CHAPTER I
INTRODUCTION

1.1 Background and Significance of Clinical Problem

WHO has predicted that by 2020, traffic accidents will be the third leading cause of the global burden of diseases and injuries (Yeoman, Pattani, Silicocks, Owen, & Fuller, 2011). In Thailand, accidents have been found to be the third leading cause of deaths after cancer and cardiovascular disease. In 2011, the total number of severe accidents related injuries was 80,962 people, while the total number of deaths was 4,534. Most of the casualties were in the age group of 15-19 years, accounting for 12,816 people (Annual Epidemiological Surveillance Report, 2011). In 2011 and 2012, the total number of deaths caused by traffic accidents was equal to 14,062 and 14,064. Of these, 11,094 and 11,066 were males, and 2,968 and 2,998 were females (Bureau of Health Policy and Strategy, Ministry of Public Health, 2011 and 2012). The estimation of WHO as well as the statistics recorded in Thailand have shown that the incidence is rising.

Traumatic brain injury is a significant problem worldwide and is one of the major causes of morbidity and mortality (Juul, Duch, & Rusmussen, 2009; Metting, Rodiger, Stewart, Oudkert, Keyser, & Naalt, 2009; Cassidy et al., 2004). Furthermore, traumatic brain injury has significant social and economic impacts, particularly on young males aged 15-24 years who constitute the most common group affected. Furthermore, traumatic brain injury has impacts on important aspects of daily life from work to routine domestic activities and leisure pursuits (Mccartan, Fleming, Motherway, & Grace, 2008). According to the World Health Organization, it was estimated in 2013 that the numbers of patients with traumatic brain injuries worldwide were about of 54-60 millions per year on average. In Ireland, traumatic brain injury is a leading cause of death and disability in young adults. More than 11,000 patients with traumatic brain injury are admitted to the hospital in Ireland annually (Mccartan, Fleming, Motherway, & Grace, 2008). In Taiwan, traumatic brain injury, a significant public health problem with an incidence of 160,000-200,000 people, produces more than 8000 deaths annually (Yang, Hua, Tu, & Huang, 2009). As for Thailand, traumatic brain injuries in the country are stemming from traffic accidents, head injuries classified as organ injuries making up 30% of the total (Bureau of Health Policy and Strategy, Ministry of Public Health, 2007).

For industrialized countries such as the United States of America, the estimates of the relative causes of traumatic brain injury are as follows: motor vehicle accidents (45%), falls (30%), occupational accidents (10%), recreational accidents (10%), and assaults (5%) (Seifert & Evans, 2010; Obermann, Keidel, & Diener, 2010). The financial cost directly caused by traumatic brain injury is, estimated to be over 60 million USD per year, (Juul, 2009). In Thailand, the motorcycle is the most important cause of traumatic brain injuries, followed by truck (6.80%), and 3-wheel bikes (4.06%), respectively. Furthermore, in terms of the affected persons, the drivers were mostly injured (73.79%), followed by passengers (21.51%) and pedestrian (4.70%), respectively. The head injury is considered the most traumatized organ, accounting for 31.75% (Bureau of Health Policy and Strategy, Ministry of Public Health, 2007). In Europe, it has been documented that approximately one million patients have traumatic brain injury that required hospitalization (Chong, 2009). Moreover, there are approximately 1.4 million incidents of traumatic brain injury reported in the United States every year (Centers for Disease Control and Prevention, 2006; Chong, 2009; Jantzen, 2010; Obermann, 2010; Seifert & Evans, 2010). The majority of the cases, ranging from 80% to 90%, are classified as mild traumatic brain injury cases (Metting, 2009; Jantzen, 2010). WHO, in 2013 stated that 95 % of patients who have suffered traumatic brain injury have mild traumatic brain injuries. Other research studies have concluded that patients who suffer from physical disturbances after mild traumatic brain injury lack of productive capabilities. This eventually causes a large burden on the economy of the country (Yang, Hua, Tu, & Huang, 2009).

Head injury is considered the most traumatized organ, accounting for 30% of all accidents among those wearing a helmet and 50% among those not wearing a helmet (Office of Epidemiology, Department of Disease Control, Ministry of Public Health, 2011). In 2011, it was reported that in Thailand patients with traumatic brain injuries from the use of motorcycle helmets account for 95% of mild traumatic brain injury patients (Bureau of Health Policy and Strategy, Ministry of Public Health, 2011).

Packard (2008) has summarized the definition of mild traumatic brain injury from the Mild Traumatic Brain Injury Committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine (ACRM) and the World Health Organization Collaborating Center Task Force on Mild Traumatic Brain Injury. The ACRM has defined mild traumatic brain injury as a trauma that induces physiologic disruption of brain function, as manifested by at least one of the following:

1. Any loss of consciousness;
2. Any loss of memory of events immediately before or after the accident;
3. Any alteration in mental state at the time of the accident (feelings dazed, disoriented, or confused) ; or,
4. Focal neurological deficits that may or may not be transient.

The period of loss of consciousness should last 30 minutes or less after the injury. After 30 minutes, the initial Glasgow Coma scale (GCS) score is 13 to 15. It is worth noting that post-traumatic amnesia should not last longer than 24 hours.

The World Health Organization Collaborating Center Task Force on Mild Traumatic Brain Injury has defined mild traumatic brain injury as an acute brain injury resulting from mechanical energy to the head from external physical forces. Operational criteria for clinical identification include the following:

1. one or more of the following: confusion or disorientation, loss of consciousness for 30 minutes or less after the injury, post-traumatic amnesia for less than 24 hours, and/or other transient neurological abnormalities such as focal signs, seizure, and intracranial lesion not requiring surgery; and
2. Glasgow Coma Scale score of 13 to 15 at 30 minutes after the injury or later upon presentation for health care. These manifestations of mild traumatic brain injury must not be due to drugs, alcohol, medications, other injuries (such as, systematic injuries or intubation), other problems (such as, psychological trauma, language barrier or coexisting medical conditions), or penetrating craniocerebral injury.

The common features in all of these definitions seem to include one or more of the following: an alteration of mental status after the injury, any memory dysfunction, loss of consciousness for less than 30 minutes, and/or observed signs of neurologic dysfunction. Most include a GCS score of 13 to 15 at 30 minutes after the injury.

In 2011, Schwedt & Buzzi summarized traumatic brain injuries, stating that the traumatic brain injury is classified as mild when there is no associated loss of consciousness or loss of consciousness lasting less than 30 minutes, with a Glasgow Coma Scale (GCS) of at least 13,and with no symptoms and/or signs of concussion

In summary, mild traumatic brain injury is an acute brain injury resulting from mechanical energy to the head from external physical forces (Chong, 2008). With the presence of head trauma, a Glasgow Coma Scale (GCS) ranges from of 13 to 15, and at least one of the following four criteria is present: 1) any period of loss of consciousness; 2) any loss of memory for events immediately before or after the accident; 3) any alteration in mental state at the time of accident (for example, feeling dazed); or 4) focal neurological deficit(s) that may or may not be transient (Gravel et al., 2013).

In general, when patients have sustained mild traumatic brain injuries, they are subject to post-concussion syndromes, confusion, nausea, dizziness, headaches, tinnitus, hearing loss, blurred vision, insomnia, light and noise sensitivity, diminished sense of smell, cognitive impairment and attention, personality change, irritability, anxiety, and depression (Chong, 2008; Lainez & Esquera, 2011; Linder, 2008; Yang, Hua, Tu, & Huang, 2009). Posttraumatic headaches occur in 30% to 90% of mild traumatic brain injury cases, and they are considered one of the post-concussion syndromes encountered in mild traumatic brain injury patients (Channell, Mueller, & Hahn, 2008; Evans, 2006; Michael, 2009; Obermann, 2010; Seifert & Evans, 2010). In other words, posttraumatic headaches are more commonly found in mild traumatic brain injury cases rather than in severe traumatic brain injury cases (Couch, Lipton, & Stewart, 2009; Channell, 2009; Obermann, 2010; Solomon, 2009). A more recent study has found that the overall severity of the traumatic brain injury was inversely proportional to the headache (severe headache was present in 33% of severe traumatic brain injury cases and in 72% of mild traumatic brain injury cases) (Evans, 2007). The impacts of headaches following injuries on persons are found to have caused suffering and disability, lost productivity, decreased quality of life, and increased health care costs (Aguggia, Cavallini & Varetto, 2006; Erickson, Neely, & Theeler, 2010). In terms of impacts at the chronic stage, chronic posttraumatic headaches are found to have impacts that disturb the daily life of patients and cause cognitive impairment while decreasing the quality of life of patients (Chong, 2008). This was found to be consistent with the studies of Boake, et al. (2005) and Nolin (2006) who found posttraumatic headache to have decreased working productivities, causing great impacts on patients in their daily life, occupations, and personalities, thereby decreasing quality of life of patients, which often interferes with interpersonal relationships among patients, families, and society, while also having impacts on the economy and society in general (Aguggia, 2006). Research conducted by Mccartan, Fleming, Motherway, & Grace (2008) to assess the management and outcome in 216 patients of working age who were admitted with traumatic brain injury found that 86% of patients with mild traumatic brain remained unfit for work after one year (Mccartan, Fleming, Motherway, & Grace, 2008). In general, mild traumatic brain injury patients tend to increase in numbers, and the condition has direct effects on patients who suffer from headaches which become an obstacle in their life and work, which, in turn, decreases their quality of life.

According to the statistics on patients with traffic accidents seeking treatment at the Accident and Emergency Department between 2006 and 2013 of Klang Hospital, which is under the supervision of the Medical Service Department, Bangkok Metropolis, there were 3,009, 3,041, 2,697, 2,769, 2,834, 2,855, 2,994 and 2,969 patients who suffered from traffic accidents, respectively. Between 2006 and 2008, 18, 10, and 10 patients died from the accidents, respectively (Statistics of Klang Hospital, 2006 to 2008). In addition, according to statistics on traumatic brain injury patients seeking treatment at Klang Hospital, Medical Service Department, Bangkok Metropolis, from 2006 to 2013, the numbers of traumatic brain injury patients were 168, 172, 254, 186, 205, 230, and 340, respectively (Statistics of Klang Hospital, 2006 to 2013). According to the aforementioned statistics, it can be seen that the numbers of patients with traumatic brain injuries tend to increase. From medical records of the total numbers of traumatic brain injury patients seeking treatment at

Klang Hospital, most of them patients were found to have mild traumatic brain injury, accounting for 82.85% and 79% in the fiscal years 2008 and 2009, respectively (Statistic of Medical Records of Klang Hospital, 2008 to 2009 fiscal years). Furthermore, according to a review of 107 medical records of mild traumatic brain injury patients (GCS = 13 to 15) in the fiscal year 2009, it was found that there were 46 patients with acute posttraumatic headache (PTH), making up 43% of the total cases. Of these patients, six of them, or 13.04%, had to return to the hospital with acute posttraumatic headaches within seven days (Statistics of Medical Records, Klang Hospital, 2009 fiscal year). Based on the aforementioned statistics, it is evident that posttraumatic headaches can be found in mild traumatic brain injury patients and that acute posttraumatic headaches are also a significant cause of re-hospitalization. Apart from having physiological and psychological impacts on patients, acute posttraumatic headaches also have other impacts on patients including loss of income due to hospitalization, increased medical expenses, along with increasing expenses in medical treatment systems (Erickson, Neely, & Theeler, 2010).

Mild Traumatic Brain Injury

Mild traumatic brain injuries are caused by force from objects acting on the head or acceleration/deceleration. Patients may not be directly injured on the head (Hughs, Jackson, Mason, Beery, Hollis, & Yates, 2004), but may be injured by rotation forces (Gladstone, 2009; Linder, 2007), resulting in axonal shearing (Jantzen, 2010; Lenaerts & Couch, 2004; Silver, 2005; Linder, 2007), tissue injuries (Obermann, 2010), and stretching vessels (Packard, 2008, 2010). When patients have sustained mild traumatic brain injuries, they are subject to post-concussion syndromes, such as confusion, nausea, dizziness, headaches, tinnitus, hearing loss, blurred vision, insomnia, light and noise sensitivity, diminished sense of smell, impaired concentration and attention, personality change, irritability, anxiety, and depression (Chong, 2008; Linder, 2008). For about 80% of mild traumatic brain injury patients, the aforementioned symptoms will improve within three months after sustaining injuries (Arciniegas, 2011; Bergman, 2009). A review of 1,670 patients from studies has revealed that chronic headaches occur in 58% of patients with traumatic brain injury (Erickson, Neely, & Theeler, 2010). In brief, headache is the most commonly found symptom after traumatic brain injury (Oberman, 2010). Although most posttraumatic headaches resolve within six to 12 months after the injury, approximately 18% to 33% of posttraumatic headaches persist for more than one year (Lew et al., 2006).

The pathophysiology of mild traumatic brain injury and associated post traumatic headaches are believed to be partly neurometabolic in origin. Release of excitatory neurotransmitters such as aspartate, glutamate, and acetylcholine may serve as a potential substrate for mild traumatic brain injury (Evans & Seifert, 2010). Acute pain following head (+/- neck) trauma may derive from injuries (laceration, traction, torsion, compression, or fracture) to the scalp, skull, dura, specific nerves of the head and neck (i.e., supraorbital, infraorbital, and occipital nerves), cervical discs, facets, ligaments, muscles, sympathetic nerve fibers along the arterial vessels, and/or the temporal mandibular joint. Acute pain frequently derives from pain impulses generated from nociceptive afferents from these affected areas; ascending pain information may enter the central nervous system via C fibers of upper cervical cord dorsal rami or via the spinal nucleus of the trigeminal-vascular system that can converge and ascend rostrally. Clinically, this leads to referred pain and poor localization of pain to the specific site of head injury (Gladstone, 2009). Dysfunction of pain-transmitting and modulating structures and trigeminal-vascular system activation are thought to be involved in posttraumatic headache (Lenaerts & Couch, 2004).

Not only is posttraumatic headache a result of nervous, musculoskeletal, and vascular injuries, but patients with chronic posttraumatic headaches also demonstrate psychological issues such as anxiety, depression, anger, and personality change. Psychological problems may trigger or contribute to a vicious cycle of pain and emotional problems. Alternatively, persistent headaches may perpetuate emotional problems. In addition, mental fatigue and cognitive impairment such as slowed information processing, impaired memory, and impaired problem-solving ability have also been reported in patients with posttraumatic headaches (Lew, 2006).

Assessments of mild traumatic brain injury patients can be done based on levels of consciousness following the injury. In this study, the instrument used to assess the severity of injuries was the Glasgow Coma Scale (GCS) score with a scoring range of 15 points divided into three levels consisting of mild traumatic brain when there was no associated loss of consciousness or loss of consciousness lasting less than 30 minutes, a Glasgow Coma Scale (GCS) of at least 13, and symptoms and/ or signs of concussion. Head injuries are considered moderate or severe when there was loss of consciousness for longer than 30 minutes, GCS less than 13, post-traumatic amnesia lasting longer than 48 hours, and/or imaging demonstration of traumatic brain injury concussion (Schwedt & Buzzi, 2011). To determine that the patients had mild traumatic brain injury, the assessment criteria with scores ranging from 13 to 15 points were employed (Gravel, 2013).

Posttraumatic Headache (PTH)

The existing literature has suggested that posttraumatic headache is similar to non-posttraumatic headache in both pathogenesis and presentation (Tatrow, Blanchard, & Silverman, 2003; Gladstone, 2009). The International Headache Society Classification of Headache Disorders, Second Edition, (ICHD-2), has defined posttraumatic headaches as a secondary headache that develops within seven days of head trauma (or within seven days of regaining consciousness after head trauma) (Formisano, Bivona, Catani, D'Ippolito, & Buzzi, 2009; Linder, 2007; Mcgeeney, 2009). Diagnostic criteria for acute posttraumatic headache attributable to mild traumatic brain injury (Erickson, Neely, & Theeler, 2010; Erickson, & Theeler, 2012; Gladstone, 2009; Formisano, Bivona, Catani, D'Ippolito, & Buzzi, 2009; Lainez, & Pesquera, 2011; Schwedt, & Buzzi, 2011) are as follows:

A. Headache, no typical characteristics known, fulfilling criteria C and D

B. Head trauma with all of the following:

1. Either no loss of consciousness or loss of consciousness of a duration less than 30 minutes

2. Glasgow coma scale (GCS) scores of 13 or higher

3. Diagnostic symptoms and/or signs of concussion

C. Headaches that develops within seven days after head trauma

D. One of the following:

1. Headache that resolves within three months after head trauma, or

2. Headache that persists, but within three months since head trauma.

Furthermore, characteristics of posttraumatic headaches are divided into two types consisting of acute posttraumatic headaches and chronic posttraumatic headaches with differences in periods of recovery because chronic posttraumatic headaches will last for longer than three months.

As regards characteristics of posttraumatic headaches, there are no unique or distinctive clinical features of posttraumatic headaches. In terms of location, posttraumatic headaches may be localized to the site of the head injury or it may be hemicranial, bilateral, or holocranial. With regard to the quality of pain, posttraumatic headaches can be dull, pressing, throbbing, stabbing, burning, and a plethora of other adjectives. In terms of duration and frequency of symptoms, posttraumatic headaches can be daily and continuous 24/7, daily and long-lasting (> 4 hours) but not continuous, daily but short-lasting (recurring paroxysmally lasting seconds or minutes), episodic and long-lasting (> 4 hours), or episodic and short-lasting. (Gladstone, 2009). According to the assessment of headache severity, 8.9% of the patients were found to have low levels of headaches, 26.89% of the patients were found to have moderate headaches, and 63.4% of the patients were found to have severe headaches (Gurr & Coetzer, 2005).

According to Seifert and Evans (2010), the tension-type posttraumatic headaches account for 85% of reported posttraumatic headaches. They can occur in a variety of distributions, including a generalized, muchal-occipital, bifrontal, bitemporal, cap-like, or headband location. The headache, which may be constant or intermittent with varying duration, is usually described as pressure, tightness, or dull aching. It may be present on a daily basis. Recurring attacks of migraine-like headaches (with and without aura) can result from mild traumatic brain injury. After mild traumatic brain injury, patients of all ages can develop a variety of transient neurological sequelae that are not always associated with headaches and are perhaps due to vasospasm. Five main clinical types are recognized: hemiparesis, somnolence, irritability, and vomiting; a confusional state; transient blindness, often precipitated by occipital impacts; and brainstem signs. Cluster-like headache is an extremely rare entity (lifetime prevalence of 1%), and it is infrequently reported in the medical literature. Cluster headache is a primary headache disorder classified as one of the trigeminal autonomic cephalgias. Acute attacks involve the trigeminovascular system with associated unilateral excruciating pain. These events typically include the autonomic symptoms of lacrimation, ptosis, conjunctival injection, nasal stuffiness, and rhinorrhea. Whiplash and cervicogenic headache and neck injuries commonly accompany head trauma and can produce headaches. The specific mechanism involves the merging of trigeminal and cervical afferents in the trigeminocervical mucleus. Typical pain includes throbbing and/or pressure-like pain originating in the occipital region, migrating anteriorly to involve the temporoparietal areas in a unilateral distribution. Posttraumatic cervicogenic headaches are also commonly associated with whiplash injuries. Whiplash is a sudden acceleration then deceleration of the neck resulting in pain at the time of trauma. The triad of neck pain, restriction/neck mobility, and headache are the major constituents of whiplash syndrome (Seifert & Evans, 2010).

It is worth noting that the aforementioned posttraumatic headaches are more frequent after mild traumatic brain injury than after severe injury, even though between 30% and 90% of mild traumatic brain injury can lead to posttraumatic headaches (Channell, Mueller, & Hahn, 2009; Gladstone, 2009; Vargas & Dodick, 2012).

Lew and colleagues (2006) conducted a study to explore characteristics and incidence of posttraumatic headaches and reported that tension-type headaches were the most frequently discovered form of headaches (ranging from 6.9% to 85.7%, with the mean of 33.6%), followed by migraine-like headaches (ranging, from 1.9% to 40.7%, with the mean of 28.6%), and mixed or unclassified headaches (ranging from 4.2% to 36.5%) (Lew et al., 2006). Furthermore, in the study carried out by Gurr and Coetzer (2005) with 41 traumatic brain injury patients aged 22-72 years with posttraumatic headache, it was found that 58.5% of the patients had tension-type headaches, 17.1% had migraine-like headaches, and 9.8% of the patients had both tension-type and migraine-like headaches. The average period of headaches was found to be at 10.46 hours per day and 14 days per month. As regards characteristics of headaches, 28.81% were tight tension headaches, 18.64% were throbbing headaches, 15.25% were stabbing and sharp pain headaches, and 5.09% were dull pain headaches.

There were also headaches with more than two characteristics. From the assessment of headaches, headache severity was ranged from low to moderate levels (Lew et al., 2006), and it was found to be heavy during the period during the first one to three days after injury with symptoms gradually improving within seven days after the injury (Mihalik, Guskiewicz, Mann, & Shields, 2007).

A study carried out by Sarmento and colleagues (2009) with 17 mild traumatic brain injury patients aged 20-66 years with posttraumatic headaches revealed that nine patients (53%) had acute posttraumatic headache, while eight patients (47%) had chronic posttraumatic headaches. As for onset, 11 of the patients began to develop headaches on the first day after the injury, three patients had headaches during the second and fourth days after the injury, and three patients had headaches on the seventh day after the injury. In terms of duration, nine patients had headaches for a month, four patients continued to have headaches after three to six months, two patients had headaches for six months to a year, and two patients had headaches for longer than a year. The mean value for the headache incidence was 13.4 days per month. Furthermore, with regard to the type of headache, eight patients (47%) were found to have tension-type headaches, five patients (29%) were found to have migraine-like headaches without auras, one patient (6%) was found to have cervicogenic headaches, one patient (6%) was found to have hemicranias continual headaches, and two patients (12%) were found to have a combination of tension-type headaches and migraine-like headaches without auras. In addition, according to the study of Romrudee Kliangda (2009) who investigated the experiences of posttraumatic headaches in 88 mild traumatic brain injury patients, 32.5% of the patients described symptoms of throbbing headaches, 27.5% described dull headaches, 47.5% described bitemporal headaches, 22.5% described generalized headaches, and 20% described central pain headaches. Moreover, regarding frequency, 50% of the patients had headaches once or twice a day, whereas 32.5% had headaches three to five times per day (Romrudee Kliangda, 2009).

Assessment of Post Traumatic Headaches

The evaluation of posttraumatic headache involves elicitation of history with an inquiry of the exact mechanism of the injury and a sense of the biomechanical force applied. Besides this, immediate post-injury symptoms should be inquired, including loss of consciousness, alteration of consciousness, confusion/loss of awareness, amnesia, dizziness/vertigo, nausea, vomiting, and visual disturbances. Assessments of the frequency, duration, quality, and characteristics of headaches and screening of physiological diseases involve assessments of headache severity (Gladstone, 2009); assessments of factors causing headaches consisting of the musculoskeletal, vascular, neural and biomechanics factors; and assessments of stress and anxiety of patients because these factors increase headaches (Lew, 2006). Comprehensive headache examinations are performed to help build clarity regarding the cause of headaches in order to provide proper treatment for each patient consisting of the following physical examinations (Linder, 2007):

1. Cervical spine examination
2. Skull-palpation of bones, muscles, and listening for bruits
3. Ears-external auditory meatus occlusion and motion
4. Temporomandibular joint-palpitation and range of motion
5. Nerves-palpation of supraorbital, trochlear, and occipital nerves, as well as cranial nerves IX-XII
6. Eyes-palpation and inspection
7. Sinuses-modified Muller’s maneuver
8. Evaluation for increased intracranial pressure
9. Teeth-inspection, percussion, and palpation
10. Carotid arteries-listen for bruits and palpate

According to the study of Faux and Sheedy (2008), the instrument used to assess pain levels of headaches was the Visual Analog Scores of Pain with pain scores ranging from 0 to 10 points, with 0 point meaning no pain and 10 points meaning maximum pain (Faux & Sheedy, 2008). Sarmento and colleagues (2009) studied tests by using spectroscopy magnetic resonance imaging (MRS) in 17 mild traumatic brain injury patients with posttraumatic headaches and 12 members of the control group. Use of proton MRS estimated the metabolic ratios of N-acetylaspartate (NAA) and choline (Cho), relative to creatine (Cr). When compared with controls, individuals with posttraumatic headaches following mild traumatic brain injuries had reduced values of NAA in the right (1.64 ppm vs. 2.05 ppm, $p = .012$) and left anterior regions of the frontal lobe white matter (1.52 ppm vs. 2.10 ppm; p = .024); anterior (1.52 ppm vs. 1.78 ppm; p=.0155**)** and posterior medical region of the frontal lobe (1.6 ppm vs. 2.07 ppm; p=.0045**)**; and medial region of parietal lobes (1.76 ppm vs. 2.23 ppm; p=.0065). Contrary to the controls, Cho measures were statistically increased in the posterior region of the white matter of the side frontal lobe (1.18 ppm vs. 0.99 ppm: p=.0095), the anterior medial region of the frontal lobe (1.20 ppm; vs. 1.07 ppm; p = .0265), and the medial region of the parietal lobes (0.92 ppm vs. 0.65 ppm; p = .0005). Therefore, it can be summarized that proton MRS may be useful as an imaging marker of posttraumatic headaches following mild traumatic brain injury. It was found that NAA will be reduced and Cho will increase in mild traumatic brain injury patients with post traumatic headache (Sarmento et al., 2009).

Management for Posttraumatic Headaches

The mainstream, of treatment is to prevent chronic headaches (Gladstone, 2009; Packard, 2005). It is noteworthy that management of headaches in traumatic brain injury patients may be difficult and complex because there are many possible underlying factors, including musculoskeletal, vascular, visceral, neural, and iatrogenic causes. At the same time, the consequences of delayed diagnosis or treatments of headaches caused by psychological factors may aggravate the conditions (Lew et al., 2006). Therefore, before providing any treatment, specialist doctors should collect data to systematically assess physiological conditions and symptoms with full coverage. Comprehensive patient assessments will help treatments properly achieve success (Lenaerts & Couch, 2004).

Pharmacological treatments for posttraumatic headaches should be provided according to pain discovered by providing pain relief medications and NSAIDs. Most headache treatments are divided into treatments for tension-type headaches and migraine-like headaches. Tension-type headache patients receive pain relievers and NSAIDs, such as paracetamol, ibuprofen, muscle relaxants, and antidepressants such as amitriptyline, so treatments can have positive outcomes (McGeeney, 2009; Lew et al., 2006). For patients with migraine-like headaches, the first option consists of tricyclic antidepressants, such as anitriptyline, nortriptyline, and calcium channel blockers such as propranolol or nadolol, and anticonvalsants, such as topiramate, gabapentin, or divalproex sodium (Lew et al., 2006).

Non-pharmacological treatment involves behavioral and psychological management combined with pharmacological treatments aimed at promoting positive outcomes of headache management (Hall Ryan et al., 2005). Non-pharmacological treatment involves physical therapy and manipulation, biofeedback, relaxation technique, behavioral therapy, Anesthetic blockade, botulinum toxins, etc. (Lew et al., 2006). As regards non-pharmacological treatments with anesthetic blockade and botulinum toxins, nerve block by local anesthetics has been advocated to relieve various kinds of primary headaches. However, the mechanisms remain unclear (Lew et al., 2006).

According to the literature review of Lew and colleagues (2006), there have been no studies conducted on the effects of botulinum toxins in the treatment of posttraumatic headaches as well as non-pharmacological treatments with psychotherapy. Psychotherapy generally enables patients with chronic posttraumatic headaches to receive counseling. The provision of education regarding mild traumatic brain injuries and headaches for patients is important for treatment (Seifert & Evan, 2010). Headaches resulting purely from musculoskeletal and biomechanical dysfunction may be relieved with appropriate physical therapy intervention. Because the peripheral contribution is variable in each patient, there is still insufficient evidence to either support or refute the effectiveness of physical therapy and spinal manipulation on treatment of primary headaches. Moreover, there is no study investigating the effects of physical therapy and manipulation on posttraumatic headaches (Lew et al., 2006).

In 2009, Romrudee Kliangda reported that more than half of the patients in her study (57.5%) were found to have selected more than one method of headache management. They were taking pain relievers and sleeping (27.5%) which were able to relieve headache at a moderate degree occurring more than five minutes to less than 60 minutes. In terms of reasons for selecting headache management methods, close to two-thirds of the patients (30%) were found to have followed recommendations given by healthcare personnel. With regard to persons who helped with headache management, most patients (80%) were found to have managed headaches by themselves. In terms of frequency in complying with methods selected for headache management, patients experienced the headaches more than ten times per week at most. Pain relief medication, head massage, and sleeping were found to be effective methods that helped reduce headaches in less than five minutes, 15 minutes, and 30 minutes, respectively. Use of more than one method was the most frequently selected method. Patients most frequently chose the method of taking pain relief medication and sleeping, which was able to moderately relieve headaches in less than five minutes up to more than 60 minutes. In addition, taking pain relief medication with head massage and sleeping were found to have reduced headaches in less than five minutes, 10 minutes, and 10-60 minutes, respectively.

With regard to mild traumatic brain injury patients, 30% to 90% of the patients in this group develop posttraumatic headaches (Obrmann, 2010; Seifert & Evan, 2010), which is the most frequently encountered symptom of all post-concussion syndrome. Posttraumatic headaches occur within seven days after injuries, and most will disappear within three months (Seifert & Evan, 2010). However, some patients continue to have chronic posttraumatic headaches for years after sustaining injuries (Lew et al., 2006; Seifert & Evans, 2010), thereby reducing quality of life for these patients (Aguggia, 2006; Chong, 2008). Posttraumatic headaches management consists of pharmacological and non-pharmacological methods (Gladstone, 2009; Lew et al., 2006). The major goals of management of posttraumatic headaches are to abort headache attack, decrease headache frequency, reduce disability, and prevent chronic posttraumatic headaches (Erickson, Neely, & Theeler, 2010). It is worth noting that successful headache management relies on timely and appropriate headache management by health care providers. If patients do not receive correct appropriate assessment and management, they will suffer the effects of headaches on their lives, including long-term sufferings and poorer quality of life.

1.2 Clinical Problem under Study

Headaches in mild traumatic brain injury patients have both physiological and psychological effects. Acute posttraumatic headaches occur in 80% of the people who have had traumatic brain injury (Lenaerts & Couch, 2004). Posttraumatic headaches are also an important public health issue due to their associated disability and often refractory clinical course (Evans & Seifert, 2010). According to reviews of the medical records of 107 mild traumatic brain injury patients (GCS = 13-15) who sought treatment at Klang Hospital, Medical Service Department, Bangkok Metropolis, in the fiscal year 2009, 46 patients with acute posttraumatic headaches (PTH) were found, making up 43% of the total. Of these, six patients, or 13.04% had to be re-hospitalized with acute posttraumatic headaches (Statistics of Medical Records of Klang Hospital, fiscal year 2009).

Based on the investigator's reviews of medical records and personal experience working in the male surgical ward, mild traumatic brain injury patients seeking treatments at the hospital generally receive closed observe and observation of symptoms. Patients are assessed for vital signs and Glasgow Coma scale scores. They are also generally kept for observation for a minimum of 12 hours. If patients are found to have no abnormal symptoms with Glasgow Coma scale scores of 15 points within 24 hours after admission, they are discharged from the hospital. If the patients have acute posttraumatic headache, they will be treated with pain relief medication according to the treatment plans of doctors. Cold compresses will also be used around the injured area of the head. According to personal conversations with patients after taking pain relief medication and cold compresses, the patients tend to report that their symptoms are only slightly alleviated. They continue to have headaches periodically, which causes suffering, stress, and anxiety from the symptoms that have occurred while also causing insomnia. In addition, the fact that patients have to be re-hospitalized causes them to lose income and suffer from the burden of incurring treatment expenses. For example, patients must have a CT scan for investigation, which can be expensive for some patients. Furthermore, there is no clearly defined practice guideline in use at the patient wards for assessments and management of headaches when providing care to these patients. Only general data are provided for patients and their relatives without specific information regarding posttraumatic headaches. It can be stated that patients lack appropriate preparations before hospital discharge, and therefore, in order for mild traumatic brain injury patients to receive proper care and assistance, they need to receive systematic provision of necessary information regarding assessment, management, monitoring, and education of acute posttraumatic headaches so as to reduce their suffering and improve the quality of nursing care. For these reasons, the investigator was interested in studying the management of acute posttraumatic headaches in mild traumatic brain injury patients. It was anticipated that the study findings would lead to development of a clinical nursing practice guideline and to improvement of the quality of nursing care as posttraumatic headaches can be found in as many as 30% to 90% of mild traumatic brain injury patients (Obermann, 2010; Seifert & Evan, 2010). In the management of posttraumatic headaches, it is important to manage symptoms and prevent chronic posttraumatic headaches (Obermann, 2010).

Most patients suffering from posttraumatic headaches recover within a few months, with a small but significant minority having persistent problems. Because of the many variables in prognostic studies, the percentage of patients with symptoms after mild traumatic brain injury varies greatly. The percentage of patients with headaches at one month varies from 31.3% to 90%, at three months from 47% to 78%, and at one year from 8.4% to 35%. More importantly, almost 25% of the patients have persistent headaches after four years (Seifert & Evans, 2010). In general, posttraumatic headaches contribute to disability, loss of productivity, high health care costs, and decreased quality of life among patients with traumatic brain injury (Erickson, Neely, & Theeler, 2011). Furthermore, posttraumatic headaches have adverse effects on families, work, and family relationships (Stevens, 2008) of the patients, while simultaneously greatly decreasing their quality of life (Aguggia, 2006; Chong, 2008). The current management of posttraumatic headaches suffers from lack of uniformly accepted diagnostic criteria, overlook, lack of interest in, not providing information to patients, lack of clinical trial research, lack of proven treatments, lack of guidelines, lack of coordinated care or "ownership" of the problem, and lack of acceptance regarding the legitimacy of the existence of chronic posttraumatic headaches (Erickson, Neely, & Theeler, 2011; Gladstone, 2009; Schwedt & Buzzi, 2011).

Therefore, with realization of the importance of an investigation of post traumatic headaches management in mild traumatic brain injury patients who are the most frequently encountered patients in the organization, it was anticipated that the findings of the present study would be used as baseline data to subsequently develop clinical practice guidelines and shed light on nursing roles in the management of acute posttraumatic headaches in mild traumatic brain injury patients to ensure effective provision of care to ensure quality of life of the patients.

1.3 Purpose of the Study

The analysis and synthesis of research evidence to develop a clinical nursing practice guideline involving assessment, management, monitoring, and education of posttraumatic headaches in mild traumatic brain injury patients based on evidence-based practice.

1.4 Expected Benefits/Outcomes

1. The study findings would shed light on the knowledge regarding assessment, management, monitoring, and education of posttraumatic headaches in mild traumatic brain injury patients.

2. The study findings could be used as a guideline in providing nursing care to manage posttraumatic headaches in mild traumatic brain injury patients.

3. The study findings will also lead to development of an evidence-based clinical nursing practice guideline for management of posttraumatic headache in mild traumatic brain injury patients.