Original Article

Prevalence of Postconcussion Syndrome after Mild Traumatic Brain Injury in Young Adults from a Single Neurosurgical Center in East Coast of Malaysia

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Abstract

Context: Postconcussion syndrome (PCS) is a set of symptoms occurred after a mild traumatic brain injury (MTBI). **Aims:** This study aims to determine the prevalence of PCS in a young adult population from a single Neurological Centre in Malaysia's East Coast and to evaluate the factors associated with PCS in MTBI patients. **Settings and Design:** This was a cross-sectional study conducted in a Neurological Centre at Hospital Tengku Ampuan Afzan, Kuantan, Pahang, Malaysia, from January 2016 to December 2016. **Subjects and Methods:** A total of 209 patients; 133 males and 76 females, in the age range of 16–84 years, were randomly recruited for this study. All the selected patients were subjected to the checklist for diagnosis of PCS as per International Statistical Classification of Diseases and Related Health Problems 10th edition classification at a 2-week interval. **Statistical Analysis Used:** Descriptive statistic and Multivariable Logistic Regression Model were used for frequency and percentage analyses of categorical variables, using SPSS version 23.0. **Results:** Only 20 patients were identified with PCS. There were more female (70%) patients with PCS than the male (30%) patients. The prevalence of PCS for 2 weeks, 3 and 6 months since injuries were 9.6%, 8.1%, and 8.1% respectively. Majority (80%) of the patients were found to have PCS due to road traffic accidents, while the remaining were attributed to assault (15%), and falls (5%). Among the sample population, 25% were smokers, while 10% of them had either skull fracture or premorbidity. **Conclusion:** Less than 10% of patients with MTBI had PCS after 6 months' following trauma. None of the variables tested were significant factors for the development of PCS symptoms.

Keywords: *Clinical symptoms, mechanism of injury, mild traumatic brain injury, postconcussion syndrome, trauma patient*

Introduction

Mild traumatic brain injury (MTBI) is the most common form of traumatic brain injury, which refers to the condition of a patient with a history of amnesia, loss of consciousness, or disorientation with a Glasgow Coma Scale (GCS) score of 13–15.[1] The most obvious clinical symptoms following MTBI was the postconcussion syndrome (PCS). PCS symptoms are divided into three clinical domains: cognitive complaints (deteriorated memory, attention, and concentration), somatic symptoms (headache, fatigue, dizziness, tinnitus, and noise or light sensitivity), and emotional problems (depression, irritability, and anxiety), in which different patients may have symptoms primarily from one or more domains.[2] There are limited clinical data about PCS covering the Asian population, in fact, it is often missed diagnosed, not treated appropriately, and in most cases, patients are resistant to the symptoms thus affecting the overall productivity.[3] Therefore, this study was initiated to determine the prevalence of PCS in terms of its duration of occurrence and also to evaluate the predictive factors including mechanism of injury, premorbidity, skull fractures, and smoking habits among the Malaysian population. Perhaps, this study could be a precursor for further studies in the future.

Subjects and Methods

Ethics approval and consent

This research work has been approved by the International Islamic University Malaysia (IIUM) Kulliyyah Research Ethics Committee with reference number: IIUM/504/G/14/3/1/1/RIGS 15-082-0082.

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All patients were provided with a patient information sheet, and a written consent was obtained before participating in this research study. Confidential protection of all information obtained was protected as per Good Clinical Practice Guidelines Third Edition 2011.

Subjects

Patients were recruited among those referred to the Neurological Centre at Hospital Tengku Ampuan Afzan (HTAA), Kuantan, Pahang, Malaysia, with Mild Head Injury from January 2016 to December 2016. A total of 209 patients diagnosed with MTBI, within the age range of 16–84-year-old, and met the inclusion and exclusion criteria were enrolled in this study. The sample size (n) was calculated using Raosoft® analysis tool. The sample size analysis indicated that a minimum sample size of 141 produced 95% confidence interval with effect size of $f = 0.30$. Thus, the sample size of 209 in this study was sufficient to represent the MTBI patients' population as the HTAA is the referral center for East Coast Malaysia. Sociodemographic characteristics (age, gender, and ethnicity) of the patients were obtained through medical records or self-reporting by the patient.

Inclusion and exclusion criteria

The inclusion criteria were as follows: (1) patients with GCS score of 13–15, (2) age older than 16 years, (3) normal preinjury mental status, and (4) without any history of psychiatric disorders or severe health problems. While the exclusion criteria used were as follows: (1) communication problems, (2) underlying history of epilepsy, (3) penetrating skull injuries, (4) open skull fractures, (5) active drug abusers, and finally (4) chronic alcoholics.

Clinical protocol

Patients with MTBI admitted to ward were examined physically and their clinical data including mechanism of injury (road traffic accidents, falls, assault, and sports), skull fractures, premorbid conditions, and smoking status were recorded. All patients were followed up in the outpatient clinic following discharge and were subjected to the checklist for diagnosis of PCS as per the International Statistical Classification of Diseases and Related Health Problems 10th edition (ICD-10) classification at a 2-week interval. Subsequently, they were followed up at intervals of 3 and 6 months through clinic appointments and telephone interviews, to ascertain the progression of PCS symptoms. At every follow-up, patients were subjected to the same checklist to ascertain the progression of symptoms.

Statistical analysis

Statistical Packages for Social Sciences version 23 (IBM, New York, United States) was used for data analysis in this study. Descriptive statistics was applied for calculating the mean, median, standard deviation, frequency, and percentage. The multivariable logistic regression model was used for scoring the factors associated with PCS. $P < 0.05$ was considered statistically significant.

Results

The study population consisted of 209 patients; 133 males and 76 females, with a median age of 22 (interquartile range [IQR] = 18.0), ranges from 16 to 84 years. The demographic and clinical characteristics of the patients were presented in Table 1. The ethnicity composition was 80.9% Malay, 12% Chinese, 4.8% Indian, and the least were from other races (2.4%). More than 60% of patients reported no history of premorbidity, skull fractures, or smoking habits. Road traffic accidents accounted for 83.7% of MTBI, while the remaining factors were attributed to falls (8.6%), assault (5.7%), and sports-based injury (1.9%).

Based on the checklist for the diagnosis of PCS symptoms (ICD-10), we have identified only 20 patients with PCS out of 209 patients. The mean age of PCS patients was 28.5 ± 14.4 whereas those without was 30.5 ± 17.5 [Table 2]. There were more female (70.0%) affected with PCS compared to male 30.0% [Table 2]. Majority of them were from the Malay ethnic group. About one-fourth of the PCS patients were smokers and only 10.0% of PCS patients had either skull fracture or premorbidity [Table 2]. Our findings showed that 16 patients developed PCS symptoms due to road traffic accidents, while 3 and 1 each

Table 1: Summary of demographics and clinical characteristics of the study population

Characteristics	*n* (%)
Median age (IQR)	22 (18.0)
Gender	
Female	76 (36.4)
Male	133 (63.6)
Ethnicity	
Malay	169 (80.9)
Chinese	25 (12.0)
Indian	10 (4.8)
Others	5 (2.4)
Premorbidity	
No	172 (82.3)
Yes	37 (17.7)
Smoking	
No	143 (68.4)
Yes	66 (31.6)
Skull fracture	
No	203 (97.1)
Yes	6 (2.9)
Mechanism of injury	
Road traffic accident	175 (83.7)
Falls	18 (8.6)
Assault	12 (5.7)
Sports	4 (1.9)

IQR – Interquartile range

due to assault and fall [Table 2]. Most of the accident cases with head injury involving motorcycle riders (62.5%) and the remaining were car drivers (37.5%). All patients have developed PCS symptoms within 2 weeks after injury, and the symptoms persisted for a few months; however, it has been resolved in certain cases (only three patients out of the total PCS patients). The prevalence of PCS for 2 weeks, 3 and 6 months since injuries were 9.6%, 8.1%, and 8.1%, respectively [Table 3].

We analyzed different categories of PCS symptoms; somatic symptoms (headache, malaise, fatigue, noise intolerance, and dizziness), emotional changes (irritability, depression, anxiety, and lability), cognitive problems (subjective concentration, memory or intellectual difficulties without neuropsychological evidence of marked impairment), postsymptoms (reduced alcohol tolerance), psychosocial behavioral (insomnia) and also presymptoms (preoccupation with symptoms and fear of brain damage with hypochondriacal concern and adoption of sick role) based on the follow-up time point. The most commonly reported symptoms among all PCS patients (100%) at first follow-up (2 weeks) were somatic symptoms [Figure 1]. These symptoms reported consistent in 85% of the patients at second (3 months) and third (6 months) follow-ups [Figure 1]. The cognitive problems were the second most highly effected symptoms. We noticed that the number of patients with emotional changes, cognitive problems, and psychosocial behavioral reduced by 10% at 6 months compared to the second follow-up at 3 months [Figure 1]. Whereas patients with presymptoms showed a reduction of 5% only at 6 months compared to the first and second follow-ups at 2 weeks and 3 months, respectively [Figure 1]. Alcohol was not consumed by any of the PCS patients before injury, therefore, they did not show reduced alcohol tolerance as postinjury symptom [Figure 1].

In addition, we also analyzed the factors associated with the development of PCS symptoms through Multivariable Logistic Regression Model. For mechanism of injuries, the road traffic accident was used as a control while for the other factors, patients without PCS symptoms were used as baseline. Our analysis showed that none of the tested factors were significantly ($P > 0.05$) associated with PCS [Table 4]. Although the ratio of patients with skull fracture was shown to be 5.7 times more likely to develop PCS, however, this factor was not significant ($P = 0.076$).

Followed by this were other factors: assault ($P = 0.123$), premorbidity ($P = 0.254$), smoking ($P = 0.471$), sports ($P = 0.754$), and finally falls ($P = 0.999$) [Table 4].

Table 2: Factors associated with the duration of postconcussion syndrome

Characteristics	pcs	
	Without pcs, *n* (%)	With pcs, *n* (%)
Mean age	30.5	28.5
Gender		
Female	62 (32.8)	14 (70.0)
Male	127 (67.2)	6 (30.0)
Ethnicity		
Malay	150 (79.4)	19 (95.0)
Chinese	25 (13.2)	0 (0)
Indian	9 (4.8)	1 (5.0)
Others	5 (2.6)	0 (0)
Smoking		
No	128 (67.7)	15 (75.0)
Yes	61 (32.3)	5 (25.0)
Skull fracture		
No	185 (97.9)	18 (90.0)
Yes	4 (2.1)	2 (10.0)
Premorbidity		
No	154 (81.5)	18 (90.0)
Yes	35 (18.5)	2 (10.0)
Mechanism of injury		
Road traffic accident	159 (84.1)	16 (80.0)
Falls	17 (9.0)	1 (5.0)
Assault	9 (4.8)	3 (15.0)
Sports	4 (2.1)	0 (0)

PCS – Postconcussion syndrome

Table 3: Prevalence and duration of postconcussion syndrome

Duration of PCS symptoms	Prevalence (95% CI)
PCS for 2 weeks (*n*=20)	9.6 (5.6-13.6)
PCS for 3 months (*n*=17)	8.1 (4.4-11.8)
PCS for 6 months (*n*=17)	8.1 (4.4-11.8)

CI – Confidence interval; PCS – Postconcussion syndrome

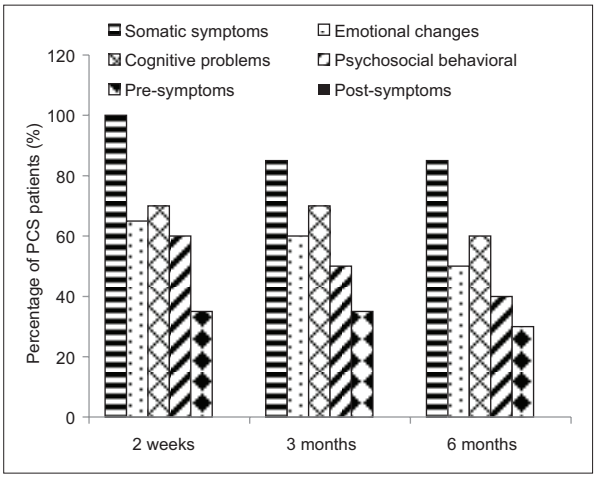

Figure 1: Percentage of patients with postconcussion syndrome symptoms at 2 weeks (first follow-up), 3 months (second follow-up) and 6 months (third follow-up). Postconcussion syndrome symptoms were categorized based on clinical domains; somatic symptoms: headache, malaise, fatigue, noise intolerance, and dizziness; emotional changes: irritability, depression, anxiety and lability; cognitive problems: subjective concentration, memory or intellectual difficulties without neuropsychological evidence of marked impairment; postsymptoms: reduced alcohol tolerance; psychosocial behavioral: insomnia and presymptoms: preoccupation with clinical symptoms and fear of brain damage with hypochondriacal concern and adoption of sick role

Table 4: Predictor for postconcussion syndrome

Variables	Adjusted OR	95% CI		*P*
		Lower	Upper	
Mechanism of injury				
Road traffic accident	1	-	-	-
Sports	0.714	0.087	5.841	0.754
Assault	3.168	0.731	13.727	0.123
Fall	0.000	0.000	0.000	0.999
Premorbidity				
No	1	-	-	-
Yes	0.392	0.078	1.962	0.254
Skull fracture				
No	1	-	-	-
Yes	5.717	0.831	39.314	0.076
Smoking				
No	1	-	-	-
Yes	0.667	0.221	2.007	0.471

OR – Odds ratio; CI – Confidence interval; PCS – Postconcussion syndrome

Discussion

Traumatic brain injury is usually categorized as mild, moderate, and severe according to the severity of the injuries based on the GCS scores. Based on the previous study, there were 1.4 million reported cases of traumatic brain injury in the United States every year, and from this figure, MTBI accounts for 70%–90% of the cases.[4] Another study stated that MTBI cases are usually underreported, and the estimated incidence of MTBI in the general population is about 130 cases in 100,000 population.[3] In this current study, we have reported 209 cases of MTBI which have been referred to the Neurological Centre at HTAA, from January 2016 to December 2016. Majority of the patients were young adults with a median age of 22 years (IQR = 18.0), which contradicted with the previous report where MTBI patients are from the middle age group with a median age of 44 years (IQR = 26–60).[5] There were more male (63.6%) patients in this study than female (36.4%). However, in the western population, more female patients (55.7%) were reported.[6] Interestingly, there were more Malay patients than Chinese and Indian. The reason for this could be, Malay is the ethnic majority in the Malaysian population.

There are substantial amount of changes in brain's pathology, physiology, and cognitive following MTBI. PCS is a cluster of symptoms which occurred in MTBI patients for weeks, months, years, or even more. Early symptoms that typically persist at all time point of injury are nausea, vomiting, headache, and drowsiness.[7-11] According to the ICD-10, PCS is sufficiently severe enough to cause unconsciousness in patients with moderate-to-severe injuries. In the western population, the prevalence of PCS ranges from 40% to 80% for the 1st week, up to 50% for 3 months, and around 10% to 15% for a year after the injury.[12,13] The variation in the prevalence changes with the study population, setting, and timing of recruitment.[14] In this study, the prevalence of PCS was 9.6% at the first follow-up (2 weeks), and it was consistent (8.1%) at the following second (3 months) and third (6 months) follow-ups. The slight reduction in the prevalence was due to the subsiding of symptoms within 3 months' following MTBI. A similar pattern of the result was observed in previous studies where PCS symptoms were completely resolved within 3 months of injury.[15,16] Although PCS is usually resolved in a few months, other studies have shown that in certain patients the prevalence continues for many years.[10,17] Literally, the persisted clinical symptoms could interfere with the patient's normal activities as well as work efficiency causing poor economic contribution and increased healthcare expenses.

Researchers stated that sociodemographic variables such as age, gender, and education level act as predictive factors for the development of PCS.[18-20] In addition, the presence of preinjury or mental health-related factors has been identified as risk factors for poorer MTBI outcomes in several other studies.[21-23] In contrast, those factors tested in this study; road traffic accidents, assault, skull fracture, premorbidity, smoking, sports, and falls were not significantly associated with PCS development. These findings could be explained, in part, because of the very small group of patients (n = 20) with PCS which was identified out of the total of 209 MTBI patients. Previous studies reported that gender as a predictive factor for PCS where female adults developed obvious symptoms at 1 week of postinjury.[6,15,22,24,25] While other studies reported that there were no association between gender and PCS especially at 3 months of postinjury.[26-28] Although there were more female PCS patients (70%) reported in this study, the impact of the factor gender in the association of PCS still remains unclear. In terms of mechanism of injury, road accidents were reported as a factor for the development of PCS at 1-week follow-up.[5] In another study, skull fracture was identified as a risk factor for PCS symptoms, in particular headache and dizziness.[26] Unlike previous findings, both road traffic accidents and skull fracture were not the influencing factors in this current study. This indicates that there are other factors likely which were not included in this study.

Begaz *et al*.[29] reported that the circulating serum biomarkers following MTBI presumably reflect some aspect of brain trauma and can influence the development and maintenance of persistent symptoms. The detection of these biomarkers could benefit future clinical studies to more accurately predict the multifactorial pathophysiology that leads to the development of PCS. Thus, early prediction of PCS symptoms with a combination of risk factors and biomarkers would be beneficial to patients and health-care providers.

Conclusion

As this is the first attempt in Malaysia to look into prevalence and risk factors of PCS, these findings would

serve as a guideline for future studies in determining risk factors associated with PCS in a larger adult population of other regions in Malaysia.

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Conflicts of interest

There are no conflicts of interest.

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