

ACUTE MANAGEMENT OF TRAUMATIC BRAIN INJURY

Karim Brohi

Management of traumatic brain injury focuses on stabilisation of the patient and prevention of secondary neuronal injury to avoid further loss of neurons. Full neuromonitoring including intracranial pressure measurement are rarely available prior to the patient's arrival in the intensive care unit. Significant neurological damage can occur between the time of injury and CT scanning, accurate measurement of ICP and other parameters. The acute management of these patients is therefore directed towards assuming there is significant intracranial pathology and instituting measures to protect living brain tissue.

Assessment

Assessment of brain injury hinges on evaluation of the Glasgow Coma Score (GCS) and examination of the pupils. Traditionally a GCS of below 9 is considered to reflect severe brain injury. However with improvements in prehospital care and greater knowledge of brain injury, patients are arriving in emergency departments earlier and their brain injury may still be evolving. Therefore the following measures should be considered and probably instituted in all patients with coma scores of 12 or below.

Hypotension will adversely affect cerebral perfusion and therefore lower the Glasgow Coma Score. However brain injury management should be instituted on the basis of the initial examination and there should be no delay to assess whether the GCS improves with volume resuscitation. It is important to identify signs of impending transtentorial herniation as this will affect the course of the immediate management of these patients. This is identified by unilateral abnormal posturing and/or the presence of a unilateral dilated pupil.

Serial assessment is vital. Patients may arrive with a mildly impaired GCS and rapidly deteriorate due to expanding haematomas or increasing cerebral swelling. Pupils may be initially normal and then dilate as intracranial pressure rises and the brain starts to herniate.

Management

The specific goals in the acute management of severe traumatic brain injury are:

1. Protect the airway & oxygenate
2. Ventilate to normocapnia
3. Correct hypovolaemia and hypotension
4. CT Scan as soon as appropriate
5. Neurosurgery if indicated
6. Intensive Care for further monitoring and management

Hypoxia and hypotension are the greatest threat to functional outcome in brain injury. Early acute control of the above three parameters may have more

impact than all other measures subsequently employed. Progressive neuronal loss occurs from the time of injury, not the time of arrival in hospital. Rapid sequence intubation should be used where available to secure the airway, provide adequate oxygenation and control ventilation. Hypovolaemia and hypotension must be corrected early and take priority over other interventions for the brain injury. Other injuries causing haemorrhage must be addressed first (or simultaneously) so that an adequate cerebral perfusion pressure is maintained. Patients should be kept sedated to prevent coughing, Valsalva manoeuvres and from dysynchrony with the ventilator, as these increase intracranial pressure.

Many of the interventions used in the management of intracranial pressure may have a detrimental effect on cardiovascular haemodynamics (eg. mannitol), which in turn will have a detrimental effect on cerebral perfusion. In addition some measures may be counterproductive when used without adequate monitoring (eg. hyperventilation). Thus these further interventions are used without guidance from CT scans or ICP monitoring only when there is evidence of impending brain herniation (unilateral posturing and/or unilateral dilated pupil).

A CT scan of the brain should be obtained when appropriate, as dictated by the presence of other injuries and physiological disturbances. This will delineate the brain injury and determine whether surgery is indicated to remove an intracranial mass lesion (epidural / subdural haematoma), and the degree of diffuse injury and cerebral swelling present.

During this period there is potentially continuing cerebral ischaemia and neuronal death and timeliness is of the essence. There should be no unnecessary investigations or procedures and damage control techniques should be employed as necessary. No spinal or long bone imaging should be undertaken prior to CT scanning as these investigations will not affect the immediate patient management. The haemodynamically unstable patient should have minimum investigations, control of haemorrhage by the simplest means appropriate (and abbreviated surgery if necessary) and then CT scan and treatment of the brain injury.

If there are signs of impending transtentorial herniation (unilateral posturing and/or unilateral dilated pupil) or if there is rapid progressive neurological deterioration (without extracranial cause), then there is significant intracranial hypertension and measures should be instituted to control ICP immediately. Hyperventilation should be instituted to reduce the PaCO₂ to no lower than 3.5kPa (25mmHg) and mannitol should be administered as a bolus. Oxygenation and cerebral perfusion must be maintained. CT scanning is emergent, as is surgery if indicated.

If there are other injuries leading to haemorrhage and hypotension these still take priority. However it may be necessary to consider treatment of the brain injury simultaneously with management of these injuries, even without a CT scan to guide therapy. Blind burr holes to detect extra-axial collections may be appropriate as a last resort in these cases.

References

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