Hydration Status and Degree of Clinical Severity Patients with Thrombotic Infarction Stroke

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Abstract

Background: Dehydration is common in acute ischemic stroke patients and associated with a poor increase in clinical outcomes. It is caused of the increase of hematocrit related to the infarct volume which is wider to the cerebra infarct patients. It is also related to the repeatedly emboli stroke and thromboembolic vena after the occurrence of the acute stroke.

Objectives: To analyze the correlation between hydration status and clinical severity in patients with acute thrombotic stroke.

Methods: This study was conducted by using control design consecutive admission sampling technique. Serum BUN and creatinine measurements were performed when patients were administered to the hospital. Dehydration was defined if the ratio of BUN/serum creatinine was >15. Patients were divided into dehydration and non-dehydrated groups. The degree of clinical severity was measured by using the National Institute of Health Stroke Scale (NIHSS) at 7 days of onset of stroke. Data were analyzed using chi square, fisher, t dependent test, and mann whitney ($p < 0.05$).

Result: There were 19.23% stroke patients with dehydration were in the case group and the control group were 9.62%. There was no significant correlation between hydration status and clinical severity in acute thrombotic stroke patients ($p = 0.126$; OR = 2.625).

Conclusion: There was no correlation between hydration status and clinical severity in acute thrombotic stroke.

Keywords: *Stroke, dehydration status, BUN/SK, NIHSS*

Introduction

Stroke is the first leading cause of disability worldwide, the second most common cause of dementia, and the third leading cause of death. Stroke resulted in major clinical, social, and economic impacts with a total death rate of 6.2 million (±11% of the total). Around 9 million people suffered a stroke in 2008, 30 million people have had previous strokes and still alive. Stroke is the main cause of disability and this recent decline has fallen from the third leading cause of death to the fourth place in the United States [1]. The incidence of stroke has increased exponentially over the last 30 years and its causes vary by age. Ninety-five percent of strokes occur in people over the age of 45 and two-thirds of strokes occur in people over age 65. The risk of death in a peron with stroke also increases with age. Stroke can occur at any age including the age of the children [2].

Stroke is also a major cause of disability. It is approximately 55% of patients who survive up to 3 years will experience a decrease in quality of life. There is only 20% of patients with stroke can return to work as before [3,4]. The association between renal function and stroke has been determined by a study assessing the association between hypertension and mortality with black patients suffering from acute stroke as the determinants. Stroke survivors have lower levels of

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urea than those who died. Friedman's findings of stroke survivors in New Zealand mentioned that serum cretinin concentrations independently as predictors of mortality even after adjustment for confounding variables [5].

Euvolemia is important for adequate blood flow and maximizing oxygen intake into optimal tissue and organ function. Research showed blood flow to organs such as muscles and kidneys decreases significantly during dehydration. Cardiac output also decreases during dehydration [6]. The brain has the ability to control blood flow through autoregulation that regulated constant cerebral perfusion pressure even when blood pressure changes. Dehydration has been shown to decrease the autoregulation response to orthostatic position changes, but in general does not decrease cerebral perfusion [7].

The role of dehydration in cerebral infarcts is thought to be multifactorial. Dehydration increases the viscosity of blood by decreasing blood flow to the brain through the decrease of intravascular volume. The increase hematocrit has been shown to be associated by a larger volume of infarction in patients with cerebral infarction [8]. Dehydration has also been shown to be associated by recurrent embolic strokes and thrombotic events including venous thromboembolism following the onset of acute stroke. Dehydration can disrupt the distribution of oxygen to the brain, increase the risk of venous thromboembolism, and be associated with poor outcome in stroke [9]. Dehydration can be detected by biomarkers of reduced fluid in the blood. Biomarkers that are often used to assess the presence of dehydration are the ratio of BUN/creatinine and plasma osmolality [5,10].

There is no hydration marker has been considered a golden standard, especially for mild dehydration. A total of 102 elderly patients were admitted to one of the educational hospitals who were diagnosed dehydrated. After a serum analysis, there is only 17% had an increase in serum osmolarity, 11% had elevated serum sodium, and 68% had an increase in blood urea nitrogen (BUN)/ serum creatinine (SCr) [11]. BUN and SC are valuable laboratory parameters for evaluating renal function. The ratio of BUN to serum creatinine (BUN/SCr) is one of the useful laboratory indicators to determine the decrease in hydration status [12]. Based on the description above, it is necessary to conduct an analysis of dehydration status and degree of clinical severity in patients with trombolytic infarction. This study aimed to analyse hydration status of clinical severity and degree of clinical severity in patients with trombolytic infarction.

Methods

The participants in this study were all acute thrombotic stroke patients who met the inclusion and exclusion criteria. The inclusion criteria included patients diagnosed clinical acute thrombotic stroke and uncompromised CT scan, first stroke occuring within 24 hours, and having National Institute of Health Stroke Scale (NIHSS) score score of <4. NIHSS is a tool used to assess stroke damage with score range of 0 to 42 [13]. Exclusion criteria include patients having chronic renal failure, congestive heart failure, hemorrhagic stroke, embolism stroke, systemic inflammatory response syndrome *pons syndrome* [14], and use diuretic drugs. Participants who were willing to be involved in this study were required to fill the informed consent form in advance.

The participants were selected by identifying the number of patients with acute thrombolytic stroke in the previous year at Dr. Soetomo Teaching Hospital Surabaya, Indonesia. Afterwards, we found 101 participants with acute thrombolytic stroke who met the inclusion and exclusion criteria. During the course of the study, some patients with acute thrombolytic stroke were excluded from the study because the participant went home forcibly or died in ≤24 hours before blood sampling was taken for BUN and SCr examination. After those processes, we found 52 participants that were able to be enrolled in this study.

The procedure of this study involved patients diagnosed with acute thrombolytic stroke [15]. Patients were examined by NIHSS on the seventh day [11]. Participants were identified and divided into 2 groups, i.e. case group (moderate NIHSS with score 4-15) and control group (NIHSS with score <4). We conducted blood presure measurement for the participants. Blood sample of 3 ml was stored in EDTA vials and identified for the BUN, SCr, Hb, Albumin, Potassium, Sodium, and Glucose. Assessment of dehydration status (BUN/ SCr) was based on two studies [6,16]. The criteria of hypertension refers to Joint National Committee 8 (JNC-8) [19].

The measurement data were analyzed according to the type of measurement results data using SPSS 22.0 (SPSS, Inc., Chicago, IL). Analysis on the participants' gender data and blood pressure were conducted using chi square test (A p value of <0.05 was considered as

statistically significant). Analysis on age, albumin, sodium, potassium, hemoglobin, and glucose data of the participants were conducted using t-dependent test (A p value of <0.05 was considered as statistically significant) with Kolmogorov Smirnov beforehand. The correlation between dehydration status and degree of clinical severity in stroke infarction patients was analyzed using chi square test (A p value of <0.05 was considered as statistically significant).

Result

Sample Characteristic

The demographic data in this study consisted of two types of data, i.e. gender and age. In case group, most participants were female (32.69%), while in control group most participants were male (32.69%). The comparison of age between the two groups showed p = 0.027 (Table 2). In case group, the mean of the participants' age was 55.43±9.05 years old, while in control group was 53.12±11.96 years old. The comparison of age between the two groups showed p = 0.233 (Table 1).

The Albumin, Glucose, Potassium and Sodium Level

The clinical data of albumin examination showed the value 4.00±0.36 mg/dl in case group and 4.18±0.42 mg/dl in control group. The comparison between the two groups showed p = 0.276. The sodium level was 134.12±3.38 mg/dL in case group and 135.12±2.52 mg/dL in control group. The comparison of sodium level between the two groups showed p = 0.653. The potassium level in case group was 3.76±0.53 mg/dL, while in control group was 4.05±0.46 mg/dL. The comparison of potassium level between the two groups showed p = 0.479. The level of hemoglobin was 14.00±2.81 mg/dL in case group and 14.10±4.95 mg/dL in control group. The comparison of hemoglobin level between the two groups showed p = 0.905. The glucose level in this study was 137.43±40.51 mg/dl in case group whereas in control group was 123.58±20.31 mg/dl. The comparison of blood glucose between the groups showed p = 0.694 (Table 1). Most participants had hypertension with 82.69%. The comparison of hypertension in the two groups showed p = 0.233.

Table 1. Mean of clinical data

Variable	National Institute of Health Stroke Scale		p
	Case (n = 26)	Control (n = 26)	
Age	55.43±9.05	53.12±11.96	0.233
Albumin	4.00±0.36	4.18±0.42	0.276
Sodium	134.12±3.38	135.12±2.52	0.653
Potassium	3.76±0.53	4.05±0.46	0.479
Hemoglobin	14.00±2.81	14.10±4.95	0.905
Blood glucose level	137.43±40.51	123.58±20.31	0.694

Hydration Status and the Stroke Severity

According to all participants in this study, 19.23% in case group experienced dehydration. However, control group was 9.62%. We did not find any significant difference, both statistically and clinically, between clinical severity degree of acute thrombotic stroke patients and dehydration condition and those with no dehydration. The p value was 0.126 and the odd ratio value was 2.625 (IK 95%; 0,748 – 9, 210; Table 2).

Table 2. Frequency of clinical data

Variable	Category	National Institute of Health Stroke Scale		P
		Case (n = 26)	Control (n = 26)	
Gender	Male	17.31	32.69	0.027
	Female	32.69	17.31	
Blood pressure	Hypertension	44.23	38.46	0.233
	Normal	5.77	11.54	
Dehydration	Dehydration	19.23	9.62	0.126
	Normal	30.77	40.38	

Discussion

The results which do not correspond with the proposed research hypothesis might be due to several things. First, the study did not include subjects suffering from ischemic stroke due to thrombotic in large vessels and therefore we did not get sufficient number of subjects into moderate to severe NIHSS groups with dehydration as well. In the studies conducted by Lin et al. and Schrock et al., the inclusion criteria included ischemic stroke patients due to large vessel disease [6,16]. Second, this study did not limit the age of the subjects, causing that the proportion of subjects in the dehydrated group and the severity of clinical/NIHSS were not as expected. It is known that the elderly subjects are susceptible to dehydration which is a major cause of fluid and electrolyte disturbances [12]. Third, this study did not consider other factors that might determine stroke prognisis, such as the location and width of the infarct. Stroke prognosis is affected by various factors including age, stroke severity degree, stroke mechanism, infact location, comorbidity conditions, clinical finding, and related complications [20].

Cerebrovascular disease is one of the causes of morbidity, disability, and mortality worldwide. Generally the different genders are associated with stroke events. The relationship between age and stroke is more influential to men except at an advanced age. Increased age affects the morbidity of stroke, mortality, and the old outcome in both minor and major stroke. The age of over 65 years has a higher mortality risk in 2 months after stroke [21].

Hypoalbuminemia is a poor predictor of prognosis in patients with ischemic stroke, but the mechanism is still unknown. The currently known mechanism is not only limited to energy depletion, but also related to the damage of one's immune and hormonal responses, as well as extracellular fluid expansion. In another study, the effect of infusion of albumin on ischemic brain of experimental animals was suggested. This is presumably because albumin has a neuroprotective effect mediated by various actions including antioxidative ability, affecting endothelial function, and venular perfusion [22].

Hyponatremia is a risk factor for stroke and cardiovascular disease. Mild hyponatremia is associated with increased mortality within 30 days of myocardial infarction and post-stroke mortality in 3 years. Hyponatremia is associated with acute mortality and worse outcome trends resulting in higher mortality within 12 months after stroke [23]. The mechanisms of potassium effect on stroke are still unclear. Patients with lower potassium serum levels during stroke and after dismissed from hospital have a poor prognosis, especially in elderly patients [24].

Hypertension is a major risk factor for stroke. The increase of systemic blood pressure associated with the increased intra-cranial pressure (ICP), mainly due to suppression of the brain stem. It is strongly associated with intracerebral and subarachnoid hemorrhage, but this increase in blood pressure does not appear to be associated with cerebral ischemia [25].

The dehydration condition characterized by an increase in BUN/SCr ratio is a factor that can be used

to estimate poor outcomes in patients with chronic heart failure [26]. The increased of BUN/SCr ratio is also reported to be associated with a neurological deterioration in ischemic stroke patients [16]. A dehydration condition that increases the BUN/SCr ratio by more than 15 is at 2.2 times risk of clinical impairment in 30 days of post-onset of ischemic stroke [6]. Infarction stroke patients with elevated BUN/SCr ratio had a higher prevalence for cardiembolic stroke compared to those without increased BUN/SCr ratio [15].

Conclusion

There was no correlation between hydration status assessed using BUN/Serum Creatinin rasio and the clinical severity degree assessed using NIHSS in acute thrombotic stroke. However, a further confirmation is still required.

Ethical Clearance: The study protocol was approved by the Ethical Commission to conduct basic science/clinical research in Dr. Soetomo General Hospital Surabaya, Indonesia. The present study was carried out in accordance with the research principles. This study implemented the basic principle ethics of respect, beneficence, non-maleficence, and justice.

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