International Journal of Research in Medical Sciences
Setyawati YD et al. Int J Res Med Sci. 2020 Jun;8(6):2028-2032
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20202238

Original Research Article

Electrolyte disturbances and lipid profiles in ischaemic and hemorrhagic stroke patients in Aisyiyah Bojonegoro Hospital, Indonesia

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Received: 28 March 2020
Accepted: 29 April 2020

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ABSTRACT

Background: The prevalence of stroke continues to increase every year. Electrolyte imbalance and metabolic disorder can cause high morbidity and mortality of stroke. There are very few studies conducted on serum electrolytes and lipid levels in stroke patients. Authors aimed to know the electrolyte disturbance and lipid profiles in acute stroke.
Methods: Retrospective case analysis was used in this study. Patients who diagnosed with hemorrhagic and ischaemic stroke in Aisyiyah Bojonegoro Hospital from January to September 2019 were selected trough electronic medical records system. Authors examine the electrolyte levels and lipid profiles. Patients with a previous history of stroke, complication that might affect electrolyte level and incomplete data in medical records were excluded. Independent T-test or Mann Whitney test were used to analyze the difference of parameters between hemorrhagic and ischaemic stroke patients. P value was considered as significant at $p<0.05$.
Results: Most common electrolyte imbalance in both hemorrhagic and ischaemic stroke was hypokalemia which is statistically significant. Comparison between stroke patients was statistically significant for mean potassium and high density lipoprotein (HDL), while other mean serum values were not different. Potassium significantly lower ($p=0.002$) in hemorrhagic stroke and HDL significantly lower ($p=0.034$) in ischaemic stroke.
Conclusions: This study reveals that hypokalemia was higher in hemorrhagic stroke and HDL was lower in ischaemic stroke. Regular monitoring of lipid levels in patients with high risk factors and correction of electrolytes imbalance for stroke patients will help in decreasing the mortality and morbidity.

Keywords: Acute stroke, Dyselectrolytemia, Electrolyte, Hypokalemia, Hyponatremia, Lipid, Low density lipoprotein, High density lipoprotein

INTRODUCTION

Non-communicable diseases (NCDs) are the leading cause of mortality worldwide. In 2016 the leading causes of NCD deaths were 44% cardiovascular diseases (17.9 million deaths), 22% cancers (9.0 million deaths), and 9% respiratory diseases, including asthma and chronic obstructive pulmonary disease (3.8 million deaths), and diabetes caused another 1.6 million deaths.[1] Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels and include coronary heart disease, cerebrovascular disease, rheumatic heart disease, and other conditions. Four out of five CVD deaths are due to heart attacks and strokes.[2] The prevalence of stroke in Indonesia continues to increase every year. National data shows there was an increased in stroke prevalence from 7 per mile in 2013 to 10.9 per mile.[3]

Strokes may be classified into two major categories based on pathogenesis: ischemic and hemorrhage.[4] Ischemic stroke due to brain vessels occlusion and blockage. Hemorrhagic stroke, which is due to blood vessel rupture are divided into intracerebral hemorrhage and atraumatic subarachnoid hemorrhage.[4]

High morbidity and mortality of stroke are due to some complications like cerebral edema, infection, deep vein thrombosis, pulmonary embolism, electrolyte imbalance, associated heart disease, and metabolic disorder.[5] Electrolyte disorders i.e sodium and potassium concentration are the commonest found in stroke patients, resulted from inappropriate secretion of antidiuretic hormones, increase in the brain and atrial natriuretic peptides, and inappropriate fluid intake and loss; this can lead to complications like seizures and death. Early diagnosis is essential to prevent morbidity and mortality. Serum electrolyte analysis is important of initial evaluation in stroke patients.[6]

The relationship of serum lipids with stroke has been studied with risk factors such as coronary heart diseases. There is a strong association between lipids and strokes due to large artery atherosclerosis.[7] Several vascular disorders such as atherosclerosis can cause focal cerebral ischemia.[4] Hence, high risk patients with stroke should be screened using serum lipid profile.

There are very few studies conducted on serum electrolytes and lipid levels in stroke patients, especially in Indonesia. Therefore, the current study aimed to evaluate the association of serum electrolyte and lipid levels in ischaemic and hemorrhagic stroke.

Studies showing the extent of dyselectrolytemia in CVA patients are rare from India.

This study is designed to document disturbances in serum sodium, potassium and chlorides as well as the urinary excretion of these electrolytes in acute phase of stroke patients

METHODS

Retrospective case analysis was used in this study. Patients who diagnosed with hemorrhagic and ischaemic stroke at Aisyiyah Bojonegoro Hospital from January to September 2019 were selected trough electronic medical records system.

A stroke case was diagnosed clinically using Siriraj score or CT scan. The data collected included demographic data, type of stroke (ischaemic or hemorrhagic), previous history of hypertension, diabetes mellitus and cardiac disease. Serum lipid levels, electrolytes, urea and creatinine measured on the first day of admission were included in this study. Patients with a previous history of stroke, patients with a complication that might affect electrolyte level such as diarrhea, hyperglycemia >300mg/dl, excessive bleeding, combustion, hypertriglyceridemia >400mg/dl, renal failure history or end-stage renal disease that need dialysis and incomplete data in medical records were excluded.

Statistical analysis

Statistical analysis was performed using SPSS software (version 16). Independent T-test or Mann Whitney test were used to analyze the difference of parameters between hemorrhagic and ischaemic stroke patients. P value was considered as significant at $p<0.05$.

RESULTS

A total of 173 cases of stroke, 61 were hemorrhagic stroke and 112 were ischemic stroke. The demographic data of the subjects are shown in Table 1.

Table 1: Demographics of patients in the study.

Variables	Hemorrhagic (n=61)	Ischaemic (n=112)	p-value
Age (years)	59.39 ±11.38	62.69±11.49	0.072
Sex			
Male	27 (44.2%)	50 (44.6%)	0.962
Female	34 (55.8%)	62 (54.4%)	
SBP	192.74±37.08	158,82±30.57	
DBP	113.57±21.56	96.1±18.213	
Risk Factor			
Diabetes Mellitus	6 (9.8%)	14 (12.5%)	0.601
Hypertension	58 (95.1%)	87 (77.7%)	
Heart disease	9 (14.7%)	48 (42.9%)	

SBP = Systolic blood pressure, DBP = Diastolic blood pressure

Comparison between stroke patients was statistically significant for mean potassium and HDL, while other mean serum values were not different (Table 2). Potassium significantly lower (p=0.002) in hemorrhagic stroke and HDL significantly lower (p=0.034) in ischemic stroke.

Table 2: Mean±SD of serum lipid profile, electrolyte, urea, and creatinine in stroke patients.

Parameters	Hemorrhagic	Ischaemic	p-value
Total Cholesterol mg/dl	197.9±34.321	190.28±40.567	0.215
Triglyceride mg/dl	132.19±58.083	137.17±65.772	0.833
HDL mg/dl	68.96±18.209	62.61±18.951	0.034
LDL mg/dl	132.29±29.244	129.33±37.295	0.593
Na^+ Meq/L	140.42±2.98	139.42±4.933	0.388
K^+ Meq/L	3.53±0.414	3.72±0.438	0.002
Cl^- Meq/L	101.32±2.42	100.62±3.587	0.291
Ur mg/dl	35.96±14.817	38.25±17.171	0.308
Cr mg/dl	1.08± 0.408	1.08±0.432	0.916

HDL = high density lipoprotein, LDL = low density lipoprotein, Ur = urea serum, Cr = creatinine serum

Seventy-four patients (42.7%) had dyselectrolytemia (Table 3) but not significantly different. Normal serum sodium (135-148 mmol/l); Normal serum potassium (3.5-5.3 mmol/l); Normal serum chloride (95-105 mmol/l).

Table 3: Frequency of dyselectrolytemia in stroke patients.

Dys-electrolytemia	Hemorrhagic (n=61)	Ischaemic (n=112)	p-value
Present	30 (49.2%)	44 (39.3%)	0.13
Absent	31 (50.8%)	68 (60.7%)	

The frequency of serum sodium, potassium and chloride imbalance in stroke patients shown in Table 4. Most common electrolyte imbalance in both hemorrhagic and ischaemic stroke were hypokalemia which is statistically significant.

Table 4: Frequency of sodium, potassium and chloride imbalance in stroke patients.

Parameter	Hemorrhagic (n=61)	Ischaemic (n=112)	p-value
Sodium			
Normal Sodium	59 (96.7%)	100 (89.3%)	0.17
Hyponatremia	1 (1.6%)	10 (8.9%)	
Hypernatremia	1 (1.6%)	2 (1.8%)	
Potassium			
Normal Potassium	30 (49.2%)	77 (68.8%)	0.01
Hypokalemia	31 (50.8%)	35 (31.2%)	
Hyperkalemia	0	0	
Chloride			
Normal Chloride	59 (96.7%)	103 (91.9%)	0.30
Hypochloremia	0	4 (3.6%)	
Hyperchloremia	2 (3.3%)	5 (4.5%)	

DISCUSSION

In Indonesia there are very few studies describing electrolyte disturbances in stroke patients. This study was done in Aisyiyah Hospital Bojonegoro. Patients who diagnosed with hemorrhagic and ischaemic stroke from January to September 2019 were selected. 173 patients of stroke were selected from patients satisfying the inclusion criteria trough total population sampling.

The mean age of the patient with ischaemic stroke was significantly higher than that of hemorrhagic stroke (62.69±11.489 versus 59.39±11.385; p>0.05) with the highest rate of age (34.2%) was between 51-60 years in all patients. This rate is similar with study of Kalyan et al, in India that 30% of stroke patients aged 51-60.[8] According to a study in Manado General Hospital in Indonesia, they found that stroke occurred more often in male than female in the middle age group and above.[9] Other studies conducted in German, Italy, and Spain indicated that there was a male predominance of stroke than female.[10-12] The multivariable studies indicated that gender was a significant factor in stroke, and men have 2 times more risk to develop a stroke than women.[10] However, in this study, there was no significant difference in distribution of two stroke types according to gender (p=0.962). This result is similar to a study conducted by Hassan et al, they found that there was no significant difference between male and female among the control and study groups (p=0.952).[13]

In this present study based on Siriraj score and CT scan finding of the studied patients show the majority 64.7% had ischaemic stroke and 35.3% had hemorrhagic stroke. The ratio of ischemic to hemorrhagic stroke is 1.8:1 which is similar to the International incidence report by WHO (2:1). According to WHO, about 34% of strokes are of hemorrhagic subtype in low- and middle-income countries.[14]

This study found that 11.6% of stroke patients had diabetes mellitus, 83.8% had hypertension, and 32.9% had heart disease. The study from Sudan, they found 43.6% of stroke patients had hypertension, 16.5% had diabetes mellitus, and 4.3% had heart disease.[15] Overall, hypertension, diabetes mellitus and cardiac disease were the major risk factors of stroke.[16,17] In the present study, 9.8% of hemorrhagic stroke patients had diabetes mellitus, 95.1% had hypertension and 14.7% had heart disease. Meanwhile, 12.5% of ischaemic stroke patients had diabetes mellitus, 77.7% had hypertension and 42.9% had heart disease. Tuttolomondo et al, found that patients with diabetes have a higher proportion of ischaemic stroke compared to hemorrhagic stroke.[18]

In the present study of 173 stroke patients, 74 (42.7%) had dyselectrolytemia. The study conducted by Kalyan et al, 50% of patients with acute stroke had electrolyte disturbances.[8] In the present study 30 (49.2%) hemorrhagic stroke patients had diselectrolytemia in comparison to 44 (39.3%) ischemic stroke patients. Dyselectrolytemia between two types of stroke was not statistically significant (p=0.13). In a study by Bandyopadhyay et al, found that 63.8% hemorrhagic stroke and 47.2% ischaemic stroke patients had dyselectrolytemia.[19]

Hypokalemia was most common among hemorrhagic stroke patients (50.8%) followed by ischaemic stroke patients (31.2%). No patient had hyperkalemia. It is similar to the study by Bandyopadhyay et al, found that hypokalemia was most common among hemorrhagic stroke patients (20%) followed by ischaemic stroke patients (12%). Chi-square test revealed significant association between hypokalemia and hemorrhagic stroke.[19] This present study found the means distribution of potassium level for hemorrhagic stroke (3.53±0.414) was lower than ischaemic stroke (3.72±0.438). Similarly, Farahmand et al, found that means distribution of potassium level in the hemorrhagic stroke (3.46±0.17)

were significantly lower than in patients with TIA (3.99±0.15) and ischemic (3.88±0.23).[20]

Hyponatremia was most common among ischaemic stroke patients (8.9%) followed by hemorrhagic stroke patients (1.6%). But chi-square test revealed no statistically significant. Only 1.7% of all stroke patients had hypernatremia which was 1.1% of ischaemic stroke and 0.6% of hemorrhagic stroke.

Hyponatremia is the most common electrolyte disturbance in acute central nervous system disease. It can present many symptoms resemble neurological disease and worsen the existing neurological deficits. Hyponatremia could induce cerebral edema and adaptive responses of brain cells to osmotic swelling lead to neurologic dysfunction like seazures, which can further deteriorate level of consciousness and outcome.[21]

This present study found the means distribution of sodium level for hemorrhagic stroke (140.42±2.98) was higher than ischaemic stroke (139.42±4.933), but not statistically significant (p=0.388). Similarly, Chakraborty et al, found that means distribution of sodium level in the hemorrhagic stroke (146±2.61) were significantly (p<0.001) higher than in patients with ischemic (142.3±3.01).[22]

Hypochloremia only found among ischaemic stroke patients (3.6%). Meanwhile, 3.3% among hemorrhagic patients and 4.5% ischaemic patients presented with hyperchloremia during stroke (p=0.3). Huang et al, found that hyperchloremia is not rare and tends to occur in patients more severely affected by ischemic and haemorraghic stroke but no independent association was found.[23] In this study, authors found that hypo- or hyperchloremia in stroke patients were not statistically significant.

A cohort study by Green et al, discovered that hypokalemia was associated with an increased risk for stroke. A low potassium level was associated with increasing mortality owing to adverse effects on blood pressure, cardiac rhythm and cardiovascular morbidity. It was implicated in the progression of hypertension and stroke.[24]

Regarding lipid levels, total cholesterol and LDL levels were seen higher in hemorrhagic stroke patients while triglyceride was higher in ischaemic stroke patients (Table 2) but no statistically significant. In the present study shows that HDL significantly lower (p=0.034) in ischaemic stroke. A study conducted by Khan et al, reported ischemic stroke patients had a significantly higher frequency of reduced HDL levels than patients of hemorrhagic stroke.[25]

Limitation of this study First, the sample size was relatively small. Second, the method was a retrospective study. Third, the definite causes of these dyselectrolytemia during acute stroke could not be carried out for exampleparticipants' medical comorbidities or medications (such as diuretic therapy).

CONCLUSION

This study reveals that hypokalemia was higher in hemorrhagic stroke and HDL was lower in ischaemic stroke. Regular monitoring of lipid levels in patients with high risk factors and correction of electrolytes imbalance for stroke patients will help in decreasing the mortality and morbidity.

ACKNOWLEDGEMENTS

Authors would like to thank the staff of neurology at Aisyiyah Bojonegoro Hospital for critically reviewed the study proposal and staff of medical record at Aisyiyah Bojonegoro Hospital for collected data.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Setyawati YD, Mastura RR. Electrolyte disturbances and lipid profiles in ischaemic and hemorrhagic stroke patients in Aisyiyah Bojonegoro Hospital, Indonesia. Int J Res Med Sci 2020;8:2028-32.