Clinical Guidelines

Acute Neurosurgical Emergency Transport

Document Control Information

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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.
1. Assessment

An acute neurosurgical emergency is time-critical.
This usually means that the patient must reach a neurosurgical centre for urgent surgery without delay, as soon as possible, and certainly within 4 hours of injury.

In order to achieve a timely transfer, the transport to a neurosurgical centre will need to be undertaken by the referring hospital team (SBNS and RCoA 2010, Anaesthesia 2019).

Urgent conference call between receiving neurosurgeon and CATS
For these reasons, early identification and appropriate management of an acute neurosurgical emergency is crucial.

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.

Useful pointers (but not a comprehensive list):

Following trauma

A. Rapid loss of consciousness  
B. Initial lucid interval followed by rapid loss of consciousness  
C. Unequal pupils  
D. Cushing’s triad: hypertension, bradycardia and abnormal respiration  
E. Focal neurological deficit e.g. hemiparesis  
F. Obvious external injury e.g. depressed skull fracture  
G. Suspicion of Non accidental injury (NICE HI pathway)

Non-traumatic

A. Suspected VP shunt block  
B. Rapid loss of consciousness in previously well patient  
C. Unexplained cardio-respiratory arrest in young infant  
D. Focal neurological deficit, including focal seizures in an older child  
E. Antecedent severe headache and vomiting
2. 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

3. Indications for intubation

- GCS of < 8 or rapid decrease in GCS
- Signs of raised ICP: pupillary asymmetry, Cushing’s triad
- Loss of airway reflexes
- Ventilatory insufficiency
- Spontaneous hyperventilation (PaCO₂ ≤ 3.5)

4. Management following intubation

- Continue complete in-line cervical immobilisation with properly fitting collar, sandbags and tape (this is a visual reminder regarding C spine clearance)
- 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 PaCO₂ (4.0 – 5.0 kPa), with mandatory ETCO₂ monitoring
- Aim for saturations of ≥94%
- Maintain MAP to maintain CPP, use adrenaline or noradrenaline

<table>
<thead>
<tr>
<th>Age</th>
<th>Mean Arterial Pressure (MAP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2 yrs</td>
<td>&gt;60 mmHg</td>
</tr>
<tr>
<td>2-6 yrs</td>
<td>&gt;70 mmHg</td>
</tr>
<tr>
<td>&gt;6 yrs</td>
<td>&gt;80 mmHg</td>
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</tbody>
</table>

- Consider mannitol (0.25 to 0.5 g/kg = 1.25 – 2.5 ml/kg of 20% solution) and/or 2.7% NaCl (3 ml/kg over 20 minutes, aim for serum Na 145) 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
5. **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 be 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 end tidal CO₂.
- Child should be fully sedated (morphine and midazolam infusions) and muscle relaxed for the transport.
- Fentanyl boluses (1-2 mcg/kg), mannitol and/or 2.7% saline should be available during transport for rapid changes in ICP.

**References**

ALSG 2016
Paediatric Trauma – Stabilisation of the Cervical Spine. Royal College of Emergency Medicine 2017
**CHECKLIST TO AID TRANSPORT OF NEUROSURGICAL EMERGENCIES FOR THE DISTRICT GENERAL HOSPITAL**

**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, mannitol and/or 2.7% saline, fentanyl)
- Ventilator and oxygen
- Infusion pumps (sedation, muscle relaxant, vasoactive infusions)
- 2 points of IV/IO access

**Adequate monitoring**
- ECG
- SpO₂
- Blood pressure (NIBP cuff or arterial)
- End tidal CO₂

**Physiological targets**
- SpO₂ ≥94%
- Mean BP = age appropriate target
- End tidal CO₂: 4.0-5.0 kPa
- Full sedation and paralysis