

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



Clinical Guidelines

Traumatic Brain Injury

Document Control Information

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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
 - Haemotympanum, “panda” eyes, CSF otorrhoea, Battle’s sign
 - External signs of head injury including skull fractures, haemorrhage control
 - Post traumatic seizures (load with phenytoin)
 - Vomiting
 - Amnesia
 - Assessment of spinal cord function (movement of limbs, priapism, spinal shock)
- Other
 - SpO₂, 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 plus/or CT), particularly CT scans and cervical spine imaging.

Initial management

- 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.*
- Immobilise cervical spine if any suspicion of cervical spine injury, i.e. if:
 - GCS < 15 at any time
 - Neck pain/tenderness
 - Focal neurological deficit, paraesthesia
 - Distracting injury
 - Intoxication
 - Significant mechanism of injury
- If cardiovascularly unstable and requiring volume resuscitation, consider other sites of blood loss: chest, abdomen, pelvis and major limb fracture.



- At least 2 good venous lines (use interosseous access if venous is difficult).
- Cross match blood and transfuse to Hb $\geq$ 10g/dL.
- Pass urinary catheter and orogastric tube.
- Perform secondary survey.
- Consider NAI, especially in children < 2 years of age.

Indications for CT scanning

- Suspicion of NAI.
- GCS < 13 at any time since injury or if < 1-year GCS < 15.
- GCS is < 15, 2 hours after the injury.
- Suspected open, depressed skull fracture, basal skull fracture or tense fontanelle.
- Post traumatic seizure.
- Focal neurological deficit
- Persistent vomiting
- Amnesia > 30 minutes of events before impact
- Dangerous mechanism of injury
- Coagulopathy
- For children under 1 year, presence of bruise, swelling or laceration of more than 5cms on the head.

Cervical spine imaging

Increasing use of CT and MRI if suspected spinal cord injury without radiographic abnormality (SCIWORA). Seek expert advice from a Major Trauma Centre (MTC).

Make the appropriate referral

- 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

Great Ormond Street Hospital (GOSH) is the receiving centre for all isolated head injury in North Thames. If the child is accepted by GOSH 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.



If no bed is available at GOSH, other centres are Kings College Hospital and St. Georges in South Thames.

Indications for intubation

- GCS of ≤ 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

Management of intubation

- Intubation should be performed by the most senior anaesthetist available (Pan London Trauma Guidelines February 2020).
- Ensure adequate circulating volume.
- Continuous in-line immobilisation of cervical spine.
- Rapid sequence induction (see CATS intubation guideline).
- Intubation must be with an oral tube.
- Secure well, preferably with Melbourne strapping (tight ties around neck may can raise ICP)

Management post intubation

- Maintain full in-line immobilisation and log rolling for transfer. Use other methods (sandbags, rolled towels, tapes).
- Sedate and muscle relax
- Use sedation boluses for procedures, e.g. suctioning, log rolling.
- Ventilate to a normal paCO_2 4.5 – 5.3 kPa, mandatory ETCO_2 monitoring.
- Aim for saturations of $\geq 94\%$ and paO_2 of ≥ 10 kPa (if arterial line already in situ- do not delay transfer to insert one).
- Haemodynamics: avoid hypotension which is associated with poor outcome.
- *Pre ICP bolt*: initially target age-appropriate systolic blood pressure $\geq 75^{\text{th}}$ centile (not less than 90 mmHg).



- *Post ICP bolt*: target cerebral perfusion pressure (CPP = mean arterial pressure MAP – intracranial pressure ICP in mmHg) of > 40 mmHg 0 to 5yrs and >50 mmHg 6 to 17 yrs to maintain cerebral perfusion pressure (CPP), with noradrenaline as necessary.
- Vasoactive drugs should be given peripherally or via IO if central access is not readily available.
- First choice for central venous line would be femoral placement.
- Fluid restrict to 50% maintenance of isotonic solution, e.g. 0.9% sodium chloride
- Maintain blood glucose in normal range – add glucose to 0.9% if;
 - Blood glucose ≤ 4.4 mmol/l < 2years
 - Blood glucose ≤ 3.9 mmol/l ≥ 2 years
- Load with anticonvulsant
- Consider 2.7% sodium chloride (3 ml/kg over 20 minutes, aim for serum Na 145) if lateralising pupillary signs
- Monitor temperature: aim 36-37°C centrally. *Avoid hyperthermia.*
- Antibiotic prophylaxis is recommended with:
 - Penetrating head injuries
 - Evidence of CSF leak
 - Use cefotaxime 50mg/kg + metronidazole 7.5mg/kg

Transport considerations

- If a child has an intracranial lesion requiring urgent neurosurgery (e.g. extradural haematoma), *the referring hospital should transport the child to the neurosurgical centre to avoid any delay.* See neurosurgical emergency guideline.
- Resuscitation of the patient should be completed before transport.
- A persistently hypotensive patient in the context of trauma may require damage limitation surgery prior to transport for definitive neurosurgery.
- An appropriate vasoactive agent, e.g. noradrenaline, should be connected to a three way tap and ready to commence. These may be given via a peripheral line – discuss with CATS consultant.
- Assume spinal injury: maintain in line immobilisation throughout.
- Prepare sedation boluses



References

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