

Original Research

Post-Concussion Syndrome Detection in Post-Traumatic Brain Injury Patients



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Article Info	Abstract
<p>Article history: Received: 21 September 2022 Accepted: 12 December 2022</p>	<p><i>Introduction:</i> Some post-traumatic brain injury patients who were treated and declared to be discharged or continued at home experienced a collection of somatic, cognitive, and psychosocial symptoms. This study was conducted to determine the initial condition of the patient when admitted to the hospital with the incidence of post-concussion syndrome.</p> <p><i>Methods:</i> This study uses a prospective cohort approach. In this study identified functional changes in patients such as cognitive disorders and sleep disturbances with respect to severity. Cognitive impairment was measured using the Mini-Mental State Examination (MMSE) and sleep disturbance was measured using the Insomnia Severity Index (ISI). The sample were 49 patients of traumatic brain injury in the emergency department of PKU Muhammadiyah Gombong Hospital.</p> <p><i>Results:</i> The Age ($p=0.000$), GCS initial score ($p=0.023$), hospital admission diagnosis ($p=0.000$) and length of stay ($p=0.000$) had a relationship with the cognitive status of post-traumatic brain injury patients. While the initial GCS score ($p = 0.000$) and the initial diagnosis of hospital admission ($p = 0.001$) had a relationship with sleep disturbances in post-traumatic brain injury patients.</p> <p><i>Conclusion:</i> Age, initial GCS score, hospital admission diagnosis and length of stay have a relationship with cognitive level in post-traumatic brain injury patients. Initial GCS scores and early diagnosis of hospital admission have a relationship with sleep disturbances in post-traumatic brain injury patients. These factors can be used as an initial identification when a patient enters the hospital emergency room and a consideration for the type of treatment and therapy given.</p>
<p>Keywords: cognitive disorder, sleep disturbance, post-concussion syndrome, traumatic brain injury</p>	

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INTRODUCTION

The main cause of death in the population under the age of 45 years or in their productive years is traumatic brain injury. The incidence of traumatic brain injury in America reaches 367 cases per 100,000 population with the highest population group aged 15-24 years. The annual report of the Emergency Room (IGD) of RSUP Dr. Sardjito Yogyakarta in 2016 showed the incidence of traumatic brain injury cases was 75% of the total patient visits [1].

Some post-traumatic brain injury patients who were treated and declared to be discharged or continued at home experienced a collection of somatic, cognitive, and psychosocial symptoms. This symptom is Post-concussion Syndrome (PCS) [2], [3]. Based on the onset of PCS is classified into acute, subacute and chronic. Approximately 40-45% of patients will develop PCS in the first to third month post-onset and 25% of patients in the year post-onset [4], [5]. In addition, cognitive problems also undergo changes, such as attention, memory and executive function. Meanwhile, sleep disturbances often occur after traumatic brain injury, in the form of insomnia, hyper insomnia and sleep apnea [6].

Research on persistent cognitive impairment in adult patients without intracranial bleeding who survived post-treatment in the Intensive Care Unit (ICU) showed that 74% of patients had cognitive impairment [7]. The incidence of cognitive impairment is more common in patients with cerebral commotion and skull fractures with a ratio of 81% versus 43%. After 2 years,

persistent cognitive impairment nearly doubled in patients with cerebral commotion and skull fractures compared with those without. During the 30-year follow-up period of patients with cognitive impairment after traumatic brain injury, the female group of patients tended to maintain their cognitive level, but the male group showed worsening[8]. Younger sufferers have the possibility to maintain or even improve cognitive function [9], [10].

The prevalence of insomnia in traumatic brain injury patients ranges from 30-50%. This could be due to focal or diffuse lesions of the brain, especially brainstem structures that can interfere with neuronal systems involved in sleep regulation. Decreased melatonin secretion in traumatic brain injury patients can affect circadian rhythm changes resulting in insomnia[11]. Traumatic brain injury patients reported having difficulty initiating and maintaining sleep at night, as well as complaints of sleepiness during the day [12], [13].

PCS is very disruptive to the patient's life. In addition to having to continually manage concussion symptoms, which can improve with normal activity, long-term PCS patients often have to restructure their lives to avoid activities and situations that cause symptoms to worsen [14]. In adults, PCS can seriously impact a patient's personal and professional life, interfering with family life, as well as the ability to focus, communicate and be effective at work [15]. In addition, social problems and the level of independence and activity will also be very disturbing [16], [17]. If it can be predicted earlier about the possibility that occurs after traumatic brain injury, it is hoped

that better preventive measures can be given so that patients will be able to survive more and have minimal complaints after traumatic brain injury. Based on this phenomenon, researchers are interested in conducting research on the detection of Post-Concussion Syndrome after traumatic brain injury. There is no development of early scoring to detect the outcome of post-head injury patients with post-concussion syndrome. This detection can be used as an initial step in the assessment before determining the type of action given to the patient while in the hospital.

METHODS

This study uses a correlative analysis design with a prospective cohort approach. In this study identified functional changes in patients such as cognitive disorders and sleep disturbances with respect to severity. Cognitive impairment was measured using the Mini-Mental State Examination (MMSE) and sleep disturbance was measured using the Insomnia Severity Index (ISI). The population in this study were all traumatic brain injury patients in the emergency department of PKU Muhammadiyah Gombong Hospital. The sample in this study were 49 patients of traumatic brain injury with inclusion criteria aged 20-55 years, mild-moderate traumatic brain injury patients with a GCS score of 9-15, 1-6 months after being hospitalized and willing to be research subjects. While the exclusion criteria were patients with worsening conditions up to death, experiencing disabilities, mental disorders and dementia.

This study uses an observation sheet, MMSE (Mini-Mental State Examination) to measure cognitive, and ISI (Insomnia Severity Index) to measure the symptoms and consequences of insomnia. The MMSE assesses a number of cognitive domains, namely time and place orientation, registration, attention and calculation, recall, and language consisting of naming objects, repeating words, understanding and executing verbal and written commands, writing, and copying pictures. Each assessment consists of several tests and is scored for each correct answer. The total score on the MMSE if all answers are correct is 30. The ISI questionnaire was first compiled by Charles M Morin in 1993, to measure the symptoms and consequences of insomnia. The ISI consisted of objective question items that assessed sleep onset, maintenance of sleep, morning awakening, impaired daily functioning, suspected impairment associated with sleep problems, concerns about sleep problems and satisfaction with sleep patterns. Each item is measured and rated on a scale of 0-4. The total score between 0-28 was obtained from a total of seven questions.

Data collection using the MMSE and ISI questionnaires was carried out when the patient did a medical check-up at the hospital. Questionnaires are given to patients by asking a number of questions while waiting in line for a medical check-up. Each answer given by the patient was included in the MMSE and ISI questionnaires. The final score is obtained after all questions have been answered by the patient. The data were then displayed in the form of diagrams and tables containing patient characteristics, functional changes,

sleep disturbances and the severity of post-traumatic brain injury patients. The data were also analyzed by Gamma Sommer's test. This research has passed the ethical test from the Health Research Ethics Committee with the number 117.6/II.3.AU/F/KEPK/VI/2022.

RESULTS

The research was conducted in August, 2022, the research subjects were 44 patients of traumatic brain injury. The following is the data of research respondents. We obtained information from study findings, where men predominate (84.1%) than women (15.9%). The majority of respondents (68.2%) are in productive age (21-30 years old). 40.9% of respondents work as self-employed with 43.2% is bachelor degree of education. 40.9% of respondents are severe TBI, 43.2% of respondents stay in hospital for 2-14 days with 56.8% caused by accident, and 45.5% of

respondents are in 9-12 of GCS score.

The Gamma Sommer's test shown that age, diagnosis (minor – severe TBI), and length of hospitalization all have an impact on patients with post-head injury patients' cognitive impairment ($p=0.000$). The severity at the emergency room (diagnosis and GCS score) are connected to the patient's sleep disturbances ($p<0.05$), as shown in **Error! Reference source not found..**

The average patient after 2-3 weeks experienced cognitive impairment at a moderate level with a total of 24 people, which can be seen in Figure 1. The problem that often occurs is remembering parameters when studied using MMSE. This is related to the recovery process in head injury patients when experiencing disturbances in the limbic system related to memory. Meanwhile, sleep disorders were also at a moderate level, with a total of 21 people.

Table 1

Demographic Data and Statistical Test Results

	n	%	MMSE p-value	ISI p-value
Age (year)				
21-30	30	68.2	0.000	0.297
31-40	8	18.2		
41-50	6	13.6		
Gender				
Man	37	84.1	0.823	0.208
Woman	7	15.9		
Work				
ASN	2	4.5	0.672	0.703
Self-employed	18	40.9		
Farmer	3	6.8		
Trader	14	31.8		
Laborer	3	6.8		
Army/Police	4	9.1		
Last Education				
Primary School	5	11.4	0.113	0.195
Junior High School	5	11.4		
Senior High School	13	29.5		
Bachelor	19	43.2		
No School	2	4.5		
GCS Score				
13-15	6	13.6	0.023	0.000
9-12	20	45.5		
3-8	18	40.9		
Injury Mechanism				
Accident	25	56.8	0.212	0.393
Fall	13	29.5		
Other	6	13.7		
Diagnosis				
Minor TBI	9	20.5	0.000	0.001
Moderate TBI	17	38.6		
Severe TBI	18	40.9		
Head CT Scan Result				
Normal	18	40.9	0.686	0.498
Cerebral Edema	8	18.2		
Epidural Hematoma	6	13.6		
Subdural Hematoma	12	27.3		
Length of Hospitalization (days)				
1-2				
2-14	8	18.2	0.000	0.322
>14	19	43.2		
	17	38.6		

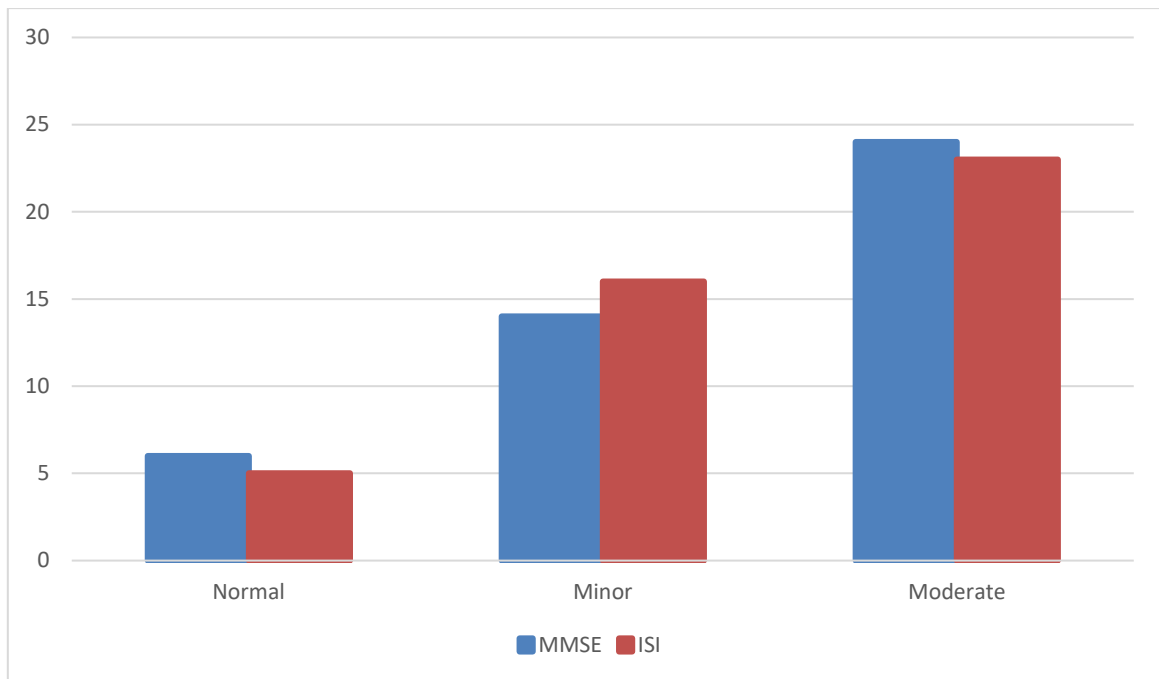


Figure 1. Frequency of Respondents Based on Cognitive Values and Sleep Disorders

DISCUSSION

Based on the results of the study, age ($p=0.000$), GCS initial score ($p=0.023$), hospital admission diagnosis ($p=0.000$) and length of stay ($p=0.000$) had a relationship with the cognitive status of post-head injury patients assessed using the Mini-Mental State Examination (MMSE). Productive age has a good memory and healing response faster than those of patients who enter the elderly. The results showed that the majority of head injury patients were in the age range of 21-30 years[18]. This age is a productive age with the ability to regenerate cells that are still very good. Head injury patients often occur in those who have high mobility and activity. Productive age also has high mobility related to the demands of work and other activities related to daily activities[19], [20].

Sleep problems are often experienced during the first 2 weeks after a head injury, namely often waking up earlier than usual and feeling dissatisfied when you wake up [21]. Post-traumatic brain injury patients experience sleep disturbances with an intermediate score [22]. Difficulty in resting at night occurs on average 2-3 weeks after treatment. This event takes place as a form of adaptation and recovery after injury.

The assessment of the level of consciousness using the Glasgow Coma Scale (GCS) is on average in the range of values 9-12. These results indicate that the patient has problems in the brain area assessed based on eye response, verbal response and motor response. Not all patients with low GCS scores, which indicate poor patient condition at baseline, always have a poor outcome[23]. The initial value of the GCS can indicate a post-

traumatic condition, but over time and the patient has received treatment at the hospital with a good response time, the patient's condition to improve is greater[5]. The good condition which is then seen from the cognitive response using the MMSE in the majority of patients is in the normal category[24].

Length of stay has a relationship with cognitive status in post-head injury patients, with an average length of stay of 2-14 days. The longer the patient is treated, the more patients get action and therapy to support the process of improving the biological condition. Patients with an average length of stay of 2-14 days have a good outcome. This time is the ideal time span for the length of treatment for head injury patients in the hospital[25], [26].

Gender, Occupation, Last Education, Mechanism of Injury and Head CT Scan Results are variables that have no relationship to the cognitive status of post-head injury patients. Characteristics of respondents based on gender, occupation and recent education become an evaluation for further study[27]. The application of advanced neuroimaging and the identification of specific molecular biomarkers in serum for diagnosis and prognosis are rapidly advancing, and might help to further categorize these injuries. While the mechanism of injury, where the average patient has an accident, be it a traffic accident or a work accident[28]. The mechanism of injury is not always significant with the severity of the head injury patient. Patients with normal head CT scan results had the highest number, so they did not have a significant value on the patient's cognitive status[29], [30]. Patients with head CT scan

results of cerebral edema and hematoma also have a good cognitive level, as long as they receive appropriate treatment and therapy during hospitalization[31].

While the initial GCS score ($p = 0.000$) and the initial diagnosis of hospital admission ($p = 0.001$) had a relationship with sleep disturbances in post-head injury patients. Patients with head injury had hypersomnia as much as 28%. This condition is due to decreased orexin levels and due to damage to areas that maintain wakefulness. Hypersomnia is also associated with healing, time-consuming sleep and accidents due to drowsiness[32]. There are no data on the prevalence of circadian rhythm disturbances after head injury[4]. This disorder is caused by injury to the suprachiasmatic nucleus and is often associated with worsening of the patient's condition. Insomnia and circadian rhythm disturbances are often associated with a specific site of injury, but hypersomnia is associated with orexin levels and is not strongly associated with specific areas[1], [33]. Insomnia and circadian rhythm disturbances are associated with worsening, but hypersomnia may signal improvement and is not associated with other disorders.

The results of a study conducted for 18 months by the Centers for Disease Control and Prevention (CDC) by looking at patients after a head injury actually had an average sleep time of one hour longer than the general population. In addition, as many as 67% of respondents reported that they often feel excessively sleepy during the day[34]. The severity, incidence, and causes of sleep disturbances are still not widely known in post-head injury patients. Most of the studies

that have been done have made observations for 6 months after a head injury, because it is assumed that the effect will fade over time. However, studies carried out longer than 18 months actually produced a different response[16], [17].

LIMITATION

Some patients with head injuries will limit their activities independently for maximum healing. This condition will make the patient feel sleepy both during the day and at night. This condition is also a good way to recover physically and mentally after a head injury. The physical domain in post-head injury patients is the most disturbing domain. If physically the patient has been declared cured and recovered, the patient will be able to adapt better to the psychological and social domains, as well as spiritually.

CONCLUSION

The results of the study of age, initial GCS score, hospital admission diagnosis and length of stay had a relationship with cognitive levels in post-head injury patients. Initial GCS score and diagnosis have a relationship with sleep disturbances in post-head injury patients. These factors can be used as an initial identification, it means assessment and examination, when a patient enters the hospital emergency room and a consideration for the type of treatment and therapy given, for example, in the administration of drugs or pharmacology, collaboration for supporting examinations (head CT scan), brain resuscitation and fluid resuscitation. It means an early predictor of

the patient's condition after a head injury in the hospital, so that it can determine the type of action that is fast and appropriate to increase survival and improve patient outcomes.

ACKNOWLEDGEMENT

We sincerely appreciate the research subjects who volunteered to take part in this study. We also acknowledge the support provided by the Indonesian Ministry of Education, Culture, Research, and Technology for funding research initiatives.

CONFLICT OF INTEREST

No authors have declared any conflicts of interest.

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