Acute Management of Moderate-Severe Traumatic Brain Injury

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KEYWORDS

• Intracranial pressure • Management • Outcome • Traumatic brain injury

KEY POINTS

- Neurocritical care management of traumatic brain injury (TBI) patients focuses on prevention and prompt treatment of secondary insults.
- The acutely injured brain is highly vulnerable to brief deviations from normal physiologic values that would normally be well-tolerated.
- Treatments administered prophylactically against intracranial hypertension or other harmful sequelae have not been shown to be beneficial in clinical trials and have sometimes produced undesirable effects.
- Future advances in the management of TBI require treatments tailored to specific subtypes of patients, such as those with diffuse injury or with surgically evacuated traumatic hematomas.

INTRODUCTION

Traumatic brain injury (TBI) has long been a major public health problem. Commonly cited statistics indicate that 1,365,000 Americans visit emergency departments every year because of TBI.[1] It is likely that many more suffer TBI but receive other types of medical care (such as from their primary care physicians) or no care at all. In the United States, TBI causes 275,000 hospitalizations and 52,000 deaths every year, and it is a contributing factor in more than 30% of all injury-related deaths. The number of Americans living with the sequelae of TBI is as high as 5.3 million.[2]

TBI represents a leading cause of death and disability not just in the United States, but across the globe. Many low- and middle-income countries are burdened by a sharp increase in the numbers of motor vehicle-related injuries, a situation often aggravated by poor roads, inadequate enforcement of traffic laws, and underdeveloped prehospital emergency care systems.

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TBI is often classified as mild, moderate, or severe based on the Glasgow Coma Scale (GCS; **Tables 1** and **2**).[3,4] It has frequently been stated that 80% of TBI cases are mild, 10% moderate, and 10% severe. More recently, the proportion of mild cases seems to have increased, possibly because of greater awareness and recognition of concussion and other forms of mild TBI, which are discussed elsewhere in this volume.

Classically, the stereotypical TBI patient is a male in his late teens or early twenties. Fortunately, the incidence of interpersonal violence and motor vehicle crashes, which disproportionately affect males in this age group, has decreased in recent years. However, the number of falls among the elderly has increased dramatically as that segment of the population has grown in number. Many of these patients also take newer antiplatelet or anticoagulant medications, which can increase the likelihood and severity of intracranial hemorrhage after a fall.

Research and clinical care in TBI have been held back by persistent use of categorization based on physical examination instead of on underlying pathophysiology. No one would base a huge infrastructure of research, acute care, and rehabilitation on something as nebulous as "abdominal pain" because that term is so broad as to be almost meaningless. Abdominal pain can be caused by gastric ulcer, appendicitis, ischemic bowel, diverticulitis, pancreatitis, and a host of other diseases, which all have their own causes and treatments. A single medication or other treatment cannot be expected to be effective against such a variety of conditions. But the term "TBI" is used to describe any mechanically induced alteration of neurologic function, regardless of the underlying pathophysiologic cause, such as enlarging extraaxial hematoma, diffuse swelling, ischemia, blossoming contusion, and so on. Applying the same uniform approach to these different conditions makes as little sense as applying a single intervention to all patients with abdominal pain. It is no surprise that clinical trials in TBI, which have adopted this approach to patient enrollment, have failed to demonstrate improved outcome from any proposed intervention.

Both the public health burden of this severe and common disease and the exasperating stubbornness with which it has resisted attempts to develop effective treatments illustrate the magnitude of the challenges posed by TBI. This article focuses on the management of adults with moderate and severe closed brain injuries sustained in a civilian setting. The basic principles of management of severe TBI apply to children as much as to adults, but specific goals and parameters may differ. Also, pediatric TBI is characterized by a lower incidence of traumatic mass lesions than seen in adults. Of course, the possibility of intentionally inflicted injury must always be considered in children, just as it is in elderly and other vulnerable patients. Penetrating brain injuries may present interesting challenges in terms of surgical approaches and techniques, but

Table 1
Glasgow Coma Scale

Score	Eye Opening (E)	Verbal (V)	Motor (M)
6	—	—	Obeys commands
5	—	Oriented	Localizes stimulus
4	Spontaneous	Confused	Withdraws from noxious stimulus
3	To voice	Inappropriate words	Abnormal flexion
2	To pain	Incomprehensible sounds	Extension
1	No eye opening	No sounds	No response