

# *Clinical Focus: Acquired Brain Injury*

## **THE SPECIALIST CARE OF ACUTE HEAD INJURY: AN OVERVIEW**

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The acute management of head injury should be considered under two headings: the prevention of secondary brain damage and the recognition of complications. By far the commonest cause of secondary brain damage is hypoxia and it cannot be overemphasised that the mainstay of management is the establishment of an airway and its maintenance with adequate ventilation.

Most head injuries are admitted to hospital for observation so that complications may be recognised as early as possible and corrective measures taken. The observation comprises measurements of pulse, blood pressure, temperature, respiration, pupil size and reaction: the Glasgow Coma Scale (GCS). Surgical intervention is rarely necessary and it is perhaps comforting to note that the majority of head injuries recover uneventfully.

### **REFERRAL**

The management of head injury ideally starts at the site of the injury or at least in the A & E department. Without satisfactory resuscitation, which of course includes the establishment and maintenance of an airway and adequate ventilation (monitored by pulse oximetry), no amount of specialised management later on will necessarily rectify the situation.

Most A & E departments now have access to CT scanning and in many this is carried out in preference to skull X-rays. It should be mentioned that although there may still be a place for skull X-rays, these will only reveal injuries to the skull vault. Interpretations may not be easy. On the other hand, scanning may not reveal fractures unless particular window settings are used, although both vault and basal fractures may be identified by so doing. The interpretation of scans is not difficult and all A & E medical staff should be able to interpret them. Scan pictures are, in the main, easier to interpret than chest X-rays. The involvement of a radiologist should not be expected or required. Undue reliance should not be placed on CT scans because scans which are normal (or near normal) may change within a matter of hours.

Seizures following head injury are not uncommon and should be treated promptly in view of the risk of hypoxic brain damage. Anticonvulsant medication needs to be continued even if the patient is paralysed and ventilated, and could be considered on a prophylactic basis, if, for example, frontal contusions are noted on the scan.

Coma or a depressed level of consciousness from alcohol should never be assumed unless it can be established that the blood alcohol level is over 200 mg/l. The estimation of blood

alcohol is rarely, if ever, available and therefore any depressed level or response should be attributed to the head injury.

The indications for referring a patient following head injury to a specialised neurosurgical unit are widely recognised and summarised in Table 1. Most people accept that the first three indications require urgent transfer whilst in the last three a degree of delay may be allowable.

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| <ol style="list-style-type: none"><li>1. Deterioration in level of consciousness and/or evolving neurological signs</li><li>2. Coma persisting after resuscitation</li><li>3. Confusional state with a fractured skull, focal signs and fits</li><li>4. Compound depressed fracture</li><li>5. Confusion and other neurological signs persisting over a period of 6-8 hours</li><li>6. Penetrating wounds including basal skull fractures.</li></ol> |
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*Table 1 – Indications for neurosurgical transfer*

Neurosurgical departments are well known for their reluctance to accept patients because of different shortages which are being identified under the present system of healthcare, particularly with regard to ICU beds – the Percy phenomenon<sup>(1)</sup>. Many neurosurgical units do not have their own ICU and usually have only 10 beds per half million catchment population for all neurosurgical problems including head injuries. As a result, most units can only accept those patients felt likely to benefit from specialised management. Those accepted tend to have a serious head injury but this is difficult to define. The patient who remains unconscious after appropriate resuscitation is easily categorised. The patient struck by a golf ball in the temple may be well at presentation but be dead within hours from an extradural haematoma. Such a head injury can hardly be classed as minor or mild. Penetrating head injuries may occur without any loss of consciousness or neurological signs yet lead to death from fatal intracranial infection. In an ideal world all head injuries whatever their classification at the outset, would be managed by specialist neurosurgeons, but on logistic and economic grounds alone this is hardly likely to happen. The local neurological unit may not be able to admit patients but advice will always be available.

### **SAFE TRANSFER**

If transfer is appropriate, this should be done speedily and safely. There is no doubt that mortality and morbidity can, and do, result from failure to heed these principles. Many patients sustain multiple injuries, some of which are missed or ignored – an obvious head injury dominating management. A useful guideline in multiple injury is to ignore the head injury, apart from maintaining blood gases, on the reasonable

principle that there is nothing that can be done about primary brain damage.

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| <ol style="list-style-type: none"> <li>1. An airway with appropriate respiratory support</li> <li>2. Cervical spine control – neck immobilisation</li> <li>3. An intravenous infusion</li> <li>4. Neurological observations with timings</li> <li>5. X-rays including CT scans and other documentation</li> </ol> |
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Table 2 – Points to establish prior to neurosurgical transfer

The important points regarding transfer are summarised in Table 2. Increasingly it has been recognised that the safest way to transfer a patient is under ventilation with sedation and muscle paralysis for those with significant reduction in level of response. The indications for ventilation are summarised in Table 3 – most would agree that a GCS of 3 or 4 is an absolute indication, whilst those with a level of 8 or less should be ventilated prior to transfer.

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| <ol style="list-style-type: none"> <li>1. Glasgow Coma Scale of 3 or 4 out of 15 (Below 8 for transfer)</li> <li>2. Two or more convulsions</li> <li>3. An inability to maintain blood gases with a PA CO<sub>2</sub> of 3.5 kPa or oxygen less than 9 kPa PA O<sub>2</sub></li> <li>4. Airway protection eg associated facial injuries</li> </ol> |
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Table 3 – Indications for ventilation in head-injured patients

Intubation of a patient is not for the faint-hearted or inexperienced. It should always be assumed that a full stomach is present and, therefore, a rapid induction is required. Injury to the cervical spine should also be assumed and appropriate stabilisation of the neck undertaken. Air entry into both lungs following intubation needs to be established – the tube sometimes enters the right main bronchus. Secure fixation of the tube is mandatory as anyone will confirm who has had the nailbiting experience of accompanying such a patient by ambulance (the escort should be suitably experienced). Although all intubated patients may not require ventilation, the guiding principle must be that if there is the slightest doubt it should be instituted.

## VENTILATION AND ICP MONITORING

The majority of patients with persistent coma following a severe head injury have raised intracranial pressure as a result of oedema. This may be diffuse (from ischaemia) or focal (related to a contusion from brain swelling and vascular engorgement) or, of course, from a localised haematoma.

Therapeutic ventilation should mean what it says – a therapeutic measure instituted for a period of between 48 hours and five days to minimise the effect of the raised intracranial pressure. It is usually counterproductive to allow sedation to wear off in order to assess the clinical state or for any other reason. If the patient fights the ventilator the ventilator usually wins.

During the period of deliberate therapeutic ventilation some form of monitoring of the intracranial state is required and this is most frequently brought about by measurement of the intracranial pressure. The insertion of an ICP probe in the majority of these patients is the only surgical interference usually required.

Raised intracranial pressure interferes with cerebral perfusion to the extent that cerebral perfusion pressure (the mean arterial blood pressure minus the intracranial pressure) is more important than absolute ICP measurements. A pressure of up to 20 mmHg is, however, probably acceptable as being within normal limits whilst a persistent level over this figure indicates that further measures are required which would usually include the administration of Mannitol and/or other diuretics with further CT scanning.

The persistence of a raised ICP may indicate surgical intervention to remove a localised clot, an area of contusion or other decompressive procedure.

## SURGICAL INTERVENTION

Surgical intervention in head injuries is uncommon. The presence of a compound depressed fracture necessitates exploration in view of the risk of infection, preferably within six hours of the injury. It is important to repair the dura whilst at the same time correcting the depression and closing the scalp wound. Simple depressed fractures may warrant surgical intervention but only on cosmetic grounds. A neurological deficit may be caused by the injury producing the depressed fracture but elevation will not relieve this deficit.

A penetrating injury, again because of the risk of infection, requires repair. Certain retained foreign bodies – shotgun pellets or a bullet – are usually left *in situ* in view of the difficulties and dangers of attempting to remove them. Complex craniofacial injuries, usually associated with a penetrating element, require a multidisciplinary approach. This is usually done in stages to treat both the penetrating injury and the associated cosmetic deformities.

Anterior skull base osteodural disruptions (a penetrating injury involving the air sinuses) do not always present with CSF rhinorrhoea. These also require operative repair. This kind of penetrating injury is frequently missed, particularly in the absence of a CSF leak. Much useful information may be ascertained from the CT scanning, when air in the head may be detected together with fluid within the sinuses. Any patient with a skull fracture in the anterior vault with extension into or towards the air sinuses should at least be considered for operative exploration and repair if necessary. Should a dural disruption be missed, the patient remains at lifelong risk of intracranial infection, usually manifesting itself in meningitis. There is no convincing evidence that the use of prophylactic antibiotics is justified for penetrating injuries and most would now say that their use should be discontinued, even bearing in mind that exploration is carried out as a delayed procedure in this latter group.

Although extradural clots have been treated conservatively in the past, the general rule remains that removal should be undertaken by way of a craniotomy as soon as possible. The evacuation of an extradural clot is one of the very few absolute surgical emergencies. Although a burr hole may be lifesaving in this situation, it is too small to remove the clot adequately. This procedure is rarely necessary outside a specialist unit but is nevertheless a procedure that should seriously be considered prior to transfer. The use of Mannitol, a powerful osmotic diuretic, could be lifesaving, and also substantially reduce morbidity, allowing time to be bought prior to specialised treatment.

Surgery is necessary to treat the very rare complications of a tension pneumocephalus. Diagnosis is always obvious on CT scanning with a relatively slow deterioration enabling transfer to be accomplished.

The removal of an acute subdural haematoma is more problematic. Some take the view that its presence is merely a manifestation of serious primary brain damage and that there is nothing to be gained by its removal. The presence of an acute subdural haematoma or persistent raised ICP in the absence of a localised cause may warrant a decompressive procedure, although such procedures are often classified as "the last hope of the destitute".

The blocking of the CSF pathways resulting in hydrocephalus is an uncommon complication giving rise to raised intracranial pressure. It is a late development accounting for arrested recovery or late deterioration. Again, it is a diagnosis easily made on CT scanning and its presence requires ventriculo-peritoneal shunting.

## **DISPOSAL**

In view of the limited facilities in neurosurgical units, the management of the patient with head injury is usually confined to the acute phase. Once these patients are felt to be in a safe state they are transferred back to the primary

physician, due to the pressure of limited resources. The immediate outcome may reflect satisfactory management but is not the end of the story. There is increasing evidence that neurosurgeons should become involved, or more involved, in longterm care, perhaps supervising rehabilitation teams. Although surgeons are motivated to "do" rather than to supervise, it is recognised that acute management in isolation is insufficient in many conditions, and this includes head injuries. Sooner or later, a national or regional policy for the rehabilitation of neurologically damaged patients will be required. The general principle of leaving head-injured patients in the care of relatives who muddle through as best they can, is no longer acceptable, and lip service to Care in the Community is insufficient, as this is frequently translated as "all possible aid save actual help".

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## **REFERENCES**

1. Mr Percy, an orthopaedic surgeon in Orpington, successfully sued a newspaper for calling him Dr Doolittle – accusing him of not doing enough to find an ICU bed.