

NHS CATS
Children's Acute Transport Service



Clinical Guidelines

Acute Neurosurgical Emergency Transport

Document Control Information

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Assessment

An acute neurosurgical emergency is time critical. This means that the patient must reach a neurosurgical centre for *urgent surgery without delay* and within 4 hours of injury/diagnosis.

To achieve this timeframe, the transport to a neurosurgical centre is the primary responsibility of the referring hospital team (SBNS and RCoA 2010, Anaesthesia 2019) unless it is mutually agreed that CATS will provide a more rapid transport.

An urgent conference call should be made between CATS and the Trauma Team Lead Consultant if polytrauma is the likely cause and/or the paediatric neurosurgeon in order to identify the destination and transporting staff.

If there is a delay in contacting the neurosurgical registrar, the consultant should be contacted.

A CT scan will usually help in identifying such situations. However, it is important to clinically consider the possibility of a neurosurgical emergency even before the CT scan is performed.

- 1) Any CT or other neuroimaging should be transferred immediately to the neurosurgical centre by IEP 'Blue Light' transfer.
- 2) If spontaneous (i.e. non-traumatic) intracranial haemorrhage is seen on the CT, a CT angiogram should be immediately performed before leaving the CT scanning suite, if possible.

Useful pointers (but not a comprehensive list):

Following trauma

- Rapid loss of consciousness.
- Initial lucid interval followed by rapid loss of consciousness.
- Unequal pupils.
- Cushing's triad: hypertension, bradycardia and abnormal respiration
- Focal neurological deficit e.g. hemiparesis
- Obvious external injury e.g. depressed skull fracture
- Suspicion of non-accidental injury (NICE HI pathway)

Non-traumatic

- Suspected VP shunt block.
- Rapid loss of consciousness in previously well patient.
- Unexplained cardio-respiratory arrest in young infant.
- Focal neurological deficit, including focal seizures in an older child.

- Antecedent severe headache and vomiting.

Initial management

Initial management should be in accordance with APLS/ATLS guidelines:

- Stabilise airway and cervical spine, breathing and circulation (ABC) as a priority. These take precedence over other injuries. *Hypotension and hypoxaemia are strongly associated with poor outcome.*
- Establish 2 points of intravenous access (consider intraosseous access if difficult).
- Pass urinary catheter and orogastric tube.
- Consider NAI, especially in children <2 years of age.
- Consider tranexamic acid (15mg/kg) in trauma.

Indications for intubation

- GCS of ≤ 8 or rapid decrease in GCS (especially motor score)
- Signs of raised ICP: pupillary asymmetry, Cushing's triad
- Loss of airway reflexes
- Ventilatory insufficiency
- Spontaneous hyperventilation ($\text{PaCO}_2 \leq 3.5$)

Management following intubation

- Continue in-line cervical immobilisation, hard collars are no longer recommended.
- Secure airway with Melbourne strapping or tape. Ensure equal air entry.
- Sedate and paralyse adequately with morphine, midazolam and vecuronium infusions.
- Ventilate to a normal PaCO_2 (4.0 – 5.0 kPa), with mandatory ETCO_2 monitoring.
- Aim for saturations of $\geq 94\%$.
- Maintain MAP to maintain CPP, use adrenaline or noradrenaline.

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

- Consider 2.7% sodium chloride (3ml/kg over 20 minutes, aim for serum Na 145) and/or mannitol (0.25 to 0.5g/kg = 1.25 – 2.5 ml/kg of 20% solution) if concerns about raised ICP or rapid changes in clinical signs (e.g. pupillary changes). Discuss with CATS consultant

and neurosurgical team.

- Frequent attention to pupil size and vital signs is essential.

Transport considerations

- Decision regarding the most time effective method of transporting the patient to tertiary centre should be made in joint consultation with the CATS consultant and neurosurgical team.
- *National guidance suggests that for a neurosurgical emergency, transport by the referring hospital team is the most appropriate.*
- Staff most familiar with inter-hospital transport and capable of managing the airway should perform the transport. This will usually include a member of the anaesthetic team from the referring hospital.
- Mandatory monitoring during transport should include ECG, SpO₂, blood pressure (non-invasive or invasive) and continuous end tidal CO₂.
- Child should be sedated and muscle relaxed for the transport.
- Sedation boluses, 2.7% sodium chloride and/or mannitol should be available during transport for rapid changes in ICP.

References

1. ALSG Seventh Ed., (2023). Advanced Life Support Group. <http://www.alsg.org/home>.
2. Nathanson et al., (2019). Guidelines for safe transfer of the brain-injured patient: trauma and stroke Anaesthesia.
3. RCEM., (2019). Paediatric Trauma – Stabilisation of the Cervical Spine. Royal College of Emergency Medicine.
4. SBNS and RCoA, (2010). Joint Statement from the Society of British Neurological Surgeons (SBNS) and the Royal College of Anaesthetists (RCoA) Regarding the Provision of Emergency Paediatric Neurosurgical Services.



Appropriate staff identified

Local ambulance service notified

State ventilated neurosurgical emergency patient transport
Expect ASAP response time

Essential equipment

Airway bag (tape, face mask, T piece, bag valve mask, ETT, laryngoscopes, scissors)
Drug bag (fluid boluses, 2.7% sodium chloride and/or mannitol, fentanyl)
Ventilator and oxygen
Infusion pumps (sedation, muscle relaxant, vasoactive infusions)
2 points of IV/IO access

Adequate monitoring

End tidal CO₂
ECG
SpO₂
Blood pressure (NIBP cuff or arterial)

Physiological targets

End tidal CO₂: 4.0-5.0 kPa
SpO₂ ≥94%
Mean BP = age-appropriate target
Full sedation and muscle relaxant
