

Traumatic Brain Injury

Head injuries affect an enormous number of people. Close to two million Americans a year go to emergency departments following a head injury and a half million are hospitalized. When they occur on the job, in a car accident, or due to structural collapse, the stage is set for a law suit.

A concussion is a blow to the head affecting its functioning. The most common symptoms of concussion are dizziness, a period of unconsciousness, a period of amnesia, dizziness or a seizure. Many individuals continue to have symptoms in what is called a post concussive syndrome: problems with attention (concentrating, shifting focus of attention, performing simultaneous cognitive tasks), memory (learning or recalling information), becoming fatigued easily, disordered sleep, headache, vertigo or dizziness, irritability or aggression on little or no provocation, anxiety, depression, affective lability, changes in personality (e.g. social or sexual inappropriateness), apathy, and lack of spontaneity.[\[1\]](#)

Evaluating head injuries is often far more complicated than evaluating physical injuries because many of the symptoms are subjective and vulnerable to malingering. Moreover, there is considerable cross over between the symptoms of PTSD and traumatic brain injury. Assessing which of these is causing symptoms, which is necessary to determine the prognosis, can be very difficult. The evaluator needs to be fully conversant with the impact of traumatic brain injury before commencing the evaluation, and needs to search for external verification of the individual's statements about his or her functioning.

Traumatic brain injury frequently leads to significant functional impairment, marked by unemployment and marital dysfunction. Vocational Econometric studies show marked lost of work life expectancy when an individual suffers cognitive dysfunction.[\[2\]](#) A huge percentage of people confined in prisons suffered head injuries in the past. Contrary to popular belief,

research has shown that involvement in litigation plays a relatively small role in either the genesis or the resolution of patients' complaints.

Second impact syndrome (SIS), although rare, is important as a cause of preventable sudden death. SIS occurs when someone not yet fully recovered from a head injury experiences another head or upper body injury, even seemingly trivial injury. After a brief delay, the person suddenly loses consciousness. Signs of brainstem compression follow, leading to death or permanent coma. The syndrome typically affects young men who participate in rough sports. [3] The mechanism may be failed cerebral autoregulation with subsequent engorgement of the brain vasculature.

Posttraumatic amnesia (PTA) describes the mental state of patients immediately following closed head injury (CHI) or after awakening from coma. PTA may persist for hours to weeks or, occasionally, months. Patients with PTA are alert and capable of complex behavior. However, they experience severe memory problems, feelings of confusion, inability to learn new information, and poor concentration. PTA sometimes involves peculiar alterations of consciousness and self-awareness.

Pathophysiology

The pathophysiology of postconcussive syndrome (PCS) involves diffuse axonal injury (DAI). Disruption of axons triggers a cascade of further insults, including calcium influx, excitotoxin release, phospholipase activation, and lipid peroxidation.

Postmortem studies of traumatic brain injury (TBI) have demonstrated pathological changes that cannot be detected by conventional neuroimaging studies. In fact, much of the pathology of TBI is under the threshold of detection in conventional MRI, which in humans is approved only to be done at 3 Tesla or less. Even when standard structural neuroimaging of the brain reveal no visible abnormality, underlying structural, biochemical, or electrophysiological abnormalities may be present.

Govindaraju et al examined volumetric proton spectroscopic imaging of the whole brain in mild TBI (mTBI) patients 1 month postinjury. [4] This method provides a mechanism for detecting biochemical perturbations of the brain brought on by injury that would not

necessarily show-up in standard imaging. The authors found “widespread metabolic changes following mTBI in regions that appear normal...” on conventional MRI. This supports the notion of nonspecific damaging effects from mTBI that occur at a subtle, microscopic level of injury⁴ and that one can have a significant brain injury, yet have normal conventional structural imaging. This has also been shown by Gaetz et al.[\[5\]](#)

Glasgow Scale

The Glasgow Scale is frequently used to assess the severity of the initial injury. It consists of measurements of eye, verbal and motor responses. The total score is found by summing the numbers for the three tests. GCS \geq 13 is defined as minor, GCS 9 – 12 is defined as moderate and GCS \leq 8 is considered severe (coma).

Eyes

1. No eye opening
2. Eye opening in response to pain.
3. Eye opening to speech.
4. Eyes opening spontaneously

Verbal response

1. No verbal response
2. Incomprehensible sounds.
3. Inappropriate words (no conversational exchange)
4. Confused. (The patient responds to questions coherently but there is some disorientation and confusion.)
5. Oriented.

Motor Response

1. No motor response
2. Extension to pain
3. Abnormal flexion to pain
4. Flexion/Withdrawal to pain

- 5. Localizes to pain. (Purposeful movements towards painful stimuli.)
- 6. Obeys commands. (The patient does simple things as asked.)

A 1968 study by Lishman of 670 patients with either closed or penetrating head injuries yielded the following relationships between PTA and psychiatric disability or cognitive impairment.

Impairment	PTA <1 h, % patients	PTA <7 d, % patients	PTA > 7 d, % patients
No psychiatric disability	67	18	15
Mild disability	52	19	29
Severe disability	28	22	5
No cognitive impairment	65	18	17
Mild cognitive impairment	45	21	34
Severe cognitive impairment	16	12	72

Diagnostic Criteria

DSM-IV-TR

Postconcussional Disorder

- A. A history of head trauma that has caused significant cerebral concussion.
- B. Evidence from neuropsychological testing or quantified cognitive assessment of difficulty in attention (concentrating, shifting focus of attention, performing simultaneous cognitive tasks), or memory (learning or recalling information).
- C. Three (or more) of the following occur shortly after the trauma and last at least 3 months:
 - 1. Becoming fatigued easily
 - 2. Disordered sleep

3. Headache
4. Vertigo or dizziness
5. Irritability or aggression on little or no provocation
6. Anxiety, depression, or affective lability
7. Changes in personality (eg, social or sexual inappropriateness)
8. Apathy or lack of spontaneity

D. The symptoms in criteria B and C have their onset following head trauma or else represent a substantial worsening of preexisting symptoms.

E. The disturbance causes significant impairment in social or occupational functioning and represents a significant decline from a previous level of functioning. In school-aged children, the impairment may be manifested by a significant worsening in school or academic performance dating from the trauma.

F. The symptoms do not meet criteria for dementia due to head trauma and are not better accounted for by another mental disorder (eg, amnesic disorder due to head trauma, personality change due to head trauma).

Course of the Disorder

The severity and duration of symptoms correlates with loss of consciousness and the duration of loss of consciousness, as well as with post traumatic amnesia (not remembering the period prior to the head trauma). Rapid improvement of head injury typically occurs within the first 6 months and often continues for 18 months. Problems continuing after 18 months usually continue indefinitely.

Headache, dizziness, memory impairment, and fatigue are present in 30-50% of people during the first month after a mild head injury. In a prospective study of mild CHI conducted in Belfast, these symptoms disappeared within 6 months in 52% of cases and persisted in 16%. Of survivors, 32% reported a worsening of symptoms between 6 weeks and 6 months.

Morbidity from closed head injury is variable and difficult to predict. Most estimates of morbidity stratify populations into those with mild, moderate, or severe injury, based on their scores on the Glasgow Coma Scale (GCS) and the duration of posttraumatic amnesia (PTA). By definition, mild injury entails less than 15 minutes of unconsciousness (GCS >13) or less than 1 hour of PTA in the absence of skull fracture. Even those with mild injury may have serious persisting symptoms while some with moderate to severe injuries may recover.

[1] DSM IV TR

[2] Anthony Gamboa, Jr., Ph.D. and David S. Gibson, MBA, CPA [2006 New Work Life Expectancy Tables](#) in [Vocational Econometrics Incorporated](#)

[3] [Bey T](#), [Ostick B](#). Second Impact Syndrome West J Emerg Med. 2009 Feb;10(1):6-10.

[4] Govindaraju V, Gauger GE, Manley GT, Ebel A, Meeker M, Maudsley AA. Volumetric proton spectroscopic imaging of mild traumatic brain injury. AJNR Am J Neuroradiol. May 2004;25(5):730-7

[5] Gaetz M. The neurophysiology of brain injury. Clin Neurophysiol. Jan 2004;115(1):4-18.