

## Head Injury Early Management in Children

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<b>Date of review:</b> <b>This is the most current version and should be used until a revised document is in place</b>	26 <sup>th</sup> March 2024

### Key amendments to this guideline

Date	Amendment	Approved by: (name of committee or accountable director)
20/08/2018	Incorporation of NICE guidance algorithms for management. <ul style="list-style-type: none"> <li>• KIDS retrieval team.</li> <li>• Emphasise if CT guideline not followed must discuss with consultant.</li> <li>• Emphasise importance of documenting all vomits.</li> <li>• Awareness that pituitary dysfunction may result from head injury.</li> <li>• Appendix 4 Nursing care plan on the ward for monitoring head injury.</li> <li>• Altering level of consciousness included as a worrying clinical sign in nurse documentation.</li> <li>• Indications for CT Head and Cervical spine imaging as per NICE guidance</li> <li>• WAHT Reporting of images (page 9)</li> </ul>	M Hanlon / Paediatric CG Committee
09/09/2019	Specific advice relating to babies accidentally dropped in hospital added to guideline – in line with NHS improvement alert May 2019 Ref NHS/PSA/RE/2019/002	Dr A Gallagher
19 <sup>th</sup> Nov 2020	Document extended for one year	Dr J West/Paediatric QIM
26th March 2021	Approved with no amendments	Paediatric QIM

### DEFINITION

Head injury can be defined as any alteration in mental or physical functioning relating to a blow to the head. Loss of consciousness does not need to occur.

### SIGNIFICANCE

- About 500,000 children per year attend A&E in the UK with head injury. The mortality is 6-10/100,000 so physicians rarely see life threatening head injury. In general children have a remarkable capacity for physical recovery. It is increasingly recognised from neuro-rehabilitation research that children who sustain even mild to moderate head injury can have subtle but significant cognitive deficits that can affect educational achievement. Pituitary dysfunction is a potential risk after traumatic brain injury. Prompt and effective early assessment and treatment is essential for all patients presenting to A&E.

In the past decade several rules for assessing clinical severity in adults have been developed but the quality of studies on children with Head Injury have been very poor (NICE 2003). The advice regarding children in the NICE guidelines 2007 on Head Injury is based on the CHALICE study. This study, the world's largest prospective study of 22,772 children (<16 year old) with head injury from 10 UK centres,

devised the CHALICE Rule. This Rule has a 98% sensitivity and 87% specificity for prediction of clinically significant Head Injury.

NICE guidance in 2014 has given us the basic guidance for this guideline.

**NB.** Consider Non Accidental Injury particularly in non-ambulant children. Check for Child Protection Plan.

### **Competencies required**

- Training in basic life support.
- Resuscitation team – trained in APLS or EPLS
- All those involved in the assessment of infants and children with head injury should be trained to detect non-accidental injury. This includes having knowledge of child development.
- Observations of patients with head injury should only be carried out by professionals competent in the assessment of head injury and assessing the presence or absence of risk factors for significant head injury. (CHALICE Rule)

### **Patients covered**

- The guideline covers management of infants, children and teenagers suffering from a recent head injury. This guideline only refers to the acute management from arrival in A&E – Acute Resuscitation if necessary; indications for admission for observation; indications for discharge.
- Although most children sustain relatively minor head injury and are either discharged direct from A&E or admitted for observation without sequelae the guideline follows the triage system of dealing with the most serious cases first.
- The list of children subject to a child protection plan should be checked for ALL children who are assessed in A&E.
- MIU Kidderminster follow the section in the NICE guideline “Community Health Services and NHS minor Injury Clinics”
- Head injury maybe associated with multiple injuries. It is not the aim of this guideline to cover management of all such injuries but to emphasise that such injuries may contribute to secondary brain injury if not properly managed.
- Babies accidentally dropped in hospital

### **GUIDELINE**

See references for basis for guideline.

This guideline refers to the Status Epileptics guideline and the Child Protection Protocol and Safeguarding Children Policy.

The list of children subject to a child protection plan should be checked routinely for all children who attend A&E. If concerned about possible child abuse the Consultant Paediatrician on call should be informed. (See Child Protection Protocol)

Appendix 1 Glasgow Coma Score for 4-15year old and < 4 year old.

Appendix 2 Head Injury proformas for use in A&E

Appendix 3 Head Injury Observations for use in A&E

Appendix 4 Nursing Care plan for Head Injury - For use on the ward

### **Causes of Head Injury:**

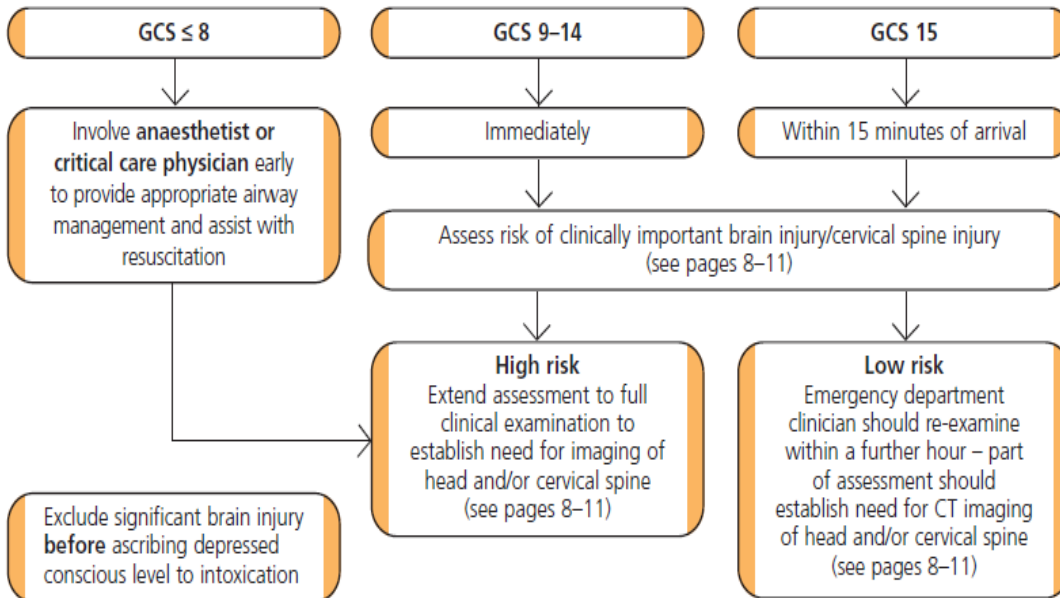
The commonest mechanisms are: (in order with the commonest first)

- RTAs
- Pedestrians
- Bicycle Accidents
- Passengers in Motor Vehicles
- Falls

**NB.** Consider Non Accidental Injury particularly in non-ambulant children

## Assessment in emergency department

Stabilise airway, breathing and circulation (ABC) before attending to other injuries.



### Pain management

- Manage pain effectively and reassure patients.
- Treat significant pain with low dose of intravenous opioids titrated against clinical response and baseline cardiorespiratory measurements.

### Training

- All emergency department clinicians involved in assessing patients with head injuries should be able to assess the presence and absence of the risk factors listed on pages 8-11 on selection and urgency for imaging – training should be available as required to ensure this.
- Emergency department (and all in-hospital) observations of patients with head injuries should only be carried out by professionals competent in the assessment of head injury.
- All those involved in the assessment of infants and children with head injury should be trained to detect non-accidental injury.

If patient returns to emergency department within 48 hours of discharge with persistent complaint relating to initial head injury, involve a senior clinician with experience in head injuries and consider CT scan.

## **ASSESSMENT /EXAMINATION**

### **The Primary Survey**

- In significant trauma – call for senior ED, anaesthetic and neurosurgical help early.
- Assess and treat ABC and C-spine immobilization as a priority to other injuries.
- Remember – resuscitation of ABC optimizes head injury management.
- Assess D – Glasgow Coma Score, pupils, posture and BM.
- GCS 8 or less will require intubation.
- If GCS 8 or less, discuss with KIDS (West Midlands Paediatric Retrieval) and BCH neurosurgeons immediately and consider treatment of raised intracranial pressure.
- Ascribe depressed conscious level to intoxication only after a significant brain injury has been excluded.
- Manage pain effectively where relevant
- Discuss with senior if unsure. IV opiates are not an absolute CI but a senior must be involved

A thorough history should be taken from any witnesses of the event and a detailed past medical history from the family/ guardians

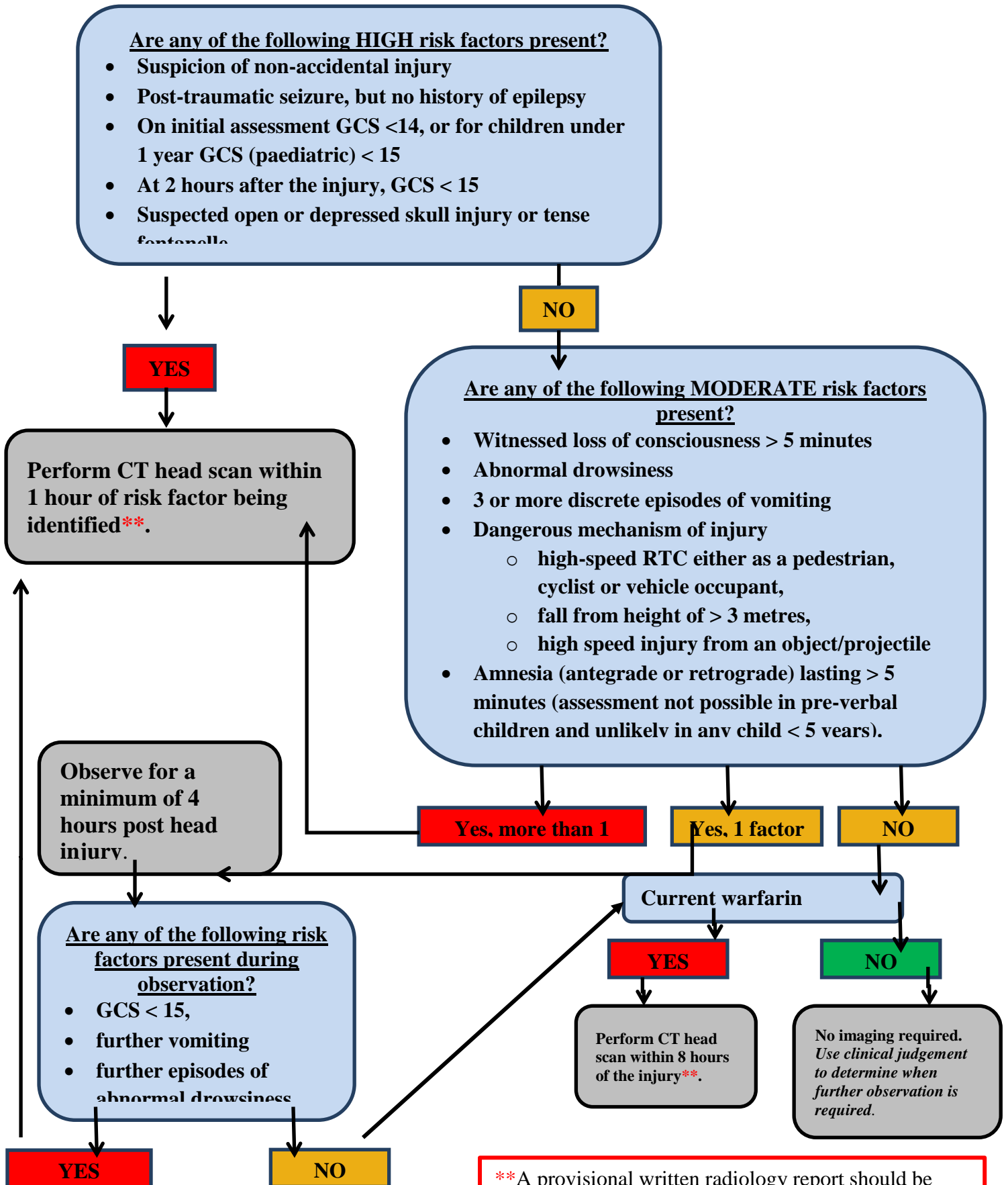
Points to cover during the history

- Mechanism, place and time of incident
- Loss of consciousness and amnesia surrounding the event
- Any paralysis/paraesthesia
- Any headache after the event; specifically thinking about relevant factors that would suggest raised ICP (worse on coughing, bending down, vomiting or straining)
- How many vomits?
- Fluid from nose/ ears (rhinorrhoea/ otorrhoea)
- Neck pain
- Associated other injuries

### **Assessment:**

- Head should be carefully examined to look for any evidence of external injury such as lacerations, boggy swellings, bruises and evidence of a depressed skull fracture.
- Any evidence of a basal skull fracture (blood or CSF from nose/ ears, haemo-tympanum, panda eyes and battle sign- bruising behind the ear over the mastoid process).
- Palpation of cervical spine to assess for any neck tenderness
- Peripheral neurological examination (including power, tone, sensation reflexes and coordination) and cranial nerve exam in older children
- Assessment of gait in older children and in younger children assessment of ability to grip objects and movements of limbs against gravity
- Assessment of pupils- looking at size, equality and reactivity (an unequal dilated non-reactive pupil indicates a third nerve dysfunction due to ipsilateral intracranial haematoma until proven otherwise).
- Fundi should be examined (papilledema will not be present in acute raised ICP however retinal haemorrhages may indicate NAI in a young infant).
- Examination for any other injuries should also be assessed along with a thorough systems examination.
- Assessment of GCS as per the Glasgow coma scale for children and infants.

**INVESTIGATIONS FOR CT HEAD**



**\*\* A provisional written radiology report should be made available within 1 hour of the CT head scan**

**INDICATIONS FOR CERVICAL SPINE IMAGING**

Are any of the following HIGH risk factors present?

- GCS < 13 on initial assessment
- Intubation
- A definitive diagnosis of cervical spine injury is required urgently (e.g. before surgery)
- Other body areas are being scanned for head injury or multi-region trauma

**YES**

**NO**

Perform CT cervical spine within 1 hour of risk factor being identified\*\*.

Is there neck pain or tenderness?

**YES**

**NO**

Was there a dangerous mechanism of injury?

- fall from > 1 metre or 5 stairs
- axial load to the head [e.g. Diving]
- high-speed motor vehicle collision
- rollover motor accident
- ejection from a motor vehicle, bicycle collision

Are any of the following LOW risk factors present?

- Involved in a simple rear-end motor vehicle collision
- Is comfortable in a sitting position in the emergency department
- Has been ambulatory at any time since injury
- No midline cervical tenderness
- Presents with delayed onset of neck pain.

**YES**

**NO**

Perform three-view cervical spine X-rays within 1 hour of risk factor being identified.

**NO**

**YES**

- Is there a strong clinical suspicion of injury despite normal X-rays, the X-rays were technically difficult or inadequate, OR
- X-ray identifies a significant bony injury?

On assessment can the patient actively rotate the neck to 45 degrees to the left and right?

**NO**

**YES**

**YES**

No imaging/ further imaging required

\*\*A provisional written radiology report should be made available within 1 hour of the CT head scan



See below comments relating specifically to Imaging in suspected cases of Non accidental Injury in section 'Reporting of Imaging at WRH'

### **Reporting of Imaging at WRH**

CT Head for the suspicion of NAI (as long as the patient is stable) is usually performed within 24 hours to allow for a skeletal survey to be performed at the same time, particularly when the child needs sedation for the CT head.

Examinations in cases of suspected NAI are performed Mon-Fri, 9-5. Unfortunately there is no out of hours cover for performing skeletal surveys. In patients who are clinically urgent, CT heads can be performed at any time and the skeletal survey arranged for a later date.

A radiologist is available on-site 9am-9pm Mon-Sun. Outside of these hours CT requests must be agreed by Medica. Requests for paediatric patients must be agreed by a paediatric consultant.

<http://nww.worcsacute.nhs.uk/departments-a-to-z/radiology/medica/>

Image transfer can be arranged to Receiving / Reviewing Hospital (usually BCH Neurosurgical Team if pathology is identified).

This can be arranged through the PACS gateway (one of the blue boxes on the side of the screen when logging into PACS) or by contacting a member of the PACS team 9-5, Mon-Fri. Outside of these hours any radiographer can transfer images via IEP - A&E x-ray is staffed 24 hours a day (Ext: 30575/30272 or bleep 154).

**Bloods** - where appropriate (e.g. GCS<8, deterioration GCS, other injuries) include:

- FBC
- Coagulation
- U&E
- Glucose
- Arterial PaO<sub>2</sub> and PaCO<sub>2</sub>
- Cross match

**Urine** - Toxicology screen if suspicions of drug misuse.

### **MANAGEMENT**

ABCDE Assessment and investigations as noted above.

Cervical spine stabilisation if necessary.



Intubation and ventilation

Circumstances	Action
<ul style="list-style-type: none"> <li>● Coma – GCS <math>\leq</math> 8 (use paediatric scale for children)</li> <li>● Loss of protective laryngeal reflexes</li> <li>● Ventilatory insufficiency:                             <ul style="list-style-type: none"> <li>– hypoxaemia (<math>\text{PaO}_2 &lt; 13</math> kPa on oxygen)</li> <li>– hypercarbia (<math>\text{PaCO}_2 &gt; 6</math> kPa)</li> </ul> </li> <li>● Spontaneous hyperventilation causing <math>\text{PaCO}_2 &lt; 4</math> kPa</li> <li>● Irregular respirations</li> </ul>	<ul style="list-style-type: none"> <li>● Intubate and ventilate immediately</li> </ul>
<ul style="list-style-type: none"> <li>● Significantly deteriorating conscious level (1 or more points on motor score), even if not coma</li> <li>● Unstable fractures of the facial skeleton</li> <li>● Copious bleeding into mouth</li> <li>● Seizures</li> </ul>	<ul style="list-style-type: none"> <li>● Intubate and ventilate before the journey starts</li> </ul>
<ul style="list-style-type: none"> <li>● Ventilate an intubated patient with muscle relaxation and appropriate short-acting sedation and analgesia</li> <li>● Aim for:                             <ul style="list-style-type: none"> <li>– <math>\text{PaO}_2 &gt; 13</math> kPa</li> <li>– <math>\text{PaCO}_2</math> 4.5–5.0 kPa</li> </ul> </li> <li>● If clinical or radiological evidence of raised intracranial pressure, more aggressive hyperventilation is justified</li> <li>● Increase the inspired oxygen concentration if hyperventilation is used</li> <li>● Adult: maintain mean arterial pressure at <math>\geq 80</math> mmHg by infusing fluid and vasopressors as indicated</li> <li>● Child: maintain blood pressure at level appropriate for age</li> </ul>	

Let carers and relatives have as much access to the patient as is practical during transfer and keep them fully informed on the reasons for transfer and the transfer process.

Patients who are to be transferred and have either bilateral fractured mandible or base of skull fracture or deteriorating GCS or have had a seizure need intubation and ventilation prior to transfer.

If GCS is 9 or greater secure the airway with basic airway manoeuvres.

If the child is not intubated then treat with high flow O<sub>2</sub> with re-breathe mask providing 90-95% inspired O<sub>2</sub> concentrations.

### **Hypotension from Hypovolaemia**

- This under-perfuses the brain. Resuscitate with fluids to a normal blood pressure and heart rate.
- Fluid overload can cause or worsen cerebral oedema but is unlikely if CVP is monitored and fluid boluses are given according to clinical response..
- Control bleeding from scalp wounds.
- Assess for other causes of blood loss e.g. intra-abdominal injuries. Surgical assessment and may need urgent CT abdomen with CT head.

### **Analgesia**

Do not be afraid to give this as pain upsets the child and raises intra-cranial pressure.

IV narcotics are safe. N.B. If standard doses are given any alteration in conscious level is due to head injury and not narcotic. Although BNF says opioids contraindicated in head injury PICU and Neurosurgery at Birmingham Children's Hospital would not agree.

Regional and local anaesthetic blocks are helpful.

### **Deteriorating Conscious Level**

This needs prompt treatment.

Tilt the trolley to 30° head-up position.

After intubation and ventilation consider IV mannitol (0.5-1.0g/kg). Consult the neurosurgical centre first as they have their own policies.

Steroids have no place in acute head injury management

### **Fitting**

A brief convulsion post head injury might be of little significance.

If it is prolonged or focal in nature it is more sinister.

After 5 minutes of fitting an anticonvulsant should be started.

Status epilepticus protocol should be followed

### **Scalp Lacerations**

*These are treated by cleaning and debridement.*

The wound is closed with sutures staples or tissue glue.

Bleeding from scalp wounds can sometimes be difficult to stop, under sew or clip the vessel if pressure or simple suture fails to stop bleeding.

Remember scalp laceration in infants and babies may cause significant blood loss +/- hypotension.

### **Involving neurosurgical Care**

Discuss with a neurosurgeon the care of all patients with new, surgically significant abnormalities on imaging.

Other reasons for discussing with a neurosurgeon (regardless of imaging)

- Persisting coma (GCS 8 or less) after initial resuscitation.
- Unexplained confusion which persists for more than 4 hours.
- Deterioration in GCS scores after admission (greater attention should be paid to motor response deterioration).

- Progressive focal neurological signs.
- A seizure without full recovery.
- Definite or suspected penetrating injury.
- A cerebrospinal fluid leak.

### **Indications for Admission**

Use the criteria below for admitting patients to hospital following a head injury:

- Patients with new, clinically significant abnormalities on imaging.
- A patient who's GCS has not returned to 15 after imaging, regardless of the imaging results.
- When a patient has indications for CT scanning but this cannot be done within the appropriate period, either because CT is not available or because the patient is not sufficiently cooperative to allow scanning.
- Continuing worrying signs (for example, persistent vomiting, drowsiness, severe headaches) of concern to the clinician.
- Other sources of concern to the clinician (for example, drug or alcohol intoxication, other injuries, shock, suspected non-accidental injury, meningism, cerebrospinal fluid leak).

Notes:

Vomiting, headache, and sleepiness are very common symptoms post head injury in children. They are usually not indications for admission unless prolonged (>4 hours).

The presence of a VP shunt in a child with a head injury is not an indication for admission unless there are persisting symptoms or worries about the function of the shunt. Nor is it an indication for CT scan on its own.

### **During admission and Nursing Care**

For patients admitted for head injury observation, the minimum acceptable documented neurological observations are: GCS; pupil size and reactivity; limb movements; respiratory rate; heart rate; blood pressure; temperature; blood oxygen saturation.

- Perform and record observations on a half-hourly basis until GCS equal to 15 has been achieved. The minimum frequency of observations for patients with GCS equal to 15 should be as follows, starting after the initial assessment in the emergency department:
- Half-hourly for 2 hours.
- Then 1-hourly for 4 hours.
- Then 2-hourly thereafter.
- Should the patient with GCS equal to 15 deteriorate at any time after the initial 2-hour period, observations should revert to half-hourly and follow the original frequency schedule.
- Any of the following examples of neurological deterioration should prompt urgent medical review. If confirmed, an immediate CT scan should be considered
- Development of agitation or abnormal behaviour.
- A sustained (that is, for at least 30 minutes) drop of 1 point in GCS score (greater weight should be given to a drop of 1 point in the motor response score of the GCS).

- Any drop of 3 or more points in the eye-opening or verbal response scores of the GCS, or 2 or more points in the motor response score.
- Development of severe or increasing headache or persisting vomiting.
- New or evolving neurological symptoms or signs such as pupil inequality or asymmetry of limb or facial movement.
- In the case of a patient who has had a normal CT-scan but who has not achieved GCS equal to 15 after 24 hours' observation, a further CT scan or MRI scanning should be considered and discussed with the radiology department.

### **SPECIAL CONSIDERATIONS FOR BABIES ACCIDENTALLY DROPPED IN HOSPITAL**

- NHS Improvement published guidance ( May 2019) following the recognition that nationally significant number of babies sustain head injuries because they are accidentally dropped whilst in hospital- usually from the arms or lap of a parent or relative.
- All incidents of an infant being dropped must be reported on Datix.
- Consider whether there are safeguarding concerns eg parent appears unable to provide safe care due to substance misuse or mental health problem.
- Baby must be reviewed by paediatric medical team for examination and further investigations as outlined in this guideline.
- Document any marks or bruises to patient in the medical notes and parent held record ( Red Book) before discharge from hospital.
- Ensure baby has received IM Vitamin K
- Infants ( child <12m of age) sustaining a head injury within the hospital should be observed for 12 hours, with normal observations, before discharge with usual head injury patient information leaflet given to parents. Usually post head injury general and neurological observations can be performed without moving the infant to a different clinical area – for example observations can be performed on the post natal ward if the infant shows no sign of serious intracranial injury.
- Discharge after 12 hours of normal observations and clinical review by the paediatric medical team

### **TRANSFER**

Children who need ventilation will be transferred to a neurosurgical unit with Paediatric ITU facilities.

KIDS Retrieval Team from Birmingham Children Hospital – 0300 200 1100. They will organise a 3 way conversation with the neurosurgical team.

The decision may be that Worcester/Redditch transfer the child with anaesthetic cover to comply with the Golden hour. The NICE guidelines recommend transfer should be undertaken by staff experienced in the transfer of critically ill children.

Otherwise the retrieval team, if available, will come for transfer. If no neurosurgical bed at Birmingham Children Hospital then the KIDS team will advise on availability of beds in other Neurosurgical Units.

Bristol PICU 0117 3428437/ Fax 348538.

John Radcliffe PICU 01865 220632/633 / Fax 222061.

**Parents should be kept informed** of progress with resuscitation and transfer plan. They should be given directions/maps and hospital contact phone numbers.

## **DISCHARGE**

All of the following must apply before discharging a child home even if they have had a normal CT head scan:

DO NOT DISCHARGE ANYBODY WITH A HEAD INJURY UNTIL GCS 15/15.

- No indication for CT scan (according to above algorithm) OR normal CT scan
- No Neurology /GCS 15
- No ongoing clinical features of concern to the clinician (e.g. persistent vomiting, severe headache).
- No other factors warranting admission
- No Drug or alcohol intoxication
- No Other injuries requiring treatment
- No Meningism
- No CSF leak
- All wounds if present adequately treated
- Appropriate and competent supervision available at home from parent/carer.
- All safeguarding concerns should be addressed with the on-call consultant prior to discharge.

Do not forget to give Head Injury advice leaflet which outlines signs and symptoms to look out for after discharge. There have been rare cases reported in the literature of pituitary dysfunction after a head injury- this is something for health care professionals to bear in mind in a child re-presenting after a head injury with symptoms suggestive of neuroendocrine dysfunction after a significant head injury.

## Discharge advice

- All patients should receive verbal advice and a written head injury advice card before discharge from emergency department or ward (an example is available from [www.nice.org.uk/CG56](http://www.nice.org.uk/CG56)).
- Discuss details of the advice card before discharge – this should include instructions on contacting community services in the event of delayed complications.
- Alert patients and carers to the possibility that some patients may make a quick recovery, but go on to experience delayed complications.
- Make all patients and carers aware of the possibility of long-term symptoms and disabilities and of the existence of services that they could contact should they experience long-term problems (details of support services should be included on patient discharge advice cards).
- If necessary, use other formats to communicate discharge advice (for example, tapes).
- If there is a need, facilitate communication in languages other than English.
- Give information and advice on alcohol or drug misuse to patients who presented to the emergency department with drug or alcohol intoxication if they are now fit for discharge.

## Outpatient appointments

- **Every patient who has undergone imaging of their head and/or been admitted to hospital:** refer to GP for follow-up within 1 week after discharge.
- **If problems persist:** there should be an opportunity for referral from primary care to an outpatient appointment with a professional trained in assessment and management of brain injury sequelae.

## Communication with community services

- **Patient who attended emergency department with head injury:** send letter or email to GP within 1 week of end of hospital episode – include details of the clinical history and examination, and ensure patient or carer has access (letter/email is open or patient given a copy).
- **School-aged child who received head or cervical spine imaging:** send letter or email to GP and school nurse within 1 week of end of hospital episode – include details of the clinical history and examination.
- **Pre-school-aged child who received head or cervical spine imaging:** send letter or email to GP and health visitor within 1 week of end of hospital episode – include details of the clinical history and examination.

## REFERENCES

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- 2002
- NICE Head Injury Guidelines, 2007.
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