

# **NHS** Children's Acute Transport Service



## Clinical Guidelines

# Traumatic Brain Injury

### Document Control Information

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## 1. Assessment

Ask about:

- History
  - Time of injury
  - Mechanism of injury – pattern of injury and prognostic information
- Clinical
  - GCS (attention to trend of motor component- may be more sensitive)
  - Airway or need for intubation
  - Pupillary response
  - Signs of base of skull fracture
    - Haemotympanium, “panda” eyes, CSF otorrhoea, Battle’s sign
  - External signs of head injury including skull fractures, haemorrhage control
  - Post traumatic seizures (consider phenytoin)
  - Vomiting
  - Amnesia
  - Assessment of spinal cord function (movement of limbs, priapism, spinal shock)
- Other
  - SaO<sub>2</sub>, Blood gases
  - Labs, including clotting
  - **Results of full secondary survey (needs senior orthopaedic surgeon/general surgeon to review) and presence of other injuries**
  - Trauma imaging (including abdominal assessment- FAST scan +/- CT), particularly CT scans and cervical spine imaging.

## 2. 1 Initial management

2.1.1. Stabilisation of airway and cervical spine, breathing and circulation (ABC) is the priority for all patients before attention to other injuries.

***Hypotension and hypoxaemia are strongly associated with poor outcome.***

2.1.2. Immobilise cervical spine if any suspicion of cervical spine injury, ie if:

- GCS < 15 at any time
- Neck pain/tenderness
- Focal neurological deficit, paraesthesia
- Distracting injury
- Intoxication
- Significant mechanism of injury

2.1.3. If cardiovascularly unstable and requiring volume resuscitation, consider other sites of blood loss: chest, abdomen, pelvis and major limb fracture.

2.1.4 At least 2 good venous lines (consider intraosseus if difficult).

- 2.1.5 Cross match blood and transfuse to Hb  $\geq$ 10g/dL.
- 2.1.6 Pass urinary catheter and orogastric tube
- 2.1.7 Perform secondary survey
- 2.1.8 Consider NAI, especially in children < 2 years of age

## 2.2 Indications for CT scanning

- 2.2.1 GCS<13 at any time since injury
- 2.2.2 GCS equal to 13 to 14 at 2h after the injury
- 2.2.3 Suspected open or basal skull fracture
- 2.2.4 Post traumatic seizure
- 2.2.5 Focal neurological deficit
- 2.2.6 > 1 episode vomiting
- 2.2.7 Amnesia > 30 minutes of events before impact
- 2.2.8 Dangerous mechanism of injury
- 2.2.9 Coagulopathy

### Cervical spine imaging:

Children  $\geq$ 10 yr can be treated as adults for the purpose of cervical spine imaging .

Children  $\leq$ 10 yr should receive AP and lateral views without an AP peg view. CT should be reserved for those with inadequate plain films.

### Make the appropriate referral.

2.2.10 Criteria for referral to ICU/Neurosurgery include:

- GCS  $\leq$  8 after initial resuscitation
- Unexplained confusion > 4h
- Deteriorating GCS
- Progressive focal neurological signs
- Seizure without full recovery
- Suspected penetrating injury
- CSF leak

2.2.11 **Great Ormond Street Hospital is the receiving centre for all head injury patients in North Thames. If the child is accepted by Great Ormond Street, the case must also be discussed with the neurosurgical registrar on call. In the event of any difficulty contacting the neurosurgical registrar, contact the neurosurgical consultant on call.**

2.2.12 If no bed is available at GOS, the child should be referred to Kings College Hospital in South Thames.

2.2.13 If no bed is available discuss with St Georges in South Thames, or refer to Addenbrookes Hospital.

Children's Acute Transport Service provides paediatric intensive care retrieval for Great Ormond Street, The Royal Brompton and St Mary's NHS Trusts. Funded and accountable to the North Thames Paediatric Intensive Care Commissioning Group through Great Ormond Street NHS Trust.

### 3. Indications for intubation

- GCS of  $\leq 8$
- Loss of airway reflexes
- Ventilatory insufficiency ( $\text{PaO}_2 < 9$  on air,  $< 13$  in oxygen or  $\text{PaCO}_2 > 6$ )
- Spontaneous hyperventilation ( $\text{PaCO}_2 \leq 3.5$ )
- Respiratory arrhythmia
- Significant maxillofacial injury
- Bleeding with airway compromise potential.
- Seizures

### 4. Management post intubation

#### 4.1 For intubation

- 4.1.1 Ensure adequate circulating volume
- 4.1.2 Continuous in-line immobilisation of cervical spine
- 4.1.3 Thiopentone, suxamethonium, rapid sequence induction (see induction of anaesthesia guideline)
- 4.1.4 Intubation must be with an oral tube.
- 4.1.5 Secure well, preferably with Melbourne strapping (tight ties around neck may can raise ICP)

4.2 Maintain full in-line immobilisation with collar/sandbags/tapes (as a visual reminder of C spine instability) and log rolling for transfer.

4.3 Sedate and paralyse adequately with fentanyl/remifentanyl, midazolam and vecuronium infusions.

4.4 Use fentanyl (5-10 mcg/kg) +/- midazolam (0.1 mg/kg) boluses for procedures, eg suctioning, log rolling.

4.5 Ventilate to a normal  $\text{PaCO}_2$  4.0 – 5.0 kPa, mandatory  $\text{ETCO}_2$  monitoring.

4.6 Aim for saturations of  $\geq 96\%$  and  $\text{PaO}_2$  of  $\geq 13$  kPa

4.7 Maintain mean arterial pressure (MAP) to maintain cerebral perfusion pressure (CPP), with noradrenaline if necessary. First choice for central venous line would be femoral placement.

Age	Mean Arterial Pressure (MAP)
0-2 yrs	>60 mmHg
2-6 yrs	>70 mmHg
>6 yrs	>80 mmHg

4.8 Fluid restrict to 50% maintenance of isotonic solution, eg 0.9% NaCl

4.9 Maintain blood glucose in normal range – add dextrose to 0.9% if

- Blood glucose  $\leq$  4.4 mmol/l < 2years
  - Blood glucose  $\leq$  3.9 mmol/l  $\geq$  2years
- 4.10 Load with phenytoin if any suggestion of seizure activity.
- 4.11 Consider mannitol (0.25 to 0.5 g/kg = 1.25 – 2.5 ml/kg of 20% solution) and/or 3% NaCl (3 ml/kg over 20 minutes, aim for serum Na 145) if lateralising pupillary signs (discuss with CATS consultant and neurosurgical SpR on call **prior** to administration).
- 4.12 Monitor temperature: aim 36-37°C centrally. **Avoid hyperthermia.**
- 4.13 Antibiotic prophylaxis is recommended with:
- Penetrating head injuries
  - Evidence of CSF leak

Use Co-amoxiclav 20mg/kg **or** cefuroxime 20mg/kg + metronidazole 7.5mg/kg.

## 5. Transport considerations

- 5.1 If a child has an intracranial lesion requiring urgent neurosurgery (eg extradural haematoma), **the referring hospital should bring the child to the neurosurgical centre to avoid any delay.** See neurosurgical emergency guideline.
- 5.2 Thorough resuscitation and stabilization of the patient should be completed before transfer. A patient persistently hypotensive despite resuscitation should not be transported until all possible causes have been identified and the patient is stabilized.
- 5.3 An appropriate inotrope, eg noradrenaline, should be connected to a three way tap and ready to commence.
- 5.4 Assume spinal injury: maintain in line immobilization throughout.  
**Hard collars should not be applied if they are likely to obstruct venous return and therefore increase ICP** (the risks of incomplete immobilization should be balanced against the risks of raised ICP). You should be able to pass a finger down a collar with ease if correctly applied.
- 5.5 Prepare sedation boluses: midazolam 0.1mg/kg boluses and/or fentanyl 5-10 $\mu$ g/kg iv if requires suction or responds to movement.