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Article

Association of Stroke with Serum Sodium and Potassium Levels in Al-Diwanyiah Teaching Hospital From June 2023 to May 2024

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Abstract: The most frequent electrolyte abnormalities seen in stroke patients are disorders of serum electrolytes, including those of potassium and sodium. During the acute phase of a stroke, imbalances in electrolytes such as hyponatraemia and hypernatraemia and an elevation in brain and atrial natriuretic peptide are frequently observed. Aim of study : to estimate the association of prevalent electrolyte imbalances experienced by various kinds of stroke patients. Patients and method: A cross sectional study enrolled 100 patients with stroke of both types admitted to Al-Diwanyiah Teaching Hospital. During period from 1st June to 30th December 2023. Serum sodium and potassium concentration were collected from lab results. Results: The study enrolled 117 patients with stroke, mean age was 66.8±13.5 and male to female ratio 1.5:1 male constituted 60.7% and female 39.3%. Electrolyte abnormality presented in 28% of patients, hyponatremia presented in 17% and hypernatremia in 7.6%. in other hand hyperkalemia presented 22.3% while hypokalemia in 10.2%. Conclusion: Electrolyte disturbance is a quite common problem that is encountered with stroke. The problem necessitate rapid detection and careful monitoring as it closely affects short term prognosis and stroke outcome.

Keywords: Stroke, Electrolyte disturbance , Serum sodium, Serum potassium

1. Introduction

A stroke, also known as a cerebrovascular accident (CVA), is a state of non-convulsive localized neurological impairment with abrupt onset caused by an ischemic infarction or bleeding in the brain. After ischemic heart disease, strokes, also known as cerebrovascular accidents, are the second leading cause of disability globally [1]. The incidence of stroke has been steadily rising, but according to recent data, it has fallen by 100% in low- to middle-income nations and by 42% in high-income ones.

Approximately 48% of stroke patients die within a year, and nearly one-third die within three weeks. Multifactorial factors, including cerebral edema infection, deep vein thrombosis, pulmonary embolism, electrolyte imbalance, concomitant cardiac disease, and metabolic disorders, are the reason for the high mortality rate [2].

Electrolyte imbalances are common in patients with acute ischemic stroke, along with other metabolic issues. If not addressed promptly, it has the potential to result in patient mortality. The most prevalent electrolyte abnormalities found in patients with acute stroke are sodium (Na) and potassium (K) balance problems [3, 4].

Previous studies has revealed the crucial role of serum electrolytes in vascular events. High dietary salt intake has been linked to an elevated risk of many forms of cerebral vascular events.[5]. High sodium intake has been linked to an increase in stroke

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and cardiovascular disease mortality. Higher potassium excretion has been attributed to a dropped incidence of CVA, while increased potassium intake shows an inverse relationship with coronary artery disease mortality [6, 7].

Despite several studies on the importance of dietary sodium and potassium consumption in cerebral vascular events, the impact of blood sodium and potassium levels in these conditions has not been thoroughly investigated. In this study, we seek to examine serum sodium and serum potassium levels in patients with various forms of CVA.

Hyponatremia is related to higher death rates following stroke, both ischemic and intracerebral hemorrhage (ICH) [8], but hypokalemia has a similar predictive relevance regardless of age, stroke severity, or history of hypertension [4].

Furthermore, new evidence indicates that serum potassium levels have a near-linear relationship with the risk of stroke [9. However, it is unclear whether a low sodium to potassium excretion ratio predicts cardiovascular events in community-dwelling persons more accurately than sodium or potassium alone [10].

Recent studies have found that a nadir value (e.g., albumin and hemoglobin levels), which may better reflect the severity of the acute event, has a stronger link with clinical outcomes than admission measurements do. Low nadir albumin levels, measured at the lowest point during hospitalization rather than before admission, were linked to an increased risk of acute renal function deterioration [9].

The nadir levels of serum sodium and potassium during hospitalization tend to represent their average levels, which reflect the overall impact during hospitalization, including the acute phase of ischemic stroke and other potential influencing factors, giving them predictive value.

Furthermore, because sodium and potassium levels fluctuate by diet and drugs, nadir values were preferred for assessing electrolyte disruption than a single measurement upon admission [10].

Alam MN et al, (2012) observed no significant difference between hemorrhagic and ischemic stroke, however hyponatremia, hypokalemia, and hypochloridemia were more prevalent than hypernatremia, hyperkalemia, and hypochloridemia. It was also shown that hypokalemia was approximately equally prevalent in both the hemorrhagic and ischemic groups, with no significant difference [11].

The syndrome of inappropriate antidiuretic hormone (SIADH) secretion is the predominant cause of electrolyte imbalance. The majority of hemorrhagic stroke patients present with headache and vomiting, which is a significant cause of dyselectrolytemia [12].

Neurological complications after acute stroke include recurrent stroke and seizures, whereas medical complications include chest infection, urinary tract infection, bowel or bladder dysfunction, deep vein thrombosis (DVT), pulmonary embolism, upper gastrointestinal bleeding, aspiration, bedsores, and malnutrition [13].

Electrolytes are vital because they enable cells to maintain voltage across their membranes and transport electrical impulses. The primary electrolytes in the body are sodium, potassium, calcium, and magnesium [14]. Sodium regulates osmotic equilibrium, blood volume, blood pressure, and acid-base balance. Plasma sodium content varies according to its dilution with water [15].

Potassium is a basic requirement for the brain and is necessary for neuronal cell viability, function, and cerebral circulation [16]. Calcium (Ca^{2+}) ions serve a physiological function in the many pathomechanisms of cerebral ischemia. Cell calcium metabolism during and soon after a brief period of ischemia alters the sequence of events that leads to neuronal damage. Magnesium is a trace metal that has a crucial impact on brain development and function. Magnesium is an essential electrolyte with potential brain-protective characteristics as a glutamate receptor antagonist and calcium channel blocker [17].

2. Materials and Methods

A cross-sectional study included 100 patients with both types of stroke who were hospitalized to Al-Diwanyiah Teaching Hospital. During the period from June 1 to December 30, 2023. All participants and their relatives provided written informed permission.

Patients (≥18 years) diagnosed with first-ever ischemic stroke according to World Health Organization criteria, with brain computed tomography (CT) or magnetic resonance imaging (MRI) scans within 24 hours of symptom onset, were recruited consecutively. Patients were evaluated clinically by trained neurologists at baseline and three months after stroke.

Each of the following medical history variables existed: hypertension, diabetes mellitus, hyperlipidemia, stroke, and heart disease (including any history of atrial fibrillation/heart attack/myocardial infarction, angina, coronary heart disease, or valvular heart disease), either self-reported or diagnosed prior to the onset of ischemic stroke in the hospital.

Comorbidities were identified if the patient had coronary heart disease, congestive heart failure, cancer, leukocythemia, chronic lung illness, diabetes mellitus, hepatic insufficiency, or renal insufficiency. This study collected data on acute reperfusion and electrolyte-related therapy throughout hospitalization, including mannitol, saline solution, and potassium consumption.

The study included participants who had been admitted for the first time with an ischemic stroke diagnosis. The following were the exclusion criteria for the study: the existence of a brain tumor or other stroke mimic, hypertension treated with diuretics, the absence of informed consent, the beginning of symptoms lasting more than 48 hours, the presence of do-not-treat or do-not-resuscitate orders, and the absence of a sodium or potassium value.

From the laboratory, serum sodium and potassium levels collected for 10 days in a row, which corresponded to the median hospitalization stay for stroke patients of 10 days (7-14).

3. Results

The study enrolled 117 patients with stroke, mean age was 66.8±13.5 and male to female ratio 1.5:1 male constituted 60.7% and female 39.3%, Table 1 and Figure 1. More than fifty percent of patients had history of hypertension and 41.8% had diabetes mellitus, smoking history presented in 23.9% as show in table one. Electrolyte level of whole sample, the potassium level was 3.9±0.6 and sodium level was 136.2±9.7 as in Table 2.

Table 1. Demographic characteristics.

Variables	No.	Percentage
Male	**71**	60.7%
Female	**46**	39.3%
Hypertension	**62**	52.3%
Diabetes mellitus	**49**	41.8%
Hyperlipidemia	**37**	31.6%
Smoking	**28**	23.9%
Age (Mean ± SD)	66.8±13.5	

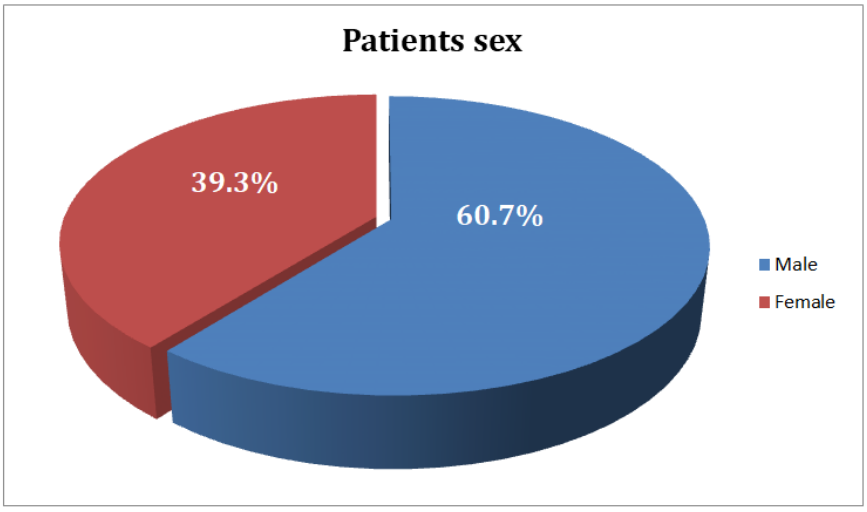

Figure 1. Patients sex distribution.

Table 2: Sodium and Potassium levels

Variables	Mean ± SD
K^+	3.9±0.6
Na^+	136.2±9.7

The difference between demographics variable according to type of stroke, show not statistical significant differences between two group of patients in respect gender, as in Table 3.

Table 3: The patients characters according to stroke type.

Patients	Ischemic stroke (77)	Hemorrhagic stroke (40)	Total
Male	**44(62%)**	**27(38%)**	71
Female	**33(71.7%)**	**13(28.3%)**	46
Hypertension	**47**	**15**	62
Diabetes mellitus	**21**	**28**	49
Hyperlipidemia	**19**	**18**	37
Smoking	**13**	**15**	28

Electrolyte abnormality presented in 28% of patients, hyponatremia presented in 17% and hypernatremia in 7.6%. in other hand hyperkalemia presented 22.3% while hypokalemia in 10.2% as shown in Table 4. Whereas no significant differences in level of sodium and potassium between type of stroke as shown in Table 5.

Table 4: Electrolyte level abnormality.

Electrolyte abnormality		No.	Percentage
Sodium	**Normal**	**88**	75.4%
	High	**9**	7.6%
	Low	**20**	17%
Potassium	**Normal**	**79**	76.5%
	High	**26**	22.3%
	Low	**12**	10.2%

Table 5: serum level of Na and K according to type of stroke.

Variables	Stroke ischemic (77)	Hemorrhagic (40)	Mean ± SD
Age	**67.8±13.6**	**64.8±13.3**	66.8±13.5
K	**4.06±0.5**	**3.8±0.6**	3.9±0.6
Na	**136.8±13.1**	**135.6±5.9**	136.2±9.7

4. Discussion

Hyponatremia and hypokalemia are common electrolyte disorders seen in clinical practice. The broad spectrum of underlying causes needs a comprehensive differential diagnosis, taking into account comorbidities, concurrent medications, clinical examination findings, and laboratory results. This holistic approach is critical in directing managerial decisions [18].

According to studies, the frequency of hyponatremia varies between 10 and 30% across a wide range of acute diseases requiring hospitalization [19]. Questions have been raised about whether restoring sodium levels to normal improves outcomes after acute stroke [20]. On the one hand, correcting hyponatremia, regardless of direct or indirect causes, may provide advantages; yet, there are possible risks associated with arrhythmias [21].

In present study, Electrolyte abnormality presented in 28% of patients, hyponatremia presented in 17% and hypernatremia in 7.6%. in other hand hyperkalemia presented 22.3% while hypokalemia in 10.2%. Whereas no significant differences in level of sodium and potassium between type of stroke. This was similar to study conducted by Kusuda K et al. (1989) noticed that 52% of patients with hemorrhagic stroke and 26% with ischemic stroke had dyselectrolytemia. They observed that 32% of all stroke patients had hyponatremia [22]. Hyponatremia was most common in hemorrhagic stroke patients, followed by ischemic stroke patients, although there was no statistically significant correlation between hyponatremia and type of stroke [22].

According to Mohan and Muddu (2020), electrolyte imbalances are common during and after an acute stroke [13]. Hyponatremia and hypokalemia are the most common electrolyte abnormalities in ischemic and hemorrhagic strokes. Electrolyte imbalance may have a negative impact on the outcome of stroke.

Every stroke patient should have their serum electrolyte levels monitored. Hyponatremia or hypokalemia is strongly associated with stroke outcome. Early detection and treatment of stroke may improve the overall prognosis of patients [13].

The findings of Bandyopadhyay et al, (2017) study, dyselectrolytemia is almost equally common in both haemorrhagic and ischemic groups, with no significant difference ($p>0.05$) [23]. Kusuda K et al. (1989) discovered that dyselectrolytemia affected 52% of individuals with haemorrhagic stroke and 26% of those with ischemic stroke. In their study, 33% of the stroke patients were hyponatraemic. Hyponatremia was most prevalent in haemorrhagic stroke patients (20%), followed by ischemic stroke patients (13%) [22].

According to Wali and Patil's (2016) study, 64% of stroke patients exhibited electrolyte imbalances. Other investigations have found electrolyte imbalance in 50-55% of stroke patients [24].

Additionally, Wafaa et al, (2018) dyskalemia was the most commonly reported electrolyte disturbance (25.7%) among patients presenting with their first acute stroke, notably hypokalemia, which was found at a higher rate in those with hemorrhagic stroke than in those with ischemic stroke. Dysnatremia, on the other hand, was the most commonly reported electrolyte disturbance in other studies [25], which documented dysnatremia in 47.3% and 38.6% of acute stroke patients, and dyskalemia in 32.7% and 28.8% of acute stroke patients, respectively [25, 11].

The reduced rate of dysnatremia and dyskalemia seen in the current study could be related to the tight inclusion criteria. There is no question that those with their first CVS had a shorter duration and/or fewer risk factors than those with recurrent stroke.

In contrast, the research in Indonesia reported that only 8.2% of acute stroke patients had dysnatremia (7.1%) hyponatremia and 1.2% hypernatremia) [25].

This could be attributed to the small sample size (n=85 patients), the higher normal range of serum sodium levels (135-153), and their selected exclusion criteria, which exclude patients on diuretics and patients with acute renal impairment [15].

The association between s-potassium and stroke did not exist in either the top or bottom quartiles of serum sodium. The causes for this interaction cannot be determined from this observational study, however one could argue that the top quartile of serum sodium contains a considerable proportion of dehydrated participants for whom high potassium simply serves as a marker of dehydration.

The bottom quartile of serum sodium may be made up of those who intake little salt and do not conserve potassium due to significant sodium excretion [26, 15].

Mansoor et al. (2021) found that hyponatremia is statistically significantly more common in ischemic stroke than in hemorrhagic stroke, although potassium levels are significantly greater in hemorrhagic stroke [27].

Siddiqui et al. (2012) found that whereas hyponatremia (32%) is the most frequent electrolyte abnormality among stroke types, hypokalemia (19%) is statistically significant ($p<0.05$) and more common in hemorrhagic stroke (28).

5. Conclusion

Electrolyte disturbance is a quite frequent prevalent issue associated with stroke. The condition necessitates immediate discovery and thorough monitoring because it has a significant impact on short-term prognosis and stroke outcome.

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