

THE PREVALENCE OF SLEEP DISORDERS IN PATIENTS DIAGNOSED WITH TRAUMATIC BRAIN INJURY

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Traumatic Brain Injury (TBI) is clinically defined as an alteration in brain function, or other evidence of brain pathology caused by an external force. TBI may result from motor vehicle accidents, falling objects, assault, bomb blasts, etc. TBI is a leading cause of death and can cause lifelong disabilities in survivors. According to the Centers for Disease Control, 1.6 to 3.2 million TBIs are reported in the United States (Singh, 2016). Following the initial injury, patients may complain of headaches, nausea or vomiting, memory loss, mood changes, and difficulty with attention or concentration.

Sleep disorders are commonly associated with TBI and can cause additional difficulty in recovery and rehabilitation. Such sleep disorders include insomnia, excessive daytime sleepiness, fatigue, parasomnias and apneas. Some studies suggest that up to 70% of patients with TBI experience some type of sleep disturbance (Grima, 2016). Compared to the general population, there is a higher prevalence of sleep disorders in patients who have suffered from a TBI.

In addition to sleep disorders, TBI patients may also suffer from mood disorders, anxiety and depression. Cognitive function is almost always impaired in patients with TBI, which may cause difficulty concentrating, paying attention, memory loss, or decreased alertness (Lucke-Wold, 2015).

According to Baumann (2012), TBIs are mostly caused by falls (28 percent), motor vehicle accidents (20 percent), impact from an object (19 percent) and assaults (11 percent). TBI can be classed as primary or secondary. Primary damage includes contusions and hematomas. Baumann states that Primary damage relates to external forces, as consequences of rapid acceleration or deceleration, direct impact, penetrating objects, or blast waves. Primary damages include shearing injuries of white-matter tracts leading to diffuse axonal injury, focal contusions, hematomas, and edema. (Baumann, 2012) Secondary damage occurs on a cellular level and effects gene activation and inflammatory response.

TBI is often classified as mild, moderate or severe. According to Wickwire, in patients with mild TBI, standard acute structural imaging studies such as head computed tomography scans do not show hemorrhage or other overt structural abnormalities (Wickwire, 2016). Collision forces that cause TBI can result in focal injury or diffuse injury. "Focal injuries may include contact contusions, subdural, epidurals, and/or intraparenchymal hemorrhages...Diffuse injuries are often caused by acceleration-deceleration forces that can cause shearing forces or wide-spread axonal injury in the brain." (Saltzman, 2016). It is suggested that the location of the traumatic injury may lead to certain sleep symptoms. For example, "Hypersomnia can result when areas involving the maintenance of wakefulness are injured. These regions include the rostral pons, caudal midbrain and thalamus" (Saltzman, 2016). Sleepiness and sleep attacks have also been linked to upper cervical cord lesions, which may possibly cause a disruption of breathing when asleep.

Saltzman (2016) found that head trauma patients with hypersomnia, and sleep-disordered breathing was found in all whiplash patients and thought to have occurred post injury. Unfortunately, TBI can cause vasospasm, which limits the blood supply going to the brain and can eventually lead to neural cell death. According to Baumann, etiology and pathophysiology of disrupted sleep and wakefulness following TBI are mostly unknown, but likely multifactorial. Baumann also mentions that it is unknown whether injury to specific brain regions might be responsible for the evolution of posttraumatic sleepiness. (Baumann, 2012).

DISRUPTIONS ASSOCIATED WITH TBI:

Disorders such as sleep apnea, hypersomnia, narcolepsy, and periodic limb movements of sleep have been associated with



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TBI. The most common sleep disruption following a TBI is insomnia (Lucke-Wold, 2015). Disrupted sleep is often associated with other symptoms, such as depression and anxiety. Mood and behaviors may include irritability, anxiety and even psychosis. Cognitive impairment is associated in almost all TBI patients, including decreased attention, concentration, and memory loss. “Evidence indicates that cognitive deficits following TBI may be influenced by the severity of TBI, as they related to the degree of axonal injury, the presence and duration of loss of consciousness, post traumatic amnesia and the degree of brain stem injury” (Lucke-Wold, 2015). Sleep disturbances following TBI include frequent night time awakenings, higher percentage of stage N1 and stage N2 sleep, decreased percentage of rapid eye movement (REM) sleep, and an overall lower sleep efficiency when compared to matched controls. (Lucke-Wold, 2015).

TBI has also been associated with parasomnias such as sleepwalking, sleep terrors, and REM behavior sleep disorder. Patients may develop mood disorders and post-traumatic stress disorder. One study showed that depression post-injury is especially prominent in female patients, and in those who are younger and who have a history of prior mental health treatment, substance abuse or self-inflicted injury. (Lucke-Wold, 2015). According to Saltzman, new onset anxiety after TBI is a significant predictor of sleep disturbance (Saltzman, 2016).

A meta-analysis was conducted to determine how sleep disorders affected patients with TBI (N=637) compared with a healthy control population (N=567). Polysomnography results showed TBI patients had a decreased sleep efficiency, shorter total sleep time, and increased wake after sleep onset time. The study also showed that TBI patients spend less time in REM sleep and reported increased sleepiness and poorer perceived sleep quality. Mild to moderate/severe TBI patients both displayed reductions in total sleep time, sleep efficiency and increases in wake after sleep onset (Grima, 2016).

Excessive sleepiness or hypersomnolence in adults has also been investigated. It is suggested that hypersomnolence in patients with post traumatic hypersomnia appears to be related to the severity of the brain trauma and the length of time since it had occurred. (Masel, 2001).

Another study was conducted to determine the prevalence and consequences of sleep disorders in patients with a TBI. The

study was designed using 87 adult TBI patients three months’ post injury. The researchers use various tests such as nocturnal polysomnography, multiple sleep latency testing (MSLT), psychomotor vigilance, profile of mood states, and functional outcome of sleep questionnaire (FSCQ), non-psychological evaluation and self-report measures. The study found that 47 percent of the participants had a sleep disorder, 23 percent had obstructive sleep apnea, 11 percent PTH, 6 percent narcolepsy, and 7 percent periodic limb movements. Twenty-six percent were found to have excessive sleepiness. The authors concluded that there is a high prevalence of sleep disorders in patients with TBI and these patients should undergo complete and thorough sleep evaluations (Castriotto R. A., 2009). According to Lucke-Wold, in the long term, sleep disruption and fragmentation can have negative consequences on recovery and can increase the progression of brain trauma from the injury (Lucke-Wold, 2015).

TREATMENT:

Treatment for sleep disorders associated with TBI includes medications such as Zolpidem and Provigil. Behavioral therapies such as cognitive behavioral therapy (CBT) and meditation are also recommended. Continuous positive airway pressure (CPAP), may benefit patients with obstructive sleep apnea. Some patients may require counseling to cope with depression. Other treatments such as SSRI, pain management, stimulant medications, Melatonin, bright light therapy, and sleep hygiene

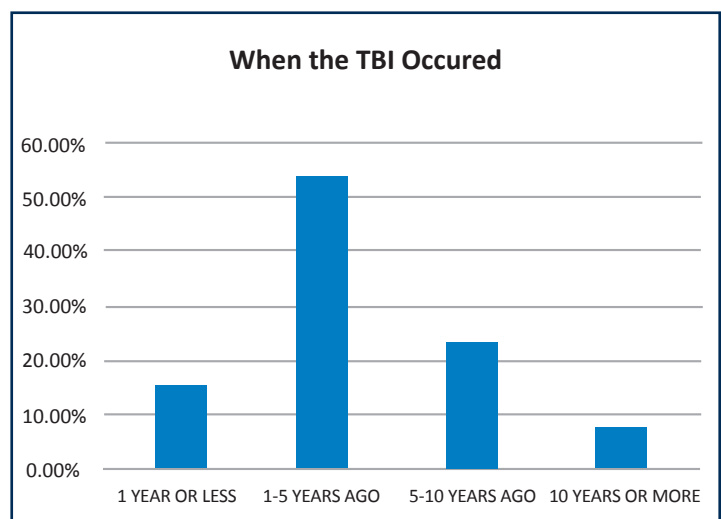


Figure 1. When the TBI Occurred

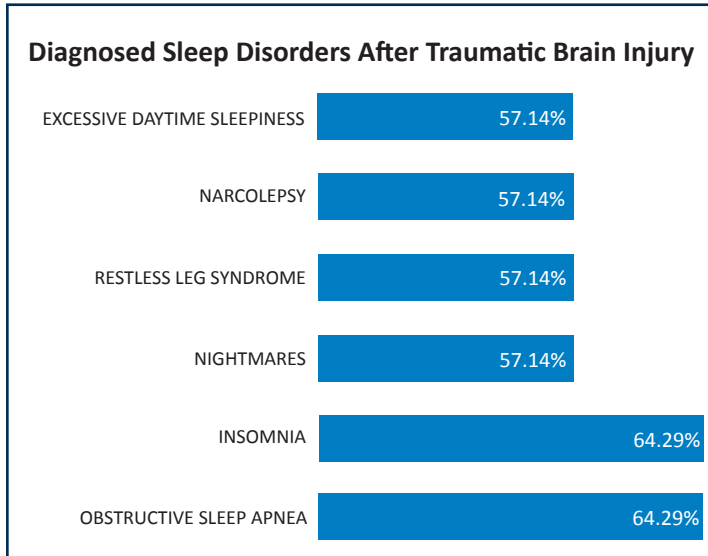


Figure 2. Diagnosed Sleep Disorders After Traumatic Brain Injury

education may also be considered. According to one study, some sleep difficulties may resolve spontaneously over time, but this study highlights that for over half of their sample, their sleep quality remained the same or deteriorated when assessed at 6 and 12 months (Theadom, 2015). These findings suggested that there is a need for treatments that can prevent sleep disturbances from becoming chronic if possible. TBI patients could also be assessed by using sleep diaries, self-report questionnaires, actigraphy and polysomnography.

DESCRIPTION OF THIS STUDY

METHODS:

A survey was designed to determine what percentage of a sample of patients had been evaluated for sleep disorders and if so, what type of disorders were diagnosed. Participants who had not been evaluated for sleep disorders after TBI were asked a series of questions to measure sleep quality and to determine the prevalence of patients in this population who are underdiagnosed for sleep disorders.

RESULTS:

Of the 21 participants 46.67 percent were diagnosed with TBI. 53.85 percent of these participants suffered the TBI within 1-5 years (Figure 1).

Of these patients 33.33 percent had been evaluated for a sleep disorder. 64.29 percent of those evaluated were diagnosed with Obstructive Sleep Apnea, 64.29 percent with Insomnia, and 57.14 percent with Nightmares, Restless Legs Syndrome, Narcolepsy and Excessive Daytime Sleepiness respectively (Figure 2).

These participants were asked a series of follow up questions to assess their sleep quality. They essentially were given the Pittsburgh Sleep Quality Index (PSQI) sleep quality assessment. Only one of the 14 participants in this group had a final score of less than 5 (Figure 3).

PSQI RESULTS:

Of these participants, 50 percent took 16-30 minutes to fall asleep, 28.57 percent had trouble sleeping because they could not get to sleep within 30 minutes, 28.57 percent complained of waking up in the middle of the night or early morning, 42.86 percent had trouble breathing at least once a week, 42.86 percent had trouble sleeping because of snoring loudly once or twice a



Figure 3. Diagnosed Sleep Disorders After Traumatic Brain Injury

week, 42.86 percent had difficulty sleeping because of nightmares at least once or twice a week, and 38.46 percent had difficulty sleeping once or twice a week because of pain. In addition, 35.71 percent took sleep medications at least once or twice a week because of difficulty sleeping, 21.43 percent had trouble staying awake while driving, eating meals, or engaging in social activity. 21.43 percent documented having problems having enthusiasm to get things done and 21.43 percent rated their overall sleep quality as very bad.

DISCUSSION:

Although the sample size was small, 66.67 percent of the participants who had TBI had not been evaluated for sleep disorders, and of these participants with TBI, all but one had a PSQI score greater than 5; indicating poor sleep quality. This raises the question of under diagnosis in this population.

The relationship between sleep and TBI is still poorly understood and requires further investigation and research. This research should include determining pathophysiology, disorder management, appropriate patient assessments and treatment. The study conducted in this research paper, used a very small sampling size. Despite this, there was an indication that patients who have suffered a TBI are not thoroughly evaluated for sleep disorders and are underdiagnosed for sleep disturbances.

CONCLUSION:

TBI is a leading cause of death and can cause lifelong disabilities in survivors. Sleep disorders are commonly associated with TBI. These sleep disorders may include insomnia, excessive daytime sleepiness, fatigue, parasomnias and sleep apnea. In addition to sleep disorders, TBI patients may also suffer from mood disorders, anxiety and depression. Compared to the general population there is a higher prevalence of sleep disorders in patients who have suffered from a TBI. Treatment for sleep disorders associated with TBI include medications such as Zolpidem and Provigil. Behavioral therapies include cognitive behavioral therapy and meditation. Extensive sleep evaluations after TBI may help with underdiagnosed for sleep disorders, behavioral disorders, and cognitive decline.

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