SERUM ELECTROLYTE AND BLOOD LIPID PROFILE IN STROKE PATIENTS

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SERUM ELECTROLYTE AND BLOOD LIPID PROFILE IN STROKE PATIENTS

Tranggono Yudo Utomo[1,3]*, Meriyanti Wimny Gwijangge[2], Agus Yudawijaya[1]
[1]Department of Neuroscience, Faculty of Medicine, Universitas Kristen Indonesia, Jl.Mayjen Sutoyo No 2. Jakarta 13630, Indonesia
[2]Undergraduate Program, Faculty of Medicine, Universitas Kristen Indonesia, Jl.Mayjen Sutoyo No 2. Jakarta 13630, Indonesia
[3]Regional General Hospital, Dr. Chasbullah Abdulmadjid, Jl. Pramuka No.55, Marga Jaya, Bekasi Selatan, Bekasi, Jawa Barat 17141, Indonesia
*tranggono.utomo@uki.ac.id

ABSTRACT

Stroke is a leading cause of death and disability worldwide, including in Indonesia. While vascular factors are the primary cause, metabolic components such as serum electrolytes and blood lipids also play a significant role in the onset and progression of stroke. Imbalances in sodium, potassium, and chloride, as well as abnormalities in cholesterol and triglyceride levels, can influence both stroke risk and prognosis. Understanding these biochemical profiles in stroke patients is essential for improving clinical outcomes. This study aims to analyze the profile of serum electrolytes and blood lipids in stroke patients treated at Dr. Chasbullah Abdulmajid Hospital, Bekasi City, during the period December 2024 to March 2025. Stroke is one of the leading causes of morbidity and mortality worldwide, which is known to occur due to vascular factors. Metabolic factors such as serum electrolytes and blood lipids can play an important role in the pathogenesis and prognosis of stroke. Using a descriptive design, patient medical record data were collected and analyzed, which were then processed univariately, with a focus on serum electrolyte profiles, including sodium, potassium, and chloride, as well as blood lipid profiles, such as total cholesterol, LDL, and HDL. The results showed that the characteristics of stroke patients treated at Dr. Chasbullah Abdulmajid Hospital, Bekasi City, during the period from December 2024 to March 2025, differed only by gender, with 46 patients (50.5%) being male and 45 patients (49.5%) being female. The most common comorbid history in stroke patients was hypertension, totaling 53 people (58.3%), followed by diabetes mellitus, totaling 26 (28.6%). The largest electrolyte imbalance disorder was hypokalemia in 43 people (47.3%), followed by hyponatremia in 35 people (38.5%) and hyperchloremia in 23 people (25.3%). The majority of patients had low HDL levels, with 46 people (50.5%), 27 people (29.7%) having increased triglyceride levels, and 20 people (22.0%) having quite high cholesterol levels. These findings are expected to provide important insights for clinical management and prevention of stroke in the future.

Keywords: electrolytes; lipids; stroke

INTRODUCTION

Stroke has become the leading cause of disability and the third leading cause of death in the world, after heart disease and cancer (Ministry of Health of the Republic of Indonesia, 2023). According to WHO, stroke is a collection of clinical symptoms caused by brain disorders, either focal or global, which develop rapidly and are characterized by symptoms that last for 24 hours or more, and can be fatal for no other apparent reason other than vascular factors (RI, 2019) Stroke is divided into two categories, namely ischemic stroke and hemorrhagic stroke. Ischemic stroke occurs due to a blood clot caused by atherosclerosis, which blocks the flow of blood to the brain, preventing brain cells from receiving enough oxygen and nutrients. Meanwhile, hemorrhagic stroke is caused by a blood vessel in the brain bursting. The incidence of hemorrhagic stroke is lower than ischemic stroke, because hemorrhagic stroke usually occurs as a result of untreated ischemic stroke, which then causes blood vessels to rupture (Kanyal, 2015). According to the World Stroke Organization (WSO) in 2019, the incidence of stroke worldwide had reached more than 80 million people. With the number of

new cases of ischemic stroke reaching 9.5 million and a death rate of 2.7 million each year worldwide, there are 4.1 million new cases with 2.8 million deaths each year in hemorrhagic stroke (WIDIYANTO, 2022).

Data from the South East Asian Medical Information Center (SEAMIC) reports that stroke is the leading cause of death in Southeast Asian countries. Indonesia has the highest death rate, followed by the Philippines, Singapore, Brunei Darussalam, and Malaysia (Putri et al., 2017). The Basic Health Research (RISKESDAS) conducted by the Indonesian Ministry of Health revealed that the prevalence of stroke in Indonesia, based on a doctor's diagnosis, has increased by 56%, from 7.0 per 1000 individuals in 2013 to 10.9 per 1000 individuals in 2018.5 West Java Province also experienced a significant increase in stroke prevalence, from 6.6% in 2013 to 11.4% in 2018 (Kemenkes, 2018).

The risk of stroke increases with the severity and number of risk factors present. Based on the analysis of risk factors for various types of stroke, the main factor identified as a cause of stroke is hypertension, while other risk factors include diabetes mellitus (DM) and dyslipidemia. A study in the United States by Ebinger et al. (2023) with a cohort design involving 48,721 participants found that hypertension had a significant relationship with the occurrence of ischemic stroke (p <0.001) and hemorrhagic stroke (p = 0.044) (Rahayu, 2023). Diabetes mellitus is a chronic metabolic disorder with high blood glucose levels due to impaired insulin production, insulin resistance, or a combination of both. High blood sugar levels, known as hyperglycemia, can cause increased blood viscosity, which in turn can lead to increased blood pressure or hypertension, which can potentially lead to stroke. In addition, stroke patients who experience hyperglycemia have a worse prognosis compared to stroke patients who have normal blood sugar levels (Balgis et al., 2022).

Dyslipidemia is a lipid metabolism disorder characterized by increased levels of total cholesterol, LDL cholesterol, and triglycerides, and decreased levels of HDL cholesterol. Cholesterol is an important component in the structure of cell membranes, including brain and nerve cells. An imbalance in cholesterol levels causes fat accumulation, which results in blockage of blood vessels, as well as calcification and hardening of blood vessels, known as atherosclerosis, which is one of the causes of stroke (Pakpahan & Hartati, 2022). The results of the analysis of 18 journals showed that triglycerides and total cholesterol function as markers of prognosis and mortality in stroke patients. Research by Yuziani et al. (2018) revealed that increased total cholesterol followed by decreased levels of high-density lipoprotein (HDL) can slow down the rehabilitation process after stroke, as well as increase the risk of death from stroke (Santoso et al., 2023). Electrolytes have been studied in various diseases, including cardiovascular disease, hypertension, diabetes, and metabolic syndrome. Previous studies have shown that electrolyte imbalance can affect morbidity and mortality in stroke patients (Pan et al., 2025). Electrolytes, such as sodium (Na+), potassium (K+), and chloride (Cl), play a crucial role in various physiological functions, including nerve impulse transmission, muscle contraction, and fluid balance regulation.

Serum sodium level disorders in the form of hyponatremia are the most common electrolyte disorders found in neurological diseases. In acute stroke, about 30% of patients experience sodium disorders, with the majority of cases being hyponatremia (28%) and only 2% experiencing hypernatremia. There is a relationship between high mortality rates and poor outcomes, as measured by (NIHSS) and (mBI), in stroke patients with hyponatremia. Meanwhile, another study by Fofi et al. found a relationship between hypernatremia and neurological deterioration in stroke patients (Wulan & Setiawan, 2019). In stroke cases, hyponatremia can be caused by inappropriate antidiuretic hormone syndrome (SIADH) or cerebral salt wasting syndrome (CSWS). In SIADH, antidiuretic hormone (ADH) secretion becomes uncontrolled in response to stimulation from the hypothalamus, resulting in

hypotonicity of body fluids and increased blood volume. In contrast, CSWS is caused by central nervous system (CNS) malfunction, leading to inappropriate renal nerve input signals, resulting in excessive secretion of brain natriuretic peptide, atrial natriuretic peptide (ANP), and suppression of renin secretion, leading to hypovolemia and hyponatremia. In addition, hyponatremia can also be caused by dietary sodium restriction in an attempt to control hypertension, use of antihypertensive drugs such as diuretics, and secondary infections.

It was found that 31% of the total 53% of acute stroke patients had impaired potassium levels. Hypokalemia is common after stroke and is associated with poor prognosis. One of them is muscle weakness, which generally occurs when serum potassium levels are below 2.5 mmol/L. Hypokalemia can cause weakness in the respiratory muscles, which can lead to respiratory paralysis but this occurs in severe cases. On the other hand, clinical manifestations in patients with hyperkalemia are usually asymptomatic, but can cause life-threatening conditions, such as cardiovascular disorders in the form of arrhythmias and hyperkalemic paralysis. Chloride is the main anion in extracellular fluid. Disturbances in chloride ion levels, either in the form of hypochloremia or hyperchloremia, are associated with an imbalance in osmotic pressure and fluid. Hypochloremia can increase pro-inflammatory molecules in ischemic stroke patients. Other studies have shown that impaired chloride levels cause a high risk of death in stroke patients (Wulan & Setiawan, 2019). Although many studies have been conducted on ischemic stroke and hemorrhagic stroke, there is still a lack of data on serum electrolyte and blood lipid profiles in stroke patients. Therefore, this study aims to explore the profile of serum electrolyte and blood lipid levels in stroke patients treated at Dr. Chasbullah Abdulmajid Hospital, Bekasi City, from December 2024 to March 2025.

METHOD

This type of research is a non-experimental study with a descriptive research design, utilizing secondary data, specifically medical records of stroke patients at Dr. Chasbullah Abdulmajid Hospital in Bekasi City, for the period from December 2024 to March 2025. This research was conducted at Dr. Chasbullah Abdulmajid Hospital, Bekasi City. The population in this study consisted of all stroke patients treated at Dr. Chasbullah Abdulmajid Hospital, Bekasi City, during the period from December 2024 to March 2025, who met the inclusion and exclusion criteria, totaling 91 respondents. Data collection was carried out by examining secondary data, namely all medical records of ischemic and/or hemorrhagic stroke patients registered at Dr. Chasbullah Abdulmajid Regional Hospital, Bekasi City for the period December 2024 - March 2025. The collected data were then analyzed statistically using SPSS version 26, by conducting univariate analysis. Univariate analysis includes descriptive analysis to determine the frequency distribution of each variable in quantitative (percentage) and qualitative (descriptive) data, which will be presented in tabular form using descriptive statistical tests

RESULT

Table 1 presents data on the characteristics of respondents, categorized by age, history of hypertension, and history of diabetes mellitus. The data shows that 46 (50.5%) of stroke patients were male and 45 (49.5%) were female. Therefore, it can be concluded that out of a total of 91 respondents, the difference in the number of male and female respondents in this analysis was only one. Based on a history of hypertension, 38 stroke patients (41.8%) had no history of hypertension, while 53 (58.2%) had a history. Therefore, it can be concluded that out of a total of 91 patients, the majority of patients in this analysis had a history of hypertension, with a frequency of 53 (58.2%). Based on a history of diabetes mellitus, 65 (71.4%) stroke patients had no history of diabetes mellitus, and 26 (28.6%) had a history of diabetes mellitus. Therefore, it can be concluded that of the total 91 patients in this analysis, the majority of patients did not have a history of diabetes mellitus, with a frequency of 65 (71.4%).

Table 1.
Respondent Characteristics

Characteristic	f	%
Gender		
Male	46	50.5
Female	45	49.5
History of Hypertension		
No	38	41.8
Yes	53	58.2
History of Diabetes Mellitus		
No	65	71.4
Yes	26	28.6

Table 2 is a description of the data characteristics of serum electrolyte profiles based on sodium levels, potassium levels, and chloride levels. Based on sodium levels, the data obtained indicate that the normal category has a frequency of 52 people (57.1%), the low category has 35 people (38.5%), and the high category has 4 people (4.4%). Thus, it can be concluded that from a total of 91 people, in this analysis most people have normal sodium levels with a frequency of 52 people (57.1%). Based on potassium levels, the data show that 44 people (48.4%) fell into the normal category, 43 people (47.3%) into the low category, and 4 people (4.4%) into the high category. Thus, it can be concluded that from a total of 91 patients, in this analysis most patients had normal potassium levels with a frequency of 44 people. Based on chloride levels, the data shows that chloride levels with a normal category have a frequency of 59 people (64.8%), low category as many as 9 people (9.9%), and high category as many as 23 people (25.3%). Thus it can be concluded from a total of 91 patients, in this analysis most people have normal chloride content with a frequency of 59 people (64.8%).

Table 2.
Serum Electrolyte Profile Characteristics

Chategory	f	%
Sodium Level		
Normal	44	48.4
Low	43	47.3
High	4	4.4
Potassium Level		
Normal	44	48.4
Low	43	47.3
High	4	4.4
Chloride Level		
Normal	59	64.8
Low	9	9.9
High	23	25.3

Table 3 is a description of the characteristic data of blood lipid profile based on triglyceride levels, total cholesterol levels and HDL levels. Based on triglyceride levels, it shows that triglyceride levels with a high category have a frequency of 27 people (29.7%) and a normal category of 64 people (70.3%). Thus it can be concluded from a total of 91 patients, in this analysis most patients have normal triglyceride content with a frequency of 64 people (70.3%); based on cholesterol levels, it shows that total cholesterol levels with a fairly high category have a frequency of 20 people (22.0%), normal categories of 63 people (69.2%) and high categories of 8 people (8.8%). Thus it can be concluded from a total of 91 patients, in this analysis most patients have normal total cholesterol content with a frequency of 63 people (69.2%) and based on HDL levels, it shows that HDL levels with a normal category have a frequency of 38 people (41.8%), low categories of 46 people (50.5%), and high categories of 7 people (7.7%). Thus, it can be concluded that from a total of 91 stroke patients, in this analysis, most patients have low HDL levels, with a frequency of 46 people (50.5%).

Table 3.
Characteristics of Blood Lipid Profile

Chategory	f	%
Triglyceride Levels		
Normal	64	70.3
High	27	29.7
Very High	0	0
Total Cholesterol Level		
Normal	63	69.2
High	8	8.8
Very High	20	22
HDL Level		
Low	46	50.5
Normal	39	42.9
High	7	7.7
LDL Level		
Normal	61	67.0
High	1	0.11
Very High	29	31.9

DISCUSSION

Distribution of Patient Characteristics by Gender

Gender is included in the non-modifiable stroke risk factors. Men are known to have a higher risk of stroke than women, although the death rate from stroke is higher in women. This is related to the higher levels of estrogen in pre-menopausal women compared to men of the same age. Estrogen functions as a vasodilator, helping to widen blood vessels and thereby protecting them from the risk of atherosclerosis, as well as directly reducing the likelihood of stroke. Research at Dr. Chasbullah Abdulmajid Hospital, Bekasi City, revealed that the incidence of stroke among men and women differed by only one, with 46 men (50.5%) and 45 women (49.5%). These results indicate that men are not always the group most at risk of stroke, because there are many other risk factors, such as an unhealthy lifestyle, including high consumption of salt, saturated fat, and excessive sugar, which can increase blood pressure and cholesterol and worsen the body's metabolism. In addition, smoking habits, excessive alcohol consumption, and lack of physical activity have also been shown to increase the risk of cardiovascular disease, including stroke (Susanti et al., 2024).

Distribution of Patient Characteristics Based on Hypertension Risk Factors

A person is considered to have hypertension if their systolic blood pressure is equal to or exceeds 140 mmHg and/or their diastolic blood pressure is equal to or exceeds 90 mmHg on repeated examinations. Uncontrolled hypertension can damage the walls of blood vessels which then block or even cause blood vessels to rupture. Plaque in blood vessels also causes decreased blood flow, this can occur in the blood vessels of the heart and brain.16 Based on research findings, it was found that the majority of stroke patients had a history of hypertension with a total of 53 people (58.3%). These results are in line with research by Utomo TY, (2021) that the percentage of patients with hypertension risk factors who were diagnosed with ischemic and hemorrhagic strokes were 65% and 100%, respectively (Dabalok & Inayah, 2022).

Distribution of Patient Characteristics Based on DM Risk Factors

The results of the study showed that 26 people (28.6%) of stroke patients had a history of diabetes mellitus. A study conducted for 10 years on 472 stroke patients found that 10.6% of men and 7.9% of women had a history of diabetes mellitus (DM) (Dabalok & Inayah, 2022). Another study by Budi et al, (2019) found that 22.6% with ischemic stroke had risk factors for diabetes mellitus (DM), while 20.8% of hemorrhagic stroke patients also had risk factors for DM (Utomo, 2022) Individuals who have diabetes mellitus, the risk of experiencing a stroke

is known to increase several times compared to those who do not have diabetes. The elasticity of blood vessels decreases in DM patients, which allows the process of atherosclerosis and embolism to occur which increases the occurrence of blockages in blood vessels, causing ischemic stroke if it occurs in the brain. In addition, blood concentration also increases when the body loses fluids due to glycosuria, which causes blood to clot or thrombose (Budi et al., 2020).

Characteristics of Serum Electrolyte Profile
Distribution of Serum Sodium Levels
Serum sodium in stroke patients shows a varied distribution. Based on the results of the study, the imbalance of serum sodium levels in this study was quite large, namely 42.9%, where most of them were hyponatremia, namely 35 people (38.5%) and hypernatremia, namely 4 people (4.4%). This is almost the same as international research that there are sodium level disorders in stroke patients ranging from 11-53%, most of which are hyponatremia (32%). The mortality rate is high in stroke accompanied by hyponatremia. There is a relationship between hyponatremia and an increased risk of death within three years after acute stroke. Hyponatremia is most often caused by SIADH and CSW. Meanwhile, the incidence of hypernatremia was recorded at 4%, which is not much different from previous findings, namely 0.3-3.5%

Serum Potassium Level Distribution
Based on clinical features, potassium disorders are the most life-threatening compared to others. This is because the symptoms are related to the nervous system and muscles including the heart muscle where all of these tissues use potassium to regulate their cell excitability. Studies have shown that hypokalemia is associated with increased mortality in acute ischemic stroke patients and a high risk of experiencing brain edema and arrhythmias that can worsen the prognosis of stroke. (21) The results of the study showed that the distribution of serum potassium with a normal category of 44 people (48.4%) and most of them experienced disorders in the form of hypokalemia, namely 43 people (47.3%) and hyperkalemia, there were 4 people (4.4%). In contrast to the Kembuan study (2014), the majority of stroke patients had normal potassium levels (63 people (84%), hypokalemia (9 people (12%) and hyperkalemia (3 people (4%). (20) Another study conducted by Kasuba et al., (2017) on hemorrhagic stroke patients with decreased consciousness showed that 35 people (53.8%) experienced hypokalemia, 26 people (40.0%) were normal and 4 people (6.2%) experienced hyperkalemia (Apriliani, 2018).

Distribution of Serum Chloride Levels
Disorders of both hypochloremia and hyperchloremia are related to osmotic pressure imbalance and fluid imbalance. The results of a study of serum chloride in stroke patients with a total of 91 people showed that 59 people (64.8%) had chloride levels within normal limits, while 9 people (9.9%) experienced hypochloremia and 23 people (25.3%) experienced hyperchloremia. This statement is the same as the study of Patricia et al (2015), who reported the prevalence of ischemic stroke patients with hypochloremia, namely six patients (8%) and hyperchloremia, 8 patients (10.7%).20 These results differ from the study of Kasuba et al (2017) in hemorrhagic stroke patients who had decreased consciousness, showing a decrease in chloride levels in 34 people (52.3%), and 31 people (47.7%) had normal chloride levels (Kasuba & Ramli, 2019).

Characteristics of Blood Lipid Profile
Distribution of Triglyceride Levels
Triglycerides serve as a storage site for fat in the body. Measuring triglyceride levels can evaluate metabolic disorders. Normal triglyceride levels are <150 mg/dl, categorized as high if >150 mg/dl. Excessive triglyceride levels can increase the risk of arteriosclerosis and coronary artery disease. (10) The results of the study showed that the majority had normal

triglyceride levels, as many as 64 people (70.3%) and as many as 27 people (29.7%) had high triglyceride levels. Not much different from the study by Laulo et al, (2016) in ischemic stroke patients, as many as 126 patients (59.43%) had triglyceride levels within normal limits and 10 patients (4.72%) experienced increased triglycerides. For hemorrhagic stroke, 75 patients (35.38%) were within normal limits and there was 1 patient (0.47%) who had elevated triglyceride levels (Laulo et al., 2016).

Distribution of Total Cholesterol Levels
Total cholesterol includes all cholesterol in the blood, consisting of LDL, HDL, and triglyceride levels. Cholesterol is produced mostly by the body, and 20% comes from food. High levels of total cholesterol lipids are associated with the risk of myocardial infarction (MI) and stroke. Based on a study of total cholesterol lipid profiles, the majority of individuals have total cholesterol levels within normal limits, namely 63 people (69.2%), while 20 people (22.0%) have quite high levels, and 8 people (8.8%) have high levels. This finding is in line with the research of Laulo et al. (2016), that 8.96% of ischemic stroke patients and 5.19% of hemorrhagic stroke patients have high total cholesterol levels. Cholesterol is a source of energy in the formation of cell walls and a basic material for the formation of steroid hormones. However, excess cholesterol can increase the risk of atherosclerosis which can lead to stroke (Laulo et al., 2016).

Distribution of HDL Levels
The results of a study of stroke patients based on the HDL lipid profile showed that the majority of patients had HDL cholesterol levels in the low category, 46 people (50.5%), followed by 38 people (41.8%) normal and 7 people (7.7%) had high HDL levels. This is not much different from the research of Kusdiantini et al, (2023) where most stroke patients had low HDL levels, namely 76 people (95%) and only 4 people (5%) indicated normal HDL levels. 24 HDL can reduce blood from bad cholesterol or LDL by transporting it to the liver to finally be gradually removed from the body. Decreased HDL levels in the blood will increase the risk of atherosclerosis which increases the occurrence of stroke. Low HDL levels, especially when accompanied by high LDL levels, can cause plaque in the arteries, which can ultimately block blood flow to all organs, including the brain (Laulo et al., 2016).

Distribution of LDL Levels
The number of patients with LDL levels in the fairly high category reached 29 people (31.9%), 61 people (67.0%) were normal, and 1 person (1.1%) was high. Thus, it can be concluded that out of a total of 91 stroke patients, most had normal LDL levels, namely 61 people (67.0%). This finding is in line with the research of Laulo et al. (2016), that among ischemic stroke patients, 111 patients (52.36%) had LDL cholesterol levels within normal limits, 13 patients (6.13%) in the fairly high category, and 12 patients (5.66%) in the high category. For hemorrhagic stroke patients, there were 60 patients (28.29%) with LDL cholesterol levels within normal limits, 12 patients (5.66%) in the fairly high category, and 4 patients (1.9%) in the high category. Excess LDL can eventually accumulate on the walls of blood vessels, especially in the capillaries that nourish the heart and brain (Laulo et al., 2016)

CONCLUSION
Based on the results of research on serum electrolyte and blood lipid profiles in stroke patients at Dr. Soetomo Hospital. Chasbullah Abdulmajid Bekasi City for the period December 2024 - March 2025, the following conclusions were obtained: 1) The characteristics of stroke patients based on gender only differ by 1, namely 46 men (50.5%) and 45 women (49.5%), 2) The characteristics of stroke patients based on risk factors were hypertension in 53 people (58.3%) and diabetes mellitus in 26 people (28.6%), 3) The distribution of serum electrolyte profiles of stroke patients was mostly in the normal category, namely sodium in 52 people (57.1%), potassium in 44 people (48.4%) and chloride in 59 people (64.8%), 4) The

distribution of lipid profiles of stroke patients was mostly in the normal category, namely triglycerides in 64 people (70.3%), total cholesterol in 63 people (69.2%), LDL in 61 people (67.0%) except for HDL, most of them had low HDL levels in 46 people (50.5%).

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