Original Article
DOI: https://doi.org/10.70749/ijbr.v3i4.2921

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://ijbr.com.pk
ISSN: 2960-2793/ 2960-2807

Frequency of Hyponatremia in Patients with Acute Stroke in Ayub Teaching Hospital Abbottabad

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ARTICLE INFO

Keywords: Acute Stroke, Hyponatremia, Incidence, Risk Factors, Sodium.

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Declaration
Authors' Contribution
All authors equally contributed to the study and approved the final manuscript

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History
Received: 09-03-2025 Revised: 03-06-2025
Accepted: 17-06-2025 Published: 30-06-2025

ABSTRACT

Background: Stroke is a serious neurological condition and is one of leading causes of death and disability. Disturbance in serum sodium is common in acute stroke and may worsen neurological outcome. **Objective:** To determine the frequency of hyponatremia in patients with acute stroke admitted in a tertiary care hospital. **Study Design:** Cross sectional study. **Duration and Place of Study:** This study was carried out from 1 January 2024 to 1 July 2024 in medical ward of Ayub Teaching Hospital Abbottabad. **Methodology:** A total of 120 patient aged more than 40 years of both gender with clinical and computed tomography confirmed stroke were included. Hyponatremia was defined as serum sodium level less than 135 millimole per liter. Data were analyzed by Statistical Package for Social Sciences version 22. Stratification was done and post stratification chi square test and Fisher exact test were applied. A p value ≤0.05 was taken as significant. **Results:** Mean age was 62.00 ± 10.32 years. Mean serum sodium level was 135.65 ± 7.28 millimole per liter. Majority were male 84 (70.0%) and ischemic stroke was seen in 92 (76.7%) patients. Hyponatremia was found in 37 (30.80%) patients. No significant association was observed with age (p=0.183), gender (p=0.365), or stroke type (p=0.218). **Conclusion:** Hyponatremia is frequent in acute stroke patients and need early identification and management.

INTRODUCTION

Stroke is a significant neurological emergency and is considered one of the top causes of mortality and disabilities worldwide.[1] It is caused by the sudden cessation of the flow of blood to the brain, which is a result of ischemia or hemorrhage.[1] Ischemic strokes are the most common and occur because of thrombosis or embolism, while hemorrhagic strokes occur because of the rupture of blood vessels.[2] Clinically, patients with stroke present with sudden weakness on one side of the body, speech difficulties, drooping eyelids, vision problems, and altered consciousness.[3] Established causes include hypertension, diabetes mellitus, lipid metabolism disorders, tobacco use, cardiac arrhythmias, and advanced age.[4]

Disturbances in electrolytes are common among acute stroke patients.[5] These electrolyte disturbances play an important role in the prognosis and outcome of stroke.[6] Brain damage can cause damage to the hypothalamus and pituitary gland, thereby causing hormonal imbalances.[7] In addition, the stress response, vomiting, oral intake, intravenous fluids and drugs can cause electrolyte imbalances.[8] Sodium, potassium, and calcium imbalances are common among stroke patients admitted to the hospital.[9]

Hyponatremia is the most common electrolyte disorder among patients with acute stroke and is characterized by a serum sodium level below 135 mEq/L.[10] It is caused by the syndrome of inappropriate antidiuretic hormone secretion (SIADH) or cerebral salt-wasting syndrome, which is associated with brain injury.[11] It causes hyponatremia through the osmotic movement of water into the brain cells, leading to cerebral edema and worsening neurological condition.[12] Severe hyponatremia is associated with increased mortality among patients with acute stroke.[12] In a study in which patients with ischemic stroke have the frequency of hyponatremia by 8.5%.[13]

There is a scarcity of information about the incidence and outcome of hyponatremia among acute stroke patients in Abbottabad. Most of the information is from other areas, and this information might not be applicable to this population due to variations in risk factors and health-care resources. This study is therefore relevant to determine the incidence of hyponatremia among acute stroke patients in Abbottabad.

METHODOLOGY

This cross sectional study was carried out in medical ward of Ayub Teaching Hospital from 1st January 2024 to 1st

July 2024. Approval was taken from hospital administration and ethical committee of the institution before starting the study. The study was conducted according to institutional ethical guidelines and confidentiality of patients was maintained. Sample size was 120 which was calculated by using WHO software for sample size determination in health studies. The assumptions were confidence level 95%, anticipated proportion of hyponatremia in stroke 8.5%[13] and absolute precision 5%. Inclusion criteria were age more than 40 years, patients of both gender and stroke patients as defined in this study. Exclusion criteria were patients with multiple co-morbids and patients with known endocrine abnormalities. Stroke was considered when patient had clinical features such as weakness of one or both sides of body, facial drop, tongue deviation, slurred speech, aphasia, irregular pulse, loss of gag reflex, bilateral or unilateral clonus along with CT findings showing ischemia or hemorrhage. Demographic information was recorded including age in years, gender, BMI, residence, socioeconomic status, serum sodium level. Duration of stroke was also documented.

A comprehensive medical history was taken from each patient, followed by a thorough clinical examination. A computed tomography scan was conducted by a radiologist to confirm the diagnosis of a stroke. On admission, a 5ml venous blood sample was collected under aseptic precautions using a serum-separating tube by qualified medical personnel and sent for the measurement of the serum sodium level at the laboratory of Ayub Teaching Hospital. After the evaluation was complete, the patients were grouped based on the presence or absence of hyponatremia. Hyponatremia was considered present if the serum Na+ level was < 135mmol/L. Severe hyponatremia was considered if the level was < 120mmol/L; moderate if the level was 120-129mmol/L; and mild if the level was 130-134mmol/L.

Data were entered and analyzed using SPSS version 22.0. Categorical variables like gender, residence, socioeconomic status, comorbidities, type of stroke and hyponatremia were presented as frequencies and percentages. Quantitative variables like age, duration of stroke, serum sodium level and BMI level were expressed as Mean ± standard deviation. Hyponatremia was stratified by age, gender, socioeconomic status, comorbidities, residence, type of stroke and BMI. Post stratification chi-square test was applied and p value ≤0.05 was taken as significant.

RESULTS

The total sample comprised 120 patients, with a mean age of 62.00 ± 10.32 years, a mean BMI of 27.40 ± 2.34 kg/m^2, and a mean serum sodium level of 135.65 ± 7.28 mmol/L (Table-I). Regarding gender distribution, majority of patients were male 84 (70.0%), while females constituting only 36 (30.0%). Most patients belonged from rural areas 66 (55.0%) as compared to urban residents 54 (45.0%). In terms of socioeconomic status, low and middle income groups were almost equal in representation, with 51 (42.5%) and 50 (41.7%) patients respectively, whereas only 19 (15.8%) patients were from high socioeconomic background. Smoking history was present in 53 (44.2%) patients, hypertension was observed in 44 (36.7%) patients, and diabetes mellitus was found in 43 (35.8%) patients. Regarding stroke type, majority 92 (76.7%) had ischemic stroke, while 28 (23.3%) patients had hemorrhagic stroke (Table-I).

Table I

Patient Demographics

Demographics	Mean ± SD
Age (years)	62.00 ± 10.32
BMI	27.40 ± 2.34
Serum Sodium Level (mmol/L)	135.65 ± 7.28
Gender	
Male n (%)	84 (70.0%)
Female n (%)	36 (30.0%)
Residence	
Rural n (%)	66 (55.0%)
Urban n (%)	54 (45.0%)
Socioeconomic Status	
Low n (%)	51 (42.5%)
Middle n (%)	50 (41.7%)
High n (%)	19 (15.8%)
Smoking History	
Yes n (%)	53 (44.2%)
No n (%)	67 (55.8%)
Hypertension	
Yes n (%)	44 (36.7%)
No n (%)	76 (63.3%)
Diabetes Mellitus	
Yes n (%)	43 (35.8%)
No n (%)	77 (64.2%)
Type of Stroke	
Ischemic n (%)	92 (76.7%)
Hemorrhagic n (%)	28 (23.3%)

The frequency of hyponatremia among acute stroke patients was found to be 37 (30.80%), while remaining 83 (69.20%) patients did not had hyponatremia (Table-II).

Table II

Frequency of Hyponatremia in Patients with Acute Stroke

Hyponatremia	Frequency	% age
Yes	37	30.80%
No	83	69.20%
Total	120	100%

When hyponatremia was stratified against various demographic factors, in age group ≤60 years, hyponatremia was present in 13 (24.5%) patients, while in age group >60 years it was present in 24 (35.8%) patients, with no statistically significant association observed (p=0.183). Among males, hyponatremia was found in 28 (33.3%) patients, and among females it was present in 9 (25.0%) patients, and this difference were also not significant (p=0.365). In rural residents, hyponatremia was seen in 23 (34.8%) patients and in urban residents it was 14 (25.9%), with p-value of 0.292. For socioeconomic status, hyponatremia was present in 17 (33.3%) patients of low, 13 (26.0%) of middle, and 7 (36.8%) of high socioeconomic group, and no significant association were found (p=0.601). Among patients with BMI >25 kg/m^2, hyponatremia was noted in 32 (32.0%) patients, compared to 5 (25.0%) in those with BMI ≤25, and Fischer Exact Test showed p=0.606. Smokers showed hyponatremia in 19 (35.8%) patients, while in non-smokers it was 18 (26.9%), with p=0.290. Hypertensive patients had hyponatremia in 15 (34.1%) patients and non-hypertensive in 22 (28.9%) patients, with p=0.557. Diabetic patients showed hyponatremia in 12 (27.9%)

cases and non-diabetics in 25 (32.5%), with p=0.604. Regarding stroke type, hyponatremia was present in 31 (33.7%) ischemic stroke patients and 6 (21.4%) hemorrhagic stroke patients, with p-value 0.218. Overall, none of the demographic factors showed statistically significant association with hyponatremia in this study (Table-III).

Table III

Association of Hyponatremia with Demographic Factors

Demographic Factors	Subgroups	Hyponatremia		p-value
		Yes n(%)	No n(%)	
Age (years)	≤60	13 (24.5%)	40 (75.5%)	0.183
	>60	24 (35.8%)	43 (64.2%)	
Gender	Male	28 (33.3%)	56 (66.7%)	0.365
	Female	9 (25.0%)	27 (75.0%)	
Residence	Rural	23 (34.8%)	43 (65.2%)	0.292
	Urban	14 (25.9%)	40 (74.1%)	
Socioeconomic Status	Low	17 (33.3%)	34 (66.7%)	0.601
	Middle	13 (26.0%)	37 (74.0%)	
	High	7 (36.8%)	12 (63.2%)	
BMI (Kg/m^2)	≤25	5 (25.0%)	15 (75.0%)	0.606*
	>25	32 (32.0%)	68 (68.0%)	
Smoking History	Yes	19 (35.8%)	34 (64.2%)	0.290
	No	18 (26.9%)	49 (73.1%)	
Hypertension	Yes	15 (34.1%)	29 (65.9%)	0.557
	No	22 (28.9%)	54 (71.1%)	
Diabetes Mellitus	Yes	12 (27.9%)	31 (72.1%)	0.604
	No	25 (32.5%)	52 (67.5%)	
Type of Stroke	Ischemic	31 (33.7%)	61 (66.3%)	0.218
	Hemorrhagic	6 (21.4%)	22 (78.6%)	

*Fischer Exact Test

DISCUSSION

Total 120 patients were enrolled, and hyponatremia was found in 37 (30.80%) patients, which is considerable proportion and suggest that electrolyte disturbance is not uncommon in stroke population. In this study, mean age of patients was 62.00 ± 10.32 years and majority were male 84 (70.0%), which is consistent with known fact that stroke occur more commonly in older age and in males due to higher prevalence of cardiovascular risk factors like hypertension and smoking in this group. Ischemic stroke was more frequent type, found in 92 (76.7%) patients as compared to hemorrhagic stroke in 28 (23.3%), this can be explained by fact that ischemic stroke is globally more prevalent type and is responsible for majority of stroke cases worldwide. Hyponatremia was observed more in patients with age >60 years 24 (35.8%) as compared to ≤60 years 13 (24.5%), although association was not statistically significant (p=0.183), but this trend can be because older patients have reduced ability to regulate sodium due to impaired renal function and decreased antidiuretic hormone sensitivity. Male patients showed a greater prevalence of hyponatremia, with 28 (33.3%) cases compared to female patients, who showed only 9 (25.0%) cases. However, this was found to be non-statistically significant (p = 0.365). This may have been due to the fact that the male population in this study showed a greater prevalence of comorbid conditions, such as hypertension and tobacco use, which may indirectly influence sodium balance. In this study, hyponatremia was found to have a slightly greater prevalence in ischemic stroke patients, with 31 (33.7%), compared to hemorrhagic stroke patients, with only 6 (21.4%), although this was found to be non-statistically significant (p = 0.218). This may have been due to the fact that ischemic stroke is associated with SIADH, which may indirectly influence water balance and thereby lead to hyponatremia. None of the demographic factors showed statistical significance with hyponatremia. This may have been due to the small sample size, which may have been insufficient to show statistical differences between the groups.

The frequency of hyponatremia found in present study was 37 (30.80%), which is quite comparable to findings of Saleem *et al.* [14] who reported 30% frequency in acute CVA patients, and also similar to Ullah *et al.* [15] who found hyponatremia in 30% of ischemic stroke patients. This similarity may be because these studies used comparable patient populations and same cutoff of serum sodium for defining hyponatremia. However, the frequency in present study was somewhat lower than that reported by Nazeer *et al.* [16] who found 40% hyponatremia, and Khan *et al.* [17] who reported 35% frequency, and Swamy *et al.* [18] who reported 36%. These slightly higher frequencies in other studies may be due to difference in sample characteristics, as Nazeer *et al.*[16] included younger patients with mean age 45.23±14.87 years and had higher proportion of smokers and diabetics which are known risk factors for electrolyte disturbance. On other hand, Hakim *et al.* [19] reported much lower frequency of 17.6%, which was considerably less than present study findings, and this difference can be explained by fact that their study included mixed stroke population from a neuroscience referral institute where clinical management protocols may have been more aggressive in correcting sodium levels early.

In present study, majority of patients were male 84 (70.0%) with mean age 62.00 ± 10.32 years, and ischemic stroke was most common type 92 (76.7%), which is in agreement with Swamy *et al.*[18] who also reported 68% males with mean age 60 years, and Kidwai *et al.* [20] who reported 60% males with mean age 61.45±11.8 years. This consistent male predominance across studies suggest that males are more exposed to cardiovascular risk factors like smoking and hypertension which predispose them to stroke at relatively earlier age through acceleration of atherosclerotic process.

Hyponatremia was slightly more frequent in ischemic stroke patients 31 (33.7%) as compared to hemorrhagic 6 (21.4%) in present study, though difference was not statistically significant (p=0.218), this pattern was also observed by Hakim *et al.* [19] who found almost equal frequency in ischemic and hemorrhagic stroke (17.2% vs 17.7%, p=0.925), suggesting no significant difference between stroke types. In contrast, Hasan *et al.* [21] reported much higher hyponatremia in hemorrhagic stroke (59.6%) compared to ischemic (21.6%), however this study was later retracted due to methodological flaws which limit its reliability for comparison. The pathophysiological basis for hyponatremia in ischemic stroke is mainly syndrome of inappropriate antidiuretic hormone secretion, while in hemorrhagic stroke, cerebral salt wasting is considered more responsible mechanism, both leading to hyponatremia *via* different pathways.

No statistically significant association was found between hyponatremia and any demographic variable in present study, which is consistent with findings of Saleem

et al. [14] and Hakim *et al.* [19] who also reported no significant association with age, gender, or stroke type. However, Shaikh *et al.* [13] found significant association of hyponatremia with hypertension (p=0.03) and higher frequency among diabetics, which was not observed in present study where hypertensive patients had hyponatremia in 15 (34.1%) and diabetics in 12 (27.9%) without reaching statistical significance. This discrepancy may be due to difference in sample size and different cutoff values used for defining hyponatremia, as Shaikh *et al.* [13] used <130 mEq/L which is more restrictive criterion and may have selected more severe cases with clearer clinical associations.

The limitations of this study need to be acknowledged. This study was conducted in a single tertiary care hospital, and the findings cannot be generalized to the general population. This study included a total of 120 patients, which is a small sample size. This might have affected the statistical power of this study to show a significant association of hyponatremia with demographic variables. This is a cross-sectional study, and causality cannot be established. Also, long-term follow-up of patients was not done, and the outcome of mortality and functional recovery cannot be assessed.

CONCLUSION

The present study has concluded that hyponatremia is a frequent electrolyte disturbances found in considerable proportions of acute stroke patients. Ischemic stroke was more common type and male gender was predominant in study populations.

Acknowledgment

The writer sincerely thankful to the doctors and other staff of the department who helped a lot in this research. Their proper maintenance of record and organized patient data management made this study possible.

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