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Electrolyte disturbances among acute stroke patients in Manado, Indonesia

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ABSTRACT

Stroke is known as main public health problem. It is one of the leading causes of chronic disability and death. Both sodium and potassium disturbances have negative influences on the outcome of stroke. There is a scarcity of data about electrolyte disturbances in acute stroke, especially from developing countries. The objectives of this study were to find out the incidence of electrolyte disturbances among acute stroke patients; and their association with severity of acute stroke. This study was a hospital-based cross-sectional study. Samples consisted of 85 patients that meet the inclusion criteria. Data of electrolyte status was obtained from medical record. The result shows that the incidence of electrolyte disturbances among acute stroke was 45.9%. Sodium disturbances was 8.2% and potassium disturbances was 40.0% from all study samples. Mean of NIHSS score on admission was 9.3 (95% CI 8.2-10.2). Mean of sodium was 141.7 (95% CI 140.7-142.7) and potassium was 3.7 (95% CI 3.0-6.0). There was no association between electrolyte disturbances and severity of stroke (p > 0.05). Conclusion: The incidence of electrolyte status disorders in acute stroke patients was high but we could not detect any association between electrolyte disturbances and the severity of acute stroke.

Keyword: "electrolyte disturbances", sodium, potassium, severity, stroke, "acute stroke", manado

INTRODUCTION

Stroke is a major public health problem. It is globally well-distributed and is ranked at the second top cause of death around the world. Stroke causes a great impact on disability rate. Stroke also has enormous contribution to economic and social burden for patients and their family[1]. In Indonesia, stroke and other cardiovascular diseases are number one cause of death among major hospitals.[2,3]

In almost all neurological disorders, electrolyte disturbances were prominent. Electrolyte disturbance are commonly found in acute stroke setting[4]. Hypernatremia, hyponatermia and hypokalemia was the commonest type of disturbance.[5,6] Recently, research with electrolyte disturbances is not only focusing on the neuro-endocrine mechanism but also on its prevalence, risk factors and association with other medical condition[5].

Even though there are some data about large number of electrolyte disturbances in acute stroke setting, reports on the association between electrolyte imbalance and severity of acute stroke are still in limited number. There is a lack of data about this association especially from developing

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countries. The objectives of this study were to find out the incidence of electrolyte disturbances in acute stroke setting and their association with severity of acute stroke.

MATERIALS AND METHODS

This was a cross-sectional hospital-based study conducted in Manado General Hospital (formally known as Professor R. D. Kandou General Hospital). All stroke patients were treated in neurological wards. Diagnosis of stroke was based on history of disease, physical examination and confirmed by neuro-imaging study. Electrolytes analyzed in this study were sodium and potassium. Sodium level in a range of 135-153 Meq/L was defined as normal. Potassium level in a range of 3.5-5 Meq/L was defined as normal. Other values were categorized as electrolyte disturbances. Hyponatremia was defined when the level below 135 Meq/L. Hipernatremia was the level of natrium above 153 Meq/L. Hypokalemia was the level of kalium below 3.5 Meq/L, while Hiperkalemia was when the level of kalium above 5 Meq/L. Based on NIHSS (Neurological Institute of Health Science for Stoke) score, we defined mild severity of acute stroke when the NIHSS score less than 4, moderate severity if the score fall within 4 to 15 dan score above 15 was defined as the most severe deficit. All the patients who met the inclusion criteria were recruited as samples. Inclusion criteria were: 1. Patients are not in diuretic therapy, 2. Patient was not in resuscitation phase. 3. There was no history of kidney or endocrine diseases. Exclusion criteria: We excluded all patients with a complication that might affect electrolyte status during their stroke management.

Data collection for demographic characteristics was obtained from interview. Patients with communication difficulties were represented by family member or spouse. Medical data was attained from medical records. One way Annova was employed to find out the association between each electrolyte disturbances and the severity of stroke. P value < 0.05 level was determined as statistically significant association. Statistical analysis was performed with SPSS version 17. Ethical consideration was obtained from Research Committee of Manado General Hospital.

RESULTS

Among 85 patients who were analyzed, 61.2% was male, 37.6% was in above 60 years age group, mean age was 56.3 (95% CI 53.8-58.8), 50% was reach secondary educational level, mostly were Minahasan ethnicity, majority of them were Christian and largely work as housekeeper or farmer (Table 1).

Table 1. Distribution of demographic characteristics and electrolyte status

Characteristics	n=85	%
Demographic		
Male	52	61.2
51-60 age group	23	27.1
>60 age group	32	37.6
High secondary school	40	50
Minahasan ethnic	62	76
Christian	70	85
Housekeeper	38	46
Farmer	12	15
Ischemic stroke	44	53.7
Sodium level		
Hyponatremia	6	7.1
Normal	78	91.8
Hypernatremia	1	1.2
Potassium level		
Hypokalemia	32	37.6
Normal	51	60.0
Hyperkalemia	2	2.4

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Sodium disturbance		
Yes	7	8.2
No	78	91.8
Potassium disturbance		
Yes	34	40.0
No	51	60.0
Electrolyte disturbances		
Yes	39	45.9
No	46	54.1
Only sodium disturbance	7	8.2
Only potassium disturbance	34	40.0
Both	2	2.4

Based on electrolyte status, the current study found that most of acute stroke patients admitted with normal sodium and potassium level (91.8% and 60.0%, respectively). Totally, there were 39 patients with electrolyte disturbances (45.9%). 8.2% of all patients had sodium disturbance, 40.0% with potassium disturbance and 2.4% with both sodium and potassium disturbances. Hyponatremia were found in 6 patients (7.1%) and only 1 case of hypernatremia (1.2%). Hypokalemia was 37.6% among all patients and hyperkalemia was only detected in 2 patients (2.4%) (Table 1).

The present study found mean GCS score was 12.4 (95% CI 11.7-13.0) for all patients. Mean of NIHSS score on admission was 9.3 (95% CI 8.2-10.2). Mean of sodium was 141.7 (95% CI 140.7-142.7) and potassium was 3.7 (95% CI 3.0-6.0) (Table 2).

Table 2. Distribution of GCS, NIHSS score, sodium and potassium level.

Variable	Mean	SD	Minimal-maximal	95% CI
GCS	12.4	2.9	6-15	11.7-13.0
NIHSS	9.3	4.5	2-20	8.3-10.2
Sodium	141.7	4.8	126-154	140.7-142.7
Potassium	3.7	0.6	3.0-6.0	3.5-3.8

Table 3 revealed the distribution of severity of stroke based on NIHSS score. Most of patients were classified as moderate deficit (80.0%). There were 8 patients admitted with mild severity (9.4%) and 9 patients with severe deficit (10.6%).

Table 3. Distribution of severity of stroke based on NIHSS score

Severity	NIHSS score	n=85	%
Mild	<4	8	9.4
Moderate	4-15	68	80.0
Severe	>15	9	10.6

Based on status of electrolyte disturbances, the present study found means of NIHSS score was 8.31 (95% CI 6.9-9.6) among patients with electrolyte imbalance. In other group, mean score of NIHSS was 10.1 (95% CI 8.7-11.4). There was no significantly difference between means of NIHSS score on both group (p>0.05) (Table 4).

Table 4. Distribution of means of NIHSS score based on status of electrolyte disturbances

Variable	Mean	SD	95% CI	p-value
Yes	8.31	4.1	6.9-9.6	0.27
No	10.1	4.5	8.7-11.4	

Based on severity of acute stroke, this study found the distribution of means of sodium level for mild deficit neurologic was 139.4 Meq/L (95% CI 136.1-142.5), for moderate deficit neurology it was 142.0 Meq/L (95% CI 140.8-143.2) and it was 141.1 Meq/L (95% CI 139.1-143.1) for patient with severe deficit. However, there was no significantly difference of means of sodium and potassium among these groups (p>0.05). Distribution of potassium level for mild cases was 3.7 Meq/L (95% CI 3.3-4.2), for moderate cases it was 3.7 Meq/L (95% CI 3.5-3.8) and for severe cases it was 3.5 Meq/L (95% CI 3.3-3.7). Again, we could not detect any significant difference between electrolyte disturbances and severity of acute stroke (Table 5).

Table 5. Distribution of means of electrolyte level based on severity of stroke

Variable	Mean	SD	95% CI	p-value
Sodium				
Mild	139.4	3.8	136.1-142.5	0.3
Moderate	142.0	5.0	140.8-143.2	
Severe	141.1	2.6	139.1-143.1	
Potassium				
Mild	3.7	0.5	3.3-4.2	0.7
Moderate	3.7	0.6	3.5-3.8	
Severe	3.5	0.2	3.3-3.7	

Among patients with electrolyte disturbances, moderately severe stroke was commonly found (84.6%) and only 7.7% was identified as severe cases. The same picture was found among all patients without electrolyte disturbances, 76.1% of which admitted to hospital with moderately severe stroke. Another 13% of cases were severe. However, there is no evident of significantly association between status of electrolyte imbalance and severity of acute stroke (p>0.05) (Table 6).

Table 6. Distribution of patients based on status of electrolyte imbalance and stroke severity

Electrolyte disturbances	Severity of stroke						Total		p-value
	Mild		Moderate		Severe				
	n	%	n	%	n	%	n	%	
Yes	3	7.7	33	84.6	3	7.7	39	100	>0.05
No	5	10.9	35	76.1	6	13.0	46	100	
Total	8	9.4	68	80.0	9	10.6	85	100	

DISCUSSION

Stroke is dominantly occurred at the middle age group or above and is commonly found in male than female. The current study also revealed that most of the patients are male and above 60 year age group. Most of them reach high secondary educational level. The majorities of patients were from Minahasa ethnicity. The mean of GCS was 12.4 (95% CI 11.7-13.0) and most of the case was ischemic stroke. These characteristics were similar with other study which found that most of the stroke patient was male, in the middle age or above and most of them admitted to hospital with ischemic stroke.[2,4,7]

We recorded that the incidence of electrolyte disturbances in this study was relatively high. If we compare to other study, it is revealed that the result of this incidence was quiet similar. The result in this study showed that only limited number of patients admitted with sodium disturbances, but large number of patients with potassium disturbances. However, we could not detect any association between electrolyte imbalance and severity of stroke.

It is found from other study that mortality rate of stroke patients with electrolyte imbalance was higher than in patients with normal level. This is especially true for hypernatremia because of its contribution on the development of brain edema. In this study hyponatremia was found in 7.1%. Some researcher reported that acute hyponatremia in acute stroke could affect the outcome of stroke negatively due to poor severity or death.[4,5,6]

Siddiqui[4] reported a high number percentage of patients with electrolyte imbalance (53%) of their acute stroke patients. Most of them were in acute hemorrhagic stroke. Among all patients in their study, it was revealed that there were 36% patients with sodium disturbance and 31% patients with potassium disturbance. Among patients with sodium disturbance, most of them were hyponatremia (32%). The majority of potassium disturbance was hypokalemia (30%). According to Siddiqui, minimum setting of acute management probably responsible for a large number of patients with electrolyte disturbances documented in their study. In the present study, we documented 45.9% of patients with electrolyte disturbances. Most of the disturbances in this stud, potassium disturbance (40.0%) while sodium disturbance was only detected in 8.2% patients. Among sodium disturbances, hyponatremia was found in 7.1% patients and hypernatremia was only 1.2%. Huang[8] reported an incidence of hyponatremia in their study was 11.6%. Siddiqui recorded an incidence of hypernatremia was 4% and hypokalemia was 30%. In this study we found the incidence of hypokalemia was 37.6% and there were 2.4% of cases with hyperkalemia.

Based on the distribution of severity of stroke according to NIHSS score, the present study documented that most of the patients (80%) was in moderate deficit neurology when admitting to the hospital. There were 10.6% patients with severe NIHSS score and small number of patients with mild deficit (9.4%). The mean of sodium in moderate deficit neurology was 142.0 Meq/L (95% CI 140.8-143.2). The mean of potassium in moderate NIHSS score was 3.7 Meq/L (95% CI 3.5-3.8). According to Huang[7], there are significant contributions of hyponatraemia in the outcome of stroke. They documented the higher death rate of patients with hyponatremic than normonatremic patients after 3 years of first stroke attack. However, Huang also reported that there was no significantly different between the two group in term of mortality rate while in hospital, functional status when discharge and the rate of stroke recurrence. Also, there was no difference in mortality rate in 1 to 3 months after discharge that study. But, Donati[9] reported the higher mortality rate of stroke cases with hyponatremia than stroke with normal level of sodium. According to Diaz[10] there are two commonest causes of hyponatremia in acute brain disorders which are SIADH (Syndrome of Inappropriate Antidiuretics Hormone) and CSW (Cerebral Salt Wasting).

Among sodium disturbance, hypernatremic patients was 1.2%. In general hospital population, the reported hypernatremia data were in between 0.3%-3.5%[6] . Therefore, the result in current study was relatively in line with previous study. Hypernatremia is one of the predictor of mortality in patients treated in ICU, especially if the sodium level exceeded 160 Meq/L[6]. In the present study, among severe deficit neurologic patients, the mean of sodium was 141.1 Meq/L. According to Aiyagari,

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most of the causes of hypernatraemia were induced by osmotic agents. Mortality rate will increase with the increasing of sodium peak level.

In this study, we concluded that the incidence of electrolyte status disorders in acute stroke patients was high but we could not detect any association between electrolyte disturbances and the severity of acute stroke. Both sodium and potassium disturbances in the current study were not significantly associated with the severity of acute stroke. Although hyponatremic or hypernatremic in acute stroke patients were associated with poor outcome of stroke, but it was not found in our study. There are several reasons as to why sodium disturbances were not associated with stroke severity in this study. First, it is because the assessment of NIHSS score was done on first admission. According to Huang[7] higher mortality rate due to hyponatremia was only significant after 3 years follow up. It means, this study should be conducted not only when the patients admitted to hospital but should be followed by a cohort study. Second, most of patients admitted in relatively moderate severity (based on GCS and NIHSS score).

LIMITATION OF THE STUDY

There are several limitations of the current study: First, based on sample size, the study had relatively small samples. Second, there was no long-term follow-up of NIHSS score could be carried out.

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