



Head Injury

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Head Injury

Overview

Head injuries are a common cause of morbidity and mortality in children, often due to falls or road traffic accidents. Most head injuries are minor and management at home. However, some children may require review in an emergency department.

Traumatic brain injury (TBI) is a significant factor in major trauma patients attending a Major Trauma Centre (MTC) or requiring transfer from a Trauma Unit (TU). Children can compensate for severe injuries until a rapid deterioration so caution should be taken to consider the mechanism of injury and adoption of suspicion with falls from height or high force injuries is appropriate.

Objectives

The management of head injuries depends entirely on the severity and the potential for deterioration due to secondary injury. It is imperative, therefore, to appropriately triage and assess a child following a head injury, understanding that there is potential to deteriorate following initial assessment.

The focus should be on:

- Initial assessment including appropriate analgesia
- [Appropriate investigation](#)
- [Management of injury](#)
 - Prevention of secondary injury
 - Appropriate on-going care

Grading of Head Injury

There are several grading systems for head injuries but the simplest is based on the Glasgow Coma Scale (GCS) after initial resuscitation. Mild head injuries can still be significant causes of morbidity and school absence. For children experiencing concussion symptoms please refer to the After Concussion, Return to Normality (ACoRN) Leaflet for **concussion and return to activity advice** for children and families (see appendix I on page 102 of this document)

<https://childbraininjurytrust.org.uk/wp-content/uploads/2019/07/ACORN-Blank-Template.pdf>.

Moderate and severe head injuries will normally need hospitalisation and investigation, and many will need to be discussed with neurosurgery. This guideline is for management of these patients who represent approximately 5% of attendees. Penetrating injury through bone and dura will always need investigation and discussion with neurosurgery whatever the grade of injury.

| Grade | GCS |
|----------|-----------|
| Mild | 13-15 |
| Moderate | 9-12 |
| Severe | 8 or less |

Safeguarding Children

For all children presenting with a head injury, it is important to complete a safeguarding assessment as part of the initial and ongoing assessment (please see safeguarding section starting on page 86). The initial assessment should include consideration of:

- Injury incompatible with history
- Unexplained delay in presentation
- Change in mechanism of injury over time
- Injury in immobile child
- Risk taking behaviours causing injury
- Lack of supervision
- Neglect

Who requires imaging?

NICE guidelines exist to clarify this. [NICE: criteria for CT head
https://www.nice.org.uk/guidance/cg176/resources/imaging-algorithm-pdf-498950893](https://www.nice.org.uk/guidance/cg176/resources/imaging-algorithm-pdf-498950893)

Criteria for performing a CT head scan

For children who have sustained a head injury and have any of the following risk factors, perform a CT head scan within 1 hour of the risk factor being identified:

- Suspicion of non-accidental injury.
- Post-traumatic seizure but no history of epilepsy.
- On initial emergency department assessment, GCS less than 14, or for children under 1 year GCS (paediatric) less than 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 more than 5 cm on the head.
- A provisional written radiology report should be made available within 1 hour of the scan being performed.

For children who have sustained a head injury and have **more than one** of the following risk factors (and none of those above) perform a CT head scan within 1 hour of the risk factors being identified:

- 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.

Assessment of amnesia will not be possible in preverbal children and is unlikely to be possible in children aged under 5 years.

A provisional written radiology report should be made available within 1 hour of the scan being performed.

Children who have sustained a head injury and have **only 1** of the risk factors in this section should be observed for a minimum of 4 hours from the time of injury.

The minimum frequency of observations for patients with GCS equal to 15 should be as follows, starting after the initial assessment in the ED:

- Half-hourly for 2 hours
- Then 1 hourly for 4 hours
- Then 2 hourly thereafter

If during observation any of the risk factors below are identified, perform a CT head scan within 1 hour.

- GCS less than 15.
- Further vomiting.
- A further episode of abnormal drowsiness.

A provisional written radiology report should be made available within 1 hour of the scan being performed. If none of these risk factors occur during observation, use clinical judgement to determine whether a longer period of observation is needed.

For patients (adults and children) who have sustained a head injury with no other indications for a CT head scan and who have a high bleeding risk, perform a CT head scan within 8 hours of the injury. A provisional written radiology report should be made available within 1 hour of the scan being performed. (For [advice on reversal of warfarin anticoagulation in people with suspected traumatic intracranial haemorrhage, see the NICE guideline on blood transfusion.](#))

Cervical Spine

For children who have sustained a head injury, perform a CT cervical spine scan only if any of the following apply (because of the increased risk to the thyroid gland from ionising radiation and the generally lower risk of significant spinal injury):

- GCS less than 13 on initial assessment.
- The patient has been intubated.
- Focal peripheral neurological signs.
- Paraesthesia in the upper or lower limbs.
- A definitive diagnosis of cervical spine injury is needed urgently (for example, before surgery).
- The patient is having other body areas scanned for head injury or multi-region trauma.
- There is strong clinical suspicion of injury despite normal X-rays.
- Plain X-rays are technically difficult or inadequate.
- Plain X-rays identify a significant bony injury.

The scan should be performed within 1 hour of the risk factor being identified. A provisional written radiology report should be made available within 1 hour of the scan being performed.

For children who have sustained a head injury and have neck pain or tenderness but no indications for a CT cervical spine scan perform 3-view cervical spine X-rays **before** assessing range of movement in the neck if either of these risk factors are identified:

- Dangerous mechanism of injury (that is, fall from a height of greater than 1 metre or 5 stairs; axial load to the head, for example, diving; high-speed motor vehicle collision; rollover motor accident; ejection from a motor vehicle; accident involving motorised recreational vehicles; bicycle collision).
- Safe assessment of range of movement in the neck is not possible.

The X-rays should be carried out within 1 hour of the risk factor being identified and reviewed by a clinician trained in their interpretation within 1 hour of being performed.

If range of neck movement can be assessed safely in a child who has sustained a head injury and has neck pain or tenderness but no indications for a CT cervical spine scan, perform 3-view cervical spine X-rays if the child cannot actively rotate their neck 45 degrees to the left and right. The X-rays should be carried out within 1 hour of this being identified and reviewed by a clinician trained in their interpretation within 1 hour of being performed.

In children who can obey commands and open their mouths, attempt an odontoid peg view.

Management of Injury

Management of Moderate and severe head injuries involves prevention of secondary injury. This is done with a combination of medical management and, when appropriate, expedited surgical intervention. If in a centre without neurosurgery this will often require urgent transfer. Appropriate ongoing care minimises the impact of the primary injury.

Most moderate or severe head injuries will need to be discussed with the Trauma Team Lead (TTL) in the MTC. This would include:

- All patients with surgically significant abnormalities on imaging
- Regardless of imaging other reasons include:
 - Persisting coma (GSS \leq 8) after initial resuscitation
 - Unexplained confusion for more than 4 hours

- Deterioration of 2 or more points in GCS after admission (motor score more significant)
- Progressive focal neurological signs
- Seizure without full recovery
 - Definite or suspected penetrating injury
 - Cerebrospinal fluid leak

Prevention of secondary injury

Tranexamic acid

The CRASH 3 study has demonstrated a beneficial effect in giving tranexamic acid (TXA) to adults within 3 hours of mild to moderate traumatic brain injury. It is plausible that the same effect can be expected in children and TXA may be beneficial in preventing progressive intracranial haemorrhage in traumatic brain injuries without an increase in adverse effects.

TXA should be given to children with suspected head injury and reduced conscious level or those with intracranial bleed confirmed on imaging if started within 3 hours of the injury.

Patients under 16 years old:

Loading dose: Dilute 15mg/kg (max. 1g) in 10mL of sodium chloride 0.9% or glucose 5% and give via intravenous injection over 10 minutes (within 3 hours of injury).

followed by

Maintenance infusion: Dilute 1g to 500mL with sodium chloride 0.9% or glucose 5% and infuse intravenously at a rate of 2mg/kg/hr [1mL/kg/hr] (max. 125mg/hr [62.5mL/hr]) for 8 hours or until bleeding stops.

Patients over 16 years old:

Loading dose: Dilute 1g in 10mL of sodium chloride 0.9% or glucose 5% and give via intravenous injection over 10 minutes (within 3 hours of injury).

followed by

Maintenance infusion: Dilute 1g to 500mL with sodium chloride 0.9% or glucose 5% and infuse intravenously at a rate of 125mg/hr [62.5mL/hr] for 8 hours or until bleeding stops.

Secondary injury occurs due to raised intracranial pressure (ICP). This can be due to expanding haematomas or swelling of intracranial structures following diffuse injury. Ultimately this can lead to ischaemic injury, trans-tentorial herniation and death.

Signs and symptoms of raised ICP include:

- Reduced conscious level
- Vomiting
- Headache
- Visual disturbance
- Neurological symptoms (weakness, hypertonia)

And in severe cases:

- Pupil dilation
- Cranial nerve palsies
- Abnormal posturing

Treatment

The ultimate management is likely to involve neurosurgical and or Intensive Care management so timely transfer to a unit where this is available is a priority. Please follow the MT transfer policy. Patients in coma or with reducing GCS should always be transferred intubated and ventilated.

Prior to and during transfer, measures can be taken to reduce ICP and reduce the chance of deterioration. These are aimed at reducing secondary injury. These include:

- Ensure well oxygenated – maintain oxygen saturations 94-98%.
- Head tilt 20 degrees upwards (with appropriate caution about spine)
- Maintain blood glucose above 3mmol/L (give 3mL/kg of glucose 10% to correct hypoglycemia)
- Maintain blood pressure (aim for age-specific MAP targets as per table below; if unable to measure MAP aim for systolic BP > 95mmHg) using fluids and inotropes if required

| Mean arterial pressure targets (age specific) | |
|---|--------------------------|
| Under 1 year | More than 50 mmHg |
| 1-5 years | More than 60 mmHg |
| 5-14 years | More than 70 mmHg |

| | |
|---------------|--------------------------|
| Over 14 years | More than 80 mmHg |
|---------------|--------------------------|

- Treat pyrexia
- Treat seizures as they occur as per local guidelines (for regional Guideline for Management of Generalised Convulsive Status Epilepticus in Children NWTS guidelines see <http://www.nwts.nhs.uk/clinicalguidelines>)
- Treat pain using opiates
- Insert urinary catheter unless urethral injury is suspected.

If signs of impending herniation, then consider:

- Hyperosmolar therapy (choice based on best availability)
 - Hypertonic sodium chloride 2.7%: 3ml/kg via intravenous injection over 15 minutes; especially consider in multiple trauma where signs of hypovolaemia/haemorrhagic shock.
 - or
 - Mannitol 20%: 1.25-2.5 mL/kg via intravenous injection over 15 minutes; avoid in renal failure and caution in haemorrhagic shock; watch for hypovolaemia
 A second treatment may be given (either the same or the alternative therapy) if required but exercise caution. If using hypertonic saline, maintain serum sodium above 140mmol/l but less than 150mmol/l.
- Controlled hyperventilation
 - Aim for end-tidal CO₂ (EtCO₂) between 3.5-4.0 KPa (equivalent to arterial PaCO₂ 4.0-4.5kPa or 30-35mmHg)
 - Requires end tidal CO₂ monitoring

Discharge advice

Patients can be discharged home following a head injury as long as they have:

- GCS 15.
- An appropriate head injury advice sheet.
- There is suitable care and supervision at home.
- No ongoing safeguarding concerns

For all CYP who have attended the emergency department with a head injury, their GP should be sent details of their clinical history and examination within 48 hours of their discharge. The discharge letter should be shared with the child's health visitor (for pre-school children) or school nurse (for school-age children). If appropriate, a copy of the letter should be shared with the patient and their family / carer. Patients and their families / carers should be provided advice about the possibility of persistent or delayed symptoms following head injury and whom they should contact if they experience ongoing problems.

Follow-up

When a patient has undergone imaging of the head and/or been admitted to hospital there must be an opportunity available for referral from primary care to an outpatient appointment with a professional trained in assessment and management of sequelae of brain injury (for example, clinical psychologist, neurologist, neurosurgeon, paediatrician) if the patient develops or experiences persisting problems related to their head injury.