34 Planning of Cranial and Extracranial Surgery in Multitraumatised Patients

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Recommendations

Level I

There are insufficient data to support a Level I recommendation for this topic.

Level II

There are insufficient data to support a Level II recommendation for this topic.

Level III

Oxygenation and blood pressure should be monitored, and hypotension (systolic blood pressure < 90 mmHg) and hypoxia (SaO_2 < 90%) should be avoided.

Multitraumatised patients should be managed according to the well-established ABCDE criteria.

The risk of secondary brain injuries can be reduced by adhering to the ABCDE criteria.

In the multitrauma setting, there are no isolated head injuries, and optimal treatment of injuries in other organ systems is crucial for better head injury and overall outcome.

34.1 Overview

Surgical management of traumatic brain injuries should as a general rule be performed as soon as possible. However, management must always be individualised and contextualised. Guidelines for the surgical management of intracranial haematomas provide recommendations primarily based on haematoma characteristics (e.g. type, volume), mass effect and clinical signs, but age, comorbidity, clinical deterioration and concomitant injuries are other important factors that must be considered. An intracranial haematoma in a young person may give rise to more severe clinical signs than in an older patient with significant brain atrophy. Old age and severe comorbidity may contraindicate surgery that is otherwise indicated in a young patient. Clinical deterioration suggestive of haematoma expansion requires more expeditious assessment and management than mass effect per se. In multitraumatised patients, there is not only a head injury to consider, but possibly several critical injuries in need of acute and appropriate treatment, either serially or in parallel.

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Tips, Tricks and Pitfalls

- Mortality is up to three times higher in multitraumatised patients with head injuries than without head injuries.
- The primary goal of neurosurgical intervention is to prevent secondary brain injuries.
- If the brain does not get a sufficient supply of blood and oxygen, it does not matter what the neurosurgeon has to offer.
- Minor neurosurgery, such as insertion of an ICP monitor or external ventricular drain, can be done at the same time as damage control surgery.

34.2 Background

Severe traumatic brain injury (TBI) is the strongest predictor of overall outcome for multitraumatised patients, and mortality rates are up to three times higher in patients with TBI than in patients without TBI. Clinical assessment and timing of acute neurosurgery in multitraumatised patients with head injuries can be very challenging. TBI-specific treatment is often complementary or adjunctive to treatment of the trauma patient without neurological injury. The basic principles of trauma resuscitation should be followed: rapid assessment and maintenance of airways, breathing and circulation.

34.2.1 The ABCDEs of Major Trauma

Treatment of trauma patients is prioritised based on their vital signs, injuries and the injury mechanism. Vital functions must be assessed quickly and efficiently. Management consists of a rapid primary survey with simultaneous resuscitation of vital functions, a more detailed secondary survey and the initiation of definitive care. The primary survey encompasses the ABCDEs of trauma care and identifies life-threatening conditions by adhering to this sequence:

Airway maintenance with restriction of cervical spine motion.

- A definitive airway must be established if there is any doubt about the patient's ability to maintain airway integrity.
- Clear the airway; inspect for foreign bodies; identify facial/mandibular/tracheal fractures that may result in airway obstruction, suctioning, supplemental oxygen or intubation if needed; or establish an airway surgically if intubation is contraindicated or cannot be accomplished.
- Manual in-line stabilisation (MILS), neck collar or other forms of spinal immobilization should be applied.

Breathing and ventilation require adequate function of the lungs, chest wall and diaphragm.

- Assessment of tracheal position, jugular venous distention, visual inspection, auscultation and percussion of the chest wall and following chest decompression if needed (tension pneumothorax/haemothorax).
- A chest X-ray should be performed.

Circulation.

- Identifying and quickly controlling haemorrhage/blood loss (level of consciousness, skin perfusion and pulse). Identify any source of bleeding by chest X-ray, pelvic X-ray, FAST (focused assessment with sonography for trauma) or diagnostic peritoneal lavage (DPL).
- Definitive bleeding control is essential, along with appropriate replacement of intravascular volume.
- Vascular access is established; typically, two large-bore peripheral venous catheters are

placed to administer whole blood or balance transfusion of blood components.
- In severe cases, laparotomy (major abdominal bleeding) or thoracotomy (cardiac tamponade, uncontrollable bleeding distal to the intrathoracic part of the descending aorta) may be indicated.

When the ABCs are assessed and under control, even if it means performing haemodynamically stabilising surgery in the trauma room, you may move on to D, *disability*:

- Rapid neurologic evaluation (GCS, pupillary examination, lateralizing signs)

Exposure and environment is the last component of the primary survey.

- Undressing the patient for a thorough examination of the skin and then covering up with warm blankets to avoid hypothermia

It is critical to adhere to the ABCDE sequence, as different injuries kill in certain reproducible time frames. The loss of an airway kills more quickly than the loss of the ability to breathe, which again kills more quickly than a depleted circulating blood volume. The presence of an expanding intracranial mass lesion is the next most lethal problem. The mnemonic ABCDE defines the specific order of evaluations and interventions that should be followed in all injured patients, as the primary goal is to keep the patient alive and the secondary goal is to prevent any secondary injury.

The secondary survey is performed only when and if the patient is haemodynamically stable. The survey includes a complete examination from top to bottom: head, face, neck, upper extremities, axilla, thorax, abdomen, pelvis, genitals and lower extremities.

The next step will typically be to run a trauma CT scan to visualise the extent of injuries and any ongoing bleeding. Next, the trauma team can plan further examinations, treatments or observation.

34.2.2 Traumatic Brain Injury in Multitraumatised Patients: Prioritisation and Timing

In multitraumatised patients with concurrent injuries, the trauma team may need to perform rapid prioritisations of timing and sequence of various required surgical procedures. The undebatable principle remains that the patient needs to be haemodynamically stable before performing neurosurgery. Open airways, breathing with sufficient gas exchange and adequate circulation are prerequisites to keep the brain alive. When the patient is stable, with or without stabilising surgery or fluid resuscitation, the neurosurgeon may be called to action. No matter how severe the brain injury, or clear the indication for immediate neurosurgery, the patient needs to be stabilised in terms of ABC first. This might include performing a laparotomy and/or a thoracotomy in the trauma room or the operating theatre (OR) before neurosurgery. Prioritising like this will secure adequate oxygenation and blood flow to the brain and hence reduce or avoid secondary brain injuries. Even though the brain injury may be addressed with quick and accurate surgery, it is of little help if the rescued brain suffers because of lack of oxygenation/perfusion due to compromised ABCs. Compromised airways, breathing and circulation are more life-threatening for the trauma patient than any coexisting head injury.

The whole scale of injuries is often unknown until the patient has undergone a trauma CT scan. If a traumatic head injury needs immediate surgery, and the patient is stable, neurosurgery has priority. If the CT scan reveals a traumatic intracranial haematoma and the indication for surgery is clear, it must generally be performed as soon as possible. Other concurring injuries (abdominal, thoracic and orthopaedic) will have to wait, as long as those injuries do not affect the haemodynamic status of the patient. If there is indication for minor surgery of other body parts (e.g. relieving a pneumothorax with a chest tube), this can be performed immediately before the neurosurgery, but without interfering or delaying the planned neurosurgical intervention. When the

neurosurgeon has finished surgery, concomitant injuries can be handled surgically in the same OR, with the necessary change of setup, or the patient may be brought to another OR more suitable for the next surgical intervention.

Occasionally the patient needs to undergo stabilising surgery in the OR after the CT scan is performed and the source of bleeding is clear (ruptured spleen or liver, damage to the heart or aorta). In this case, if there also is an intracranial haematoma, the patient needs to undergo stabilising surgery first. This is necessary even if the patient shows signs of herniation (both clinically and radiologically). The neurosurgeon must optimise the conservative management as much as possible until it is time for decompressive neurosurgery. No matter how frustrating, this is the logical sequence of prioritisation, so that secondary injury to the brain can be minimised or avoided. The neurosurgeon should, however, be ready to commence immediately after, or by the closing up of, the latter surgery.

Minor neurosurgery, which doesn't interfere with the timing of stabilising surgery, e.g. insertion of an ICP probe or external ventricular drain, might be done simultaneously with damage control surgery in the thorax, abdomen or pelvis. You will only need access to the patient's head, requiring a small amount of space. Moreover, the equipment needed may be easily transferred to the OR of choice and may even be done in the ICU.

As already mentioned, it might be very frustrating for neurosurgeons not to be able to perform immediate surgery when indicated. Nevertheless, it is crucial to realise that decision-making in a multitraumatised patient with severe injuries to other organs in addition to the brain is more challenging. The prioritising sequence must, however, be clear and not up for discussion during critical minutes in the trauma room. A haemodynamically unstable patient needs to be stabilised so that secondary brain injuries can be reduced or avoided; in this way, patients will have a better chance of survival and better outcome.

34.3 Specific Paediatric Concerns

Head injuries in children due to, for example, traffic accidents, child abuse or falls can be associated with injuries in other organ systems. Hypotension and hypoxia ("the evil duo") from associated injuries adversely affect the outcome from head injuries.

The priorities for assessing and managing paediatric trauma patients are the same as for adults. However, the unique anatomical and physiological characteristics of children produce distinct injury patterns. The most serious paediatric trauma is blunt trauma that involves the brain. As a result, hypoventilation, apnoea and hypoxia occur up to five times more often than hypovolemia with hypotension in multitraumatised children. Consequently, treatment protocols emphasise aggressive management of the airway and breathing in children.

Children are particularly susceptible to the effects of secondary brain injury. Although the combined effect of hypovolemia and hypoxia is devastating, hypotension from hypovolemia is the most serious single risk factor. Therefore, any bleeding source causing hypovolemia needs to be addressed. Hence, a rapid ABCDE assessment and management is just as crucial as in adults.

Suggested Readings[1]

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[1] In addition to the below list of references, this chapter is heavily based on expert opinion and local experience.

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