

Definition of Traumatic Brain Injury, Neurosurgery, Trauma Orthopedics, Neuroimaging, Psychology, and Psychiatry in Mild Traumatic Brain Injury

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KEYWORDS

- Traumatic brain injury (TBI) • Neurotrauma • Concussion • Trauma orthopedics
- Traumatic brain injury imaging • Postconcussion syndrome

KEY POINTS

- This article describes traumatic brain injury (TBI) and presents classification systems (eg, mild, moderate, or severe).
- Classification of neurotrauma orthopedics is presented.
- Initial assessment and intensive care management of TBI is discussed, including airway, breathing, circulation, and managing and stabilizing the disability (cervical and open skull fractures) come first and foremost.
- The goals of neurosurgical management are to stop the hemorrhage, remove the lesion causing mass effect, relieve high intracranial pressure, and place an invasive intracranial monitoring device, if indicated.
- Recognizing postconcussion syndrome depends on detailed history taking and focused clinical and neurologic examination.

DEFINITION OF TRAUMATIC BRAIN INJURY

Traumatic brain injury (TBI) is defined as a disruption in the normal function of the brain that can be caused by a bump, blow, or jolt to the head or a penetrating head injury.¹ The alteration in brain function caused by TBI can lead to one or more of the following symptoms:

1. Period of loss or a decreased level of consciousness;
2. Loss of memory for events immediately before (retrograde) or after the injury;
3. Neurologic deficits (weakness, loss of balance, change in vision, dyspraxia, paresis/plegia, sensory loss, aphasia, etc.); and
4. Alteration in mental state at the time of the injury (confusion, disorientation, slowed thinking, etc).²

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Classically, TBI is defined on the basis of clinical symptoms; however, modern neuroradiologic imaging techniques (eg, MR imaging–based diffusion tensor imaging) and laboratory biomarkers are being studied, which may enable a diagnosis of TBI when there is minimal or delayed clinical evidence.

SPORT-RELATED CONCUSSION

For years, the term mild TBI has been used interchangeably with sport-related concussion. More than 50 years ago, the Committee on Head Injury Nomenclature of the Congress of Neurologic Surgeons proposed a “consensus” definition of concussion, which was recognized to have a number of limitations in accounting for the common symptoms of concussion.^{3,4} In the effort to update the definition, and provide recommendations for the improvement of safety of athletes who suffer concussive injuries, the international conference on concussion in sport was conducted in 2001. In 2016, the fifth International Conference on Concussion in Sport was held in which the Concussion in Sport Group updated the definition to develop further conceptual understanding of sport-related concussion. Briefly, sport-related concussion is a subset of TBI induced by biomechanical forces caused by direct blow to the head or elsewhere on the body with an impulsive force transmitted to the head. This leads to a rapid onset of short-lived impairment of neurologic function that resolves spontaneously. Sport-related concussion may result in neuropathologic changes, but the acute clinical signs and symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies. Loss of consciousness may or may not be a part of a vast range of clinical signs and symptoms experienced by the athletes. Ultimately, resolution of the clinical and cognitive features typically follows a sequential course. However, in some cases symptoms may be prolonged.⁵

EPIDEMIOLOGY

TBI is a major cause of disability and death, especially in young adults, and contributes to approximately 30% of all injury deaths.⁶ More than 2.5 million emergency department visits, hospitalizations, and deaths in United States are associated with TBI. The rate of TBI has also increased over the past decade from 521.0 per 100,000 in 2001 to a rate of 823.7 per 100,000 in 2010.⁷

Brain injury occurs in all age groups; however, mortality is highest in the population older than

65 years of age. Overall rates of TBI in men are 29% higher than in women. TBI-related deaths in children 0 to 4 years are primarily associated with assault (42.9%) and motor vehicle accidents (29.2%). Motor vehicle traffic crashes account for a majority of TBI-related deaths (55.8%) in youth 5 to 14 years and almost one-half (47.4%) in young adults 15 to 24 years. Falls account for the majority (54.4%) of TBI-related deaths in adults 65 years of age and older.⁷

CLASSIFICATION OF TRAUMATIC BRAIN INJURY

TBI can be classified in a number of ways but traditionally the classification is based on:

1. Clinical severity and duration of symptoms,⁸ and
2. Characteristics and location of the injury.⁹

Clinical Severity and Duration of Symptoms

Concussion or cerebral contusion

- No loss of consciousness or loss of consciousness for less than 6 hours.
- No or mild memory deficit.
- Minutes to hours of posttraumatic amnesia.
- No or mild motor deficits.

Diffuse axonal injury

Mild

- Loss of consciousness lasting for 6 to 24 hours.
- Mild to moderate memory deficit.
- Hours of posttraumatic amnesia.
- Mild motor deficit.

Moderate

- Loss of consciousness for more than 24 hours.
- Moderate memory deficit.
- Days of posttraumatic amnesia.
- Moderate motor deficit.

Severe

- Loss of consciousness lasting for days to weeks.
- Severe memory deficit.
- Weeks of posttraumatic amnesia.
- Severe motor deficit.

Acceleration–deceleration injuries of the head cause the stretching, shearing, and disruption of the reticular activating system and has been proposed to be the cause of the loss of consciousness.

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