**Algorithm: Imaging & Observation Decision-Making for Children with Head Injuries**

**Clinician assessment of child presenting within 72 hours of head injury**

- **GCS ≤ 13**
  - Alert senior clinician: Very close observation required
  - Head CT: Is the CT normal OR Showing an isolated non-displaced skull fracture AND GCS 15?
    - **YES**: Consult neurosurgery and admit
    - **NO**: Senior clinician concerns?
      - **YES**: Senior clinician review to consider need for observation vs head CT vs discharge.
      - **NO**

- **GCS 14-15**
  - Does the child have these special conditions?
    - Possible abusive head trauma
    - Drug or alcohol intoxicated
    - < 6 months old
    - Neurodevelopmental disorders
    - Ventricular shunt
    - Bleeding disorders
    - Please see page 2

**Assess for risk factors for intracranial injury & initial observation**

- **All children:** GCS 14 or other signs of altered mental status
  - Abnormal neurological examination
  - Severe mechanism of injury
  - Post-traumatic seizure(s)

- **Age < 2yrs:**
  - Palpable skull fracture
  - Non-frontal scalp haematoma
  - History of LOC ≥ 5 seconds
  - Acting abnormally per parent

- **Age ≥ 2yrs:**
  - Signs of base of skull fracture
  - History of LOC
  - History of vomiting
  - Severe headache

**Any risk factors**: Recommended observation period is up to 4 hours post injury including 1 hour return to normal. Clinician reassessment with deterioration, return to normal, or at 4 hours.

**High risk = imaging**

- Palpable skull fracture OR
  - Signs of base of skull fracture OR
  - Worsening signs and symptoms OR
  - Persistent GCS 14 OR
  - Persistent signs of altered mental status.

**Intermediate risk = consider imaging**

- ≥ 2 Risk factors OR
  - Post-traumatic seizure(s) OR
  - Persistent severe headache or persistent vomiting > 4 hours post injury.

**Low risk**

- Not intermediate or high risk AND
  - Improving signs and symptoms: GCS 15, acting normally, no current signs of altered mental status, vomiting has stopped, severe headache resolved.

**Very low risk**

- No risk factors

**Further observation with serial reassessment**

- Is there neurological deterioration OR Patient has GCS 14 after 6 hours total observation?
  - **YES**: Senior clinician review
  - **NO**

**Discharge with advice if no other factors requiring admission**

---

**Algorithmic rules**

- **≥ 2 Risk factors** OR **Post-traumatic seizure(s)** OR **Persistent severe headache or persistent vomiting > 4 hour s**
  - Senior clinician concerns?
    - **YES**: Senior clinician review
    - **NO**

- **Not intermediate or high risk AND Improving signs and symptoms**: GCS 15, acting normally, no current signs of altered mental status, vomiting has stopped, severe headache resolved.

- **Alert senior clinician**
  - Very close observation required

- **Head CT**
  - Is the CT normal OR Showing an isolated non-displaced skull fracture AND GCS 15?
    - **YES**: Consult neurosurgery and admit
    - **NO**: Senior clinician concerns?
      - **YES**: Senior clinician review
      - **NO**
Non-frontal scalp haematoma: occipital, parietal, or temporal.

Palpable skull fracture: on palpation or possible on the basis of swelling or distortion of the scalp.

Risk factors adapted from Kuppermann N et al.

Children with delayed initial presentation (24-72 hrs post head injury) and GCS 15 should be risk stratified the same way as children presenting within 24 hours. They do not need to be assessed with a further 4 hrs of observation.

Always consider possible cervical spine injuries and abusive head trauma in children presenting with head injuries.

Severe mechanism of injury: motor vehicle accident with patient ejection or rollover, death of another passenger, pedestrian or cyclist without helmet struck by motor vehicle, falls of ≥ 1m (< 2 yrs), fall > 1.5m (≥ 2yrs), head struck by high impact object.

Other signs of altered mental status: agitation, drowsiness, repetitive questioning, slow response to verbal communication.

Loss of consciousness.

Other factors warranting hospital admission may include other injuries or clinician concerns e.g. persistent vomiting, drug or alcohol intoxication, social factors, underlying medical conditions, possible abusive head trauma.

Do not use plain X-rays, or ultrasound of the skull, prior to or in lieu of CT scan, to diagnose or risk stratify a head injury for possible intracranial injuries.

Shared decision-making between families and clinicians should be considered.

Observation to occur in an optimal environment based on local resources. Frequency of observation to be ½ hourly for the first 2 hours, then 1-hourly until 4 hours post injury. After 4 hours, continue 2-hourly as long as the patient is in hospital.

If there are local signs of shunt disconnection/shunt fracture (such as palpable disruption or swelling) or signs of shunt malfunction, consider obtaining a shunt series based on consultation with a neurosurgical service.

If there are local signs of skull fracture: haemotympanum, ‘raccoon’ eyes, cerebrospinal fluid (CSF) otorrhoea or CSF rhinorrhoea, Battle’s signs.

It is unclear whether these children have a different background risk for intracranial injury. As these children may be difficult to assess, consider structured observation or head CT scan and include the paediatric team that knows the child (parents, caregivers, and clinicians) in shared decision-making.

Signs of base of skull fracture: haemotympanum, ‘raccoon’ eyes, cerebrospinal fluid (CSF) otorrhoea or CSF rhinorrhoea, Battle’s signs.

Isolated vomiting, without any other risk factors, is an uncommon presentation of clinically important traumatic brain injury (cTBI). Vomiting, regardless of the number or persistence of vomiting, in association with other risk factors, increases concern for cTBI.

Observation duration may be modified based on patient and family variables. These include time elapsed since injury/symptoms and ability of child/parent to follow advice on when to return to hospital.

Shared decision-making between families and clinicians should be considered.

Do not use plain X-rays, or ultrasound of the skull, prior to or in lieu of CT scan, to diagnose or risk stratify a head injury for possible intracranial injuries.

Other factors warranting hospital admission may include other injuries or clinician concerns e.g. persistent vomiting, drug or alcohol intoxication, social factors, underlying medical conditions, possible abusive head trauma.

Special Conditions

Possible abusive head trauma

Follow local screening tools for abusive head trauma (AHT). CT should be used as initial diagnostic tool to evaluate possible intracranial injury and other injuries relevant for the evaluation of AHT e.g. skull fractures. The extent of the assessment of a child with possible AHT should be co-ordinated with the involvement of an expert in the evaluation of non-accidental injury.

Drug or alcohol intoxicated

Treat as if the neurological findings are due to the head injury. Decision to CT scan or observe should be informed by risk factors for intracranial injury rather than the child being intoxicated.

< 6 months of age

Consider at higher risk of intracranial injury with a lower threshold for observation or imaging. Discuss with a senior clinician.

Neurodevelopmental disorders

It is unclear whether these children have a different background risk for intracranial injury. As these children may be difficult to assess, consider structured observation or head CT scan and include the paediatric team that knows the child (parents, caregivers, and clinicians) in shared decision-making.

Ventricular shunt (e.g. ventriculo-peritoneal shunt)

Consider structured observation over immediate CT scan if there are no risk factors of intracranial injury. If there are local signs of shunt disconnection/shunt fracture (such as palpable disruption or swelling) or signs of shunt malfunction, consider obtaining a shunt series based on consultation with a neurosurgical service.

Bleeding disorders or anti-coagulant or anti-platelet therapy

Urgently seek advice from the treating haematology team around risk of bleeding and management of coagulopathy. Consider structured observation over immediate CT scan if there are no risk factors for intracranial injury. If there is a risk factor for intracranial injury a head CT should be performed. If there is a deterioration in neurological status, perform urgent head CT scan.

Coagulation factor deficiency

CT scan or decision to observe must not delay the urgent administration of replacement factor.

Immune thrombocytopenias (ITP)

Check a platelet count in all patients and blood group in all symptomatic patients if not already available. For ITP with platelet counts < 20 x 10⁹/L, consider empirical treatment after discussion with the treating haematology team.

On warfarin therapy or other newer anticoagulants (e.g. direct oral-anticoagulant) or anti-platelet therapy

Consider CT regardless of the presence or absence of risk factors for intracranial injury. Seek senior clinician review to inform timing of the CT and discuss the patient with the team managing the anticoagulation regarding early consideration of reversal agents. For children on anticoagulation therapy, if available, check the appropriate anticoagulant measure (e.g. International normalised ratio).