Neurosurgical Considerations in Craniofacial Trauma

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KEYWORDS

• Craniofacial trauma • Traumatic brain injury (TBI) • Critical care of TBI
• Medical home for TBI • Medical home for craniofacial trauma

KEY POINTS

- Craniofacial trauma is often accompanied by traumatic brain injuries (TBIs). Proper stratification of all of the patient's injuries is crucial in avoiding complications and optimizing outcomes.
- A coordinated multidisciplinary approach is ideal in each medical setting: emergency department, operative theater, intensive care, acute care, rehabilitation, and outpatient clinics.
- Hypotension and hypoxia invite deleterious effects on patients with TBI. If cerebral autoregulation is disrupted, fluctuations in mean arterial pressure or intracranial pressure caused by anesthetics can result in secondary insults and further injury.

INTRODUCTION

> *Every important hospital should have on its resident staff of surgeons at least one who is well and able to deal with any emergency that may arise.*
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> *—William S. Halstead, MD*[1]

> *If we were to start all over again and there were no surgical specialties, the ideal would be to create a single society of head and neck surgery to include everything above the clavicles with the exception probably of the eye and brain.*
>
> *—Joel J Pressman, MD*[2]

Although Halstead and Pressman[2] were well intentioned, most trauma centers in the United States offer comprehensive craniofacial trauma care through consultations of multiple subspecialties: neurologic surgery, otolaryngology–head and neck surgery (HNS), ophthalmology, general surgery, oral-maxillofacial surgery, plastic surgery, critical care medicine, anesthesia, interventional radiology, and physical medicine and rehabilitation. In this setting of multiple specialties, optimal care for patients with complex craniofacial injuries requires coordination, understanding of the complications each specialty encounters, and stratification of the severity of each injury by its implications for morbidity and mortality. Traumatic brain injury (TBI) is a common and often life-threatening comorbidity in the setting of craniofacial trauma. This article discusses TBI and the role of neurosurgery in the setting of craniofacial trauma and the effects of TBI on the overall care of patients.

CAUSE OF TRAUMATIC BRAIN INJURY IN CRANIOFACIAL TRAUMA

TBI is a leading cause of death and permanent disability for patients. Of all patients with

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trauma, nearly half of all deaths are associated with TBI.[3] Although trauma has been globally associated with young adults, in economically wealthy countries, elderly patients have the highest mortality associated with TBI and the incidence of hospital admissions for TBI in elderly patients continues to increase.[4] Motor vehicle crashes (MVCs) and assaults have always been associated with TBI and craniofacial trauma but, with the increase in elderly patients, falls are becoming a more frequent mechanism of injury.

TBI can be broadly classified by mechanism of injury: blunt force trauma, penetrating trauma, or a combination of both. Although blunt trauma–associated TBI is more prevalent, almost half of the approximately 50,000 annual TBI-related deaths are associated with gunshot wounds to the head (GSWH).[4] MVCs (particularly high-impact crashes) are the most common source of blunt TBI in the United States in all patients, and GSWH are the most common penetrating TBI managed at our institution. For elderly patients, falls have become the most common cause of TBI. In all cases, the precipitating event often results in maxillofacial trauma to accompany the TBI. For neurosurgeons, each mechanism portends unique complications and challenges. The blast or impact associated with penetrating trauma can also cause injuries seen in blunt trauma, but penetrating objects such as bullets, knives, or shrapnel can also inflict harm through disruption of brain by the path of the object and cavitation forces related to high-velocity missiles.

GSWH are particularly serious injuries. In the state of Maryland, 786 GSWH were recorded over a 2-year period. Of those, 594 (75.6%) of the injured died at the scene. Patients with GSWH admitted to trauma centers experienced a 61.5% mortality. Of those admitted to the hospital, 18.4% of GSWH had an orbital or facial point of entry with associated craniofacial trauma. Of the patients who survived to hospital discharge, 59.5% died within the 2-year follow-up, but 35.7% of discharged patients had Glasgow Outcome Scale scores of 4 or 5 (**Table 1**). The strongest predictors of death or a debilitating outcome include Glasgow Coma Scale (GCS) less than 8 and absent pupillary light reflex on admission; bullet trajectory that crosses beyond the x, y, and z planes; intraventricular hemorrhage; and effacement of the basal cisterns were also associated predictors of poor outcomes.[5,6]

Besides the devastating initial injury from GSWH or other penetrating injuries, delayed infections leading to abscess, meningitis, and ventriculitis often preclude any chance of meaningful recovery. In the setting of GSWH, prophylactic antibiotic use to prevent meningitis and/or abscess has not been studied in a controlled manner. An association between postoperative antibiotic use and a decreased infection rate in military GSWH case series was recognized. The Guidelines for the Management of Penetrating Brain Injury recommend postoperative antibiotic administration, although neither the type nor duration of antibiotics could be specified.[7] Broad-spectrum antibiotic coverage for 48 to 72 hours is the current practice at our institution.

Table 1
Glasgow Outcome Scale

Score	Description
1	Death
2	Persistent vegetative state Patient exhibits no obvious cortical function.
3	Severe disability Conscious but disabled. Patient depends on others for daily support.
4	Moderate disability Disabled but independent. Patient is independent as far as daily life. Disabilities include varying degrees of dysphasia, hemiparesis, or ataxia as well as intellectual and memory deficits and personality changes.
5	Good recovery Resumption of normal activities even though there may be minor neurologic or psychological deficits.

Data from Jennett B, Snoek J, Bond MR, et al. Disability after severe head injury: observations on the use of the Glasgow Outcome Scale. J Neurol Neurosurg Psychiatry 1981;44(4):285–93.

PATHOPHYSIOLOGY OF TRAUMATIC BRAIN INJURY IN CRANIOFACIAL TRAUMA

TBI with craniofacial trauma has a variety of causes, the most common of which include MVCs, ground-level falls, and assaults. Subdural, epidural, and intraparenchymal hematomas displace normal brain, with midline shift being the most common result. Without intervention, a large enough hematoma will cause herniation of a lobe or region of the brain from its native intracranial compartment into a non-native intracranial compartment or an extracranial space, resulting in physical tissue injury and stroke caused by interruption of cerebral blood flow. Edema from intraparenchymal hemorrhages, ischemic injury (stroke), or venous injuries can also result in mass effect. Subfalcine and uncal herniations are