Head Injury: Evidence Based Review

The immediate priorities in the management of head-injured patients are twofold:

1. Timely identification of intracranial haematoma requiring surgical intervention
2. Reducing secondary brain injury

Clinical management
In the multiply traumatised patient with head injury, the priorities of assessment and resuscitation should follow:

A: airway with cervical spine control
B: breathing and ventilation
C: circulatory assessment and support

Attention to these aspects of trauma care will reduce secondary brain injury, as the pathophysiological response of the traumatically injured brain is accelerated and worsened by tissue hypoxia and inadequate perfusion.

A: Airway with cervical spine control
Patients with a low conscious level may lack protective airway reflexes and require a definitive airway (cuffed tube in the trachea). Those with a Glasgow Coma Score of 8 or less should be considered at such a risk and should therefore be intubated and ventilated. Patients with higher scores may have similar risks and intubation should be considered based on clinical findings. An unstable cervical spine injury should be anticipated in all such patients, and manoeuvring the airway during management should therefore avoid neck movement.

B: Breathing and ventilation
Optimising respiratory physiological parameters will reduce the risk of worsening secondary brain injury after trauma.

Oxygenation
Inadequate oxygenation is detrimental to injured brain tissue. Causes of low oxygen saturation should be identified and treated from the outset of any trauma resuscitation. Reduced respiratory effort as a result of severe brain injury can be one cause of hypoxia. Supplementary oxygen should be given (15 l by reservoir bag mask) to all multiply injured patients.

Ventilation
Raised intracranial pressure can be exacerbated by the vasodilatation associated with hypercapnia. Therefore, current recommendations are that the PaCO₂ be maintained in the normal range (25–45 mmHg (3.5–6 kPa)). If this is not the case then the patient will require intubation (if this has not already been done for airway protection) and ventilation.
C: Circulatory assessment and support
In a healthy person, there are autoregulatory mechanisms that maintain a steady perfusion pressure in the brain despite variations in mean arterial pressure (MAP). In severely brain-injured patients, particularly when a haematoma is present or the brain is swelling, these mechanisms are not as effective. In this setting, a drop in MAP can lead to a drop in cerebral perfusion.

When intracranial pressure is raised, low MAP will lead to further lowering of perfusion pressure and, therefore, lower the cerebral blood flow and worsen the brain injury through hypoperfusion. In turn, this will lead to more brain oedema and swelling, and the intracranial pressure will increase. To offset this spiral of events, MAP should be kept up (>65 mmHg). This is achieved by aggressive fluid resuscitation if there is coincident hypovolaemia. Pressor support and inotropes may also be required if low pressure persists once volume is restored.

Once ABC has been assessed and stabilised it is important to evaluate the extent of neurological impairment. At this point it is also vital to check a glucose-oxidase strip (BM) on any patient with altered consciousness.

**A B C D**on't **E**ver **F**orget **Glucose**!

D: Disability/ neurologic assessment
The Glasgow Coma Scale is used to numerate conscious level (see Figure 1). Individual components are added to score a patient out of 15. The lowest possible score is 3/15.

Neurological examination should include pupil reactions and as thorough a motor and sensory examination as the patient’s condition will allow. Examination of the cranium should include a careful search for wounds and signs of basal skull fracture. This includes looking in the ears, as the only sign of basal skull fracture may be blood behind the ear drum (haemotympanum).
<table>
<thead>
<tr>
<th>Eye opening</th>
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<tbody>
<tr>
<td>Spontaneous eye opening</td>
<td>4</td>
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<tr>
<td>Eyes open to voice</td>
<td>3</td>
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<tr>
<td>Eyes open to pain</td>
<td>2</td>
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<tr>
<td>No eye opening</td>
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<tr>
<th>Motor response</th>
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<tbody>
<tr>
<td>Obeying commands</td>
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<tr>
<td>Localising response to pain</td>
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<tr>
<td>Withdraws to pain</td>
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<tr>
<td>Flexor posturing to pain</td>
<td>3</td>
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<tr>
<td>Extensor posturing to pain</td>
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<tr>
<td>No response to pain</td>
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<tr>
<th>Vocal response</th>
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<tbody>
<tr>
<td>Orientated speech</td>
<td>5</td>
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<tr>
<td>Confused conversation</td>
<td>4</td>
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<tr>
<td>Inappropriate speech</td>
<td>3</td>
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<tr>
<td>Incomprehensible sounds</td>
<td>2</td>
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<tr>
<td>No response</td>
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**Figure 1.** The Glasgow Coma Scale

**Imaging**

**Severe head injury (GCS 3-12)**

Once a severely head injured patient is stabilised, urgent CT imaging is required to assess for a surgically redeemable lesion, such as an extradural haematoma (see Figure 2).

**Figure 2.** CT scan image of an extradural haematoma
A haematoma is a time-critical finding. Outcome for patients deteriorates markedly when delay between injury and surgery is more than four hours. It is therefore a matter of urgency to transfer a patient requiring surgery in a safe and timely fashion to a neurosurgical centre.

**Mild head injury**

Around 90% of head-injured patients do not have markedly reduced conscious level; approximately 85% are fully conscious when seen in the ED. A small proportion of these patients (around 0.5%) are at risk of developing life-threatening haematoma, and around 6% will have some abnormality on their CT scan. Clearly, not all of these patients can or should be scanned.

In 2003, NICE drew up UK guidelines on head injury management that included guidance on who to scan after head trauma. These guidelines, which were updated in September 2007 (NICE guideline 56), are shown in Figure 3.
Figure 3. Selection of adult patients for CT after head injury (NICE, 2007). *If the patient presents out of hours and is ≥65 years of age, with amnesia of greater than 30 minutes before injury or dangerous mechanism, it is acceptable to admit for overnight observation with CT scanning in the morning, unless the CT result is required within one hour for one of the indications above. The guidelines are designed for use regardless of whether the clinical state of the patient is deemed to be the result of concurrent drug or alcohol intoxication.
NICE (2007) also provides guidance for the selection of children under the age of 16 years for scanning based on recent evidence (see Figure 4).

Are any of the following present?

- Witnessed loss of consciousness lasting >five minutes
- Amnesia (antegrade or retrograde) lasting >five minutes
- Abnormal drowsiness
- Three or more discrete episodes of vomiting
- Clinical suspicion of non-accidental injury
- Post-traumatic seizure with no history of epilepsy
- Less than one year old: GCS <14 on assessment in the ED
- Less than one year old: GCS (paediatric) <15 in the ED
- Suspected open or depressed skull fracture or tense fontanelle
- Any signs of basal skull fracture (haemotympanum, “panda eyes”, cerebrospinal fluid otorrhoea or Battle’s sign)
- Focal neurological deficit
- Less than one year old: presence of bruise swelling or laceration >5 cm on head
- Dangerous mechanism of injury (fall more than 3 m or five stairs; pedestrian or cyclist knock down; or vehicle occupant ejected or high speed projectile)

Figure 4. Guidelines for scanning children aged less than 16 years (NICE, 2007)

Patients with a normal CT scan who are safe to leave the ED do not require admission. There is local variation in adherence to the guidelines for imaging. Some departments may admit patients overnight and scan those that show clinical neurological deterioration.

Patients who have had an intracranial haematoma excluded, whether by CT or by the use of the decision rule, may leave the ED safe from the risk of this complication. However, NICE still recommends that such patients receive advice about further symptoms that should prompt a return for reassessment (NICE, 2007).
## Eye opening
1. No eye opening
2. Eye opening to painful stimulus
3. Eye opening to voice
4. Eyes open spontaneously

## Best verbal response
1. No vocal response
2. Occasionally whimpers and/ or moans
3. Cries inappropriately
4. Less than usual ability and/ or spontaneous irritable cry
5. Alert, babbles, coos, words or sentences to usual ability

## Best grimace response
1. No response to pain
2. Mild grimace to pain
3. Vigorous grimace to pain
4. Less than usual ability and/ or spontaneous irritable cry
5. Spontaneous normal facial/ oromotor activity

## Best motor response
1. No motor response to pain
2. Abnormal extension to pain (decerebrate)
3. Abnormal flexion to pain (decorticate)
4. Withdrawal to painful stimuli
5. Localises to painful stimulus or withdraws to touch
6. Obeys commands or performs normal spontaneous movements

Figure 5. Paediatric GCS for those aged less than 16 years (NICE, 2007)