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The Severity of Head Injuries Based on Injury Location: a Cross-Sectional Study

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ABSTRACT
Background: The mortality and morbidity rates in patients with traumatic head injuries are still high, caused by primary damage due to internal bleeding. Intracerebral hemorrhage is a common complication of traumatic brain injury. The severity of head injury patients is a predisposing factor that causes high mortality and morbidity rates. The presence of bleeding in the head affects the severity of the patient's injury, bleeding in the head will reduce blood flow to the head, which will cause decreased blood perfusion to the brain. In severe head injury, a hematoma of more than 50 mL is associated with higher mortality. Acute ICH (Intra Cerebral Haemoraghea) can be a catastrophic event with the mortality largely predicted by the hematoma size, location, and the patients' GCS (Glasgow Coma Scale) on admission.
Objective: This study aims to determine the relationship between the location of intracerebral hemorrhage and the severity of head injury.
Methods: This study uses a correlational analytical approach with a cross-sectional design, utilizing secondary data from medical records of patients with traumatic head injuries from January to December 2022. The calculation of severity using RTS (Revised Trauma Score). These three scores (Glasgow Coma Scale, Systolic Blood Pressure, Respiratory Rate) are then used to take the weighted sum by RTS = 0.9368 GCSP + 0.7326 SBPP + 0.2908 RRP Values for the RTS are in the range 0 to 7.8408. Scores range from 0-4. The study population was patients with moderate to severe traumatic head injuries. Data were analyzed using a correlation test based on Spearman's rank correlation. Results: The results showed a significant relationship between the location of head trauma lesions and the severity of head injury patients (p value = 0.008, correlation coefficient 0.378).
Conclusion: Mortality and morbidity rates in patients with traumatic head injuries are still high, caused by primary damage due to internal bleeding. The majority of patient with Trauma brain Injury is male and were in the productive age range ranging from 12-35 years. Epidural hematoma (EDH) is one of the most life-threatening lesions in patients with craniocerebral disease.

Keywords: location of head bleeding, Traumatic Brain Injury (TBI), RTS (Revised Trauma Score)

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BACKGROUND

Mortality and morbidity rates in patients with traumatic head injuries are still high, caused by primary damage due to internal bleeding (Lutfi, et al. 2019). Traumatic brain injury (TBI) is an acquired disorder of the normal function or structure of the brain caused by a blow to the head or an external force. Blunt head trauma is a common cause of increased intracranial pressure (ICP) (Casey M. Woster, et al. 2017). The severity of head injury patients is a predisposing factor that causes high mortality and morbidity rates (Fatwati, 2019).

Intracerebral hemorrhage is a common complication of traumatic brain injury.The presence of bleeding in the head affects the severity of the patient's injury, bleeding in the head will reduce blood flow to the head, which will cause decreased blood perfusion to the brain, decreased perfusion causes cerebral infarction which will cause decreased brain function and cause brain failure (Ginsburg J, Huff JS, 2023).

The location of a head injury greatly influences the severity of the injury. Injury to areas containing important structures such as the brain and nerves can cause more serious damage than injury to the scalp or skull. Extradural bleeding in adults, usually due to arterial bleeding (especially from the middle meningeal artery) and In children, subdural bleeding is due to venous bleeding, especially from skull fractures. Subdural bleeding Associated with injury to the cortical communicating veins such as occurs in birth trauma, accidental injuries and head injuries. In addition, subdural bleeding is seen in cortical injuries adjacent to cortical and pial tears and may be seen in traumatic rupture of an arachnoid cyst. Subarachnoid hemorrhage - occurs after injury to the small blood vessels that traverse the subarachnoid space. Intra-parenchymal hemorrhage ranges from small foci of blood visible on directional imaging to frank hemorrhage and blood clot formation within the brain parenchyma as in a torn and perforated vessel. Intra-ventricular hemorrhage - blood within the intraventricular space can cause obstruction to the flow of CSF, and further increase intracranial pressure.

Emergency triage assessment using RTS (Revised Trauma Score) has begun to be developed in the ER, one of which is in cases of head trauma (Erik & Meirna, 2024) (Daishan Jiang, et al. 2023). The use of RTS as an indicator of the assessment of the severity of head trauma because this assessment involves vital signs (components that assess respiratory function, namely respiratory rate and circulatory function, namely the systolic blood pressure component) so that it will describe the impact of bleeding on head trauma with vital signs of the body (Debojit Basak, et al. 2023). The Revised Trauma Score assesses the entire human physiological system, and the Revised Trauma Score instrument is the result of completing the Glasgow Coma Scale instrument to assess the previous condition of head injury patients (Lutfi et al, 2019). These three scores (Glasgow Coma Scale, Systolic Blood Pressure, Respiratory Rate) are then used to take the weighted sum by RTS = 0.9368 GCSP + 0.7326 SBPP + 0.2908 RRP Values for the RTS are in the range 0 to 7.8408. Scores range from 0-4. The lower the RTS value, the worse the patient's condition will be (Eom KS, et al, 2021). The severity of RTS can be categorized with values (1) Morgue / life trathening (<6), (2) Intermediate / critical (7-8), (3) Urgent / emergency (9-10) and (4) Delayed / non emergency (11-12). More men than women experience TBI (68.8%) (Eom KS, et al, 2021).

Intracranial hemorrhage consists of 4 broad types of hemorrhage, including epidural hemorrhage, subdural hemorrhage, subarachnoid hemorrhage, and intraparenchymal hemorrhage. The first 2 types of hemorrhages epidural and subdural are referred to as extra-axial hemorrhages, while the latter 2 hemorrhages subarachnoid and intraparenchymal are categorized as intra-axial (Tenny S, Thorell W, 2025). In severe head injury, a hematoma of more than 50 mL is associated with higher mortality (Unnithan AKA, Das JM, Mehta P, 2025). Acute ICH can be a catastrophic event with the mortality largely predicted by the

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hematoma size, location, and the patients' GCS on admission (Rajashekar D, Liang JW, 2023). A clot size of 60 ml or more have a nearly 90% mortality rate patient with Trauma Brain Injury ((Rajashekar D, Liang JW, 2023).

OBJECTIVE

This study aims to determine the relationship between the location of intracerebral hemorrhage and the severity of head injury.

METHODS

Data sources and study population

This research is correlation analytical with a cross sectional approach. This research includes retrospective research with secondary data obtained from patient medical record data at Dr. Iskak Hospital in the period January - December 2022. The population in this study are patients with moderate to severe head injury during the year 2022. In total there were 49 research subject. The data collection instrument in research using a checklist sheet.

Instrument and measurement

These three scores (Glasgow Coma Scale, Systolic Blood Pressure, Respiratory Rate) are then used to take the weighted sum by RTS = 0.9368 GCSP + 0.7326 SBPP + 0.2908 RRP Values for the RTS are in the range 0 to 7.8408. Scores range from 0-4. The lower the RTS value, the worse the patient's condition will be. The severity of RTS can be categorized with values (1) Morgue / life trathening (<6), (2) Intermediate / critical (7-8), (3) Urgent / emergency (9-10) and (4) Delayed / non emergency (11-12) (Eom, KS et al. 2021).

Data analysis

Data analysis used the SPSS version 26.0 program including descriptive analysis and relationship testing. Relationship test using Spearman. All results were considered statistically significant if the p value was <0.05.

Ethical consideration

This research has received ethical clearance from the Health Research Ethics Commission (KEPK) regional public Hospital dr. iskak Tulungagung No. 070/3984/35.04.24.09/2023.

RESULTS

The research subjects in the study were 49 people. (Table 1) Characteristics of research respondents were divided based on patient age, gender, and location of the head trauma patients.

Table 1. Subject Characteristics

Characteristics	Description	Frequency (%)
Respondent Age	12-25	17 (34,6)
	26-35	8 (31.4)
	36-55	12 (24,5)
	>56	12 (24,5)
Gender	Male	36 (73,5)
	Female	13 (26.5)
Location of the Intra cerebral hemorage	Epidural hemorrhage	31 (63,3)
	Sub dural hemorrhage	6 (12,2)
	Sub arachnoid hemorrhage	11 (22,4)
	Intra parenkim hemorrhage	1 (2)

Severity head Injury Patients (Score RTS)	Morgue / life trathening(<6)	17 (34,7)
	Intermediate / critical (7-8)	32 (65,3)
	Urgent / emergency (9-10)	0
	Delayed / non emergency (11-12)	0

In the analysis of head injury patients, the majority of research subjects were male(73%) and the majority of patients were in the productive age range ranging from 12-35 years (66%).

Most head trauma patients who experience intracerebral hemorrhage are in the epidural (63.3%). Severity of head injury using the RTS formula calculation (0.9368 GCSP + 0.7326 SBPP + 0.2908 RRP) was obtained from 32 research respondents in the severe category and 17 patients in the very severe category.

Table 2. Correlation the location of intracerebral hemorrhage and the severity of head injury

Characteristics	P value	Correlation coefficient
Location of the head trauma lesion	0,008	0,378

Based on the analysis test, there is a relationship between the location of the head trauma lesion (location of bleeding due to trauma in the epidural, sub dural, sub arachnoid and intra parenkim areas) and the Severity of Head Injury Patients with a p value of 0.008 with a category correlation coefficient of 0.378 (strong relationship) (Table 2).

DISCUSSION

Based on the analysis test, there is a relationship between the location of the head trauma lesion (location of bleeding due to trauma in the epidural, sub dural, sub arachnoid and intra parenchymal areas) and the Severity of Head Injury Patients. Intracranial hemorrhage consists of 4 types of bleeding, including epidural hemorrhage, subdural hemorrhage, subarachnoid hemorrhage, and intraparenchymal hemorrhage (Rohadi, MR, et al. 2019). The presence of bleeding in the head affects the severity of the patient's injury, bleeding in the head will reduce blood flow to the head, which will cause decreased blood perfusion to the brain. In severe head injury, a hematoma of more than 50 mL is associated with higher mortality. Acute ICH (Intra Cerebral Haemoraghea) can be a catastrophic event with the mortality largely predicted by the hematoma size, location, and the patients' GCS (Glasgow Coma Scale) on admission.

The location of a head injury greatly influences the severity of the injury. Injury to areas containing important structures such as the brain and nerves can cause more serious damage than injury to the scalp or skull. Extradural bleeding in adults, usually due to arterial bleeding (especially from the middle meningeal artery) and In children, subdural bleeding is due to venous bleeding, especially from skull fractures. Subdural bleeding Associated with injury to the cortical communicating veins such as occurs in birth trauma, accidental injuries and head injuries. In addition, subdural bleeding is seen in cortical injuries adjacent to cortical and pial tears and may be seen in traumatic rupture of an arachnoid cyst. Subarachnoid hemorrhage - occurs after injury to the small blood vessels that traverse the subarachnoid space. Intra-parenchymal hemorrhage ranges from small foci of blood visible on directional imaging to frank hemorrhage and blood clot formation within the brain parenchyma as in a torn and perforated vessel. Intra-ventricular hemorrhage - blood within the intraventricular space can cause obstruction to the flow of CSF, and further increase intracranial pressure.

Based on the results of the study, most respondents experienced head trauma accompanied by intracerebral hemorrhage in the epidural (63.3%). Epidural hemorrhage accounts for 5% to 15% of fatal head injuries (Jeong YH, Oh JW, Cho S, 2016). Epidural hematoma (EDH) is one of the most life-threatening lesions in patients with craniocerebral disease (Khairat A, Waseem M. 2023). Although the incidence of epidural hematoma (EDH) from previous assessments differs from the population, (2% of total traumatic brain injury (TBI)) but the severity is the same where the death rate reaches 33%23, this is in accordance with the results of the study, where most head trauma patients have a severe and very severe level of severity.

EDH is a type of intracranial haemorrhage that commonly occurs due to a skull fracture from a head injury, causing blood vessels to rupture and blood to accumulate in the space between the dura mater and the skull. EDH will occupy the intracranial space, so rapid expansion of the lesion can lead to pressure on the brain which can result in loss of consciousness, reversible or irreversible disability and even death. Rapid disease progression can lead to increased intracranial pressure leading to brain herniation, a potentially deadly problem that requires immediate medical or operative management (Putra RO, et al. 2024).

CONCLUSION

Mortality and morbidity rates in patients with traumatic head injuries are still high, caused by primary damage due to internal bleeding. The majority of patient with Trauma brain Injury is male and were in the productive age range ranging from 12-35 years. Epidural hematoma (EDH) is one of the most life-threatening lesions in patients with craniocerebral disease.

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