Guidelines for the pre-hospital care of patients with severe head injuries

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Introduction

Assessment and stabilization of patients with head injuries begins at the scene of the injury by emergency medical personnel. It includes the following tasks:

- securing the patient’s airway,
- maintenance of oxygenation and normal ventilation,
- initiation of haemodynamic resuscitation and fluid administration,
- assessment of the level of consciousness,
- stabilization of the cervical and thoracolumbar spine,
- identification and stabilization of extracranial injuries.

Other critical components of the initial management of such patients are to obtain information about the circumstances of the injury as well as to provide transport to a qualified medical center.

The present guidelines were drafted by the Working Group for “Neurosurgical Intensive Care” of the European Society for Intensive Care Medicine. The document is the general consensus on the minimal care which should be provided to patients with severe head injuries in all European countries.

Influence of systemic adverse events on outcome in patients with head injuries

Incidence

In large series of patients with traumatic brain injury the incidence of pre-hospital hypotension/shock varies from 12.2 to 34.6% [1-6]. Hypoxaemia is present in 14.3 to 45.6% of these cases. Even in patients with moderate injuries, the incidence of hypoxaemia is 14.8% [1-6]. Hypercarbia will occur in up to 6.1% [6]. The incidence of hypocarbia in this setting has not been studied.

Influence on outcome

Adverse events, such as arterial hypotension, hypoxaemia or hypercarbia eventually determine adjunctive brain damage to the primary direct traumatic damage to neural tissues. This secondary brain damage adversely influences the outcome of the majority of head trauma patients.

Extracranial complications occur frequently in patients with severe head injuries. Although the outcome of an individual patient may be adversely affected by a number of different complications, only a few have been identified as having an independent influence on outcome including hypotension, pneumonia, coagulopathy and sepsicaemia [5, 7-21]. If pre-hospital hypoxia and/or hypotension is present in such patients, the mortality rate is twice that of patients without these insults. Conversely, normotensive/normoxic patients are twice as likely to make a good recovery [1, 4, 7, 9, 18, 21]. The risk of pneumonia increases with the presence of coma and with impairment of airway reflexes [22]. Intubation in patients with severe head injuries reduces the rate of aspiration and helps to prevent respiratory insufficiency [23].
Conclusion

Primary care of the patient with traumatic brain injury is aimed at preservation of a clear airway and adequate circulation at the scene and during the entire transport.

Initial administration of oxygen is mandatory in all patients with an isolated traumatic brain injury. Patients with a Glasgow Coma Scale [24] score of 8 or a motor score of less than 5 should be intubated and ventilated as soon as safely possible. In patients with better motor scores and associated injuries, the risk of acute hypoxia, intubation and ventilation should also be considered. Aspiration should be avoided and/or vigorously treated. Artificial ventilation should be adjusted to achieve an arterial saturation of more than 95%. Aggressive hyperventilation should be avoided in the early phase of the injury when cerebral blood flow is typically at its lowest [25]. Aggressive hyperventilation can be considered only when signs of impending brain herniation are present. If end-tidal CO₂ can be measured, it should be kept between 30-35 mmHg (4-4.5 kPa) in normotensive patients [26, 27].

At least two large peripheral i.v. cannulas should be in place and secured. The first step in establishing an adequate cerebral perfusion pressure is establishing normal blood pressure. Treatment of low blood pressure should be aimed at a systolic blood pressure of more than 120 mmHg (16 kPa) for adults. An increase in blood pressure is usually caused by inadequate sedation and analgesia. If this is not the case, treatment of raised blood pressure (> 200 mmHg = 26.6 kPa) by vasodilating agents is usually not indicated and may cause fatal hypotension. It should be kept in mind that hypotension is rarely caused by an isolated head injury [14] and that the most common cause for this event is an extracranial injury (exception: newborns).

Sedation/analgesia

Adequate sedation and analgesia are essential in patients with head injuries, especially if ventilated. Sedatives and analgesics should be carefully titrated as overdosing may cause profound hypotension, especially in hemodynamically unstable patients. Short-acting drugs should be preferred.

Muscle relaxants

When needed, short-acting muscle relaxants are advocated.

Vaspressors

Vaspressors should be considered if volume replacement fails to assure an adequate systemic blood pressure within minutes. From a neurosurgical/neuro-anaesthetic point of view no one vasopressor has been shown to be superior to others, subsequently no recommendations concerning the type of vasopressors can be given.

“Neuroprotective” agents

So far no “neuroprotective” agents (e.g. steroids, nimodipine, barbiturates) have been used in large, randomized, placebo-controlled pre-clinical trials in patients with severe head injuries, and they have shown minor effects in patients in the clinical setting [45–48].

Drugs

Volume replacement

Adequate volume resuscitation should be initiated. Isotonic solutions (e.g. Ringer’s solution, NaCl 0.9%) and colloids are advocated. Although controversial [28], hypertonic saline has recently been used in the acute resuscitative phase after head injury both experimentally and clinically [29–38]. Hypertonic saline [39–43] is a therapy which is not generally accepted for resuscitation in this patient group. If given, hypertonic saline (250 cc of NaCl 7.25% ) should be administered first, followed by rapid infusion of colloids. Hypotonic crystalloids (e.g. Glc 5%, Ringer lactate) may worsen cerebral oedema [44].

Mannitol

Although mannitol has been shown to be effective in reducing intracranial pressure [49–55], its general use is not advocated during pre-hospital care. In emergency situations (dilating of a formerly contracted pupil) however it can be administered (0.5–1 g/kg with an infusion time of 10–15 min).

Transport

Although controversial [56, 57], the patient’s head should be elevated at a 15–30° angle. About 5% of head injury victims sustain cervical spine injury [58–63]. A rigid collar should be applied in order to secure the cervical spine as soon as possible and this should be kept in position until radiographic images verify, beyond any doubt, the absence of any cervical spine lesion down to the second thoracic vertebra. The
spine should always lie in a neutral position on a rigid plate.

Unstable fractures should be immobilized. Rolled sheets, sandbags, or commercially available devices should secure the position of the head. Endotracheal tubes should be secured by tapes, but the tape should not be passed around the neck in order to avoid compromising jugular venous return.

After his/her clothes have been removed, the patient should be carefully checked for further injuries. Of particular importance are thoracic, abdominal, pelvic and limb injuries which carry a high risk for hypotension and/or hypoxaemia. The patient’s temperature should be kept at normothermia [64–67].

A complete system of transport with the patient “packed” together with monitoring and therapeutic devices is very useful.

**Stretcher (trolley)**

The patient should be positioned on a stretcher that will allow various radiological imaging (X-ray, computer tomography) in hospital so that he can remain on the one from the scene of the injury until admission to the ward/ICU/OR.

**Transporting team**

Besides the driver (transport and communication) at least two people should be devoted to the patient’s care. One of the team members should be a physician. Members of the team should be very familiar with the equipment and have personally checked it before use. They should have received a specific training in:

- airway care and tracheal intubation,
- ventilation by mask and portable mechanical ventilator,
- peripheral and central vein access,
- drainage of tension pneumothorax,
- neurological examination of unconscious patients.

**Medical history (if possible)**

- neurological state: GCS scale (broken down into visual, verbal and motor), pupil reactivity, focal neurological deficits
- extracranial injuries
- trauma score (any score which is standardized at least on a regional level)
- repeated documentation of pulse, blood pressure; SO₂, end-tidal CO₂ (if possible)
- medication administered (type, dose, timing)
- interventions (type, timing)
- free space for comments
- name and telephone number of the transporting physician.

Precautionary radio communication of the patient’s clinical status to the receiving hospital medical staff is strongly advocated and deserves standard local guidelines.

**Feed-back and quality assessment**

After handover of the patient, members of the hospital medical staff should compile a form containing any observation (especially problems) related to the handover of the patient. This form (standardized at least at a regional level) should be given to the transporting team in order to assure the quality of patient transport. Regional conferences on a regular base should be held between emergency teams and the receiving hospitals to assure and to improve the quality of pre-hospital care.

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**Neurological assessment and documentation**

A complete and comprehensive chart should be compiled by the transporting team. A protocol should be used which is standardized at the regional level, at least. The chart should contain additional copies to provide the referring hospitals with the information. Documentation should include information (minimum) on:

- patient’s name, gender, address, birth date
- time, nature, cause of the injury
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