Section: General Medicine

Original Research Article

PROFILE OF HYPONATREMIA IN STROKE PATIENTS: AN OBSERVATIONAL STUDY AT A TERTIARY CARE CENTRE IN EASTERN INDIA

Hafijur Rahaman[1], Uday Shankar Ghosh[2], Kaushik Ishore[3], Ramtanu Banerjee[4]

[1]*Senior Resident, General Medicine, Raiganj Govt. Medical College, Raiganj, West Bengal, India*
[2]*Professor, General Medicine, Barasat Govt. Medical College and hospital, North 24 Pargana, West Bengal, India*
[3]*Associate Professor, Department of Community Medicine MJN Medical College and Hospital, Cooch Behar, West Bengal, India*
[4]*Professor, General Medicine, RG Kar Medical College and Hospital, Kolkata, West Bengal, India*

Received *: 30/11/2025*
Received in revised form *: 11/01/2025*
Accepted *: 28/01/2026*

Corresponding Author:
Dr. Hafijur Rahaman,
Senior Resident, General Medicine, Raiganj Govt. Medical College, Raiganj, West Bengal, India.
Email: hafijur.cmc@gmail.com

DOI: 10.70034/ijmedph.2026.1.388

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (1); 2239-2242

ABSTRACT

Background: Hyponatremia is the most common electrolyte abnormality encountered in hospitalized patients and is frequently observed in acute neurological conditions such as stroke. It is associated with increased morbidity, prolonged hospital stay, and mortality. Syndrome of inappropriate antidiuretic hormone secretion (SIADH) and cerebral salt wasting syndrome (CSWS) are the two principal etiologies of hyponatremia in cerebrovascular accidents. However, data from eastern India regarding the profile and outcome of hyponatremia in stroke patients are limited. The objective is to determine the prevalence, severity, and etiology of hyponatremia in patients with acute stroke and to assess its association with Glasgow Coma Scale (GCS) and in-hospital mortality.

Materials and Methods: This hospital-based cross-sectional observational study was conducted in the Department of General Medicine, R.G. Kar Medical College & Hospital, Kolkata, over one year (July 2019–June 2020). Ninety-six adult patients with newly diagnosed stroke were enrolled. Serum sodium, serum osmolality, urinary sodium, and urine osmolality were measured within 24 hours of admission and monitored serially. Hyponatremia was defined as serum sodium <130 mEq/L with plasma osmolality <275 mOsm/kg. Etiology was categorized as SIADH, CSWS, or undetermined. Statistical analysis was performed using SPSS version 22.

Results: Hyponatremia was observed in 31.3% of stroke patients. Moderate hyponatremia (120–129 mEq/L) was present in 25% and severe hyponatremia (<120 mEq/L) in 6.3% of patients. SIADH was the most common cause (56.7%), followed by CSWS (20%). Mortality was significantly higher among patients with hyponatremia compared to normonatremic patients (36.7% vs 9.1%, p=0.001). Improvement in serum sodium levels was associated with a statistically significant improvement in GCS scores.

Conclusion: Hyponatremia is a common and clinically significant complication in acute stroke patients and is associated with increased in-hospital mortality. Early detection, etiological differentiation, and appropriate management of hyponatremia may improve neurological outcomes and survival.

Keywords: Stroke, Hyponatremia, SIADH, Cerebral salt wasting syndrome, Glasgow Coma Scale, Mortality.

INTRODUCTION

Stroke is defined by the World Health Organization as rapidly developing clinical signs of focal or global disturbance of cerebral function lasting more than 24 hours or leading to death, with no apparent cause other than vascular origin.[1] Stroke remains the second leading cause of death globally and a major cause of long-term disability. In India, the burden of stroke is steadily increasing due to rising prevalence

of hypertension, diabetes mellitus, and lifestyle changes.[2]

Electrolyte disturbances are frequently encountered in patients with acute neurological illnesses, among which hyponatremia is the most common.[3] Hyponatremia in stroke patients may result from SIADH, cerebral salt wasting syndrome, excess hypotonic fluid administration, or medications.[4] Differentiating between SIADH and CSWS is clinically crucial, as their management strategies are fundamentally different.[5]

Hyponatremia can worsen cerebral edema, precipitate seizures, impair consciousness, and adversely affect neurological recovery.[6] Several studies have reported increased mortality and poorer functional outcomes in stroke patients with hyponatremia. However, there is limited data from eastern India evaluating its prevalence, etiology, and clinical impact.[7]

This study was undertaken to evaluate the profile of hyponatremia in stroke patients admitted to a tertiary care hospital in eastern India and to assess its association with neurological status and hospital outcomes.

MATERIALS AND METHODS

Study Design and Setting: This was a descriptive, hospital-based cross-sectional observational study conducted in the Department of General Medicine, R.G. Kar Medical College & Hospital, Kolkata.

Study Period: July 2019 to June 2020.

Study Population: Adult patients (≥18 years) with newly diagnosed cerebrovascular accidents admitted during the study period.

Inclusion Criteria

- Age ≥18 years
- Clinically and radiologically confirmed acute stroke (ischemic, hemorrhagic, or SAH)

Exclusion Criteria

- Previous stroke with residual neurological deficits
- Head injury
- Renal, hepatic, or cardiac failure
- Meningitis, encephalitis, malignancy, or gastroenteritis
- Patients on diuretics or steroid therapy
- Severe hyperglycemia (>300 mg/dL) or hypertriglyceridemia (>400 mg/dL)

Sample Size: A sample size of 96 was calculated based on an expected prevalence of hyponatremia of 35.3%, with 95% confidence level and 10% absolute precision.

Data Collection: Detailed clinical evaluation, neurological examination, and laboratory investigations were performed. Serum sodium, serum osmolality, urinary sodium, and urine osmolality were measured within 24 hours of admission and followed for three days. GCS was recorded daily.

Definitions

- Hyponatremia: Serum sodium <130 mEq/L with plasma osmolality <275 mOsm/kg
- SIADH: Hyponatremia with euvolemia, urine output <3 ml/kg/hr, urine sodium >20 mEq/L
- CSWS: Hyponatremia with hypovolemia, urine output ≥3 ml/kg/hr, urine sodium ≥100 mEq/L

Statistical Analysis: Data were analyzed using SPSS version 22. Categorical variables were expressed as percentages. Chi-square test was used for associations. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 96 patients with acute cerebrovascular accidents were included in the study. The results are presented under the following subheadings.

1. Baseline Demographic Characteristics

The majority of patients were aged ≥60 years (53.1%), with a mean age of 60.09 ± 10.42 years. Males constituted 56.3% of the study population. Most patients belonged to the Hindu religion (58.3%) and were residents of rural areas (53.1%).

Table 1: Demographic Profile of Study Participants (n = 96)

Variable	Category	Number (n)	Percentage (%)
Age (years)	< 40	5	5.2
	40–59	40	41.7
	≥ 60	51	53.1
Gender	Male	54	56.3
	Female	42	43.7
Religion	Hindu	56	58.3
	Muslim	40	41.7
Residence	Rural	51	53.1
	Urban	45	46.9

2. Clinical Characteristics of Stroke Patients

Ischemic stroke was the most common type (53.1%), followed by hemorrhagic stroke (42.7%). Hypertension was the most frequent comorbidity, present in 43.8% of patients.

Table 2: Clinical Profile of Study Participants (n = 96)

Variable	Category	Number (n)	Percentage (%)
Type of Stroke	Ischemic	51	53.1
	Hemorrhagic	41	42.7

	SAH	4	4.2
Co-morbidities	None	28	29.2
	Hypertension	42	43.8
	Type 2 Diabetes Mellitus	18	18.8
	Hypothyroidism	3	3.1
	HTN + DM	5	5.2

3. Prevalence and Severity of Hyponatremia

Hyponatremia was observed in 30 patients (31.3%). Moderate hyponatremia (120–129 mEq/L) was present in 25%, while 6.3% had severe hyponatremia (<120 mEq/L).

4. Etiology of Hyponatremia

Among patients with hyponatremia, SIADH was the most common etiology (56.7%), followed by CSWS (20%). In 23.3% of cases, the etiology could not be determined.

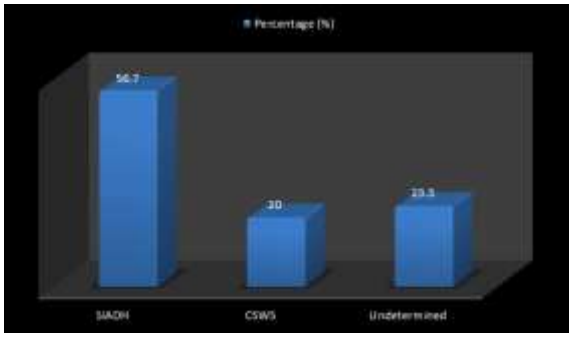

Figure 1: Etiology of Hyponatremia (n = 30).

Table 3: Prevalence and Severity of Hyponatremia (n = 96)

Serum Sodium Level (mEq/L)	Number (n)	Percentage (%)
<120 (Severe hyponatremia)	6	6.3
120–129 (Moderate hyponatremia)	24	25.0
≥130 (Normal sodium)	66	68.7

5. Laboratory Parameters

The mean serum sodium level of the study population was 135.04 ± 8.36 mEq/L. Elevated blood urea was seen in 52.1%, while elevated creatinine was noted in 19.8% of patients.

Table 4: Laboratory Profile of Study Participants (n = 96)

Parameter	Normal n (%)	Elevated / Abnormal n (%)
Hemoglobin (Anemia)	48 (50.0)	48 (50.0)
Total Leukocyte Count	89 (92.7)	7 (7.3)
Blood Urea	46 (47.9)	50 (52.1)
Serum Creatinine	77 (80.2)	19 (19.8)
Capillary Blood Glucose	28 (29.2)	68 (70.8)

6. Outcome of Stroke Patients

Overall, 79 patients (82.3%) were discharged, while 17 patients (17.7%) died during hospitalization.

7. Association Between Hyponatremia and Mortality

Mortality was significantly higher in patients with hyponatremia (36.7%) compared to those without hyponatremia (9.1%) ($\chi^2 = 10.76$, $p = 0.001$).

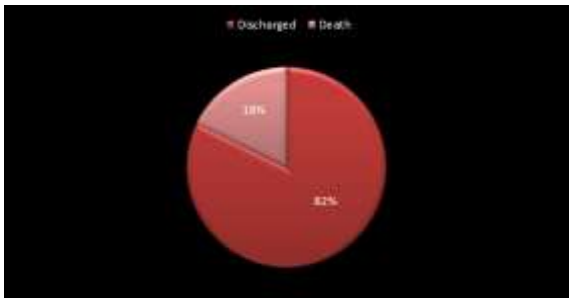

Figure 2: Outcome of Study Participants (n = 96)

Table 5: Association Between Hyponatremia and In-Hospital Outcome (n = 96)

Hyponatremia Status	Discharged n (%)	Death n (%)	Total n (%)	p-value
Present	19 (63.3)	11 (36.7)	30 (100.0)	0.001
Absent	60 (90.9)	6 (9.1)	66 (100.0)	
Total	79 (82.3)	17 (17.7)	96 (100.0)	

8. Association of Hyponatremia with Glasgow Coma Scale (GCS): Improvement in serum sodium levels was associated with a statistically significant improvement in GCS over three days ($p < 0.001$).

Table 6: Change in GCS with Correction of Hyponatremia (n = 30)

Day	Mean GCS	Median (IQR)	p-value
Day 1	13.03	12.75–15.00	<0.001
Day 2	13.60	13.00–15.00	<0.001
Day 3	13.46	14.50–15.00	<0.001

DISCUSSION

In this study of 96 stroke patients, the mean age was 60.1 ± 10.4 years, with a slight male predominance (56.3%). Ischemic strokes (53.1%) were more common than hemorrhagic (42.7%), and hypertension was the most frequent comorbidity (43.8%).

Hyponatremia was observed in 31.3% of patients, with moderate hyponatremia (120–129 mEq/L) being the most common. SIADH was the leading cause (56.7%), followed by CSWS (20%). These findings are comparable with previous studies in Indian stroke populations.

Patients with hyponatremia had significantly higher in-hospital mortality (36.7% vs. 9.1%, p = 0.001) and showed improvement in Glasgow Coma Scale with correction of sodium levels. Hyponatremia was slightly more frequent in ischemic stroke and among females and younger patients, though these associations were not statistically significant.

These results highlight the importance of early recognition and management of hyponatremia in stroke patients to improve neurological recovery and reduce mortality.

CONCLUSION

Hyponatremia is a common electrolyte disturbance in patients with acute stroke, observed in 31.3% of cases in this study, with moderate hyponatremia being the most frequent. The majority of cases were due to SIADH, while a smaller proportion was attributed to CSWS or remained undetermined. Patients with hyponatremia had significantly higher in-hospital mortality and showed poorer neurological status as reflected by Glasgow Coma Scale scores, which improved with correction of sodium levels. Although hyponatremia was slightly more prevalent in ischemic stroke, younger patients, and females, these associations were not statistically significant. These findings emphasize the importance of early detection and timely management of hyponatremia in stroke patients to improve outcomes and reduce mortality.

REFERENCES

1. Coupland AP, Thapar A, Qureshi MI, Jenkins H, Davies AH. The definition of stroke. J R Soc Med. 2017 Jan;110(1):9-12. doi: 10.1177/0141076816680121. Epub 2017 Jan 13. PMID: 28084167; PMCID: PMC5298424.
2. Behera DK, Rahut DB, Mishra S. Analyzing stroke burden and risk factors in India using data from the Global Burden of Disease Study. Sci Rep. 2024 Sep 30;14(1):22640. doi: 10.1038/s41598-024-72551-4. PMID: 39349946; PMCID: PMC11443044.
3. Kim DK, Joo KW. Hyponatremia in patients with neurologic disorders. Electrolyte Blood Press. 2009 Dec;7(2):51-7. doi: 10.5049/EBP.2009.7.2.51. Epub 2009 Dec 31. PMID: 21468186; PMCID: PMC3041486.
4. Saleem S, Yousuf I, Gul A, Gupta S, Verma S. Hyponatremia in stroke. Ann Indian Acad Neurol. 2014 Jan;17(1):55-7. doi: 10.4103/0972-2327.128554. PMID: 24753660; PMCID: PMC3992770.
5. Hall WA, Thorell W. Cerebral Salt Wasting Syndrome. [Updated 2025 Jun 2]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK534855/
6. Giuliani C, Peri A. Effects of Hyponatremia on the Brain. J Clin Med. 2014 Oct 28;3(4):1163-77. doi: 10.3390/jcm3041163. PMID: 26237597; PMCID: PMC4470176.
7. Ehtesham M, Mohmand M, Raj K, Hussain T, Kavita F, Kumar B. Clinical Spectrum of Hyponatremia in Patients with Stroke. Cureus. 2019 Aug 2;11(8):e5310. doi: 10.7759/cureus.5310. PMID: 31592365; PMCID: PMC6773452.