EFFECTIVE TREATMENT MODALITIES FOR MILD TO MODERATE TRAUMATIC BRAIN INJURY AND ITS SEQUELAE:
A REVIEW OF LITERATURE

By

YANA BOJILOVA-NORMAN

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Mel Haleman  
Chair

Lorna Schuman
EFFECTIVE TREATMENT MODALITIES FOR MILD TO MODERATE TRAUMATIC
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Abstract

Yana Bojilova-Norman
WASHINGTON STATE UNIVERSITY
College of Nursing
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Chair: Mel Haberman

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Background: Traumatic Brain Injury (TBI) is one of the leading causes of death and disability worldwide. Each year eight million Americans suffer a traumatic brain injury and 10% of them become permanently disabled. Many patients experience temporary physical, cognitive and psychiatric complaints.

Purpose: The purpose of this paper is to examine the literature regarding effective treatment modalities for mild to moderate TBI and post-concussive syndrome. Incorporated into the paper is a discussion of the pathophysiologic mechanisms of injury, how injuries are classified and their clinical presentation, cross-cultural findings, as well as pharmacologic and non-pharmacologic management of mild to moderate TBI.
Data Sources: The review was conducted using three databases: “Up to Date,” CINAHL and ProQuest. The search words included “Traumatic Brain Injury treatment” and “Post-concussion syndrome.” Articles were chosen based on their inclusion of the words “management,” “treatment” and “traumatic brain injury.”

Conclusions: Effective treatment for traumatic brain injury and post concussive-syndrome includes both pharmacological and non-pharmacological therapies, used to achieve maximum function, recovery and reduction in symptoms, as reported by objective and subjective measures. Studies have shown that prophylactic medications are not helpful in reducing potential outcomes or speed up recovery. Some studies suggest that pharmacologic treatment should be reserved for the acute post-TBI period and should continue no longer than six months. Studies showed that children have been shown to benefit from educational interventions and cognitive behavioral therapy in the recovery from TBI.

Implications for Practice: To guide nursing practice, the Health Belief Model can be used to evaluate patients’ perceptions about the severity of their illness and benefit in seeking treatment after a mild to moderate TBI. Based on the findings of the studies identified, protocols should be developed to assess both adults and children for the presence of clinical manifestations associated with mild and moderate TBI in order to facilitate treatment. Psychological factors associated with both mild and moderate TBI should be assessed and treated with both pharmacologic and behavioral therapies.
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Problem Statement

Traumatic brain injury (TBI) is the leading cause of disability in people less than 40 years of age, disabling 150-200 people per million annually (citation). Each year more than eight million Americans experience a traumatic brain injury. More than half of them will develop symptoms of post-concussive syndrome (Frey, 2003). Post-concussive syndrome is defined as a complex of symptoms after a head injury that involves headaches, dizziness, neuropsychiatric and cognitive complaints (Evans et al., 2010). About 10% of those injured will have permanent disability (Frey, 2003). Many of those suffering from TBI present to local emergency rooms, where they are rapidly triaged and evaluated for severity of their clinical manifestations. The severity of TBI determines its treatment and course.

Those patients diagnosed with mild to moderate TBI often are evaluated and then discharged from the emergency department (ED), only to develop post-concussive syndrome along with other physical, cognitive, and psychiatric complaints later. Due to the complex and multi-variant nature of post-TBI complaints, there is a lack of a systematic evaluation and treatment for post-concussive syndrome. Pharmacologic and non-pharmacologic treatments are varied across healthcare settings, as well as across countries. The purpose of this paper is to examine effective treatment modalities for mild to moderate TBI and post-concussive syndrome. This assessment includes discussion of the pathophysiologic mechanisms of injury, how injuries are classified and their clinical presentation, cross-cultural findings, as well as pharmacologic and non-pharmacologic management of mild to moderate TBI.
Theoretical Framework

According to the Health Belief Model (HBM), people are moved to seek preventive action in health care by three key components: perceived susceptibility, perceived severity, and perceived benefits (Marriner & Raile, 2005). Inherent in seeking emergency care is a perceived threat of illness, such as a traumatic brain injury. Along a continuum, patients and nurses seek to lower this threat of illness by stabilizing initial physical ailments. The nurse practitioner’s role is to communicate and develop protocols that engage patients into the necessary follow-up and provide information about the expected outcomes of their injuries in the post-traumatic period. Nursing is in a unique position to not only evaluate and treat patients, but also provide education to influence the patient’s perception about their recovery, reduce barriers through reassurance, promote awareness, while providing assistance to the patient in the process of healing. According to Janz and Becker (1984), “It is important to remember that the HBM is a psychosocial model; as such it is limited to accounting for as much of the variance in individuals’ health-related behaviors as can be explained by their attitudes and beliefs” (p. 44). The HBM is based on the premise that people inherently value their health and believe in the positive effects of their actions on it. Given that these two conditions did not exist, this model would be ineffective in explaining or predicting behavior (Janz & Becker, 1984).

Literature Review

Methods

The review was conducted using three databases: “Up to Date,” CINAHL and ProQuest. The search words included “Traumatic Brain Injury treatment” and “Post-concussion syndrome.” Articles were chosen based on their inclusion of the words “management,” “treatment” and “traumatic brain injury.” Articles were excluded if their primary focus was on
severe TBI, as its course and treatment vary widely and are beyond the scope of this paper. The “Up to Date” database included extensive information in 91 articles referencing post-concussive syndrome. Only two articles were obtained in the final review from “Up to Date.” CINAHL yielded six articles but only two of them were used because they had a direct discussion of TBI, post-concussive syndrome and treatment strategies. Using ProQuest, 511 articles were obtained and 8 of them were used for this review for their content pertaining to TBI management. The resulting 12 research articles were categorized into six sections that provide background or pertain specifically to the purpose of the paper: pathophysiologic mechanisms of injury (one article), classification of injury (two articles), clinical presentation (two articles), cross-cultural findings (one article), pharmacologic management (six articles), and non-pharmacologic management (four articles).

Pathophysiologic Mechanisms of Injury

Traumatic brain injury is a process in which the head is subjected to violent contact or acceleration/deceleration forces (Kushner, 1998). The neuro-pathologic mechanisms involved include ionic shifts, neuronal depolarization, release of neurotransmitters, reduced cerebral blood flow and reduced axonal function due to shearing. Factors that may affect an individual’s injury severity and outcomes include the age at injury, the pre-morbid brain reserve, genetic vulnerability, history of previous concussions, existence of comorbid conditions and the type of post-injury management (Kirkwood, 2008).

Classification of Injury

The degree of injury is classified into categories based on whether loss of consciousness has occurred, duration of amnesia, and the scores on the Glasgow Coma Scale (GCS) (Evans et al., 2010). Based on these criteria, TBIs are classified as mild, moderate or severe. Mild TBI, as
defined by the American Congress of Rehabilitation Medicine, is either the absence of, or a loss of consciousness < 30 min, GCS score >13, and post-traumatic amnesia of less than 24 hours (Kushner, 1998). Moderate TBI is defined as a GCS score of 9-12 and may or may not be characterized by loss of consciousness and axonal injury. Severe TBI is defined as GCS < 8, presence of loss of consciousness is there a time frame for LOC? and the existence of neurological deficits (Evans et al., 2010).

Concussion has often been associated with mild TBI and the terms are used synonymously. Concussion, as defined by the American Academy of Neurology, is “trauma-induced alteration in mental status that may or may not involve loss of consciousness” (Evans et al., 2010, p. 2).

**Clinical Presentation**

As a consequence of mild to moderate TBI, patients may present with variety of symptoms. Some of the most common symptoms include headaches and dizziness, insomnia, emotional and cognitive dysfunction (cite). Post-concussive syndrome (PCS) most often follows mild TBI and is defined as a complex of these symptoms, which gradually improve over time, and is not necessarily associated with loss of consciousness (Evans et al., 2010). Children often complain of fatigue, sensitivity to light and noise, difficulty concentrating, trouble remembering and increased anxiety (cite). Academic achievement tests in children show that symptoms of mild TBI often resolve in 2-3 months (Kirkwood, 2008). Less common symptoms of mild TBI include seizures, tinnitus, loss of olfaction and taste, neck pain and stiffness (cite). Several treatment modalities have been proposed. Studies include pharmacological interventions, behavioral therapies and use of educational materials.

**Cross Cultural Findings**
Because of the wide gap in treatment of TBI across healthcare settings and countries, De Silva et al. (2009) conducted a study to examine whether there were differences in outcomes of TBI in low-income countries versus high-income countries at six months after the injury. This was a post hoc review of another large study, which included 8,927 patients from 239 hospitals in 48 countries. The larger study explored the different outcomes between these [two settings identify the two settings]. Injury severity was measured by GCS and pupil reactivity, in all countries. The findings revealed that patients from low-income countries had half the risk of being disabled from a mild TBI of those from high-income countries; however, those from low-income countries were twice as likely to die from severe TBI. When it came to mild TBI, patients in the low-income countries had much better [outcomes be specific] (De Silva et al., 2009). This study was very large (N= 8927) and though it did not explain why these differences exist, such as variability in medical care or socio-cultural factors, it may shed a light into disparities in mild TBI treatments (De Silva et al., 2009).

**Pharmacologic Management**

In an observational pilot study of 126 Iraq veterans, Ruff, Ruff and Wang (2009) found that patients with neuro-cognitive deficits due to TBI had a greater frequency of headaches and increased pain severity, lasting longer than six months. They performed a prospective non-randomized unblinded study in which they gave prazosin in an attempt to improve sleep and headache symptom control. The subjects were provided sleep counseling and prazosin at bedtime during a nine-week intervention period and follow-up was done at six months. This drug was chosen because it is an alpha-adrenergic blocking agent that has been shown to block nightmares associated with stress disorders. It is currently used by active duty military personnel. Previous placebo-controlled clinical trials have demonstrated that prazosin reduces nightmares.
and improves sleep in veterans with PTSD (cite). In the Ruff, Ruff and Wang (2009) study, the findings suggested that prazosin was effective for improving sleep and decreasing the severity of headaches. With a mild side-effect profile, prazosin appeared to effectively reduce daytime sleepiness, headache intensity and frequency, and increase cognitive performance in veterans with mild TBI histories (Ruff et al., 2009). This study has a few limitations (non-randomized, unblinded) and the fact that it represents veterans seeking care for TBI and PTSD and did not represent those without PTSD.

Zeitzer, Friedman and O’Hara (2009) reported the results of a literature review of the treatment for sleep disruption caused by TBI. The authors explained that mild TBI leads to axonal shearing injury and disruption in dopamine, serotonin and hypocretin-1, which have been found to be in low volumes in post-TBI cerebral spinal fluid samples and may be responsible for insomnia. One study (Baumann, Werth, Stocker, Ludwig & Bassetti, 2007) identified in the review showed abnormally low hypocretin-1 levels in cerebrospinal fluid in the acute post TBI stage and normal levels within six months. Single drug-therapy with zopiclone and lorazepam were found effective in the treatment of insomnia, but not melatonin or amitriptyline. Zeitzer et al. (2009) concluded that most medication therapy for insomnia should be used for the acute phase of the symptoms and no longer than six months, as few studies have been published to validate a continual single-drug use for longer periods of time.

Insomnia, along with depression and cognitive impairment, are the most common sequela of TBI (Silver, McAllister & Arciniegas 2009). Silver, McAllister and Arciniegas (2009) proposed instituting treatment when functionally significant neuropsychiatric symptoms (anxiety, personality changes, affective disorders, psychosis, sleep disorders, aggression and irritability) are present. Studies show that education, counseling and rehab interventions all speed
up recovery and lessen the persistence of symptoms (Silver et al., 2009). Pharmacotherapy reduces the effects of post-concussive syndrome, increases the patient’s functioning and quality of life and limits the likelihood that symptoms will become chronic. The suggested therapy includes the initiation of SSRI’s (sertraline or citalopram) with a “start low and go slow” approach (Silver et al., 2009).

Chew and Zafonte (2009) described a retrospective study done by Mysiw, Jackson and Corrigan which compared 17 patients that were treated with amitriptyline for agitation to those without agitation and found that twelve out of seventeen patients had a dramatic decrease in agitation within seven days of initiating amitriptyline. There was no noted effect on cognitive recovery (Mysiw, Jackson & Corrigan, 1988). A study by Wroblewski, McColgan, Smith, Whyte, and Singer cited by Chew and Zafonte, 2009, revealed an increase in the seizure rate with various tricyclic antidepressant use in TBI patients of 19 % (Chew & Zafonte, 2009).

Because seizures are a less common serious complication of TBI, a brief discussion on presence, severity and treatment is warranted. According to Frey (2003), the incidence of post-TBI seizures is 4-53%. An important distinction between early (within one week of injury) and late (> one week after injury) seizures should be made. Early seizures are associated with greater injury severity and are more common in children (Frey, 2003). Later seizures with an incidence of 14-53%, may occur several years after an injury and the greatest risk factor for their development is the presence of early seizures. They are extremely rare in individuals with mild TBI. Complex partial seizures are the most common type of seizure following TBI (McNamee & Walker, 2009). According to Frey (2003), people respond differently to head injuries and vary in their potential for seizure development. This variation is unlikely to be genetically based. The highest predisposing risk factors for seizure development after a TBI include hemorrhage,
younger age, higher injury severity, brain contusion, and age >65 (Frey, 2003). Valproate acid seems to be more effective or seizure treatment as it does not impair cognitive function or delay recovery after TBI, as do carbamazepine and phenytoin (Chew & Zafonte, 2009). Evans et al (2010) has reported that, pharmacologic prophylactic treatment for seizures has not been effective.

Non-Pharmacologic Management

Ponsford et al. (2001) evaluated the effectiveness of an educational intervention for pediatric TBI patients at one-week post injury and compared it to controls at three months post injury. A total of 61 children between the ages of six and fifteen with mild TBI were assessed at one week and three months after the injury; an additional 58 children in the same age group were assessed at three months after the injury only. Measures were collected of pre-injury behavior, psychological adjustment, post concussion symptoms, tests of attention, speed of information processing and memory. Children seen at one week were also given a pamphlet describing mild TBI symptoms and suggested coping strategies. Those seen at three months only were not given the pamphlet. The investigators' found that individuals who received the intervention (pamphlet) had less anxiety and ongoing cognitive problems. The authors state that although it is clear that simply providing information will not prevent all further problems, it can minimize the stress that children and parents experience, may optimize early management and decrease the attribution of pre-existing problems to the injury.

Children in the study by Ponsford et.al (2001) with pre-existing behavioral problems, such as psychiatric or neurologic problems or learning difficulties, family breakdown or premorbid stressors did worse over all. One potential problem with the conclusions of this study was that the educational pamphlet itself as the independent variable may not have been the only
contributor to better outcomes, as patients were also seen by the neuropsychologist at the time of the one-week appointment. Although researchers concluded that providing information will not prevent ongoing problems, they do point out that it may minimize stress, optimize early management and reduce the attribution of old problems to the new injury. Additional non-pharmacologic treatment for post-concussive syndrome’s cognitive effects recommended by Silver et al. (2009) include education regarding recovery expectations, reassurance, and frequent support, which all contributed to better outcomes in the first year after the injury. Cognitive behavioral therapy was found to decrease depression, anxiety and improve problem solving, self-esteem and social function after a TBI.

Behavioral prescriptions should be included in a healthcare provider’s recommendations, such as when to return to school, how to cope with schoolwork, household demands and re-engagement in social activities. According to Kirkwood (2008), the following criteria must be met before returning to athletics: lack of physical, cognitive or behavioral symptoms, normal neurological examination and lack of neuro-imaging findings. The risk for children who return to sports who are in the post-concussive period may be the development of second impact-syndrome (SIS), associated with an increase in intracranial pressure, permanent neurological damage and death. Kirkwood (2008) states that there are still no evidence-based guidelines established for children when returning to athletics and further research and guidance is necessary. Mention American Academy of Pediatrics guidelines here.

The effect of post-TBI bed rest on long-term outcomes was studied by de Kruijk, Leffers, Meerhoff, Rutten, and Twijnstra (2002). A randomized controlled study was performed using patients with mild TBI seen in an emergency room. Some patients were assigned randomly to six days of bed rest and others to no bed rest at all. The measurable outcomes included the severity
of post-traumatic complaints, as well as a physical and mental health survey. The results of the study concluded that there was no statistically significant difference in the two groups at the six-month mark. There was a slight improvement in symptoms in the bed rest group at two weeks, but not after that. The authors concluded that bed rest is no more effective than no bed rest for the recovery after mild TBI. The authors postulated that there maybe a palliative effect of bed rest in the first two weeks post a TBI (de Kruijk et al., 2002).

**Implications for Practice**

The Health Belief Model guides nursing practice by providing insight into what motivates people to seek medical care after a TBI. This model proposes that the presence of a positive incentive and belief that one will be successful at avoiding the negative impact of the injury, may lead to positive health behaviors. Perceived severity of illness is another component of the HBM. The model can guide the development of protocols for the clinical assessment and treatment of symptoms experienced by adults and children with mild and moderate TBI. People perceive the severity of their symptoms of TBI, which in turn leads them to take some form of action (or inaction). For example, the most common symptoms of TBI are headaches, dizziness and insomnia. Less common symptoms include changes in smell and taste, seizures, tinnitus and neck pain. Any one of these symptoms or a cluster of inter-related symptoms has the potential to motivate people to seek health care.

People may also perceive the severity of the psychological symptoms of TBI and evaluate the benefits of seeking treatment or the liability of postponing symptom evaluation. Psychological factors associated with both mild and moderate TBI include depression, anxiety, and cognitive impairments such as problems with memory, attention, language, and behavioral
problems. These conditions can be treated with both pharmacologic and behavioral therapies. Patients’ perception of the severity of their illness and benefit from therapy can be assessed by nurse practitioners and further education can be provided to explain symptoms, the benefits of treatment, and to provide reassurance that recovery is a gradual process. Parents of children with TBI may need education about the perceived susceptibility, severity of symptoms, and benefits of treatment. Children should be monitored closely for the presence of seizures immediately post TBI and treated. Further investigation is necessary to understand why people in low-income countries have better outcomes after mild TBI than those in high-income countries.

**Summary**

Treatment of the mild to moderate post-traumatic brain injury patient includes both pharmacological and non-pharmacological therapies, which are used to achieve maximum function, recovery and reduction in symptoms. Pharmacologic treatment should be reserved for the acute post-TBI period and should last no longer than six months.

Children are receptive to educational interventions with a demonstrated decrease in anxiety and disruptive cognitive symptoms. Along with educational pamphlets, cognitive behavioral therapy should be used in patients with neuropsychiatric sequelae. Some evidence suggests that patients do not need bed rest after the acute injury period for better long-term outcomes, however patients may find it therapeutic in the first two weeks post injury. Despite all of our knowledge about TBI management, patients in low-income countries continue to have less disability and better outcomes with mild TBI than high-income countries.

**References**


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