



# Traumatic Brain Injury

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## ABSTRACT

Nurse practitioners have a major role to play in the detection and diagnosis of traumatic brain injury (TBI), which can be challenging if symptoms appear after the injury but go unrecognized. TBI should be considered when the patient reports a possible brain injury or experiences driving, sports, assault, falls, injuries, and combat. Recognizing the broad spectrum of symptoms will help NPs remain alert to the possibility of a TBI. Because symptoms are diverse and patients may not realize that the brain was injured, clinicians need a high index of suspicion. Early identification can improve treatment effectiveness, rehabilitation, and prognosis.

**Keywords:** brain injury, neurological

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Traumatic brain injury (TBI) is an expanding public health epidemic, and 75% of cases are mild.<sup>1</sup> TBI is poorly recognized by patients and primary care clinicians. It has high impact in epidemiological and economic terms as well as loss in quality of life, particularly in physical dimensions.<sup>2,3</sup> Over 7 million brain injuries occur yearly in the United States, with a death rate of 22–25/100,000.<sup>4</sup> Approximately 52,000 adults die, 275,000 are hospitalized, and 1.365 million—nearly 80% of diagnosed cases—are treated and released from an emergency department; the number who are not seen or treated is unknown.<sup>4</sup>

Approximately 10%–20% of patients with mild TBI continue with psychosocial problems, mostly mood disorders. Those with mild TBI have higher rates of depression and poor global outcome than those with more severe disease.<sup>1</sup> Depression is a risk factor for poor recovery.<sup>1,4</sup> Risk of TBI is highest for men age 14–24. Among the military branches, TBI affects 231/100,000 men and 150/100,000 women age 18–24.<sup>4</sup> TBI is a contributing factor to a third (30.5%) of all US injury-related deaths.<sup>2</sup> About 75% of TBIs that occur each year are concussions or other mild forms.<sup>5</sup>

TBI occurs when an external force impacts the brain, alters consciousness, impairs cognitive abilities or physical functioning, and requires costly treatment. More than 5.3 million Americans live with cognitive, physical, and behavioral disabilities related to TBI resulting from sports impact, bombs, blasts, childhood injury, or falls. Direct hospital and medical costs equaled \$4.5 billion and indirect costs were \$37.5 billion.<sup>5</sup> People with TBI and their families report that this condition is poorly recognized by primary care health professionals. The risk of TBI can be reduced by preventive measures (eg, seat belts, air bags, car design, safety helmets, and drunk driving prohibitions).<sup>4,6–8</sup>

Mild TBI is often misdiagnosed because symptoms may be missed, sedatives may temporarily mask mild or moderate TBI, and evidence-based correlates of these clinical manifestations are lacking. Damage may range from mild with a temporary concussion, headache, and dizziness to moderate, severe, or potentially fatal. In 1 study, 35% of 1853 people reported experiencing at least 1 TBI and said they were not treated but experienced symptoms 3 months after the injury.<sup>7</sup> The impact can alter consciousness (eg, amnesia, confusion, or loss of

consciousness), fracture the skull, or damage the brain. Fifteen percent of people with mild TBI have symptoms that last a year or more. Education helps patients and family understand and cope with the consequences and symptoms. The Veterans Administration and Department of Defense have guidelines for managing mild TBI.

This article focuses on the mild TBI that may often be present in primary care clinics and recognition of its symptoms. To update your knowledge about this disorder, this article focuses on the pathophysiology, symptoms, and assessment.<sup>9</sup> Several nurse practitioner (NP) specialties may come in contact with TBI, including clinicians with FNP, ANP, ACNP, PMHP, and WHNP (during wellness exams for women) designations. TBI is diverse in presenting symptoms; therefore, the range of sensory, motor, and other losses are described. Along with multidisciplinary colleagues, the NP plays an important role in case finding, assessment, management, and education.

### CASE ILLUSTRATION

History: RM is a 52-year-old professional woman presenting to the primary care clinic with her sister and a friend. She reports recent insomnia, headache, and poor concentration. She sleeps 4–5 hours a night and reports difficulty concentrating. Recently while driving, she hit another car. She was not injured, but she left the scene of the accident without checking the other driver, saying it was just a small fender bump. Her sister and friend report that RM has been uncharacteristically angry, forgetful, and very short-tempered recently, and leaving the scene of the accident was atypical and resulted in pending legal issues. Her sister says RM is usually an outgoing, organized person who is cheerful and responsible.

Based on the history and negative mental status and physical findings, the NP treated the headache and ruled out a possible stroke, transient ischemic attack, mood disorder, and possible dementia but did not think about a TBI because RM denied any injuries, bumps, or bruises from the accident. RM's risk of TBI was not evaluated or considered in a differential diagnosis.

**When violence causes TBI, the individual has more symptoms, poorer reintegration, and greater disability.**

### PATHOPHYSIOLOGY

TBI pathophysiology is not completely clear.<sup>10</sup> TBI may result from a closed head injury or a penetrating wound. Open injuries occur when a fracture, bullet, or sharp object penetrates the scalp, skull, meninges, and brain tissue.

Closed head injury (eg, pressure from a bomb blast or a football pile-up) occurs with acceleration and deceleration of the brain that may potentially involve a skull fracture.<sup>11</sup> The head injury may cause microscopic or gross structural changes ranging from minor to major. Intracranial damage can be focal, such as epidural and subdural hematomas, parenchymal contusions, or diffuse edema. Minor trauma may have no structural changes. Secondary damage results from complications (eg, infection, hemorrhage, hydrocephalus, edema, respiratory failure, and hypotension).

The outcome of a head injury depends on the brain's preinjury status, the total immediate damage from the impact, and the cumulative effects of secondary pathological damage to the injured brain.<sup>11</sup> Signs and symptoms of TBI vary, depending on the location and severity of the insult. Blood vessels and axons can be sheared or torn, causing leaks and creating bruising, hemorrhage, or hematomas. Often, however, one third of patients see no evidence of injury or bleeding and conclude that the symptoms were not bothersome and that the injury was not serious.<sup>7</sup>

### EPIDEMIOLOGY

Because of inconsistent definitions, classifications, and measurements, the epidemiology of TBI is difficult to describe accurately. An annual estimate for TBI among children 14 and younger is 511,257, while TBI in adults 65 and older is 237,844. While these are high risk groups, NPs who treat other age groups can expect TBI in them as well. The incident rate for ages 15–25 is 31.7%, ages 26–35 is 22.5%, ages 36–45 is 19.5%.<sup>5</sup> TBI-related emergency department visits accounted for a larger proportion in children (92.7%) compared to the same visits among older adults (59.7%). An estimated average annual number of 998,176 TBIs among males is higher than the 693,329 among females.<sup>2,4,5</sup> Children and elders are at highest risk for falls.

Motor vehicle accidents (MVAs) are the second largest cause of TBI for all age groups. Percentage of diagnosed TBI from an MVA who were men (59%) exceeded the percentage of women. Children younger than 4 accounted for about 18% of all TBI-related emergency visits, and adults over 74 accounted for 22% of TBI-related hospitalizations.<sup>2</sup> Overall, approximately 1.4 times as many TBIs occurred among males as among females.<sup>5</sup> Falls and MVAs (eg, car and motorcycle) most commonly cause severe TBI. Other causes include assaults and industrial accidents. When violence causes TBI, the individual has more symptoms, poorer reintegration, and greater disability.

## SIGNS AND SYMPTOMS

TBI has no set pattern of symptoms because deficits reflect the area of the brain injured and the degree of injury. The severity of symptoms is defined by the Glasgow Coma Scale (GCS) score, loss of consciousness, and posttraumatic anesthesia. Disorders of sensation, behavior, emotions, learning, memory, information processing, planning, organizing, and communication are common. TBI produces a host of behavioral changes, and specialized training in behavioral management is essential to resolve crises and calm aggressions.<sup>5,12</sup> Symptoms typically occur in the following major categories, so the advanced practice nurse needs to recognize these problems and patterns of symptoms.<sup>13</sup> Often, the individuals who see no evidence of bleeding or injury conclude that all is well. They fail to realize that the brain may have suffered in the injury and sustained a TBI with some of the following problems.

### Psychosocial Problems

While up to 20% of patients with mild TBI may have depression or mood disorders, other problems may include anger, poor concentration, swearing, yelling, physical violence, and sexually offensive behavior from decreased inhibitions. TBI increases the risk for depression, bipolar disorder, suicide, acute stress disorder, posttraumatic stress disorder, antisocial or aggressive behavior, and substance abuse.<sup>13</sup> Anxiety disorders and depression are common and often continue for a year after the trauma.

Other neuropsychiatric complications include impaired consciousness, posttraumatic amnesia, cognitive disorders, dementia, posttraumatic epilepsy, aphasia, mania, psychosis, anxiety disorders, personality changes, aggression, behavioral dyscontrol, fatigue/apathy, and increased risk of suicide.<sup>14</sup> These behavioral disorders may confuse and increase stress for families. Physical or verbal violence and sexually offensive behaviors are more challenging to manage but do respond to behavior modification. Severe behavioral disturbance and suicidal behavior benefits from referral to psychiatric mental health.

Cognitive difficulties may occur with learning, memory, information processing, organizing, intellectual processing, and communication. Reasoning, problem solving, judgment, attention, thinking, and multitasking may be altered.<sup>13</sup> These problems may disrupt the ability to organize thoughts and ideas. Cognitive rehabilitation programs are popular and can be tailored to specific behavior problems, such as memory or executive deficits.

**The family plays an essential role in rehabilitation and should be involved in all aspects of the therapeutic process.**

### Motor/Sensory Problems

Sensory deficits are common after brain damage. Disruptions may include impaired smell, vision, hearing, equilibrium, taste, and somatosensory perception that emerge from trauma to the sensory organs.<sup>15</sup> People may have limb numbness and visual deficits in which bright lights

and noise are often painful. Hearing loss and tinnitus is common after a bomb blast. Those with visual field loss can learn to compensate by increased scanning. For example, a man with TBI lost his peripheral vision and would easily walk into a post on the impaired side. He learned to scan the environment for dangerous objects and avoid them. Visual sensory deficits may include blind spots or blurred vision and difficulty recognizing objects. Visual problems, such as myopia, can be reduced through treatment or lenses. If they become deaf, people can learn sign language or can work with a speech and language therapist to learn alternative communication strategies. If the brain trauma has paralyzed a limb, sensory loss may occur.

## ASSESSMENT

The clinician collects data to evaluate the degree of impairment in physical, cognitive, behavioral, and psychosocial

**Table 1. Common and Associated Symptoms of Mild and Moderate TBI**

Level of TBI	Common Symptoms	Associated Symptoms
<b>Mild:</b> The person looks normal and symptoms are easy to miss.	Fatigue Headaches Visual disturbances Memory loss Poor attention/concentration Sleep disturbances Dizziness/loss of balance Irritability/emotional disturbances Feelings of depression Seizures	Nausea Loss of smell Sensitivity to light and sound Mood changes Getting lost or confused Slowness in thinking
<b>Moderate:</b> The list of mild symptoms grows to include the following possibilities to the right.	Persistent headache Repeated vomiting or nausea Convulsions or seizures Inability to awaken from sleep Dilation of 1 or both pupils Slurred speech Weakness or numbness in the extremities Loss of coordination Profound confusion Agitation, combativeness	

TBI = traumatic brain injury.

functioning. An important initial history question is whether the patient has suffered any trauma, such as blow to the head from a fall, accident, or explosion that may have preceded the onset of symptoms (Table 1). Although amnesia may occur after injury, people are likely to report the associated somatic (eg, headache, dizziness, balance impairment) and neuropsychiatric symptoms (eg, irritability, memory loss) after the injury.<sup>16</sup> Routine assessment of the patient's clinical condition is an essential in the management of a TBI outpatient. This assessment should include:

- Acute medical or psychiatric symptoms, such as the emergence of migraine headaches, emotional outbursts or worsening depression
- Pain level and intensity and the quality/quantity of sleep
- Medication compliance and assessment of any adverse reactions
- Mental status and neurological evaluation
- Physical therapy and occupational therapy exam

Information to collect about history and physical exam is outlined in Table 2.

Testing may include neuropsychiatric testing or brain imaging and is typically a multidisciplinary activity<sup>16</sup> because no one discipline can typically answer all of the issues that emerge during rehabilitation. Tests may include a GCS, imaging studies (magnetic resonance imaging [MRI] and

computerized tomography [CT] scans), and monitoring of intracranial pressure, as well as neuropsychological tests. Crisis intervention skills are useful in evaluating TBI.<sup>17</sup>

### DIFFERENTIAL DIAGNOSIS

Diagnosis reflects a detailed neurological exam to evaluate brain injury and brain imaging with various tests (eg, computerized axial tomography, MRI, single-photon emission CT, and positron emission tomography). Neuropsychological testing may clarify cognitive functioning. Physical, occupational, and speech therapists evaluate the specific sensory motor and behavioral deficits and strengths.<sup>8</sup>

### TREATMENT

Recovery of mild TBI happens quickly over the 18–36 months after injury, with 80%–85% of recovery occurring in the first 6 months. During the acute treatment, diuretics reduce swelling or fluid overload, and antiepileptics help reduce seizures. Most people with mild TBI recover rapidly and return to functioning in about 3 months.<sup>18</sup> People with a prior head injury are at risk for symptoms that last longer than a few weeks. About 20% of individuals who have mild TBI will continue to experience problems and require ongoing medical care. When this occurs, the disorder is called postconcussion syndrome.

**Table 2. History and Physical Exam**

Topic	Data to Collect	Exam
Headaches	Precipitants, quality, frequency,	Abnormal gait/cerebellar
Balance problems	severity, location, duration, type	
Fatigue		
Sleep disturbance		
Dizziness/vertigo		
Ambulation		
Pain		
Malaise		
Bowel problems		
Bladder problems		
<b>Sensory</b>		Screen, refer for evaluation
Hearing/tinnitus		Screen, If verified on exam or
Vision problems; hypersensitivity to		claimed, refer for eye exam
noise, light		Screen
Taste/smell		Reflexes, strength, nerves, functional
Seizures		impairment; muscle tone, atrophy,
Motor/mobility problems; numbness		strength, spasticity, or rigidity
Weakness/paralysis	Location	Muscle strength
Speech/swallowing	Frequency, precipitants, quality,	How often is able to be understood
	duration	
Sexual dysfunction	Onset, duration, problem of desire,	
	performance, satisfaction	
Behavioral disturbance	Type, frequency, precipitants, quality,	Conduct screening (PTSD, etc). Mini
Psychiatric problems	duration, triggers	Mental Exam: if problems in memory,
Cognitive disturbance		learning, concentration, or attention,
Memory loss		request neurocognitive testing or
		neuropsychiatric evaluation
Dental/oral	Problems, missing or cracked teeth,	Refer for dental exam
	TMJ; misaligned jaw	
Endocrine dysfunction related to TBI	Precipitants, quality, frequency,	Refer
	severity, location, duration, type	
Autonomic nervous system		Orthostatic hypotension,
		hyperhidrosis—consider or refer for
		autonomic nervous system evaluation

PTSD = Post-Traumatic Stress Disorder; TMJ = Temporomandibular Joint Disorder; TBI = traumatic brain injury.

The NP's treatment of mild TBI includes education, rest, observation, and treatment of persistent or bothersome symptoms. Treatment for continued headache and sleep disruption includes nonsteroidal anti-inflammatory drugs (NSAIDs), tryptans, and Midrin. If the headache accompanies dysregulation, valproate is useful. Selective serotonin reuptake inhibitors may be useful for depression and irritability after brain injury. Patients often complain of fatigue, irritability, and labile mood. They are discouraged and require education to understand the time required for the brain to recover. They tend to associate emotional symptoms with the idea that they are

going crazy and do not realize that these symptoms are typically related to the brain injury. NPs can teach approaches to stop unwanted thoughts by using cognitive behavioral interventions and reducing negative thoughts. Stress reduction and relaxation strategies help reduce insomnia and hyperalertness.

### DEPRESSION

Major depression is a costly but treatable mood disorder characterized by sad mood or loss of interest or pleasure, with a total of 5 symptoms over 2 weeks (eg, fatigue, significant weight loss, insomnia, diminished concentration,

thoughts of death or suicide). It is not a short-term emotional upset or a few days of sadness. A diagnosis of major depression requires all the criteria listed above; milder versions include dysthymia with fewer symptoms for a longer period. The Diagnostic and Statistical Manual (DSM) diagnostic criteria for depressive disorders identify some of the mood symptoms.<sup>19</sup> A depressive episode may also be the result of another medical condition, such as TBI.

Depression intensifies suffering, morbidity, and suicidal thoughts, but the diagnosis is often missed or undertreated.

Depression includes weeks and months of costly and needless emotional suffering. It increases costs of treating other disorders, triggers short-term disability, and impairs work performance. Untreated depressive disorders increase costly clinic visits, hospitalizations, substance abuse, risky behaviors, and reduce adherence to treatment and quality of life. Treatments for major depression are effective and beneficial.

## REHABILITATION

Rehabilitation of TBI requires an early and well-coordinated multidisciplinary approach.<sup>20</sup> Evidence-based interventions were suggested for four areas: neuropsychological rehabilitation of attentional disorders, neuropsychological rehabilitation of neglect disorders, neuropsychological rehabilitation of dysexecutive disorders, and rehabilitation trainings for patients with mild TBI.<sup>21</sup> Treatment focuses on coma management and control of behaviors that could lead to harmful outcomes (eg, agitation, angry outbursts, and impulsivity).<sup>22</sup>

Cognitive restructuring has long been the cornerstone of specialized TBI inpatient rehabilitation programs.<sup>23</sup> Both individual and group therapy, structured milieu, and recreational and occupational therapy are useful, although ongoing and costly. Outpatient interventions assist the development of personal awareness, cognitive function, social skills, and vocational readiness. Wii videogames are gaining popularity as useful adjuncts in physical rehabilitation. In outpatient settings, the clinician plays a considerable role conducting a clinical assessment and providing rehabilitative and emotional support. Rehabilitation may include measures of quality of life and functional disability. Rehabilitation also includes education, coaching, and emotional support.

## EDUCATION AND COACHING

In rehabilitation, the nurse functions as both educator and coach for the patient and family. In addition to a dis-

cussion of TBI and expected course of recovery, the nurse will also guide the development of a consistent daily schedule with healthy meals and cognitive and physical exercises.<sup>21,24</sup> Patients may need help with establishing a weekly schedule (eg, menus, shopping lists, and appointments). Memory aids, such as sticky notes, an expanded calendar, and alarms, may be useful. Education in relaxation techniques, such as progressive relaxation, deep breathing, or meditation, may reduce stress and increase calm. The nurse may identify distractions, encourage coping strategies, and teach the concept of focusing on 1 component of a task at a time.

Patients may need assistance to develop realistic short- and long-term goals and begin participation in new activities, particularly those involving socialization. When the patient becomes agitated easily, he or she needs help to identify triggers that lead to emotional outbursts or social withdrawal and identify positive coping strategies.

People with prior histories of poor coping or emotional regulation may experience more symptoms than those with robust coping or self-management skills. Alternatively, the individual may be resilient and have developed strengths in focusing, confronting issues, and adapting to challenges. Emotional support is critical to the recovery of the TBI patient and their family. Typically, a third of patients with TBI report mild aggression, and another third report moderate aggression.<sup>23,25</sup> These patients need strategies to manage affect and aggression and to help the family understand affect regulation. The family plays an essential role in the patient's rehabilitation and therefore should be involved in all aspects of the therapeutic process.

The nurse in this phase of treatment should:

- Support and praise for all successes (eg, maintaining schedule, using positive coping strategies, attempting new experiences)
- Support expressions of grief
- Provide information about community support groups
- Assist the family in identifying its strengths and positive coping strategies
- Reinforce positive coping techniques
- Encourage family discussions on how best to support the patient and how to cope with aggression and emotional reactions
- Explore with patient and family the ways in which TBI has changed their lives
- Encourage verbalization of thoughts and feelings

**Table 3. Traumatic Brain Injury Prevention**

Prevention	Methods
<b>Vehicle safety</b>	Always wear a seatbelt in a motor vehicle Use an appropriate child safety seat or a booster Never drive under the influence of alcohol or drugs Always wear a helmet when on a bicycle, motorcycle, scooter, snowmobile, and other open, unrestrained vehicles Wear a helmet when participating in contact sports Wear a helmet when horseback riding Wear a helmet with skis, snowboards, skates, and skateboards
<b>Fall prevention</b>	Use the rails on stairways Provide adequate lighting, especially on stairs for people with poor vision or who have difficulty walking Place bars on windows to prevent children from falling Sit on safe stools Do not place obstacles in walking pathways
<b>Firearm safety</b>	Keep guns locked in a cabinet Store guns unloaded Store ammunition apart from guns

### COGNITIVE BEHAVIORAL THERAPY

As a coach, the psychiatric NP may use cognitive behavioral therapy, including individual, group, and family therapy, which is particularly useful for treating depression. One study evaluated the impact of cognitive behavioral therapy (CBT) on acquired brain injury and found that CBT treatment significantly improved symptoms, depression, and anxiety. Compared with controls, treatment was effective both in groups and telephone counseling.<sup>22,23</sup> Cognitive therapy—an effective, directive, time-limited approach to helping change irrational thoughts, assumptions, and beliefs—and antidepressants have been effective.<sup>23</sup>

CBT teaches about automatic negative thoughts and attitudes about oneself, the world, and the future in determining mood. NPs can teach patients to identify and change their negative thinking patterns and automatic thoughts. Treatment includes amending negative and automatic thoughts, emphasizing small steps of mastery, and acknowledging pleasant activities. Activities include the person's potential for mobility, hearing, or visual limits. Recommendations for prevention are also important to prevent reinjury (Table 3).<sup>26</sup>

### CONCLUSION

Although 75% of TBI cases are mild, they cause major physical and emotional disruption. TBI has high impact in economic terms, as well as loss in quality of life. About 20% of individuals with mild TBI will continue to experience

problems and require ongoing medical care. The diagnosis of TBI is often missed by primary care clinicians who do not realize that emotional symptoms, depression, and physical symptoms may stem from the head injury. The NP has a major role to play in detecting TBI and its associated depression and emotional symptoms. Management may include therapy, medications for depression, and treatment for a host of other symptoms, depending on the brain area impacted. Patients may need help with coping and self-management strategies as well as symptom management, education, coaching, and referrals. **JNP**

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