Chapter

Introductory Chapter: Concomitant Traumatic Brain Injury and Haemorrhagic Shock

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1. Introduction

Younger people in developing countries are more frequently affected by head injuries, which have substantial economic and social effects. In patients with traumatic brain injury (TBI), external or internal haemorrhages have the potential to cause systemic hypotension [1, 2]. They can be associated with poorer outcomes (increased morbidity and mortality) compared to patients with TBI alone [3, 4]. Even brief episodes of hypotension have been shown to cause both systemic and cerebral hypoperfusion and secondary brain injury [5]. This systemic hypertension can be further complicated by raised intracranial pressure (due to TBI-related lesions), which can further compound the treatment protocols [6]. In trauma patients, the occurrence of haemorrhagic shock is associated with high mortality (as high as 50%) [7], and the reported incidence ranges from 6-16% [8]. These cases need to be differentiated from those in the paediatric population, where the isolated TBI can lead to severe shock (in the absence of apparent haemorrhage) [9, 10]. Understanding the interaction of the simultaneous presence of TBI and haemorrhagic shock is essential to implement the optimal resuscitation strategy [11] and, thus, developing strategies to improve outcomes in this subgroup of patients [5]. Investigators have used animal models to define the optimal post-resuscitation mean arterial pressure levels to ensure organ perfusion and, thus, maintain good organ functions and survival patterns [2]. The present article discusses the concepts and controversies associated with concurrent TBI and haemorrhagic shock, the clinical approach, and the management of this subgroup of patients.

2. Clinical examination

The clinical examination of a patient with suspected haemorrhagic shock and TBI is aimed at determining the source of the bleeding from any systemic external or internal injuries and understanding the severity of the head injury. The cursory examination of the neurological status involves the evaluation of the Glasgow Coma

Scale (GCS) and pupils, which will help assess the need for further radiological evaluation or urgent surgical intervention. One should be mindful that haemorrhagic shock is one of the confounding factors in the assessment of GCS. The detailed examination of the patient must include an assessment of the airway, breathing, circulation, and disability. While the patient is being stabilized, the neurological examination and examination to rule out other injuries like haemothorax, hemoperitoneum, or long bone fractures will continue, and appropriate measures can be taken to control the ongoing haemorrhage, if any. It is important to remember that the scalp can be a significant source of bleeding in children and should be scrutinized. In a patient with TBI and shock, bilaterally dilated and fixed pupils (in the absence of local injury and any drug overdose) can be an ominous sign that signifies a poorer outcome [12].

3. Diagnosis

Haemorrhagic shock in a patient with traumatic brain injury must be defined using a standard definition in the given setting [13, 14]. The diagnosis of traumatic brain injury and haemorrhagic shock will be evident in most cases. However, a careful clinical evaluation, including a detailed clinical history that can be supplemented with appropriate investigations, is needed to assess the extent of brain injury and haemorrhagic shock [14]. The detailed laboratory investigations shall include complete blood counts (including haemoglobin levels), a coagulation profile, and imaging of the brain or approximate regions to find the cause of haemorrhagic shock.

4. Management

Management of TBI with haemorrhagic shock remains a challenge [13] which is further compounded by the fact that there is wide variability in clinical practices. Various parameters must be kept in mind while managing this patient population, including intracranial pressure monitoring, a coagulation profile, an optimum blood pressure target, and the issue of performing combined surgical procedures for a combination of injuries [13]. In addition to the standard management protocol, the objective of management in these cases is "hemodynamic and haemostatic resuscitation" [13]. An optimal blood pressure management strategy will be necessary as there may be a combination of systemic hypotension and intracranial hypertension. It will be better to maintain the systemic blood pressure on the higher side [15]. The management strategy in these patients is debatable; however, the management should focus on the management of hypotension, cerebral oedema, coagulopathy (if present), judicious use of antiepileptics, and blood replacement [13]. As recommended, tranexamic acid can be given to reduce the mortality rate in these patients [16]. A few words of caution: aggressive fluid resuscitation in these patients must be avoided as it may have deleterious effects and increase short-term mortality [17]. Although head-end elevation is a standard practice in managing patients with TBI and raised intracranial pressure, its role in managing these patients is controversial [18]. Similarly, the role of the Trendelenburg position, which has been suggested to improve transient hypotension in haemorrhagic shock [19], is doubtful [20]. Maintain a neutral head and neck position to prevent jugular compression which would further impede venous return to the heart in the background of haemorrhagic shock.

5. Outcome

The outcome of patients who sustain TBI and concomitant haemorrhagic shock is unfavourable. It has been reported that 33-50% of patients die before they can reach the hospital [21]. These patients' significant causes of mortality are exsanguination and its sequelae, multi-organ dysfunction and coagulopathy [13]. Brain injury-related insults aggravate cardiovascular dysfunction and result in poorer outcomes [22]. TBI can cause cerebral oedema, requiring a higher systemic blood pressure to maintain cerebral perfusion. On the other hand, systemic hypotension in haemorrhagic shock results in decreased mean arterial pressure and subsequent decreased cerebral perfusion pressure. This interdependent impairment of haemodynamic regulatory mechanisms in a vicious cycle further leads to unfavourable outcomes [22].

6. Conclusions

In summary, patients with concomitant TBI and haemorrhagic shock usually sustain multisystem injuries that need an urgent and comprehensive team approach and may receive excellent pre-hospital care wherever possible. Although in most patients with TBI, shock is caused by haemorrhage, TBI can cause shock, particularly in the paediatric population. In either circumstance, the main objective is early identification of the underlying pathology and comprehensive management of responsible pathologies to improve outcomes. In traumatic intracranial pathologies, there may be a mismatch between systemic blood pressure and intracranial pressure that needs to be closely monitored to maintain optimal cerebral perfusion pressure.

Conflict of interest

The authors have NO conflict of interest to declare.

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