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Original Research Article

Study of Electrolyte Imbalance in Patients with Acute Stroke and Effect of Serum Sodium Levels on the Outcome of Cerebro Vascular Accident in Patents of Telangana

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Conflict of interest: Nil

Abstract

Background: Acute stroke presents a complex clinical emergency that not only disrupts the central nervous system but also initiates a series of pathophysiological complications due to biochemical imbalances, with increased rates of morbidity and mortality.

Method: 80 (eighty) patients having strokes (ischemic/hemorrhagic) were studied. Biochemical tests included fasting blood glucose, lipid profiles, Serum electrolytes were studied in both ischemic and hemorrhagic strokes and compared with normal (control) groups, yielding significant results.

Results: Ischemic strokes were highest in the 46-55 age group, followed by the 35-45 age group, and lowest in the 76-80 age group. Hemorrhagic strokes were highest in 5 (28.5%) in the 46-55 age group and in the 65-75 age group.

Conclusion: Elevated imbalances are often exacerbated by a late approach to medical aid, preexisting malnutrition, and dehydration. Elevated serum sodium is observed in acute stroke patients. It will help the physician to treat such patients efficiently and reduce morbidity and mortality.

Keywords: lipid profile, Ion Selective Electrode (ISE) method, Electrolyte imbalance, hemorrhagic stroke, Ischemic stroke.

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Introduction

Ischemic infarction or hemorrhage in the brain leads to a state of non-convulsive focal neurological deficit of abrupt onset known as stroke or cerebro-vascular accident (CVA). Out of all the neurological disorders, CVA is the most debilitating and is ranked as the third leading cause of death [1]. According to the World Health Organization (WHO), mortality due to stroke accounts for approximately 85% in developing countries.

Electrolyte disturbances are commonly found among other metabolic problems in patients with acute ischemic stroke. It is a potential cause of patient death unless corrected promptly [2].

The disorders of sodium (Na) and potassium (K) balance are identified as the most common electrolyte abnormalities in patients with acute stroke. Patients with hemorrhagic stroke present with symptoms like headache and vomiting, which in turn is a potential cause of electrolyte imbalance [3]. This disturbance in the electrolyte balance is due to deranged secretion of anti-diuretic hormones (ADHs), rise in the levels of atrial and brain natriuretic peptides, and inappropriate fluid input and output, causing complications like seizures and death [4]. Therefore, to prevent morbidity and mortality in CVA patients, early diagnosis of electrolyte imbalance is important. Hence, an attempt is made to determine the frequency of occurrence of electrolyte imbalance in patients presenting with acute stroke and to find out the effect of serum sodium levels on mortality, morbidity outcomes

Material and Method

80 (eighty) adult patients admitted to Princess Esra Hospital, Charminar Road, Moghalpura, Hyderabad, Telangana-500002, having the signs and symptoms of strokes were studied.

Inclusion Criteria: Patients with clinically diagnosed and CT/MRI-proven acute stroke patient (ischemic/hemorrhagic). The patients who gave their consent in writing for the study were selected.

Exclusion Criteria: Patients receiving dialysis for chronic renal disease or failure (CRF), uncontrolled diabetes, patients with cirrhosis of the liver; and immune-compromised patients and refused to give consent in writing were excluded from the study.

Method: Detailed previous history, family history of hypertension, diabetes, dietary pattern, addiction, and medication, and biochemical parameters including fasting blood glucose (FBG) and lipid profile (total cholesterol, triglyceride, HDL, serum electrolytes). Estimation was done with the help of a semi-automated biochemical analyzer (ACCLAB-AT-112+) using marked kits. (Accurex Diagnostics). Serum electrolytes were estimated by the direct Ion Selective Electrode (ISE) method using the Enlite Series Electrolyte Analyzer (Acurex Biomedical Pvt. Ltd.).

The stroke patients were compared with 40 (forty) normal (control) group to confirm and record the findings.

The duration of the study was from August 2025 to January 2026.

Statistical Analysis: Various parameters in different age groups were classified with percentages. Serum electrolyte levels were compared in both stroke patients and the normal (control) group with the t-test. The statistical analysis was carried out using SPSS software. The ratio of male and female was 2:1.

Observation and Results

Table 1: Distribution of patients based on the age group and diagnosis

- Age group 35-45 had 10 (35.7%) ischemic stroke, 8 (28.5%) hemorrhagic stroke.
- 46-55 age group had 14 (33.7%) had ischemic, 10 (23.8%) had hemorrhagic stroke.
- 56-65 age group had 8 (19.04%) had ischemic, 8 (19.04%) had hemorrhagic stroke.
- 66-75 age group had 6 (18.7%) had ischemic, 10 (31.28%) had hemorrhagic stroke.
- 76-80 age group had 2 (12.5%) had ischemic, 4 (25%) had hemorrhagic stroke.

Table 2: Distribution of stroke patients based on sodium, potassium and chloride levels

- Sodium (m Eq/L): 142.80 (± 4.70) mean value of ischemic stroke, 149.90 (± 5.24) hemorrhagic stroke, t test was 4.51 and $p<0.001$ (p value is highly significant).
- But potassium, chloride had insignificant ($p>0.82$) p value.

Table 3: Comparative study of stroke patients with normal (controlled) group, based on sodium, potassium and chloride

- Sodium level: mean value of 142.03 (± 5.26) in and 136.42 (± 2.12) in normal group, t test was 8.84 and $p<0.001$ (p value is highly significant).
- 3.82 (± 0.26) in potassium level stroke patients, 4.30 (± 0.30) in normal group, t test was 10.8 and $p<0.001$ (p value is highly significant).
- Chloride level was more or less same in both groups hence p value was insignificant ($p>0.35$).

Table 1: Distribution of patients based on the age group and diagnosis

Age group	No's & %	Ischemic stroke (40)	Haemorrhagic stroke (40)	Normal (80)	Total (160)
35-45	N	10	8	10	28
	%	(35.7%)	(28.5%)	(35.7%)	(100%)
46-55	N	14	10	18	42
	%	(33.3%)	(23.8%)	(42.8%)	(100%)
56-65	N	8	8	26	42
	%	(19.04%)	(19.04%)	(61.9%)	(100%)
66-75	N	6	10	16	32
	%	(18.7%)	(31.2%)	(50%)	(100%)
76.80	N	2	4	10	16
	%	(12.5%)	(25%)	(62.5%)	(100%)
Total	N	40	40	80	160
	%	(25%)	(25%)	(50%)	(100%)

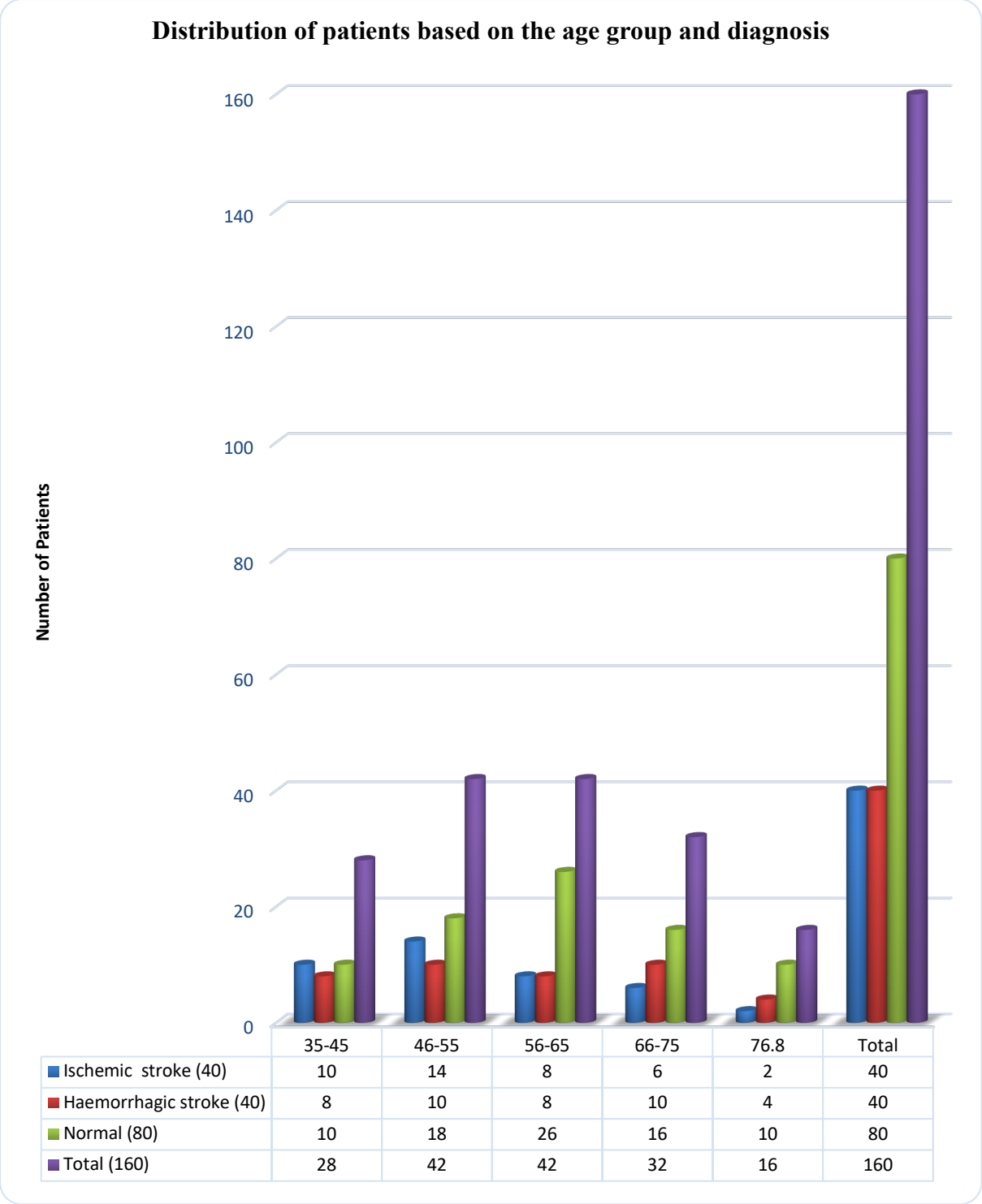

Figure 1: Distribution of patients based on the age group and diagnosis

Table 2: Distribution of stroke patients based on sodium, potassium and chloride levels

Electrolytes	Ischemic stroke	Haemorrhagic stroke	t test	p value
Sodium (m Eq/L)	142.80 (± 4.70)	149.90 (± 5.24)	4.51	P<0.001
Potassium mm 01/L	3.78 (± 0.26)	3.76 (± 0.32)	0.21	p>0.82
Chloride (m Eq/L)	98.78 (± 1.82)	96.54 (± 1.42)	0.46	p>0.64

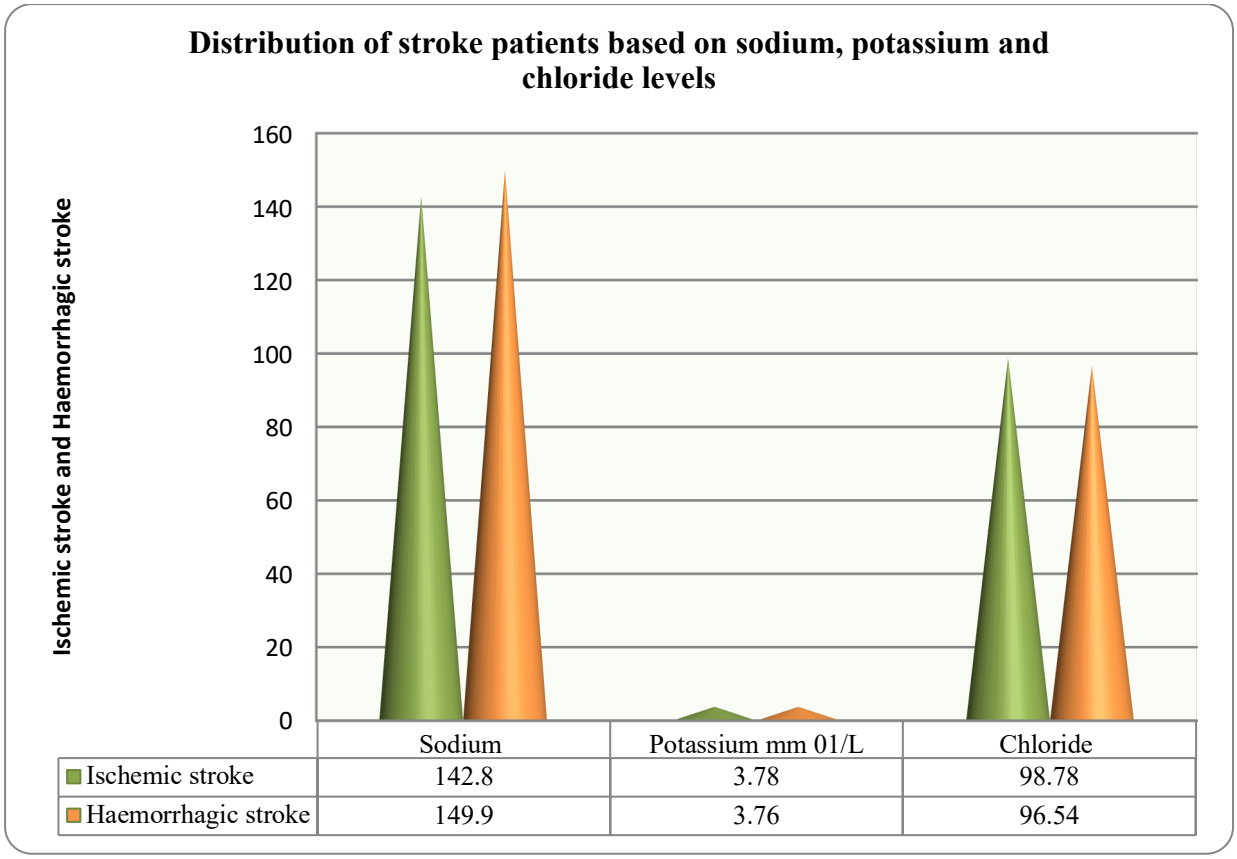

Figure 2: Distribution of stroke patients based on sodium, potassium and chloride levels

Table 3: Comparative study stroke patients with normal group based on sodium, potassium and chloride levels

Electrolytes	Stroke Patients (80)	Normal group (80)	t test	p value
Sodium (m Eq/L)	142.03 (± 5.26)	136.42 (± 2.12)	8.84	P<0.001
Potassium (mm 01/L)	3.82 (± 0.26)	4.30 (± 0.30)	10.8	P<0.001
Chloride (m Eq/L)	98.62 (± 1.56)	98.84 (± 1.42)	0.93	P>0.35

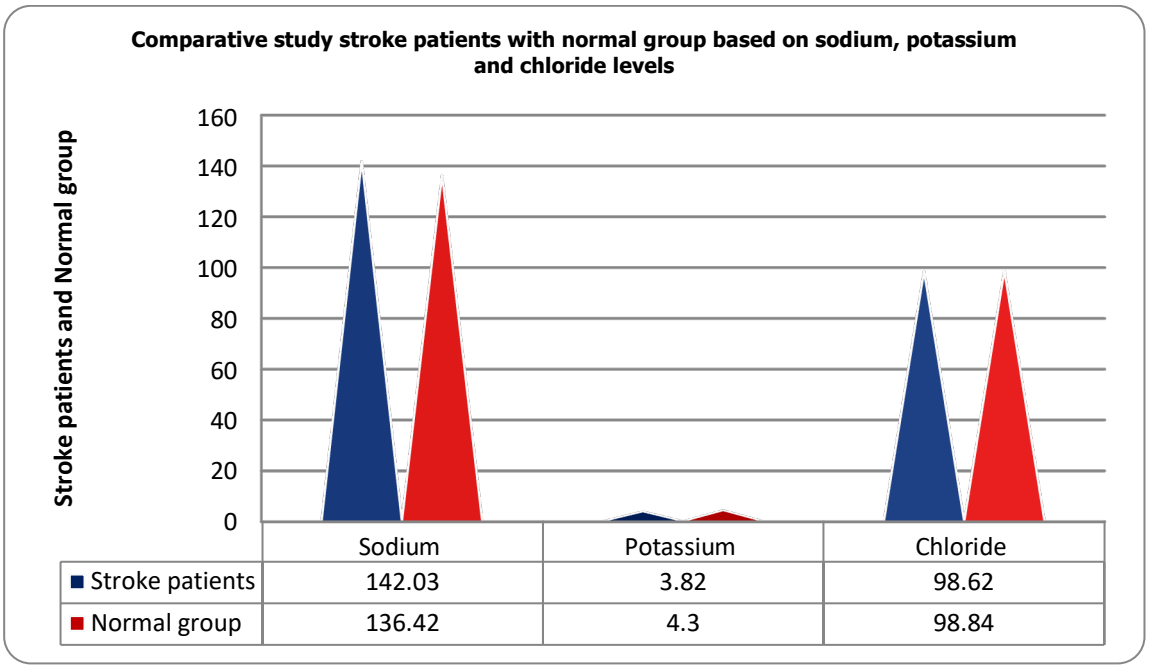

Figure 3: Comparative study stroke patients with normal group based on sodium, potassium and chloride levels

Discussion

Present study of electrolyte imbalance in patients with acute stroke and the effect of serum sodium levels on the outcome of CVA in the Telangana population. Ischemic stroke was highest in the 46-55 age group, 14 (33.3%), followed by the 35-45 age group, 10 (35.7%), and lowest in 2 (12.5%) in the 76-80 age group.

The highest number of hemorrhagic strokes, 10 (31.2%), was in the 66-75 age group (Table 1). In the comparison of ischemic stroke and hemorrhagic stroke, the p-value was significant in sodium level (Table 2). In the comparison of stroke electrolytic level and the normal group (controlled group), the p-value was significant in the sodium and potassium study (Table 3). These findings are more or less in agreement with previous studies [5,6,7].

Serum sodium levels are physiologically maintained within a narrow range, despite wide variations in water and salt intake. Serum osmoregularity is tightly regulated by the interaction between. The secretion and action of the antidiuretic hormone vasopressin (AVP), which is synthesized in the hypothalamus, and the sensation of thirst to promote water intake from the thirst center of the hypothalamus [8].

Hyponatremia (defined as serum sodium level <135 mmol/L) is frequent in patients who had an acute stroke and is associated with longer hospitalization, higher short-term mortality, and poorer outcomes. The cause of this disorder is usually due to the syndrome of inappropriate antidiuretic hormone (SIADH) and, less frequently, cerebral salt wasting syndrome (CSWS) and inappropriate fluid intake and loss [9]. Clinically low potassium levels can result in muscle cramps, flaccid paralysis, and dangerous cardiac arrhythmias, complicating the course of recovery. On the other hand, hyperkalemia, although less common, may arise due to renal dysfunction, acidosis, hemolysis, or excessive potassium supplementation. It is a medical emergency, as it may cause life-threatening arrhythmias, such as ventricular fibrillation.

In both cases, prompt diagnosis through ECG monitoring and regular serum potassium estimation is vital; corrective measures, including oral or IV potassium supplements or insulin dextrose infusion with calcium gluconate for hypokalemia, must be undertaken based on severity. Inclusion of routine potassium monitoring in stroke management protocols is therefore essential to prevent cardiac and neuromuscular complications [10]. In hemorrhagic strokes, symptoms like headache and vomiting are frequent, which contribute further to dyselectrolytemia. Apart from neurological complications such as recurrent strokes and seizures, stroke patients are also vulnerable to several medical complications, including chest infections, urinary tract infections, bowel and bladder dysfunction, deep vein thrombosis, pulmonary embolism, gastrointestinal bleeding, aspiration pneumonia, pressure ulcers, and malnutrition [11].

As compared to males, females are less affected, which may be because of the positive effects of estrogen on cerebral circulation. The incidence of stroke rises with age, maybe because of an unhealthy diet and lack of exercise. Multiple studies have affirmed that patients with electrolyte imbalances, particularly hyponatremia and hypernatremia, have significantly worse outcomes [12]. Rural patients face delays in reaching stroke-ready hospitals, further worsening the prognosis. Poor nutrition, dehydration due to a hot climate, and underlying co-morbidities such as diabetes or hypertension complicate electrolyte profiles [13].

Summary and Conclusion

Electrolyte imbalances are often exacerbated by a late approach to medical aid, pre-existing malnutrition, dehydration, and lack of awareness. Routine electrolyte screening, early identification of syndrome of inappropriate antidiuretic hormone secretion (SIADH) or cerebral salt wasting syndrome (CSWS), and timely correction are essential to improve outcomes. The present study demands that such a study must be conducted in a large number of patients in high-tech hospitals, where the latest technological facilities are available to treat emergency conditions, to confirm the present findings and results.

Limitation of study: Owing to small number of patients and lack of latest techniques, we have limited findings and results.

This research work was approved by the ethical committee of Deccan College of Medical Sciences Hyderabad, Telangana-500058.

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