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# Study of Serum Sodium Levels in Acute Ischemic Stroke Patients in Tertiary Care Hospital

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**Abstract** **Original Research Article**

Dyselectrolytaemia is one the most common complication of acute stroke that to be corrected immediately, otherwise it may lead to death. As there are predominant contributions of studies analyzing electrolyte abnormalities in acute stroke were reported worldwide, very few studies were reported in India. This study aims to quantify the hyponatremia in acute ischemic stroke patients and to observe the association of co morbidities like hypertension and diabetes with hyponatremia in acute ischemic stroke patients. So, in this regard we designed a cross sectional study in King George Hospital Visakhapatnam on 50 acute ischemic stroke patients. Diagnosis was confirmed by both neurological examination and radiological basis. Detailed patient history and serum sodium levels were taken from case sheets of the patients with their prior concern in 24 hours of stroke attack. The data was analyzed using Chi squared test using SPSS software version 21. The study revealed that there is strong association of hyponatremia among acute ischemic stroke patients in relation to gender (p=0.03), out of 50 patients, 13 male and 5 female patients had hyponatremia. Majority of the patients had mild hyponatremia (24%), few had moderate hyponatremia (6%) and few had severe hyponatremia (6%). 11 out of 50 patients who were hypertensive had hyponatremia. 10 out of 50 patients who had other risk factors like previous history of heart disease and stroke, alcohol and smoking presented with hyponatremia. 5 out of 50 who were diabetes had hyponatremia. This study also found that most of the patients with hyponatremia were males in the age range of 56-80 years. Hyponatremia was common in patients with acute ischemic stroke, but only with mild alteration in sodium levels.

**Keywords:** Hyponatremia, Acute ischemia, Stroke, Visakhapatnam, Dyselectrolytaemia.



## INTRODUCTION

Stroke is the most common emergency condition [1]. It is the second leading cause of death worldwide with an annual mortality rate of 5.5 million [2]. It also had high morbidity, 50% of survivors are chronically disabled [2-4]. Stroke is classified into two major types, they are namely ischemic stroke and hemorrhagic stroke. Ischemic stroke occurs due to blockage of blood supply to a part of brain resulting in sudden loss of brain function, whereas hemorrhagic stroke is due to rupture of blood vessels or abnormal vascular structure [5].

Electrolyte disturbance is commonly found in acute stroke settings, hypernatremia, hyponatremia and hypokalaemia being a few common incidences amongst them. The prevalence of hyponatremia in the community is ~8% and it is increased significantly with age [6, 7]. The disturbances usually result from the syndrome of inappropriate antidiuretic hormone (SIADH), increase of brain natriuretic peptides (BNP), inappropriate fluid intake and loss, and can result in seizures or death of the patient [8].

Sodium is essential for the body to maintain fluid balance and for normal body functions. It also helps to regulate nerve function and muscle contraction. Alteration in sodium levels leads to many complications.

Hyponatremia develops when there are low serum sodium levels in the body. Hyponatremia results from the inability of the kidney to excrete a water load or excess water intake. Water intake depends upon thirst mechanism. Thirst is stimulated by increase in osmolality. Thirst is sensed by osmoreceptors located in the hypothalamus and leads to the release of anti-diuretic hormone (vasopressin) from the posterior pituitary. Antidiuretic hormone acts on the V2 receptors

located at the basolateral aspect of the collecting duct cells and leads to increased aquaporin expression on the luminal aspect of the collecting duct cells which increases water absorption and abolishes thirst [9].

This present study was focused on observation of serum sodium level alteration in acute ischemic stroke patients. According to European guidelines hyponatremia in adults is classified according to serum sodium concentration as three phases, mild hyponatremia (130-134mmol/L), moderate hyponatremia (125-129 mmol/L) and profound hyponatremia (<125 mmol/L) [10]. Our present study on the basis of the EUROPEAN GUIDELINES divided acute ischemic stroke patients with hyponatremia into 3 groups namely mild, moderate and severe hyponatremia.

## MATERIALS AND METHODS

**Study Design:** cross sectional study

**Study Population:** department of general medicine, king George hospital, Visakhapatnam

**Study Period:** From 2018 august to September 2019

**Inclusion Criteria**

1. Age: adult patients 25 to 80 years of both sexes
2. Data collection: with in 24 hours of admission
3. Only Acute Ischemic stroke patients were included
4. Risk factors like diabetes mellitus, hypertension, alcohol, smoking, previous history of heart disease and previous history of stroke were included

**Exclusion Criteria**

1. History of TIA [transient ischemic attack]
2. Stroke due to infection
3. History of Acute and Chronic renal disease
4. Previous steroid or diuretic therapy
5. History of carcinomas and paraneoplastic syndrome

**Sample size:** 50

**Data Collection**

- Serum sodium values had taken from the test reports entered in the case sheets
- Detailed patient history was taken.
- All the data was noted in excel sheet

## STATISTICAL ANALYSIS

Data was analysed using SPSS (statistical package for social sciences) version 21. Chi square test was done.

## ETHICAL CONSIDERATIONS

- Prior permission had taken from institutional Ethics Committee, Andhra Medial College, Visakhapatnam.
- A written informed consent was taken from each individual of the study.

## RESULTS

**Table-1: Distribution Of Ischemic Stroke Patients Based On Age And Gender**

| | MALES | FEMALES | TOTAL |
|---|---|---|---|
| 25-40 | 1 | 4 | 5 |
| 41-55 | 10 | 6 | 16 |
| 56-80 | 15 | 14 | 29 |
| TOTAL | 26 | 24 | 50 |

In the present study among 50 ischemic stroke patients, 26 were male and 24 were female. Majority of the stroke patients, that is 29 out of 50 were in the age group ranging between 56-80 years, among which 15 were male and 14 were female.

**Table-2: Association of Hyponatremia among Ischemic Stroke Patients In Relation to Gender**

| GENDER | HYPONATREMIA | | TOTAL |
|---|---|---|---|
| | PRESENT | ABSENT | |
| MALES | 13 | 13 | 26 |
| FEMALES | 5 | 19 | 24 |
| | 18 | 32 | 50 |

$X^2$=4.6; df=1; $p$=0.03(significant)

Males developed hyponatremia in more number compared to females. Out of 18 patients who developed hyponatremia, 13 were male and only 5 were female, with significant association of gender and hyponatremia ($p$=0.03).

**Table-3: Association of Hyponatremia among Ischemic Stroke Patients In Relation To Age**

| AGE | HYPONATREMIA | | TOTAL |
|---|---|---|---|
| | PRESENT | ABSENT | |
| 25-40 | 1 | 4 | 5 |
| 41-55 | 5 | 11 | 16 |
| 56-80 | 12 | 17 | 29 |
| TOTAL | 18 | 32 | 50 |

$X^2$=1.07; df=2; $p$=0.58(not significant)

12 out of 18 patients, who developed hyponatremia belongs to 56-80 years of age group, but no significant association ($p$=0.58) was found with age and hyponatremia development.

**Table 4: Levels of Hyponatremia among Ischemic Stroke Patients**

| LEVEL OF HYPONATREMIA | NUMBER OF PATIENTS (N) | PERCENTAGE OF PATIENTS (100%) |
|---|---|---|
| MILD HYPONATREMIA | 12 | 24% |
| MODERATE HYPONATREMIA | 3 | 6% |
| SEVERE HYPONATREMIA | 3 | 6% |
| NO HYPONATREMIA | 32 | 64% |

18 out of 50 stroke patients were found with hyponatremia, among which majority (N=12; 24%) were found with mild hyponatremia.

**Table 5: Association of Hyponatremia among Ischemic Stroke Patients In Relation To Co-Morbidities**

| CO-MORBIDITIES | HYPONATREMIA | | TOTAL |
|---|---|---|---|
| | PRESENT | ABSENT | |
| DIABETES | 5 | 7 | 12 |
| HYPERTENTION | 11 | 17 | 28 |
| OTHERS | 10 | 32 | 42 |
| NO | 5 | 4 | 9 |

$X^2$=0.01; df=2; $p$=0.8(not significant)

Ischemic stroke patients were presented with co-morbidities. 5 out of 12 diabetics had developed hyponatremia and 11 out of 17 hypertensives had developed hyponatremia. Whereas 10 out of 42 patients with different other co-morbidities (history of stroke, alcohol, smoking, heart disease) had developed hyponatremia with no significant difference ($p$=0.8) among them.

**Table-6: Association of Mild, Moderate and Severe Hyponatremia among Ischemic Stroke Patients In Relation To Co-Morbidities**

| Co-Morbidities | Mild Hyponatremia | Moderate Hyponatremia | Severe Hyponatremia | Total |
|---|---|---|---|---|
| DIABETES | 4 | 1 | 0 | 5 |
| HYPERTENTION | 8 | 2 | 1 | 11 |
| OTHERS | 6 | 4 | 0 | 10 |

$X^2$=0.735; df=2; $p$=0.69 (not significant)

In those stroke patients with associated co-morbidities, who presented with hyponatremia, majority were found with mild hyponatremia. 4 out of 5 diabetics, had mild hyponatremia and 1 with moderate hyponatremia. 8 out of 11 hypertensives, had mild hyponatremia, 2 had moderate hyponatremia and 1 had severe hyponatremia. 6 out of 10 others with different comorbidities had mild hyponatremia and 4 had moderate hyponatremia. No significant association ($p$=0.69) was found among the patients with difference in co-morbidities and hyponatremia presentation.

## DISCUSSION

Hyponatremia is an important and common clinical problem. The aetiology is multifactorial. Hyponatremia in patients with an acute central nervous system (CNS) disease is the most common electrolyte disturbance encountered in neurological clinical practice [11, 12]. Most of the previous studies proved that hyponatremia was more common in haemorrhagic stroke patients compared to ischemic stroke patients. Therefore this present study had focused on severity of sodium alteration from the normal in acute ischemic stroke patients.

In the present study among 50 ischemic stroke patients, 26 were male and 24 were female. Majority of the stroke patients, that is 29 out of 50 were in the age group ranging between 56-80 years, among which 15 were male and 14 were female (Table-1). Males developed hyponatremia in more number compared to females. Boutayeb *et al.*, in their study they observed that the stroke is more prevalent in men than women with ratios varying from 1.3:1 to 2:1 [13]. In Md. Narse *et al*., study male and female ratio in hemorrhagic and ischemic 1:0.62 and 1:0.089 respectively [14]. Study of Chowdhury *et al.*, and Kurtzke showed that frequency of stroke is 30% higher in males than females [15, 16]. In this present study out of 18 patients who developed hyponatremia, 13 were male and only 5 were female, with significant association of gender and hyponatremia ($p$=0.03) (Table-2).

In our study 12 out of 18 patients, who developed hyponatremia belongs to 56-80 years of age group (Table-3). Mahmudur *et al*., in his study of stroke found that maximum number of patients (29%) were in between 51-60 years age group followed by (22%) between 61 – 70 years age group [17]. Bevan *et al.*, in their study regarding stroke also had similar results as Mahmudur et al. A hospital-based study done in DMCH (Darbhanga Medical College and Hospital) revealed that only 1% occurred in <20 years and 26% in 20 – 45 years and most of them are above 45 years [18]. In

Manaswini panda *et al.*, study electrolyte imbalance was most common among 61-70 years (56.67%) age group [19]. Older subjects are more prone to hyponatremia because of impaired water-excretory capacity mainly attributed to aging-related reduction of glomerular filtration rate (GFR). Additionally, the decreased intrarenal generation of prostaglandins seen in advanced age may also be involved in the impaired ability of elderly individuals to excrete water [20]. Another contributing factor in elderly patients is the age-related reduction in the percentage of total body water content, leading to greater fluctuations in serum sodium concentration, because: serum sodium levels = exchangeable total (sodium + potassium)/total body water.

In this study 18 out of 50 acute ischemic stroke patients were found with hyponatremia, among which majority (N=12; 24%) were found with mild hyponatremia (Table-3). In Sarfraz A *et al*., study also Majority of patients were presented with mild hyponatremia (25%), only few had moderate hyponatremia [9.8%] or profound hyponatremia (3.8%) [21]. In Sarfraz study they found that the exact state of sodium levels in the patients admitted for at least 24 hours in the neurological ward but for not more than a week, 33 out of 51 cases had a decrement of only 2-3 mmol/L whereas in our present study serum electrolytes data was collected within 24 hours of the patients stroke attack. Study done by Sarfraz A *et al*., was similar to the study done by Pradhan *et al.*, [22] which showed that out of 64 patients from 100, diagnosed for ischemic stroke, only 6 developed a change in sodium level with a mean level coming out to be 136 mmol/L. Their study displayed 33 out of 132 identified ischemic stroke patients developing hyponatremia with their sodium levels in the range of 130 mmol/L to 134 mmol/L. our present study was similar to Sarfraz A *et al*., study in classifying hyponatremia according to European guidelines. In another study done by Meenakshi *et al*., had hyponatremia was common among ischemic stroke patients [37.0%] in comparison to hemorrhagic stroke patients (26.1%) [23].

Hypertension is most common risk factor of stroke. In middle and late adult life, hypertension was the strongest modifiable risk factor for ischemic stroke and hemorrhagic stroke cases. In one study, among risk factors of stroke, the prevalence of diabetes mellitus was significantly higher among hyponatremic patients ($p = 0.001$) [24]. Uncontrolled diabetes mellitus can also induce osmotic diuresis and hypovolemic hyponatremia.

These patients have a higher mortality, worse functional outcome, more severe disability after stroke and a higher frequency of recurrent stroke. In this present study acute ischemic stroke patients with associated co-morbidities, who presented with hyponatremia, majority were found with mild hyponatremia. 4 out of 5 diabetics, had mild hyponatremia and 1 with moderate hyponatremia. 8 out of 11 hypertensives, had mild hyponatremia, 2 had moderate hyponatremia and 1 had severe hyponatremia. 6 out of 10 others with different comorbidities had mild hyponatremia and 4 had moderate hyponatremia (Table-6).

## CONCLUSION

Electrolyte disturbances are common at the time of presentation of patients with acute stroke associated with increased morbidity and mortality irrespective of types, location, and size of strokes and associated co- morbidities. The results of the present study clearly shows that male gender are most commonly presenting with hyponatremia in acute ischemic stroke patients. A strongest association of hyponatremia among acute ischemic stroke patients in relation to gender was observed. Hyponatremia was common in patients with acute ischemic stroke, but only with mild alteration in sodium levels. Early detection and management can improve overall outcome of stroke patients.

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