



UK HEMS

*Clinical Excellence in
Helicopter Medicine*

Head Injury and Neuroprotection

Aims:

- Describe the rationale of clinical care for head injuries
- Describe the appropriate triage of head injuries
- Describe the appropriate use of analgesia in head injury
- Describe the special considerations during rapid sequence induction in head injury
- Describe the neuroprotective treatment options for patients with head injury
- Describe patient packaging for head injury

Background:

The principles of head injury management are the provision of adequate oxygenation and cerebral perfusion, treatment of other significant injuries and rapid transfer to a neurological centre. Many patients with head injury do not require surgery but, if they do require time critical intervention, taking them directly to a neurosurgical centre cuts the time dramatically. Even when surgical intervention is not required patients with head injury do better when managed in neurosurgical centres.

Indications for RSI in patients with head injury are straightforward – unconsciousness, airway compromise and ventilatory compromise make up the majority. We also anaesthetise a number of patients with head injury and a relatively high GCS (9 – 14). Often HEMS are specifically called to agitated head injuries by local ambulance crews because they are unmanageable. A number these agitated patients will benefit from a neuroprotective care package that aims to limit secondary brain injury.

Policy:

Use of Analgesia/ Sedation

Ketamine: This is rarely used in patients with head injury because of the possibility that ketamine raises ICP (it may also cause a temporary rise in BP and intraocular pressure).

Midazolam: If the patient is agitated or combative, sedate with aliquots of midazolam until control is achieved and then proceed to rapid sequence induction. This also enables effective pre-oxygenation.

Morphine: Commonly used as an adjunctive agent to maintain anaesthesia in intubated and ventilated patients. Analgesia is important for head injured patients to avoid distress and a physiological pain response

Fentanyl: There may be a place for the use of fentanyl as an adjunct to prehospital RSI for head injured patients to minimise the elevations in ICP associated with the procedure. Local policies should be followed

Rapid Sequence Intubation (RSI)

The RSI technique in head injury should minimise both increases in pCO₂ and pharyngeal and laryngeal stimulation in an attempt to limit and rise in ICP. Meticulous attention to oxygenation is also important as is prevention of hyper and hypoventilation (which has been associated with poor outcomes).

This may be achieved by:

- Adequate induction agent:
 - Use the maximum possible dose of Etomidate [0.3mg/kg] that the patient's cardiovascular status allows.
 - Fentanyl may be considered (see above)
- Adequate paralysis:
 - Use the normal dose of Suxamethonium (1.5mg/kg).
 - Gentle and minimal laryngoscopy: Avoid touching the posterior pharyngeal wall during intubation.
 - Minimal tube movement. Hold the tube when the patient is moved.

Ventilation

- Ventilate to low normocapnia [end-tidal CO₂ of 30 mmHg, 4.0KPa]. This equates to a PaCO₂ of approximately 4.5KPa in normal individuals. This minimises the risk of cerebral vasodilation (high PaCO₂) and cerebral vasoconstriction (low PaCO₂).
- High levels of PEEP can increase ICP.

Use of IV Fluids

After significant head trauma, the brain may lose the ability to autoregulate cerebral blood flow. A fall in MAP may therefore result in a reduction in cerebral oxygen delivery even if the ICP is normal. When splintage of limbs / pelvis has been maximised, fluids should be administered to achieve a systolic blood pressure of 100mmHg. This can be increased to 120mmHg in isolated head injury.

Packaging

- Compression of the jugular veins will reduce venous return from the head and neck. This can increase ICP. The cervical collar should therefore be left slightly loose. Cervical spine immobilisation will be maintained with head blocks and tape.
- The neck veins can also be constricted by a tight tracheal tube tie – this should be checked and loosened before transport.
- The patient should be transported in a 20 degrees head up position to maximise venous drainage.

Control of ICP / impending herniation

Mannitol

Mannitol crystallizes in cold conditions limiting its prehospital use. It remains in regular use to good effect in neurosurgical centres across the United Kingdom

Hypertonic Saline (HTS)

HTS has been shown to lower ICP in severe head injuries and may have other beneficial effects such as increasing circulating volume, minimal alteration to coagulation and anti-inflammatory properties. It is used extensively in ICU to lower refractory ICPs. There is no evidence that one formulation of hypertonic saline offers advantages over another.

Typical clinical criteria for use of mannitol or hypertonic saline:

- Unilateral or bilateral pupil dilation in association with GCS < 8 (and usually 3)
- Progressive hypertension (SBP over 160mmHg) and bradycardia (pulse below 60) in association with GCS < 8 (and usually 3)