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Relationship of The Degree of Head Injury Based on Glasgow Coma Scale (GCS) with the Arrival of Acute Post Concussion Syndrome (PCS) Onset in Post-Head Injury Patients in General Hospital Dr.M.Djamil Padang

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ABSTRACT

Background: Traumatic brain injury is the main cause of death in the population under the age of 45 years, and the fourth leading cause of death in the entire of population. Based on the degree of traumatic brain injury, it is commonly categorized based on the Glasgow Coma Scale (GCS). Post-Concussion Syndrome (PCS) is the set of somatic, emotional / behavioral and cognitive symptoms that occur after a traumatic brain injury. The aim of this study was to find out the prevalence and correlation of the degree of traumatic brain injury based on the Glasgow Coma Scale (GCS) and the emersion of Post-Concussion Syndrome (PCS) acute onset in patients with head injuries **Method:** This study was a cross-sectional analytic study of patients who experienced Post-Concussion Syndrome (PCS) after traumatic brain injury at DR. M. Djamil Hospital Padang in 2020 from June to November 2020. Data were collected by filling in a questionnaire (The Rivermead Post Concussion Symptoms Questionnaire) and medical record data of neurosurgical patients that met the inclusion and exclusion criteria. **Result**: : It indicated that 70 patients were included in the inclusion criteria of this study. A total of 38 (54.3) respondents did not undergo the acute onset of PCS, meanwhile respondents who experienced acute onset of PCS were 32 (45.7) respondents. The results showed that 25 (67.6%) respondents with mild traumatic brain injury had PCS acute onset, while 4 (17.4%) respondents with moderate degree of traumatic brain injury had PCS acute onset, and 4 (17.4%) respondents had PCS acute onset PCS 3 (30%) respondents experienced severe traumatic brain injury with acute onset PCS and statistically the difference in the proportion of data from each of these variables was significant with a p-value of 0.0001. The results of statistical tests showed that p value> 0.05 on the correlation between PCS and GCS, thus, it can be concluded that there was no correlation between the direction of the relationship between PCS and GCS. **Conclusion** There was no correlation between the degree of traumatic brain injury based on GCS and the incidence of PCS acute onset, either it was unidirectional or vice versa in patients with head injuries at RSUP M. Djamil Padang.

1. Introduction

Head injury is the leading cause of death in the population under 45 years of age, and is the 4th leading cause of death in the entire population. The incidence of head injury in America ranges from 132-367 per 100,000 population with the highest population group aged 15-24 years. The frequency of head injuries in males and females was 2-2.8: 1, most of them had mild head injuries (80%), the rest had moderate head injuries (CKS) (10%), and severe head injuries (CKB) (10%).[1] Based on data from Basic Health Research (RISKESDAS) in 2018, the proportion of head injuries nationally is 11.9%, with the proportion of head injuries in West Sumatra province 14.3%, where at Dr. M Djamil Padang, there were a number of head injury cases in 2017 of 356 cases, in 2018 of 505 cases.[2]

Based on the degree of head injury, generally categorized based on Glasgow Coma Scale (GCS). GCS assesses the level of consciousness based on three clinical components, namely eye opening response, motor and verbal responses. The GCS score is the total value of the three components, namely between 3-15. A value of 3 means that the patient does not respond to any stimuli, while a value of 15 means that the patient is fully aware. GCS assessment is usually performed during trauma resuscitation. The classification of head injuries is divided into 3 where severe head injury with a GCS score of 3 to 8, moderate head injury with a GCS score of 9 to 13, minor head injury with a GCS score of 14 to 15.3

Post Concussion Syndrome (PCS) is a collection of somatic, emotional / behavioral and cognitive symptoms that occur after a head injury. [4] Which include somatic symptoms are headache, fatigue, sleep disturbances, nausea, vomiting, visual disturbances, tinnitus, vertigo, sensitivity to sound and light. Emotional / behavioral symptoms consist of a low tolerance for frustration, anxiety, emotional build-up, depression, anxiety, and personality changes. While cognitive symptoms consist of decreased thinking responses, decreased concentration, mental fogginess, difficulty learning and remembering disorganization, reduced problem solving abilities.

Based on the onset PCS was classified as acute (symptoms appearing less than one month after injury), subacute (> 1-12 months), and chronic (more than a year). About 40-50% of patients will experience PCS in the first to third month post-onset, and 25% of patients at a year of onset.

Research on persistent cognitive impairment in adult patients without intracranial hemorrhage who survived after treatment at the Intensive Care Unit (ICU) showed that 74% of patients had cognitive impairment.6 At 2 years of follow-up, persistent cognitive dysfunction almost doubled in patients with head injuries and head fractures than those without. During the 30-year follow-up period of patients with cognitive impairment after head injury, the female patient group tended to maintain their cognitive level, but the male group showed worsening. Younger sufferers have the possibility to maintain or even improve cognitive function. [7,8]

The decline in cognitive function in the form of memory impairment was 60% after CKR, while the CKS was 50%, and post CKB was 20%. Difficulty in concentration occurred in patients after CKR (65%), post CKS (60%), and post CKB (40%). Fatigue is complained of 60% after CKR and CKS and 35% after CKB. Empirical studies report that anxiety is a specific symptom of PCS which is more prevalent in the CKR population than CKS or CKB.[9]

The prevalence of post-injury headaches ranges from 30–90%, and can occur as a result of minor, moderate, or severe head injuries.10 Post-injury headaches occur in 50-80% immediately after the incident and can continue for 1-2 years later around 20- 30% .11 A review of the scientific literature conducted by Seifert & Evans reported that as much as 85% of post-injury headaches were tension-type headaches.12 Research on military soldiers showed different results that 78% of headache symptoms were migraine-type headaches.[13] Other studies show migraine headaches and tension type headaches have almost the same prevalence after the incidence of head injury, namely 39% for migraine headaches and 34.1% for tension headaches.14 Moderate or severe head injuries cause headaches in three times more than post minor head injury. [15,16]

But what is of concern is the high incidence of head injuries and sequelae in the form of Post Concussion Syndrome which is not followed by high awareness for patients to get maximum management of the incidence of Post Concussion Syndrome in the medical field, so that the Post

Concussion Syndrome incident continues and interfere with the daily activities of the patient.

2. Method

This study is an analytical study using the Cross Sectional method for patients who experience Post Concussion Syndrome (PCS) after a head injury in RSUP. DR. M. Djamil Padang between June and November 2020. The number of samples was determined using the Modified Lemeshow formula. The inclusion criteria in this study were: Patients who suffered head injuries in RSUP. DR. M. Djamil Padang in the span of the study period, Patients with acute Post Concussion Syndrome (PCS) symptom onset or less than 1 month after the incident, aged more than 18 years, the patient left the ward alive without disabilities, minimum level of elementary school education / equivalent, and the patient is willing to participate in this study after being given an explanation.

While the exclusion criteria in this study were patients who had a history of complaints such as complaints on Post Concussion Syndrome before the occurrence of head injury and patients who had a history of comorbidities who gave the same complaints as complaints on Post Concussion Syndrome before the occurrence of head injury.

The data in this study were obtained by filling out a questionnaire (The Rivermead Post Concussion Symptoms Questionnaire) by conducting interviews with patients. Data on the degree of head injury based on GCS were obtained from medical records of neurosurgical patients at RSUP. DR. M. Djamil Padang. Data were processed and analyzed using SPSS version 22. Data are presented in tables. Univariate analysis was performed to describe the characteristics of the research baseline data. Bivariate analysis with the Chi-Square test was performed to see the relationship between GCS and PCS. The results are said to be significant if the P value <0.05.

3. Results

Table 1 shows that the mean age of the study respondents was 39.97 ± 17.21 years. More than half of the respondents were male, namely 48 (68.6) respondents. For the incidence of head injury, it was found that 37 (52.9) respondents had a mild degree of head injury, followed by a moderate degree of head injury, namely 23 (32.9) and finally the degree of severe head injury was 10 (14.3). Then, 38 (54.3) respondents with acute onset PCS were negative (did not experience acute onset PCS), while respondents with acute onset PCS were positive (experienced acute onset PCS), namely 32 (45.7) respondents.

Table 2 shows that the mean age of the study respondents who experienced acute onset PCS was 41.19 ± 18.48 years. More than half of the respondents who experienced acute onset PCS were 23 (71.9) male respondents. For the degree of head injury, 25 (67.6) respondents with mild head injury had acute-onset PCS, whereas in the group with moderate-onset PCS, 4 (17.4) respondents had acute-onset PCS, and for respondents with the degree of injury. 3 (30) respondents developed acute onset PCS.

Table 3 shows that the degree of mild head injury has a mean total score of acute onset PCS of 17.2 with the lowest total score of 8 and the highest of 30. At moderate degree of head injury, the mean total score of acute onset PCS is 11.3 with a total score. the lowest score was 4 and the highest was 14. At the degree of severe head injury, the mean total score for acute onset PCS was 13 with the lowest score being 10 and the highest being 17.

Table 4 shows that the symptoms most often felt in respondents who suffered from acute onset PCS were; Headache 32 (100), Dizziness 30 (93.7) and feeling of unexplained restlessness 27 (84.4). Meanwhile, symptoms that are rarely felt are hearing sensitivity impairment 4 (12.5), visual impairment 6 (18.7), and sensitivity to light 8 (25).

Table 5 shows that respondents with mild head injury who experienced acute-onset PCS had the most headache symptoms 25 (100), dizziness 23 (92), and feelings of uneasiness 22 (88), etc.

Table 6 shows that as many as 25 (67.6%) respondents with mild head injury had acute-onset PCS, whereas in the group with moderate-onset PCS, 4 (17.4%) respondents had acute-onset PCS, and those with the degree of 3 (30%) of respondents experienced severe head injury with acute onset PCS and statistically the difference in the proportion of data from each of these variables was significant with a p-value of 0.0001

Table 7 shows the results of the Spearman correlation analysis, the correlation between PCS and GCS is -0.145. According to the level of closeness between the independent variable and the dependent variable, it shows that there is a low relationship with the direction of the negative and positive relationship. And the results of statistical tests showed a p value> 0.05, so it can be concluded that there is no correlation between the direction of the relationship between PCS and GCS.

Table 8 shows that there was no major differentiation of neutrophil value in minor head injury with and without intracranial hemorrhage (p value = 0.487) and there was no major differentiation of neutrophil value in moderate head injury with and without intracranial hemorrhage (p value = 0.016).

From the data above, it was found that the incidence of acute onset PCS was mostly in the degree of mild head injury followed by the degree of severe head injury and the last was the degree of moderate head injury. So, from this data, it is clear that there is no relationship between the degree of head injury based on GCS and the incidence of acute onset PCS, either one-way or vice versa in patients with head injuries at RSUP M. Djamil Padang.

Table 1 Characteristics of Research Respondents

Characteristics	Means ± SD	F (%)
Age	39.97 ± 17.21	
Gender		
Male		48 (68.6)
Female		22 (31.4)
Degree of head		
Injury Light (GCS 14-15)		37 (52.9)
Moderate (GCS 9-13)		23 (32.9)
Weight (GCS 3-8)		10 (14.3)
Post Concussion Syndrome (PCS)		
Negative		38 (54.3)
Positive		32 (45.7)

Table 2 Characteristics of respondents with acute onset pcs

Characteristics	Mean ± SD	F (%)
Age	41.19 ± 18.48	
Gender		
Male		23 (71.9)
Female		9 (28.1)
Degree of head injury		
Light (GCS 14-15)		25 (67.6)
Moderate (GCS 9-13)		4 (17.4)

Table 3 Distribution of Total Score Lowest, Highest and Average Score of Respondents who experienced acute onset PCS

Degree of Head Injury	PCS Acute Onset		
	Lowest	Highest	Mean
Mild (GCS 14-15)	8	30	17.2
Moderate (GCS 9-13)	4	14	11.3
Weight (GCS 3-8)	10	17	13

Table 4. The distribution of symptoms felt among all respondents who experienced Acute Onset PCS

Symptoms	F (%)
Headache	32 (100)
Dizziness	30 (93.7)
Nauseous vomit	25 (78.1)
Hearing sensitivity impairment	4 (12.5)
Trouble starting to sleep	25 (78.1)
Fatigue	22 (68.8)
Easy to get angry	24 (75)
Feelings of depression	23 (71.8)
Feelings of frustration / impatience	25 (78.1)
Easy forgetting / memory disturbances	18 (56.3)
Hard to concentrate	22 (68.8)
Difficulty thinking	23 (71.8)
Visual disturbances	6 (18.7)
Sensitive to light	8 (25)

Double view	9 (28.1)
Uneasy feeling for no reason	27 (84.4)

Table 5 Distribution of symptoms in each group of the degree of head injury with acute onset pcs

Minor head injury	**F (%)**	**Minor head injury**	**F (%)**	**Minor head injury**	**F(%)**
Headache	25 (100)	Headache	4 (100)	Headache	3 (100)
Dizziness	23 (92)	Dizziness	4 (100)	Dizziness	3 (100)
Uneasy feeling for no reason	22 (88)	Nauseous vomit	3 (75)	Uneasy feeling for no reason	3 (100)
Trouble starting to sleep	21 (84)	Trouble starting to sleep	3 (75)	Nauseous vomit	2 (66.6)
Easy to get angry	21 (84)	Feelings of depression	3 (75)	Hearing sensitivity impairment	2 (66.6)
Feelings of frustration / impatience	21 (84)	Difficulty thinking	3 (75)	Feelings of depression	2 (66.6)
Nauseous vomit	20 (80)	Double view	3 (75)	Feelings of frustration / impatience	2 (66.6)
Difficulty thinking	20 (80)	Fatigue	2 (50)	Hard to concentrate	2 (66.6)
Fatigue	19 (76)	Easy to get angry	2 (50)	Easy to get angry	1 (33.3)
Feelings of depression	18 (72)	Feelings of frustration / impatience	2 (50)	Easy forgetting / memory disturbances	1 (33.3)
Hard to concentrate	18 (72)	Hard to concentrate	2 (50)	Visual disturbances	1 (33.3)
Easy forgetting / memory disturbances	16 (64)	Uneasy feeling for no reason	2 (50)	Sensitive to light	1 (33.3)
Sensitive to light	7 (28)	Easy forgetting / memory disturbances	1 (25)	Double view	1 (33.3)

Double view	5 (20)	Visual disturbances	1 (25)	Fatigue	1 (33.3)

Table 6 The relationship of degree of head injury based on GCS with the incidence of PCS on Acute was based on differences in the proportion of data

Degree of Head Injury	PCS		Total	P value
	Positive	Negative		
Light	25 (67.6 %)	12 (32.4 %)	37	0.0001
Moderate	4 (17.4 %)	19 (82.6 %)	23	
Weight	3 (30 %)	7 (70 %)	10	

Table 7 Correlation of the direction of the relationship between variables

		Correlation		
			PCS	GCS
Spearman's rho	PCS	Correlation Coefficient	1.000	-.145
		Sig (2-tailed)		.672
		N	70	70
	GCS	Correlation coefficient	-.145	1.000
		Sig (2-tailed)	.672	
		N	70	70
", correlation is significant at the 0.01 level (2-tailed)				

Table 8 Result of Head Injury Patients' Analysis Based on Neutrophil Value

Variable	R count	R table	Conclusion
PCS-GCS	0.145	0,235	There is no correlation

4. Discussion

In this study, researchers discussed head injuries and sequelae that are caused by structural changes and metabolic reactions in the brain, which is called Post Concussion Syndrome (PCS) .4 Head injury itself is defined as a complex pathophysiological process in the brain that involves biomechanical forces of traumatic events.20 The pathophysiology of PCS is still not completely clear, but the pathophysiology of PCS cannot be separated from the pathophysiology of head injury itself.30

In this study, the researchers tried to link the incidence of head injuries classified according to the Glasgow Coma Scale (GCS) scoring and the incidence of acute-onset PCS in patients with head injuries. From the research results described in the previous chapter, the researcher gets some discussion in this chapter.

The results of this study indicate that more than half of the respondents, namely 37 (52.9) respondents with a minor degree of head injury, followed by a moderate degree of head injury, namely 23 (32.9) and finally the degree of severe

head injury was 10 (14.3). This is consistent with research conducted by Jagoda et al. in 2006 which stated that of all head injuries that occurred, most had minor head injuries (80%), the rest had moderate head injuries (10%), and severe head injuries (10%). 1

Meanwhile, for the onset of acute-onset PCS in patients with head injuries from this study, 32 (45.7) of the total respondents had acute-onset PCS, this is similar to that stated in the literature from Acedemy Emergency Medicine in 2001 in America. states that about 40-50% of patients will experience PCS in the first to third months after a head injury. 5

For the age range of patients with acute onset PCS in this study the researchers obtained a mean of 41.19 + 18.48 years. In another study by Brenda et al. states that the incidence of PCS is more common at the age above 50 years. In the same study conducted by Brenda et al. in 2018 at the Toronto Western Hospital stated that the incidence of acute-onset PCS in women was higher than in men.52 However, the researchers found that the incidence of acute onset PCS was different in men 23 (71 , 9) more than women 9 (28.1). Meanwhile, results were similar to those of ours in other studies conducted by Asres et al. In 2018 at Hawassa University Hospital, it was stated that the male gender (75 people) experienced more acute onset PCS than women (39 people) .53

From the literature, it is said that Post Concussion Syndrome (PCS) is a collection of symptoms consisting of somatic, emotional / behavioral and cognitive symptoms.4 Where symptoms such as headache, fatigue, sleep disturbances, nausea, vomiting, visual disturbances, tinnitus, vertigo, sensitivity to sound and light are included in somatic symptoms Meanwhile, emotional / behavioral symptoms consist of low tolerance for frustration, anxiety, emotional increase, depression, anxiety, and personality changes. And cognitive symptoms consist of decreased thinking responses, decreased concentration, mental fogginess, difficulty learning and remembering disorganization, reduced problem solving abilities. From the symptoms above in this study the researchers found that headache 32 (100), dizziness 30 (93.7) and feeling restless without cause 27 (84.4) were the three most common symptoms complained of by respondents who experienced PCS while the symptoms rarely felt by respondents are hearing sensitivity impairment 4 (12.5), visual impairment 6 (18.7), and sensitive to light 8 (25).

According to Hoffman JM et al. in 2011, said that headache was the most frequent symptom that patients complained about, both minor, moderate and severe head injuries.10 Researchers also found the same thing in this study that headache was the most common symptom that occurred at every degree of head injury, where At each degree of head injury, complaints of headache had a percentage of 100% or always complained of, followed by Dizziness symptoms, namely 23 (92) in mild head injuries, 4 (100) in moderate head injuries and 3 (100) in severe head injuries, feeling anxiety without cause is 22 (88) in mild head injury and 3 (100) in severe head injury while nausea / vomiting 3 (75) occurs in moderate head injury, where these symptoms are the other most common symptoms after headache. Whereas for rare symptoms and symptoms that were not found in this study, it was found that hearing sensitivity symptoms were the most rare symptoms found in mild 2 (8) and moderate 0 (0) head injuries, while for severe head injuries, difficulty thinking was a symptom no complaints 0 (0).

PCS is a collection of symptoms that occur immediately after a head injury which mostly improves after the third week after head injury. However, PCS can be chronic and persistent.55 PCS is a group of symptoms experienced by a

person which can occur in minor, moderate or severe head injuries.56

Based on research conducted by Mullaly et al. in 2017 in Boston, USA, the incidence of PCS was more common in minor head injuries, reaching almost 80% compared to moderate and severe head injuries. Based on the above research, it is stated that PCS is more dominant or often occurs in minor head injuries. And from the results of this study, it was found that the incidence of PCS was more common in minor head injuries compared to moderate and severe head injuries, according to a study conducted by Mullaly et al. 23

Based on research conducted by Permenter CM et al. In 2020 in Puerto Rico and Miami, which tried to link the severity of head injury to the incidence of PCS, it was found that there was no relationship between the degree of head injury based on GCS and the incidence of acute onset PCS in patients with head injuries.57 This is in line with the results of our study. This shows that there is no relationship between the degree of head injury based on the Glasgow Coma Scale (GCS) and the onset of acute onset Post Concussion Syndrome (PCS), either one way or the other way around in patients with head injuries at RSUP M. Djamil Padang

From this study shows that Post Concussion Syndrome (PCS) is a collection of symptoms that is more common in minor head injuries than moderate and severe head injuries. In other words, the symptoms of Post Concussion Syndrome (PCS) predominantly occur in the degree of minor head injury. It is hoped that this can become data and a basis for clinicians to be able to provide education and more optimal management for all head injury patients, especially minor head injuries.

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6. Funding : -

7. Author contributions:

Muhammad Reza Azriyantha was responsible for data collection, research administration and writing the original draft. Syaiful Saanin and Hesty Lydia Ningsih were responsible for statistical analysis and writing the original draft. All authors have reviewed the latest version of the manuscript.

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