- size symmetry, Fundoscopy, N.B. NAI

Eye Movements- focal sign?

Skull: Panda Eyes? Battle's Sign? Check for CSF/blood in nose/ears. Measure head circumference <1yr olds.

Palpate Head, Neck, Face, Teeth for fractures. Ensure no orbital floor fracture causing ocular muscle entrapment in facial trauma.

Neurological exam, including balance + gait, if able.

Categories of TBI:

MINIMAL	MILD/minor	MODERATE	SEVERE
GCS 15, no symptoms	GCS 14-15 <u>AVPU</u>	GCS 9-13 <u>AVPU</u>	GCS 3-8 <u>AVPU</u>
Discharge advice SEE Minimal Head Injury SEE compulsory Parent Info	Guidelines for imaging SEE BELOW	<i>ABCDE as per APLS/ATLS</i> <i>Organise Imaging</i> <i>Secondary Survey</i> <i>Requires Admission</i>	<i>ABCDE as per APLS/ATLS</i> <i>See TBI IPAT algorithm</i> <i>Contact PICU 1890 213213</i> <i>Earliest Neurosurgery input</i> <i>Secondary Survey</i>
	These patients have <i>at least</i> a mild Traumatic Brain Injury They may have a clinically important Traumatic Brain Injury		SEE Severe Injury guideline

Management

Mild to Moderate Traumatic Brain Injury Algorithm

Investigations:

Imaging:

Balance the need for imaging with the risks of ionizing radiation in this population. If an appropriate facility to observe children is available the rate of CT scan drops with each hour in children of intermediate risk in whom observation is appropriate¹¹. The reason to image is to out-rule clinically important bleeding or oedema, skull fracture or NAI. See [WHO communicating radiation risk in pediatric imaging](#).

- X-rays are not appropriate and miss up to 20% of skull fractures¹², if a fracture is suspected a non-contrast CT should be performed. 3D reconstruction will reveal fractures.
- Approximately 3%–5% of children with GCS >13 have identifiable abnormalities by CT imaging, and typically less than 1% require neurosurgical intervention.
- A negative CT scan is reassuring: 13,000 children in a study with normal imaging did not require neurosurgical intervention¹³.
- The CHALICE OR PECARN algorithm can be used to assist the decision to CT scan.
- Parents can be advised that over 20,000 children were studied to evaluate these rules¹⁴.
 - Using the below 'CHALICE' clinical decision rule the sensitivity of picking up abnormality on CT or need for neurosurgery is 90-92%.
 - The negative predictive value of the 'CHALICE' rule is 99.9%.
 - Pitfalls of this rule have been shown to be falls less than 3 m, fewer than three vomiting episodes, and change in mental status besides abnormal drowsiness.
 - PECARN rule offers test probability of findings with given findings.
- The decision to defer imaging is based on isolated findings rather than multiple, physician experience, parental preference and improving clinical picture.
- Delayed presentations >24hrs, still present with risk of clinically important TBI.¹⁵ Children can compensate longer for with epidural bleeding.¹⁶

AS PER CHALICE GUIDELINES

Always Image:	Suspicion of non-accidental injury. Post-traumatic seizure but no history of epilepsy. On initial assessment, GCS <14, or for children under 1 year GCS <15. At 2 hours after the injury, GCS less than 15. Suspected open or depressed skull fracture or tense fontanelle. Any sign of basal skull fracture (haemotympanum, 'panda' eyes, cerebrospinal fluid leakage from the ear or nose, Battle's sign). Focal neurological deficit. For children under 1 year, presence of bruise, swelling or laceration of <i>more than</i> 5 cm on the head. <i>*warfarin treatment- these patients should be discussed with senior staff +/- haematology</i>
Image if more than one: Observe if <i>only</i> one of:	Loss of consciousness lasting more than 5 minutes (witnessed). Abnormal drowsiness. Three or more discrete episodes of vomiting. Dangerous mechanism of injury (high-speed road traffic accident either as pedestrian, cyclist or vehicle occupant, fall from a height of greater than 3 metres, high-speed injury from a projectile or other object). Amnesia (antegrade or retrograde) lasting more than 5 minutes.
If during observation the following occurs	GCS< 15 Further vomiting Further episode of abnormal drowsiness.

Ongoing ED management:

- **Assess for symptoms of concussion:** [SEE CONCUSSION GUIDELINE](#)
- **Fluids**

Euvolaemia should be maintained if a child cannot tolerate oral fluids.
 With ongoing vomiting IV fluids should be isotonic 0.9% saline/dextrose 5% or Hartmanns at 80-100% of usual maintenance².
 Significant losses can be replaced for comfort and to prevent worsening headache.
 If no glucose in fluids, 2-4hrly glucose checks.
 Electrolytes and Fluid balance should be assessed initially and at 24hrly³ intervals.
- **Anti-emetics**

The safety of the practice of giving ondansetron and discharging a child without imaging has not been evaluated.
It is NOT recommended to administer ondansetron unless a CT scan is performed^{4, 5}
- **Analgesia**

Both paracetamol and ibuprofen should be offered to patients immediately.
 Consider opioids as per pain ladder in a subset who do not respond.

Regular pain relief should be used in the first 5 days promptly when needed.
 Advise against ongoing regular pain relief after 5 days, and advise them to get prompt treatment of muscular neck pain if it emerges (particularly in sporting injuries) as it can cause cervicogenic headaches.
- **Treatment of Seizures**

Treat seizures - as per APLS – lorazepam 0.1mg/kg x2 then phenytoin load 20mg/kg IV over 20minutes (max 1gram). Reassess as per APLS, arrange urgent imaging.
- **Tranexamic Acid** In trauma and severe bleeding TXA should be used promptly (the golden hour) to reduce need for transfusion and death^{8, 9}. A case like this warrants urgent discussion with neurosurgery.
- **Admission**
 - Any positive finding on CT should be admitted⁶ under neurosurgery team
 - Admit to Short Stay Unit if decision is made to safely observe rather than image. If SSU unavailable admit to ED if likely <6hrs or onto ward for further observation.
 - Where a child meets any criteria on the [CHALICE guideline](#) they should be observed for at least 4hrs.
 - Loss of consciousness lasting more than 5 minutes (witnessed).
 - Abnormal drowsiness.
 - Three or more discrete episodes of vomiting.
 - Dangerous mechanism of injury (high-speed road traffic accident either as pedestrian, cyclist or vehicle occupant, fall from a height of greater than 3 metres, high-speed injury from a projectile or other object).
 - Amnesia (antegrade or retrograde) lasting more than 5 minutes.
 - Asymptomatic Children for 4 hrs with a normal scan can be discharged⁷

- **Avoidance of precipitating factors**

Aim during observation to keep the room or area dark. Allow the child to rest their eyes, avoid ambulation, **avoid screen time or reading**, as these may precipitate vomiting.

Special Considerations

When is repeat imaging appropriate?

We recommend that repeat CT should be performed in patients with clinical or neurological deterioration⁷.

Anticoagulation:

With the exception of urgent cases paediatric haematology patients should be discussed first with their specialist team. NICE guidelines prefer patients on warfarin with a TBI should undergo CT imaging. They should be admitted for observation regardless of CT findings.

Coagulation Disorders: Individualised care plans. Discuss with haematology.

DISCHARGE REQUIREMENTS

- A TRIVIAL HEAD INJURY WITHOUT SYMPTOMS OR SIGNS CAN BE DISCHARGED DIRECTLY WITH HEAD INJURY +/-SAFETY IN THE HOME ADVICE
- Head Injury general advice for parents handout, and understanding of when to return
- Observations for 4 hrs post symptoms
- Normal conscious state
- No further vomiting
- Tolerating oral fluids
- Headache improving and not worsening
- Social circumstances
- *Any consideration of NAI must be brought to a senior member of staff*

- **Advice**

Regardless of whether a child is admitted or discharged home, is imaged or not, if they present with a symptomatic head injury it is important to tell them they are concussed.

It is important to manage patients expectations of recovery, and the stress the importance of rest to aid this. This will prevent undue worry and representation with symptoms within the expected time-frame (up to one month). 70-80% of children will be well at 7-10 days.

1. Sleep hygiene: sufficient, regularly timed
2. Nutrition: avoid fasting, regular snacks
3. Cognitive Rest: Avoid moving visual images- reading, T.V., video games/phone for 24-48hrs minimum
4. Physical Rest: Avoid activity for 48hours and if it aggravates symptoms
5. Commence graded physical activity without contact after 48 hours
6. Avoid sport/activity that risk 2nd impact x23 days minimum

Companion Documents

Please list useful companion documents. A link will be created to these. Example:

- [Parent information leaflet "Mild Traumatic Brain injury"](#)
- [Parent information leaflet when to return to hospital in the case of a head injury](#)
- [Concussion Guideline](#)
- [Mild to Moderate Traumatic Brain Injury Algorithm](#)



Links to useful websites

- CDC heads up <https://www.cdc.gov/headsup/youthsports/index.html>
- IRFU http://www.irishrugby.ie/downloads/IRFU_2018_-_Concussion_Wallet_Card_Amateur_Rugby.pdf
- GAA <https://learning.gaa.ie/Concussion>
- WHO radiation guide https://www.who.int/ionizing_radiation/pub_meet/radiation-risks-paediatric-imaging/en/

Upcoming Research in the Area

TIC-TOC will address TXA in paediatrics¹⁷
CRASH3 will address TBI alone specifically¹⁸.
PLAYGAME will address use of melatonin for concussion¹⁹

Additional Documentation

[Appendix – Excerpt from WHO radiation guidelines](#)

[Appendix – Chalice Rule guidelines algorithm](#)

[Appendix – Pecarn Rule](#)

[Appendix WHO communicating radiation risk in pediatric imaging](#)