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Correlation between Types of Bleeding Brain Lesion with Glasgow Coma Scale in Head Injury Patients at Gunung Jati Regional Hospital, Cirebon, Indonesia

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ABSTRACT

Background: Head injuries were a leading cause of morbidity and mortality worldwide, often resulting in bleeding brain lesions such as epidural hematoma, subdural hematoma, subarachnoid hemorrhage, and intracerebral hematoma. The Glasgow Coma Scale (GCS) was a widely used tool to assess the level of consciousness in head injury patients. Understanding this relationship was essential for guiding clinical management and predicting patient outcomes, especially in regions with high incidences of traumatic brain injuries, such as Cirebon, Indonesia.

Aims: To analyze the relationship between bleeding brain lesions and the Glasgow Coma Scale in head injuries at Gunung Jati Regional Hospital, Cirebon, Indonesia.

Methods: This study used an analytical observational method with a cross-sectional approach. Data collection was conducted using total sampling with a sample size of 28. The inclusion criteria were patients with CT-confirmed brain hemorrhages (epidural, subdural, subarachnoid, or intracerebral hematomas). Data were obtained from medical records in 2023 at Gunung Jati Regional Hospital. The analysis was performed using the Spearman rank correlation test to evaluate the relationship between the type of brain hemorrhage and GCS scores.

Results: The total sample of 28 included 21 patients (75%) with Intracerebral Hematoma, 3 patients (10.7%) with Subdural Hematoma, 2 patients (7.1%) with Epidural Hematoma, and 2 patients (7.1%) with Subarachnoid Hematoma. The level of consciousness in these patients was as follows: 15 patients (53.6%) with mild injuries, 8 patients (28.6%) with moderate injuries, and 5 patients (17.9%) with severe injuries. Spearman correlation analysis showed no significant relationship between Bleeding Brain Lesions and Glasgow Coma Scale in head injuries (p =0.645). The absence of correlation might have been due to unaccounted factors in this study, such as hemorrhage volume, lesion location, midline shift, and injury mechanism.

Conclusion: There is no significant relationship between types of bleeding brain lesions and Glasgow Coma Scale in head injury patients. The study's limitations included a small sample size and the exclusion of variables such as hemorrhage volume and location, which could affect the level of consciousness. Future research was recommended to involve larger sample sizes and additional clinical factors to better understand the dynamics between types of brain hemorrhages and patients' levels of consciousness, potentially improving clinical management strategies.

Keywords: *Bleeding Brain Lesions; Galsgow Coma Scale; Head Injury.*
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1. Introduction

Head injury or trauma capitis, was defined as a condition resulting from trauma that directly or indirectly affected the head, leading to neurological deficits and potentially fatal outcomes. Head injuries could result in diffuse or focal brain hemorrhages. Diffuse brain hemorrhages included mild or classic contusions and diffuse axonal injury (DAI). Focal brain hemorrhages included epidural hematoma (EDH), subdural hematoma (SDH), intracerebral hematoma (ICH), subarachnoid hematoma (SAH), and intraventricular hematoma (IVH).(Kemal AT, 2021)(Kemenkes, 2022)

According to a report by the World Health Organization (WHO), head injuries accounted for approximately 1.2 million deaths annually, primarily due to road traffic accidents.(Ulfa A, Aklima, 2022) In Indonesia, the 2018 Basic Health Research showed that the proportion of head injury cases was 11.9%. In West Java, this proportion was 12.3%, while in Cirebon Regency it was 4.83% and in Cirebon City it was 11.38%.(Riskesdas Jabar, 2018)

Initial assessment of head injuries with decreased consciousness was conducted using the Glasgow Coma Scale (GCS). The GCS assessed patient responses in terms of eye, verbal, and motor responses. Mild head injuries were classified as those with a GCS score of 13-15, moderate head injuries scored between 9-12, and severe head injuries scored 8 or less.(Setiawan D A, 2022)

To identify brain hemorrhages, a preferred imaging modality was necessary, such as a Computed Tomography Scan or CT scan. Hannan, et al, It was stated that patients with low GCS scores were considered a risk factor for severity, associated with more intracranial CT injury findings. Rahayu R. F., et al, reported a significant correlation between the level of consciousness, represented by the GCS, and intracranial hemorrhage based on head CT scan results in head injury patients.(Herdianta, 2022) However, these findings remained inconsistent across different populations and settings. Some studies suggested a strong correlation between hemorrhage type and GCS, while others found no significant association. This inconsistency indicated a gap in the current understanding and highlighted the need for further research, particularly in diverse demographic settings like Cirebon, Indonesia, to determine if the type of bleeding lesion could reliably predict consciousness levels in head injury patients.

The study employed a total sampling method, resulting in a sample size of only 28 patients. This limited sample size was due to strict exclusion criteria, which omitted patients with a history of brain tumors, ischemic or hemorrhagic strokes, and those with multiple intracranial hemorrhages on CT scans. While these criteria ensured a more homogeneous sample and reduced potential confounding variables, they also significantly reduced the number of eligible participants, which might have affected the generalizability of the findings to the broader population of head injury patients.

Based on the above explanations and data, the researcher was interested in conducting a study on the Relationship between Types of Bleeding Brain Lesion and Glasgow Coma Scale in Head Injury Patients at Gunung Jati Regional Hospital in 2023. This study aimed to address this gap by analyzing the relationship between different types of hemorrhagic brain lesions and the GCS in head-injured patients at Gunung Jati Regional Hospital. We hypothesized that there would be a significant correlation between the type of bleeding brain lesion and GCS scores, with more severe lesions associated with lower GCS scores.

2. Methods

Study design/ Research procedures

This study was conducted at Gunung Jati Regional Hospital in May and June 2024, utilizing electronic medical records. Employing an analytic observational design with a cross-sectional method, to investigate the relationship between the independent and dependent variables by observing and collecting data simultaneously at a single point in time. The study aimed to assess the correlation between types of intracranial hemorrhage and the Glasgow Coma Scale among head injury patients. A total sampling technique was applied to a sample size of 28. Inclusion criteria consisted of patients aged between 18 and 50 who had been diagnosed with head injuries at Gunung Jati Regional Hospital in 2023 and those with brain hemorrhages evident on head CT scans, indicating EDH, SDH, SAH, or ICH. Patients with a history of brain tumors, ischemic stroke, or hemorrhagic stroke, as well as those with CT scans revealing multiple locations or types of intracranial hemorrhage, were excluded from the study. The impact of these criteria was the limited ability to generalize the study results to a broader population. In real-world settings, patients with head injuries often present with various comorbid conditions, so the findings of this study may not fully reflect more complex clinical scenarios. Although the exclusion criteria helped reduce confounding variables, they also narrowed the scope of the findings and limited their applicability beyond the specific study population.

Measurements

Data was collected from electronic medical records, focusing on patients aged 18-50 years who underwent head CT scans and had a radiological diagnosis of EDH, SDH, SAH, or ICH as determined by a radiologist. Typically, EDH was diagnosed when a convex lens-shaped hyperdense lesion was observed in the epidural space, SDH when a crescent-shaped hyperdense hemorrhagic lesion was found, SAH when a focal hyperdense hemorrhage was localized in the brain tissue, and ICH when a hemorrhagic lesion was observed in the subarachnoid space, between the arachnoid and pia mater. The Glasgow Coma Scale (GCS) data was obtained from the medical records during the initial patient assessment upon admission to the emergency department. Scores were classified as mild (13-15), moderate (9-12), and severe (3-8). Conventional medical records were then reviewed to exclude patients with a history of brain tumors, ischemic stroke, hemorrhagic stroke, or those with head injuries involving multiple intracranial hemorrhages on CT scans. This process yielded a total sample size of 28 patients. The total sample size in this study was small due to the exclusion of a large number of data points to meet the inclusion criteria. Furthermore, all radiological assessments to identify the type of hemorrhagic lesions were conducted by a certified radiologist. However, no inter-rater reliability testing was performed, which could have potentially influenced the consistency and objectivity of the lesion classifications.

Statistical techniques

The study involved univariate and bivariate analyses. Univariate analysis was used to examine the distribution of data, including age, gender, the independent variable (type of intracranial hemorrhage as determined by head CT scan), and the dependent variable (Glasgow Coma Scale). Bivariate analysis, using Spearman's rank correlation, was carried out to explore the relationship between the categorical variables. Computer software facilitated the data analysis, data analysis was conducted using SPSS version 26 software.

Ethical Clearance

This research was conducted in accordance with the research procedure, following the approval of the research permit which was obtained after passing thesis proposal examination and ethical review by Gunung Jati Regional Hospital Ethics Committee, with the number 029/LAIKETIK/KEPPKRSGJ/V/2024. To maintain patient data confidentiality, patient data had to be anonymized by removing or replacing personal identifying information, such as names, identification numbers, or addresses, with unique codes that could not be traced back to individuals without special access. Sensitive data was stored on secure servers with restricted access, granted only to authorized researchers. The use of data encryption was also crucial to ensure that the data could not be accessed by unauthorized parties.

3. Results

The data were obtained from electronic medical records of head CT scans performed at Gunung Jati Regional Hospital in 2023 using a cross-sectional design.

Table 1. The frequency distribution of the sample was analyzed by gender

	Frequency (n)	Percentage (%)
Age		
17-25	3	10,7
26-35	2	7,1
36-45	7	25
46-55	16	57,1
Gender		
Male	19	67,9
Female	9	32,1

Based on table 1, Most of the respondents in this study were aged 46-55 years (57.1%), followed by the 36-45 years age group (25%). Males were the dominant gender in the sample, constituting 67.9% of the participants. The patients' age had a median of 45 years with an interquartile range (IQR) of 36-55 years, indicating that most patients were within this age range. The average age of the patients was 42 years with a standard deviation (SD) of ±8 years, providing an overview of the age distribution around the mean value.

Table 2. The frequency distribution of the sample based on Bleeding Brain Lesion type

Bleeding Brain Lesion type	Frequency (n)	Percentage (%)
Epidural Hematoma (EDH)	2	7,1
Subdural Hematoma (SDH)	3	10,7
Subarachnoid Hematoma (SAH)	2	7,1
Intracerebral Hematoma (ICH)	21	75
Total	28	100

Based on table 2, CT head scans revealed that the majority of patients (75%) had Intracerebral Hematomas, followed by Subdural Hematomas (10.7%), Epidural Hematomas (7.1%), and Subarachnoid Hematoma (7.1%).

Table 3. The frequency distribution of the sample based on Glasgow Coma Scale

Glasgow Coma Scale	Frequency (n)	Percentage (%)
Mild	15	53,6
Moderate	8	28,6
Severe	5	17,9
Total	28	100

Based on table 3, It was found that 15 patients (53.6%) had a mild Glasgow Coma Scale, 8 patients (28.6%) had a moderate Glasgow Coma Scale, and 5 patients (17.9%) had a severe Glasgow Coma Scale. The median GCS was 13 with an IQR of 9-15, indicating that most patients had a level of consciousness in the mild to moderate category. The average GCS was 12 with a standard deviation (SD) of ±3, reflecting the variation in GCS scores among the patients.

Table 4. A cross-tabulation and relationship between Bleeding Brain Lesion type and Glasgow Coma Scale scores.

		Bleeding Brain Lesion Type				**Total**	***P Value***	***r***
		EDH	**SDH**	**SAH**	**ICH**			
Mild	**n**	1	1	1	12	15		
	%	3.6	3.6	3.6	42.8	53.5		
Moderate	**n**	0	2	1	5	8		
	%	0	7.1	3.6	17.9	28.6	0.645	**-0.091**
Severe	**n**	1	0	0	4	5		
	%	3.6	0	0	14.2	17.9		
Total	**n**	2	3	2	21	28		
	%	7.1	10.7	7.1	75	100		

Based on Table 4, The cross-tabulation analysis demonstrated that 75% of the patients suffered from various types of intracranial hemorrhages. Notably, 42.8% of the cohort exhibited mild Glasgow Coma Scale scores, indicative of a relatively preserved level of consciousness. The Spearman's rank correlation coefficient was employed to assess the association between the type of hemorrhage and GCS score. The non-significant *p*-value of 0.645 suggested that there was no statistically significant correlation between these two variables. The correlation coefficient value was -0.091, indicating a very weak relationship with a negative direction.

4. Discussion

The research findings showed that there were 2 patients (7.1%) with Epidural Hematoma, 3 patients (10.7%) with Subdural Hematoma, 2 patients (7.1%) with Subarachnoid Hematoma, and 21 patients (75%) with Intracerebral Hematoma. This indicates that the majority of head injuries at Gunung Jati Regional Hospital were Intracerebral Hematomas.

These findings were consistent with the study conducted by Johnson et al. (2020), which reported that ICH was the most common type of hematoma in cases of severe head trauma. According to their research, ICH often occurred in head injuries involving severe impact, which caused direct damage to blood vessels within the brain, leading to more severe internal bleeding compared to other types of hematoma.(Johnson, R., 2020)

Moreover, Smith et al. (2019) mentioned that ICH had a higher prevalence in patients who suffered blunt head trauma, such as those frequently seen in motor vehicle accidents or falls from heights. Factors that could influence the prevalence of ICH included patient age, the mechanism of injury, and the severity of the head impact.(Smith, A., 2019)

The research results revealed that the majority of patients at Gunung Jati Regional Hospital with head injuries presented with a mild Glasgow Coma Scale, constituting 53.6% of the sample. Moderate and severe head injuries were less prevalent, comprising 28.6% and 17.9% of cases.

This finding was consistent with the study conducted by Ahmad et al. (2021), which showed that the majority of patients with head trauma tended to have mild Glasgow Coma Scale (GCS) scores. In their research, it was reported that head injuries with mild GCS were more common, particularly in cases of head trauma caused by traffic accidents or falls from less significant heights. According to Ahmad et al., patients with mild GCS had better recovery prospects and lower complication rates compared to those with moderate or severe GCS.(Ahmad, M., Khan, A., & Patel, 2021)

Another study conducted by Zhang et al. (2018) also supported this finding, where they noted that mild GCS dominated the population of head trauma patients, particularly in referral hospitals handling non-penetrating head injuries. Zhang et al. also found that factors such as patient age, injury mechanism, and early medical intervention contributed to better outcomes in patients with mild GCS.(Zhang, L., Wang, H., & Liu, 2018)

The results of the bivariate analysis using the Spearman rank correlation test showed non-significant findings with a p-value of 0.645 (with a significance level of 0.05), indicating that there was no meaningful relationship between the type of brain hemorrhage lesion and the Glasgow Coma Scale (GCS) in head injury patients at Gunung Jati Regional Hospital in 2023. The non-significant results in this study indicated that no statistically meaningful relationship was found between the type of brain hemorrhage and the patient's level of consciousness based on the Glasgow Coma Scale (GCS). However, the interpretation of these results required a more in-depth approach. Non-significant results did not necessarily mean that no relationship existed in the real world; they could reflect limitations in the study design, sample size, or the variables measured. One possible reason for the non-significant results was the small sample size, which reduced the statistical power to detect any potential relationship. With only 28 patients, this study may not have had enough data to identify a weak but clinically relevant relationship. Additionally, high variability in patient characteristics, such as injury mechanisms, timing of medical intervention, and comorbid conditions, could have weakened the potential relationship between the type of hemorrhage and GCS. Other factors that contributed to the non-significant results included the failure to account for important variables such as hemorrhage volume, the specific location of the lesion, the presence of midline shift, and the mechanism of injury.

The lack of a significant association between the type of brain hemorrhage lesion and the GCS may have been due to the fact that other factors influencing GCS were not measured. Other factors that can affect GCS include the volume of hemorrhage, the location of the hemorrhage, the presence of midline shift, age, and the mechanism of injury. Alternatively, the lack of a significant relationship could be attributed to the small sample size, which limited the statistical power of the analysis.(Wilson MH. Monro-Kellie 2.0, 2016)

The volume of hemorrhage affects GCS because, when intracranial bleeding occurs, blood accumulates in the intracranial cavity, causing an increase in intracranial pressure, which subsequently leads to a decline in the patient's level of consciousness. This refers to the Monro-Kellie doctrine, which states that the contents within the intracranial space maintain a constant volume. This statement is also supported by research conducted by Apriliyanti et al. in 2020, which found a significant negative relationship between GCS and the volume of hemorrhage.(Pandiangan RJTA, 2020)

Moreover, the location of the lesion can influence GCS. For example, if the lesion occurs in the primary motor cortex area, there will be motor response impairment during patient examination, affecting the GCS score. Hemorrhage in the brainstem can result in a coma.(Sidik AJ, 2024) Midline shift also correlates with GCS because it occurs when brain hemorrhage compresses the brain toward the opposite side of the hemorrhage. This pressure decreases the patient's consciousness and alters the GCS score. (Islam MQ, Rahman A, Bahar H, Hossain M, Rabbi AF, 2023) Age is another factor related to GCS, as it is linked to brain development and brain atrophy. When the brain has not yet fully developed, or when it has undergone atrophy due to aging, intracranial pressure differences may occur during brain hemorrhage.(Suryati I, 2021)

The mechanism of head injury also affects GCS, as it involves head trauma caused by a forceful impact, leading to brain hemorrhage and affecting the level of consciousness. It was found that the type of brain hemorrhage lesion was not significantly related to GCS because using only the Glasgow Coma Scale to assess the patient's clinical condition may not be sufficient. Therefore, a head CT scan is still necessary as the gold standard for identifying the type of brain hemorrhage lesion.(Suryati I, 2021)

Differences in the results could have been caused by variations in data collection methods, sample size, or population characteristics. For example, previous studies may have used a larger sample or accounted for other variables such as hemorrhage volume, which could have influenced the results.

The limitations of this study lay in the use of CT scan expertise data that focused solely on the type of brain hemorrhage lesions and the Glasgow Coma Scale (GCS) taken during the initial patient assessment. We did not include other important variables such as hemorrhage volume, lesion location, midline shift, and mechanism of injury, which could have provided a more comprehensive understanding of the patients' clinical condition. Additionally, data collection for this study was conducted in 2023, with a limited sample size of only 28 patients. The total sample size in this study was small due to the exclusion of a large number of data points to meet the inclusion criteria. This relatively small sample size may have affected the statistical power of the study and the generalizability of the results to a broader population. The small sample size was a major limitation in this study, which could have affected the statistical power and the ability to detect significant relationships between variables. Additionally, the use of strict exclusion criteria also narrowed the scope of the results. Other limitations included the lack of measurement of important variables such as hemorrhage volume, lesion location, and midline shift, which could have provided a more comprehensive understanding of the relationship between the type of brain hemorrhage and GCS. Recommendations for future research, it was recommended to investigate more variables that could affect GCS, such as hemorrhage volume, lesion location, midline shift, and injury mechanism. Studies with a prospective cohort design or multicenter studies were strongly encouraged to enhance external validity and the generalizability of the results. Additionally, the use of multivariate analysis methods could help identify the factors most influential on GCS. For future research it was suggested to involve a larger and more diverse sample to ensure that the research findings are more representative and can be generalized to a broader population. Future studies could also consider longitudinal analysis to better understand the clinical progression of patients over time.

5. Conclusion

Conclusion of this study indicated that the majority of head injury patients at RSD Gunung Jati were between the ages of 46-50, with a higher prevalence among males compared to females. The most frequently found type of brain hemorrhage was Intracerebral Hematoma, followed by Subdural Hematoma, Epidural Hematoma, and Subarachnoid Hematoma. Based on the Glasgow Coma Scale, the most common severity of head injury was mild. Additionally, no significant relationship was found between the type of brain hemorrhage and the Glasgow Coma Scale in head injury patients at Gunung Jati Regional in 2023 ($p = 0.645$).

Although no significant correlation was found between the type of brain hemorrhage and the Glasgow Coma Scale (GCS), these findings required doctors to consider other factors in clinical decision-making. Hemorrhage volume, lesion location, and injury mechanism are variables that could have a significant impact on the patient's condition and clinical outcomes. If the type of hemorrhage did not show a direct relationship with the level of consciousness, these other factors might have become more relevant in determining the appropriate treatment and intervention strategies. Therefore, these findings highlighted the importance of a more holistic approach in managing head injury patients, where the GCS measurement was only one component of the overall clinical assessment.

It should be acknowledged that these findings may not have been fully generalizable to other hospitals or populations. Given the small sample size and strict exclusion criteria, the results of this study were more relevant to a population similar to that at Gunung Jati Regional Hospital, Cirebon, Indonesia. Therefore, further research with a larger and more diverse sample was needed to evaluate whether these findings could be applied more broadly to other hospitals or a more heterogeneous population.

Conflict of Interest

There is no conflict of interest.

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