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The Correlation between Dehydration and Early Neurological Deterioration in Acute Hemorrhagic Stroke

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ABSTRACT

Introduction: Early Neurological Deterioration (END) is a worsening of symptoms within a few hours or days after an acute stroke which occurs in around 25,5% of patients with intracerebral hemorrhage. Dehydration is one of the conditions that is widely observed as a non-neurological cause of END in acute ischemic stroke, but in hemorrhagic stroke the correlation is still unclear. The aim of this study was to determine the correlation between dehydration and END in acute hemorrhagic stroke.

Method: In this cross-sectional study, we assessed acute hemorrhagic stroke patients within 72 hours of onset at Haji Adam Malik General Hospital Medan, Indonesia, from April to October 2023. Patients are categorized as dehydrated if BUN/Cr ⩾15 and urine specific gravity >1,010. END was defined as an increase in National Institutes of Health Stroke Scale (NIHSS) score of ⩾ 2 points on the total score, or ⩾ 1 point on motor items. Bivariate analysis was carried out to determine the correlation between dehydration and END in acute hemorrhagic stroke using the contingency correlation test.

Results: A total of 30 subjects were included, with a mean age of 56,47 ± 12,75 years and 53,3% women. In this study, END was identified in 11 (36,7%) patients and dehydration was detected in 13 (43,3%) patients. The results of statistical analysis found no significant correlation between dehydration and END in acute hemorrhagic stroke (p=0,88 and r=0,298).

Conclusion: There was no significant correlation between dehydration and END in acute hemorrhagic stroke.

Keywords

Dehydration, Early Neurological Deterioration, Acute Hemorrhagic Stroke

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INTRODUCTION

Stroke is an acute clinical manifestation resulting from neurological dysfunction in the brain, spinal cord and retina, either focal or global, that persists for ≥24 hours or causes death due to blood vessel disorders.[1] Stroke is the second leading cause of death worldwide, with approximately 80% of strokes caused by ischemic stroke and 20% caused by hemorrhagic stroke.[2]

Early Neurological Deterioration (END) is a worsening of symptoms within hours or days after an acute stroke and is associated with worse clinical outcomes.[3] END occurs in approximately 25,5% of patients with intracerebral hemorrhage.[4] There are various mechanisms for the occurrence of END which can be divided into 2, namely neurological causes as a direct result of neurological damage to the brain and non-neurological causes such as abnormal physiological parameters.[5]

Dehydration is a condition that is often observed in patients with acute ischemic stroke as a predictor of END. The risk of dehydration in stroke patients increases due to stroke-related factors such as decreased consciousness, physical dependence, dysphagia and decreased oral intake.[6] Meanwhile, the correlation

between dehydration and END in hemorrhagic stroke is still unclear. In intracerebral hemorrhage, dehydration on admission is associated with reduced mortality. It is associated with intracerebral hemorrhage leading to increased intracranial pressure, mass effect and immediate early herniation. Dehydration on admission is associated with reduced mass effect and herniation after intracerebral hemorrhage compared with patients without dehydration thereby reducing mortality in intracerebral hemorrhage.[7]

METHOD

This research is an observational study with a cross-sectional approach. The study was conducted in the stroke corner and inpatient ward of H. Adam Malik General Hospital Medan in April – October 2023. The inclusion criteria for this study were acute hemorrhagic stroke patients with onset ≤ 72 hours, aged > 18 years and giving consent to participate in the study. Exclusion criteria were patients with recurrent stroke, stroke in the brain stem, patients with chronic kidney disease and heart failure. Patients who meet the inclusion and exclusion criteria will have their blood creatinine ratio and urine specific gravity checked via urinalysis as well as their NIHSS score on the first and third days of admission. Patients are categorized as dehydrated if BUN/Cr ≥15 and urine specific gravity >1,010. END was defined as an increase in National Institutes of Health Stroke Scale (NIHSS) score of ≥ 2 points on the total score, or ≥ 1 point on motor items.

This study was analyzed univariately and bivariately using the SPSS Statistics for Windows version 26 computer program. Univariate analysis was carried out to analyze variable characteristics descriptively. Categorical data is presented in percentage form, namely N (%), while numerical data is presented in the form of mean ± standard deviation if the data is normally distributed. If the data is not normally distributed then the numerical data is presented in median (min-maks) form. Bivariate analysis was carried out to determine the correlation between dehydration and END in acute hemorrhagic stroke using the contingency correlation test.

RESULTS

Table 1. Demographic Characteristics of The Study Subjects

Characteristics	(n = 30)
Age (year)*, mean ± SD	56,47 ± 12,75
Gender, n (%)	
Man	14 (46,7)
Woman	16 (53,3)
Occupation, n (%)	
Self-employed	7 (23,3)
Housewife	6 (20)
Farmer	5 (16,7)
Retired	4 (13,3)
Government employees	3 (10)
Employee	5 (16,7)
Education, n (%)	
Elementary School	1 (3,3)
Junior High School	2 (6,7)
Senior High School	21 (70)
College	6 (20)
Ethnicity, n (%)	
Batak	18 (60)
Javanese	7 (23,3)
Malay	3 (10)
Nias	1 (3,3)
Minangnese	1 (3,3)

* Numeric data is normally distributed

In this study, the mean BUN/Cr ratio was 15,12 (4,38- 45,83), the mean urine specific gravity was 1,013 (1,00-1,03). The average NIHSS on the first day admission was 12,03 ± 8,08 and the average NIHSS on the third day admission was 13,10 ± 8.69. Dehydration was found in 13 people (43,3%) and END was found in 11 people (36,7%) of the study. (Table 2)

Table 2. Clinical Characteristics of The Study Subjects

Characteristics	(n = 30)
BUN/Cr**, median (min-max)	15,12 (4,38 – 45,83)
Urine Specific Gravity **, median (min-max)	1,013 (1,00 – 1,03)
NIHSS day 1*, mean ± SD	12,03 ± 8,08
NIHSS day 3*, mean ± SD	13,10 ± 8,69
Dehydration, n (%)	
Yes (BUN/Cr ≥15 and urine specific gravity >1,010)	13 (43,3)
No (BUN/Cr <15 or urine specific gravity ≤1,010)	17 (56,7)
Early Neurological Deterioration (END) , n (%)	
Yes	11 (36,7)
No	19 (63,3)

* Numeric data is normally distributed; ** Numeric data is not normally distributed

The correlation between dehydration and END in acute hemorrhagic stroke using the contingency coefficient correlation test obtained p = 0,88 and r = 0,298. Research is considered to have a significant correlation if the p value is <0,05. This study shows there is no significant correlation between dehydration and END in acute hemorrhagic stroke. (Table 3)

Table 3. Correlation of Dehydration with Early Neurological Deterioration (END) in Acute Hemorrhagic Stroke

		END				p	r
		Yes		No			
		n	%	n	%		
Dehydration	Yes	7	23,3	6	20	0,88*	0,298
	No	4	13,3	13	43,3		
	Total	11	36,7	19	63,3		

* contingency coefficient correlation test

DISCUSSION

The results of this study showed that there was no significant relationship between dehydration and END in acute hemorrhagic stroke (p=0,88 and r=0,298). In the study, it was found that patients with dehydration experienced more END than those without END. This is in line with study by Liu, et al which stated that there was no significant relationship between dehydration and the outcome of hemorrhagic stroke patients.[8] In study by Gao, et al. there was a significant relationship between dehydration and mortality in hemorrhagic stroke patients. It is associated with intracerebral hemorrhage leading to increased intracranial pressure, mass effect and herniation directly in hemorrhagic stroke. Dehydration is associated with reduced mass effect and herniation after intracerebral hemorrhage compared with patients without dehydration thereby reducing mortality in intracerebral hemorrhage.[7]

In patients with ICH, factors linked to larger hematoma volume, such as a higher ICH score, signs of cerebral herniation, and elevated midline shift, were linked to an admission dehydration status.[9] Although the underlying mechanism is unclear, Qureshi, et al. suggested that decreased cerebral perfusion due to hypovolemia in dehydrated patients with ICH leads to increased perihematomal ischemia.[10] Conflicting theories suggest that the decrease in blood pressure caused by hypovolemia inhibits hematoma expansion and that dehydration-related hypernatremia increases intravascular osmolality leading to a decrease in perihematomal edema and intracranial pressure. However, dehydration on admission and poor outcome may be a consequence of lower GCS, greater ICH volume, and therefore higher ICH scores on admission may also result in greater neurological deterioration.[9]

CONCLUSION

Based on the analysis in this study, there is no significant correlation between dehydration and Early Neurological Deterioration in acute hemorrhagic stroke. There are other factors that can influence END in

acute hemorrhagic stroke that need further investigation, such as hematoma volume, ICH score, GCS score, signs of cerebral herniation, and the presence of midline shift.

DECLARATIONS

Ethics approval and consent to participate. Permission for this study was obtained from the Ethics Committee of Universitas Sumatera Utara and Haji Adam Malik General Hospital.

CONSENT FOR PUBLICATION

The Authors agree to publication in Journal of Society Medicine.

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COMPETING INTERESTS

The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTIONS

All authors significantly contribute to the work reported, whether in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas. Contribute to drafting, revising, or critically reviewing the article. Approved the final version to be published, agreed on the journal to be submitted, and agreed to be accountable for all aspects of the work.

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