Timing of Craniotomy in a Patient With Multiple Trauma Including Head Injury
—Case Report—

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Abstract

A 7-year-old boy suffered blunt multiple injuries to the head, face, chest, and abdomen in a motor vehicle accident. On admission he had impaired consciousness and dyspnea. Radiographic studies revealed facial fracture and pulmonary contusion. Shortly after admission, he fell into shock due to intraabdominal bleeding. Laparotomy revealed spleen rupture. His vital signs remained unstable and bloody drainage from the abdominal cavity continued after surgery. Computed tomography showed traumatic intracerebral hematoma in the right temporal lobe, enlarging and compressing the brainstem. Abdominal reoperation was performed first to control the bleeding and stabilize the hemodynamics, disclosing renal laceration. Then evacuation of the intracerebral hematoma and decompressive craniectomy was performed. Postoperatively, his hemodynamics were stabilized. Clinical course was uneventful and neurological deficits gradually improved. Three months after the trauma, the patient was discharged on foot. This case emphasizes the importance of hemodynamic stability in decisions of neurosurgical indication and timing in patients with multiple trauma including head injury.

Key words: multiple trauma, head injury, abdominal injury, craniotomy, laparotomy

Introduction

Severe head injury is commonly associated with multiple blunt systemic injuries, and the head is the most frequent site of injury in such patients. Patients with head injury have much higher mortality than patients without head injury, so head injury is the most important cause of traumatic death. Immediate computed tomography (CT) of the brain followed by surgical removal of any intracranial mass is generally recommended, but the risk of ongoing hemorrhagic shock resulting from extracranial injuries should be carefully considered. Occasionally emergency operations including both neurosurgical and general surgical interventions are required. However, the priority of procedures may be difficult to decide.

Recently, we treated a patient with head, chest, and abdomen injuries suffered in a motor vehicle accident. Emergency laparotomies were performed, followed by urgent craniotomy, resulting in good recovery.

Case Report

A 7-year-old boy, 20 kg in weight, suffered craniofacial, thoracic, and abdominal injuries in a motor vehicle accident. He was immediately transferred to our medical center. On admission, he was comatose (Glasgow Coma Scale 4) with dyspnea. CT revealed left zygoma fracture and left pulmonary contusion (Fig. 1).

The patient was intubated and a chest tube was inserted. Shortly afterwards his vital signs became unstable, with distended abdomen. Ultrasonography indicated intraabdominal bleeding. Immediate fluid resuscitation with blood transfusion was begun.
Emergency laparotomy revealed splenic laceration, so splenectomy was performed. Follow-up head CT showed intracerebral hematoma in the right temporal lobe, which was enlarging and compressing the brainstem (Fig. 2). Rapid decrease of platelet count, remarkable prolongation of prothrombin time, and elevation of fibrin degradation product D-dimer suggested the disseminated intravascular coagulation, which was supposed to be associated with enlargement of intracerebral hematoma. Craniotomy was considered to be necessary, but bloody drainage from the intraabdominal cavity continued and his hemodynamics remained unstable (Fig. 3). Therefore, repeat laparotomy was under-

Fig. 1  Computed tomography scans of the head (A, B), chest (C, D), and abdomen (E, F) on admission revealing left zygoma fracture (B) and left pulmonary contusion (C, D). The spleen and left kidney were shown in E and F, respectively.

Fig. 2  Serial computed tomography scans at 1, 2.5, 6, and 13 hours postinjury (A, B, C, and D, respectively) demonstrating intracerebral hematoma in the right temporal lobe, enlarging and compressing the brainstem.

Fig. 3  (A) Time course of hemodynamics after admission. Blood transfusion (arrowheads), hemoglobin administration (Hb), and platelet count (Plat) are indicated. FFP 2E, MAP 2E, Plat 10E, and WB 400 means 2 units of fresh frozen plasma, 2 units of concentrated red blood cells, 10 units of platelet, and 400 ml of whole blood, respectively. (B) Computed tomography scan just before craniotomy.

Neurol Med Chir (Tokyo) 49, January, 2009
taken first to control the blood loss and stabilize the hemodynamics. Renal bleeding from the left parenchyma was revealed and the laceration repaired. Subsequently, the intracerebral hematoma was removed and external decompression conducted (Figs. 3 and 4). As a result, the Abbreviated Injury Scale (AIS) scores were AIS\text{head} 4, AIS\text{face} 2, AIS\text{chest} 3, and AIS\text{abdomen} 4.

His vital signs stabilized after these surgical interventions. Mild hypothermia and high dose barbiturate therapies were instituted. The clinical course was uneventful. His neurological deficits gradually improved. Cranioplasty was performed 8 weeks later (Fig. 4). Three months posttrauma, the patient was discharged on foot, when only left oculomotor nerve palsy and mild left hemiparesis was found.

**Discussion**

The aim of neurosurgical care for severe head injuries is to minimize the secondary brain damage that occurs after injury. Procedures include evacuation of the intracranial space-occupying hematomas, decompressive craniectomy, reduction of intracranial volume, and external ventricular drainage for hydrocephalus, and conservative therapy to reduce intracranial pressure and to maintain cerebral perfusion pressure and brain tissue oxygen $P_{bto_2}$. Neurosurgical intervention should be performed before irreversible brainstem damage or generalized brain damage has occurred. Any life-threatening lesion in the cranial vault must be treated immediately. However, the prognosis for a patient with severe head injuries depends not only on the clinical status on admission and the intracranial lesions, but also on the presence of other systemic injuries.

Major extracranial injuries have important effects on the outcome, and multiple trauma is associated with increased mortality. A survey of preventable traumatic deaths found that most central nervous system deaths were caused by delays in craniotomies, whereas most non-central nervous system deaths resulted from inadequate resuscitation for extracranial bleeding. Timely treatment of trunk injuries is very important if hemorrhagic shock is present. Therefore, patients with multiple blunt trauma including head injury sometimes require both neurosurgical and general surgical interventions, but the priority of diagnostic studies and interventions may be difficult to decide.

The indications for cranial or general diagnostic and therapeutic procedures may be difficult to establish in hypotensive patients with disturbed consciousness. Few studies have investigated the priorities for the management of patients with suspected injuries to both the head and the chest or the abdomen. Resuscitation procedures can be summarized as diagnosis and emergent treatment of severe torso injury should take precedence over detection and treatment of possible intracranial mass lesion. Therefore, general surgery should be performed first in a patient with ongoing hemorrhagic shock, and head CT can be delayed. After stabilization of the vital signs, head CT should be performed as soon as possible, followed by craniotomy to remove any intracranial mass if necessary. This protocol depends on the likelihood of different injuries. Although serious head injury is common, patients with surgically correctable injuries of both the head and the trunk are rare. Therapeutic laparotomy has been delayed in more cases because of head CT with negative findings than craniotomy has been delayed for nontherapeutic laparotomy. The frequency of urgent laparotomy is much greater than that of emergency craniotomy. However, the optimal timing of head CT and surgery for intracranial versus abdominal or thoracic bleeding has not been fully discussed because of the rare occurrence in hemodynamically unstable patients with clinical signs of impending herniation.

In our case, craniotomy was successfully performed after repeat laparotomies to identify and stop the ongoing hemorrhage. This case illustrates the dilemma for the physician who must balance the risk of impending herniation from an intracranial hematoma against the hemorrhagic shock from intraabdominal bleeding. Ongoing hemorrhage must be controlled immediately or is likely to be fatal to the patient. Additionally, hemorrhagic hypotension worsens neurological outcome so the hemodynamics should be stabilized first. Then the
neurosurgical indication and timing should be decided. However, the importance of identification and removal of intracranial mass lesions must not be underestimated. A life-threatening lesion in the cranial vault must be treated immediately.\(^{8}\) Suspected intracranial lesion should be evaluated by immediate head CT or intracranial pressure monitoring to prevent any delay in treatment.\(^{2,15}\) Burr hole craniotomy or simultaneous craniotomy combined with laparotomy or thoracotomy should be considered.

Prioritizing diagnostic and therapeutic procedures in the management of multiple trauma patients is a complex task for the trauma teams who must balance the necessity of controlling abdominal or thoracic hemorrhage for hemodynamic stability against the potential risk of delaying craniotomy for repair of treatable lesions at risk of herniation and death. Cooperation between general surgeons and neurosurgeons during this process is essential to ensure the best patient care.\(^{8}\)

The present case treated by emergency laparotomy or thoracotomy shows that hemodynamic stability should be considered in decisions of neurosurgical indication and timing in patients with multiple trauma including head injury.

**References**


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