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Factors Related to Outcome of Traumatic Brain Injury Patients at M Djamil Padang Hospital

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ABSTRACT

Background: Traumatic brain injury is still a major threat because it can cause global morbidity and mortality. Many factors can affect the outcome of a traumatic brain injury. Some conditions that can exacerbate traumatic brain injury include GCS conditions, blood pressure variability, and pupillary reflexes. **Methods:** The research was conducted in M. Djamil Padang Hospital from October 2020 to March 2021. The study design was a cross-sectional study in traumatic brain injury patients with ≤ 48 hours of onset and the aged between 18-60 years. The subjects in this study consisted of 66 subjects. At 6 weeks after onset, a GOS assessment was performed to assess patient outcomes. Statistical analysis was performed computerized with SPSS 22.0. P-value <0.05 was considered statistically significant. **Results:** Most of the patients were male (71.2%) with an average age of 36.41 ± 14,275 years, and the most common injury mechanism was traffic accidents (95.5%). There was a significant relationship between onset of incidence, hypotension, pupillary reflexes, and Rotterdam score with the outcome of traumatic brain injury patients (p<0.05) and there was no significant relationship between age, gender, and mechanism of injury with the outcome patients with traumatic brain injury. **Conclution:** The onset of events, hypotension, pupillary reflexes, and Rotterdam scores significantly affect the outcome patients of traumatic brain injury.

1. Introduction

Traumatic brain injury continues to be a threat to the human as a major cause of morbidity and mortality globally. In the United States (US) approximately 1.7 million people suffer from traumatic brain injuries each year, also in globally traumatic brain injuries are the leading cause of death and disability in children and young adults. [1,2]

Many prognostic factors that influence outcome of traumatic brain injury consist of age, race, gender, mechanism of injury, onset of events, GCS on admission, presence or absence of hypotension, pupillary reflexes, and CT scan imagings. Patients with low baseline GCS scores (3-8) have a poorer prognosis than patients with better baseline GCS. [3,4] Age is an important independent predictor for outcome. Several studies have reported that traumatic brain injury at the age of >40 years has a poorer prognosis. The onset of brain injury and the patient admission also affects the outcome. [5,6,7]

CT scan evaluation and assessment of midline shift, edema, subarachnoid hemorrhage, or subdural hemorrhage are associated with an unfavorable outcome. The study of Ostermann 2018, showed a significantly higher risk of death in patients with a

midline shift >15 mm compared to patients without a midline shift.[8] Traumatic brain injury patients have a risk of developing disability where the risk increases with age and is significantly higher in women (49.5%) compared to men (39.9%). The risk of death after traumatic brain injury is increased 7 times compared to the general population.[9]

2. Methods

The study was conducted on patients with traumatic brain injury who were admitted to the Emergency Department (ER) of the RSUP Dr. M. Djamil Padang. Patients were consecutively collected from October 2020 to March 2021. The study design was cross-sectional in patients with traumatic brain injury with onset ≤ 48 hours and aged between 18-60 years. Traumatic brain injury patients who did not have a brain CT scan, patients with history of stroke, epilepsy, central nervous system infection, parkinson's disease, tumors, open traumatic brain injury, spinal cord injury, and received drugs with sedative effect were excluded from this study.

At first, data were recorded on demographic characteristics such as age, gender, the onset of events, mechanism of injury, and clinical characteristics of patients such as GCS admission, pupillary reflexes, hypotension, and Rotterdam scores. Patients received initial treatment and were hospitalized if the patient had indications. At 6 weeks after onset, a GOS assessment was performed to assess patient outcome. Statistical analysis was performed computerized with SPSS 22.0. The results are considered significant if the p-value < 0.05.

3. Result

In this study, 66 patients with traumatic brain injuries were admitted to the ER, Dr. M. Djamil hospital with the same number of patients for each severity of the brain injury. 26 people (39.4%) had bad outcome where 1 of them had a mild brain injury, 6 people had moderate brain injury and 19 people had severe brain injury. Most of the samples of this study were male, specifically 47 people (71.2%) and 27 people age ≥ 40 years. The mechanism of brain injury in this study is 95% from traffic accidents.

Table 1. Characteristics of traumatic brain injury patients

Variable	Value
Sex, n (%)	
Male	47 (71,2)
Female	19 (28,8)
Age, years, mean (±SD)	36,41 (14,275)
Mechanism of injury, n (%)	
Traffic accident	63 (95,5)
Fall	3 (4,5)
Onset, time, mean (±SD)	12,56 (±9,105)
Hypotension, mmHg, n (%)	
< 90	4 (6,1)
≥ 90	62 (63,9)
Pupillary reflexes, n (%)	
No	6 (9,1)
Yes	60 (90,9)
Rotterdam scores, n (%)	
≥ 4	7 (10,6)
< 4	59 (89,4)
Outcome, n (%)	
Poor	26 (39,4)
Good	40 (60,6)

The onset of brain trauma when sampling obtained 10 people with ≥ 24-hour onset. The Rotterdam score on the non-contrast CT scan in this study had score ≥ 4 for 7 patients. The basic characteristic data are presented in table 1.

Table 2 shows the relationship between the factors that affect the outcome in patients with traumatic brain injury, p value < 0.05 was considered to have a significant relationship. From the chi square analysis in this study, it was found that the duration of the incident, the presence of hypotension, the absence of pupillary reflexes and the Rotterdam score statistically affected the outcome of traumatic brain injury.

4. Discussion

Profiles of sex and age in this study are consistent with previous studies. In this study, it was found that there were more males (71.2%) than females (28.8%). This is suitable with the epidemiological study in Australia that studying the ratio of male to female in traumatic brain injury patients, Chang study in 2014 which included 4186 subjects, found that 63.6% were male.[10] In another study, it was also found that out of 175 adult patients (>18 years) diagnosed with traumatic brain injury, the majority were male as 116 people (66.29%).[11] Male in their productive age becomes the most common brain injury patients, ie 78.4%,[12] with a male to female ratio of 4.9:1.[13]

Table 2. Relationship of factors affecting outcome in patients with traumatic brain injury

Variable	Outcome		OR	CI 95%		p value
	Poor	Good		Min	Max	
Age			1,857	0,679	5,081	0,226[a]
≥ 40 years	13	14				
< 40 years	13	26				
Sex			1,172	0,396	3,465	0,774[a]
Female	8	11				
Male	18	29				
Onset			4,544	1,054	19,590	0,041[b]
≥ 24 hours	7	3				
< 24 hours	19	37				
Mechanism of injury			1,316	0,113	15,293	1,000[b]
Traffic Accident	25	38				
Fall	1	2				
Hypotension			2,818	2,015	3,942	0,021[b]
< 90 mmHg	4	0				
≥ 90 mmHg	22	40				
Pupillary reflexes			3,000	2,098	4,291	0,003[b]
No	6	0				
Yes	20	40				
Rotterdam score			11,700	1,317	103,974	0,013[b]
≥ 4	6	1				
< 4	20	39				

a: pearson chisquare b: fisher exact test

Nguyen study conducted a meta-analysis on the epidemiology of traumatic brain injury which included 82 studies. From this meta-analysis it was concluded that the number of male traumatic brain injury patients was significantly higher than female in all age groups, namely 151 per 100,000 for male and 86 per 100,000 for female.[14] Men have a tendency to suffer more from traumatic brain injuries than women because men have higher mobility and work more, especially outdoors.[10] However, there is no evidence that gender is associated with outcome in traumatic brain injury patients.[15]

The mean age of traumatic brain injury patients in the study was 36.41 ± 14,275 years, with the mean age of severe brain injury being higher (40.32 ± 16,019 years) than mild and moderate brain injuries. In another study, it was found that 67.9% of patients with traumatic brain injury admitted to Mulago Hospital, Uganda were aged 18-24 years, 25.3%, aged 35-50 years, and the remaining 6.8% were aged >50 years. The median age was 30 years and the mean age was 32 years (SD ±11).[12] The mean of this study was also lower than a prospective multicenter study conducted in the Netherlands where the mean age was 47.3 ± 20.4 years with a mean severe brain injury of 46.1 ± 20.0 years.[16] In this study, the mean age of the subjects was lower due to differences in the inclusion criteria. In this study, the age limit was 18-60 years. Meanwhile, the study of Andriessen, 2011 did not limit the maximum age of the study.[16]

Traumatic brain injury is caused by direct or indirect impact of the brain crash with a sudden or continuous mechanism by acceleration, deceleration, or rotational forces.[17] The mechanism of traumatic brain injury in this study was mostly traffic accidents (95.5%). Traffic accidents were the most common mechanism of injury, accounting for 108 cases (56.8%) in Uganda. Other mechanisms such as assault (36.8%), fall (5.8%), and shooting (0.5%).[12] This was also found in several other studies where traffic accidents were still the main injury mechanism from 58% to 98.6%.[4,16,17] Faal for the cause of injury was mostly at the age of 0-17 years and age >55 years,[18] while in this study the average age of the patients was 36.41 years (SD±14.275).

Mechanism of traffic accident injury had a significant relationship as a predictor of death in cases of traumatic brain injury (p = 0.013), although in this study no significant relationship was found between the mechanism of injury and outcome (p = 1.00).[4] The outcome in this study was generally good (60.6%). Death within 24 hours after hospital admission was 11.1%, death during hospitalization 19.9% with an average length of ICU stay about 10.3 days and hospitalization about 19.3 days. The factors that were found to significantly influence poor outcomes in this study included the onset of injury, the presence of hypotension, the absence of pupillary reflexes and the Rotterdam score.[4]

In this study, onset of injury >24 hours had a worse outcome than <24 hours and was one of the factors influencing poor outcome in traumatic brain injury patients. This is due to vasospasm caused by chronic depolarization of the vascular to reduce Na channel activity, prostaglandin-induced vasoconstriction and free radical formation. Brain oxygen consumption in this condition will decrease causing a decrease in cerebral metabolism resulting in a poor outcome.[19] Onset ≤ 24 hours usually indicates a better outcome and the majority are minor brain injuries, while the onset > 24 hours indicates a poor outcome and is usually a moderate to severe brain injury and more than 40% will have long-term disability.[18]

Blood pressure ≤90 mmHg was significant as a predictor of mortality in traumatic brain injury (p<0.001).[4] Hypotension due to secondary traumatic brain injury is one of the predictors of poor outcome in traumatic brain injury patients. Systolic blood pressure values >135 or ≤90 mmHg is associated with poor outcomes.[15] The mean arterial pressure (MAP) was also significant as a mortality factor in brain injury patients (p<0.012).[13] In this study, the hypotension that occurred in the patients significantly worsened the patient's outcome. Traumatic brain injury creates an imbalance between oxygen delivery and consumption as a result of hypoxia. Therefore, hypotension will worsen the outcome of a traumatic brain injury.[19]

This study found a significant relationship between

pupillary reflexes and patient outcome (p=0.003). The American Association of Neurological Surgeons and the Brain Trauma Foundation guidelines state that every patient with a severe traumatic brain injury is found to have asymmetric pupil size or pupillary reactivity to light, both fixed and/or dilated pupils. The literature on traumatic brain injury provides many evidences that pupillary reflexes, pupil size, or anisocoria are closely correlated with patient outcomes.[20]

Another suitable studies suggest that pupillary reflexes are an important prognostic instrument for cases of traumatic brain injury ($p < 0.001$).[11] There was also an association between abnormal or negative pupillary reflexes and the worst outcome.[15] Fixed pupil (OR 4.197, 95% CI 3.271– 5,386) and both dilated pupils (OR 2.848, 95% CI 2.282–3.556) were associated with a higher mortality rate.[4] Brain injury patients with abnormal pupillary reflexes had the highest intracranial pressure of 30.5 mmHg compared to 19.6 mmHg in the population with normal pupillary reflexes (p=0.0014). Patients with nonreactive pupils had the highest intracranial pressure (mean = 33.8 mmHg, p = 0.0046). These pupillary reflex abnormalities may reflect intracranial pressure and herniation in traumatic brain injuries. It can also be a prognostic indicator of functional healing.[20]

The Rotterdam score is a calcification system based on brain CT scan results developed by Maas in 2005. The Rotterdam score describes the basal cisterns, midline shift, the presence of an epidural mass and the presence of subarachnoid hemorrhage. In this study, a Rotterdam score >4 had a poor outcome with p value of 0.01. This is suitable with the research of Ramadhan, 2020 which states that the higher the Rotterdam score, the higher the mortality rate. This is because the higher the Rotterdam score, the more damage and bleeding that occurs in the brain.[17]

The multivariate logistic regression study also found that Rotterdam scores were also significantly associated with mortality (OR 4.98, 95% CI 1.40–17.78, p = 0.01) and poor outcome (OR 3.66, 95% CI 1.29–10.39, p = 0.02). In addition, the assessment of changes in the Rotterdam score can be a prognostic indicator that can help determine which patients require decompressive craniectomy.[21]

5. Conclusion

Traumatic brain injury is a threat to the human population as a major cause of morbidity and mortality globally. Many prognostic factors influence the outcome of traumatic brain injury. Control of factors that can worsen the outcome is expected to improve the prognosis of traumatic brain injury. This study found a significant relationship between the onset of events, hypotension, pupillary reflexes and Rotterdam score with the outcome of traumatic brain injury patients.

6. References

1. Sharma R, Rosenberg A, Bennet ER, Laskowitz DT, Acheson SK. A blood-based biomarker panel to risk-stratify mild traumatic brain injury. *Plos one*. 2017: 1-18
2. Tomar GS, Singh GP, Lahkar D, Sengar K, Nigam R, Mohan M, Anindya R. New biomarker in brain trauma. *Clinica Chimica Acta*. 2018; 487: 325-9
3. Mondello S, Hayes RL. Wang KKW. Utilities of TBI Biomarkers in Various Clinical Settings. In : Biomarkers for traumatic brain injury. Ed. Dambinova SA, Hayes RL, Wang KKW. Royal Society Chemistry Publishing. Cambridge. Chapter 12. 2012: 184-199
4. Emami P, Czorlich P, Fritzsche FS, Westphal M, Rueger JM, Lefering R et al. Impact of Glasgow Coma Scale score and pupil parameters on mortality rate and outcome in pediatric and adult severe traumatic brain injury: a retrospective, multicenter cohort study. *Journal of neurosurgery*. 2017; 126(3), 760–767
5. Dhandapani SS, Manju D, Sharma BS, Mahapatra AK. Prognostic significance of age in traumatic brain injury. *Journal of Neurosciences in Rural Practice*. 2012; 3(2): 131-136
6. Ostermann RC, Joestl J, Tiefenboeck TM, Lang N, Pletzer P, Hofbauer M. Risk factors predicting prognosis and outcome of elderly

patients with isolated traumatic brain injury. *Journal of Orthopaedic Surgery and Research*. 2018; 13: 1-6

7. Shibahashi K, Sugiyama K, Okura Y, Tomio J, Hoda H, Hamabe Y. Defining hypotension in patients with severe traumatic brain injury. *World Neurosurgery*. 2018: 1-8
8. Ostermann RC, Joestl J, Tiefenboeck TM, Lang N, Pletzer P, Hofbauer M. Risk factors predicting prognosis and outcome of elderly patients with isolated traumatic brain injury. *Journal of Orthopaedic Surgery and Research*. 2018;13:1-6
9. Orman JAL, Kraus JF, Zaloshnja E, Miller T. Epidemiologi dan patofisiologi. In: Textbook of traumatic brain injury. Editor: Silver JM, McAllister TW, Yuclofsky SC. Editor 2nd. American phychiatric publishing. Washington. 2011; Part I: 3-22.
10. Chang VC, Ruseckaite R, Collie A, Colantonio A. Examining the epidemiology of work-related traumatic brain injury through a sex/gender lens: analysis of workers' compensation claims in Victoria, Australia. *Occup Environ Med*. 2014; 71: 695-703
11. Amna A. Butt, Folefac D. Atem, Sonja E. Stutzman, Venkatesh Aiyagari, Aardhra M. Venkatachalam, DaiWai M. Olson, Shoji Yokobori. Contribution of pupillary light reflex assessment to Glasgow Coma Scale for prognostication in patients with traumatic brain injury. *J Neurocrit Care*. 2021; 14(1): 29-35
12. Ariaka H, Kiryabwire J, Hussein S, Ogwal A, Nkonge E, Oyania F. A comparison of predictive value of the Glasgow Coma Scale and The Kampala Trauma Score for mortality and length of hospital stay in brain injury patients at a Tertiary Hospital in Uganda: A diagnostic prospective study. *Surgery Research and Practice*. 2020: 1-9
13. Okidi R, Ogwang DM, Okello TR, Ezati D, Kyegombe W, Nyeko Det al., Factors affecting mortality after traumatic brain injury in a resource-poor setting. *BJS Open*. 2020; 4: 320-325
14. Nguyen R, Fiest Km, McChesney JM, Kwon CS, Jette N, Frolkis AD, et al. The International Incidence of Traumatic Brain Injury: A Systematic Review and Meta-Analysis. *Can J Neurol Sci*. 2016; 43: 774-785
15. Kulesza, Bartłomiej & Nogalski, Adam & Kulesza, Tomasz & Prystupa, Andrzej.. Prognostic factors in traumatic brain injury and their association with outcome. *Journal of Pre-Clinical and Clinical Research*. 2015; 1-9
16. Andriessen TMJS, Horn J, Franschman G, Naalt JV, Haitsma I, Jacobs B, et al. Epidemiology, Severity Classification, and Outcome of Moderate and Severe Traumatic Brain Injury: A Prospective Multicenter Study. *Journal of Neurotrauma*. 2011; 28: 2019-2031
17. Ramadhan BZ, Saragih SGR, Natalia D, Handoko W. Korelasi antara rotterdam ct score sebagai prediktor mortalitas pada penderita cedera kepala di RSUD dr Abdul Aziz Kota Singkawang tahun 2016-2018. AN-Nur: Jurnal Kajian dan Pengembangan Kesehatan Masyarakat. 2020; 01:33–43
18. Capizzi A, Woo J, Verduzco-Gutierrez M. Traumatic Brain Injury An Overview of Epidemiology, Pathophysiology, and Medical Management. *Med Clin N Am*. 2020; 104: 213–238
19. Werner C, Engelhard K. Pathophysiology of traumatic brain injury. Br J Anaesth. 2007;99(1):4-9
20. Chen JW, Gombart ZJ, Rogers S, Gardiner SK, Cecil S, Bullock RM. Pupillary reactivity as an early indicator of increased intracranial pressure: The introduction of the Neurological Pupil index. *Surgical neurology international*. 2011; 2:1-82.
21. Fujimoto K, Miura M, Otsuka T, Kuratsu J. Sequential changes in Rotterdam CT scores related to ourcomes for patients with traumatic brain injury who undergo decompressive

craniectomy. *Journal of Neurosurgery*. 2016; 124(6): 1640-1645