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Original Research Paper

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IMBALANCES OF SERUM AND URINARY ELECTROLYTE (SODIUM AND POTASSIUM) IN ACUTE STRIKE

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ABSTRACT

BACKGROUND: In patients with Cerebrovascular accident electrolyte imbalance is an important factor leading to high mortality and morbidity. Timely identification and intervention can decrease morbidity significantly.

OBJECTIVE: To study various electrolytes imbalance in acute stroke. And compare sodium and potassium level in patients of stroke and to compare the outcome with normal and abnormal initial electrolyte level.

MATHOD &MATERIALS: A prospective observational study was performed on patients of acute stroke admitted to ICU of department of Medicine, SRN Hospital, MLN Medical College, Prayagraj from September, 2018 to August 2019. We studied serum and urine electrolyte levels in CVA patients.

RESULT: A total of 102 acute stroke patients aged 52-78 year (Mean age 61.82 ± 5.65 year, 65.7% male) were enrolled in the study. Majority of patients (n= 65; 63.7%) had ischemic stroke and 37 (36.3%) had haemorrhagic stroke. Majority (n=56, 54.9%) were hyponatremic followed by hypernatremic (n = 24, 21.6%) respectively with respect to serum potassium level, majority had normal (n=63, 61.8%) followed by hypokalemia (n=36, 35.3%) and only 3 (2.9%) had hyperkalemia. Mortality rate and longer hospital stay (> 14 days) was significantly higher in hyponatremic, hypernatremic groups, and hypokalemic group as compared to that in normal group.

CONCLUSION: There is high incidence of electrolyte imbalance in acute stroke patients and its is associated with clinical outcomes. Present study shows that monitoring and maintaining serum electrolyte in normal range have important role in better outcome in acute strok.

KEYWORDS : Electrolyte level, acute stroke, hypernatremic, hyponatremic, hyperkalemia, hypokalemia.

INTRODUCTION

Stroke is the second leading cause of death after ischemic heart disease and major cause of disability worldwide (World health statistics 2011). Current data suggest that approximately 20 million people suffer from stroke each year, 5 million die and 5 million more are left with chronic disability[1]. In India and other developing countries, rapid demographic, lifestyle, and socioeconomic transitions have significantly contributed to the emergence of the stroke epidemic[2]. The prevalence of stroke in India shows a huge variation of 147-922/100,000 across diverse community-based studies[3,4].

There are two types of stroke – ischemic and haemorrhagic. Of the two, ischemic stroke is the dominant one and is responsible for 85% of total strokes while haemorrhagic stroke contributes towards remaining 15% of strokes. The consequence of stroke is loss of control on different cellular and extracellular processes. At cellular level there is depletion of ATP production which in turn results in failure of ionic pump and depolarization at one end and decreased glutamate uptake, both these mechanisms are responsible for increased glutamate concentration Introduction 2 resulting into excitotoxicity which then triggers the excessive electrolyte influx. All these mechanisms induce oxidative stress which is responsible for inflammatory response[5].

Change in electrolyte levels is a commonly observed phenomenon in acute stroke cases[6,7,8]. There are multiple pathways affecting their levels. Not only the cellular mechanisms but extracellular mechanisms could also play a role in disturbing the electrolyte balance. Hormonal factors such as inappropriate secretion of antidiuretic hormone (ADH) or cerebral salt wasting syndrome (CSWS) are also responsible for affecting the electrolyte levels in stroke cases[9,10]. Apart from this, there is increased renal excretion of various cations and this also contributes to the serum electrolyte disturbances[11]. Use of diuretics too could precipitate hyponatremic [12].

Electrolytes, particularly, sodium and potassium have a detrimental effect on human health. Sodium has a bi-fold effect on human health, both excess as well as deficiency of sodium poses a threat to human health. While excessive sodium (hypernatremia) is considered to affect the cardiovascular health and has been an issue of great concern, deficiency of sodium (hyponatremic) is frequent finding in critical Introduction 3 illness and stroke[13,14]. Similarly, maintenance of potassium levels is also quite important. Its normal range is defined as 3.5-5.0 mEq/L. Both hypo- and hyperkalemia are associated with an increased risk of cardiac events like ventricular tachycardia and ventricular fibrillation[15,16]. Disorders of sodium and potassium concentration are the commonest electrolyte abnormalities found in CVA patients[17]. It has also been observed that reduced electrolyte levels (hyponatremia and hypokalemia) are more frequent than increased electrolyte levels (hypernatremia and hyperkalemia) among stroke patients.

While mild hypo or hypernatremia may be auto reversible—but when it becomes severe and develops all on a sudden—it itself can cause death of a patient. Further - convulsion due to hyponatremia may aggravate the intracerebral edema in a stroke patient to worsen the situation[18].

MATERIAL AND METHOD

This is the prospective observational study was performed on patients of acute stroke admitted to ICU of Department of Medicine, SRN Hospital, MLN Medical College, Prayagraj over a period of one year. Patients of CVA diagnosed by suggestive symptoms and confirmed by physical examination and brain imaging either CT scan or MRI, will be selected randomly admitted and enrolled from the General medicine IPD of SRN Hospital, Prayagraj. The calculated sample size was 91, however after adding for a contingency of 10% we targeted a sample size of 100. Finally, a total of 102 patients were enrolled in the study.

INCLUSION CRITERIA: Age more than 18 years. Either sex of acute strokes (both haemorrhagic and ischemic). Admitted within 48 hours after onset of CVA.

EXCLUSION CRITERIA: Patients with renal failure. Those on previous diuretic or steroid therapy. Patients with documented infection were excluded from the study. Patients presenting with severe hyperglycemia (>300 mg/dl) and hypertriglyceridemia (> 400 mg/dl) were excluded from the study to avoid the chance of pseudohyponatremia.

DATA COLLECTION

Data was collected using a Proforma designed specifically for the study. Detailed history, physical examination and necessary investigations were undertaken. Material and Method 24 Details regarding age and sex of patients were obtained followed by clinical examination for blood pressure, pulse rate and systemic examination. The biochemical investigations included were: random blood sugar, blood urea, complete blood picture, serum creatinine and electrolytes, complete urine picture, was done in hospital biochemistry department. Chest X-ray, electrocardiography, and ultrasound abdomen were done when indicated.

Corrective interventions were done as per standard protocol. 3% Normal saline was used among cases with serum sodium level <130 mEq/L with a targeted sodium level ≥130 mEq/L at the end of ICU stay and corrected by at least 5 mEq/L. Repeat measures of serum and urinary potassium levels were done at Day 3, Day 5 and Day 7 of admission. All the patients were followed up till their ICU stay. Duration of ICU stay, outcome (expiry/discharge/LAMA) was noted. Data so obtained was entered into an excel worksheet and was subjected to statistical analysis. Data was analyzed using Statistical Package for Social Sciences (SPSS) version 20.0.

RESULTS

The present study was carried out to study imbalance of serum and urinary electrolytes (sodium and potassium) in acute stroke. For this purpose, a total of 102 acute stroke patients falling in sampling frame were enrolled in the study.

Age of patients ranged from 52 to 78 years. Maximum number of cases (n=49; 48.0%) were aged 51-60 years followed by those aged 61-70 years (n=47; 46.1%). Only 6 (5.9%) patients were aged >70 years. Mean age of patients was 61.82±5.65 year. Majority of cases were males (n=67; 65.7%). There were 35 (34.3%) females. Male to female ratio of study population was 1.92. There was a dominance of ischemic stroke (n=65; 63.7%) over hemorrhagic stroke (n=37; 36.3%).

Table 1: General and Clinical Profile of Acute stroke patients enrolled in the study.

SN	Characteristic	Statistic
1.	Age	
	51-60 Years	49 (48.0%)
	61-70 Years	47 (46.1%)
	>70 Years	6 (5.9%)
	Mean age±SD (Range) in years	61.82±5.65 (52-78)
2.	Sex	
	Male	67 (65.7%)
	Female	35 (34.3%)
3.	Stroke type	
	Ischemic	65 (63.7%)
	Hemorrhagic	37 (36.3%)
4.	Territory	
	ACA	5 (4.9%)
	MCA	83 (81.4%)
	PCA	14 (13.7%)

Age of patients ranged from 52 to 78 years. Maximum number of cases (n=49; 48.0%) were aged 51-60 years followed by those aged 61-70 years (n=47; 46.1%). Only 6 (5.9%) patients were aged >70 years. Mean age of patients was 61.82±5.65 years (Table 1).

Majority of cases were males (n=67; 65.7%). There were 35 (34.3%) females. Male to female ratio of study population was 1.92 (Table 1; Fig. 1.2). There was a dominance of ischemic stroke (n=65; 63.7%) over hemorrhagic stroke (n=37; 36.3%) (Table 1).

Middle cerebral artery (MCA) was most commonly involved (n=83; 81.4%) followed by posterior cerebral artery (PCA) (n=14; 13.7%) and anterior cerebral artery (n=5; 4.9%) respectively (Table 1).

Table 2: Hematological and Biochemical Profile at admission

Parameter	Minimum	Maximum	Mean	SD
Hb (gm/dl)	8.4	14.2	11.48	1.50
TLC ('000/mm³)	4.8	22.3	13.71	3.86
S. Bilirubin (mg/dl)	0.48	1.3	0.83	0.13
SGOT (IU/L)	24.68	50.64	33.53	5.88
SGPT (IU/L)	30.11	80.44	45.46	8.22
S. Urea (mg/dl)	18	65	30.18	8.83
S. Creatinine (mg/dl)	0.64	1.32	0.91	0.16
FPG (mg/dl)	70	106	88.49	8.59
PPG (mg/dl)	129	144	135.27	3.62
TG (mg/dl)	116.31	156.45	138.42	9.67
LDL (mg/dl)	88.16	126.49	109.27	10.85
HDL (mg/dl)	29.12	70.12	48.38	7.86

At admission, hemoglobin levels ranged from 8.4 to 14.2 gm/dl with a mean of 11.48±1.50 gm/dl. Total leukocyte count ranged from 4.8 to 22.3 x103/mm3 with a mean of 13.71+3.86 x 103/mm3 . Mean S. bilirubin, SGOT and SGPT levels were 0.83±0.13 mg/dl, 33.53+5.88 IU/L and 45.46+8.22 IU/L respectively. Mean S. urea and creatinine levels were 30.18±8.83 and 0.91±0.16 mg/dl respectively. Mean fasting and post-prandial plasma glucose levels were 88.49±8.59 and 135.27±3.62 mg/dl respectively. Mean serum triglyceride, Low density lipoprotein and high density lipoprotein levels were 138.42±9.67, 109.27±10.85 and 48.38±7.86 mg/dl respectively.

Table 3: Serum Electrolytes (Sodium and Potassium) levels at day 1, 3, 5 and 7 of study.

(a) Serum Sodium

Time	Mean±SD (Range) in mEq/L	Normal	Hypo	Hyper
Day 1	135.25±12.43 (118.16-162.44)	22 (21.6%)	56 (54.9%)	24 (23.5%)
Day 3	138.09±9.63 (122.20-158.20)	28 (27.5%)	42 (41.2%)	32 (31.4%)
Day 5	139.40±9.32 (124.15-158.16)	38 (37.3%)	36 (35.3%)	28 (27.5%)
Day 7	140.25±8.34 (122.14-159.16)*	41 (40.2%)	31 (30.4%)	30 (29.4%)

*Difference significant as compared to Day 1 (Paired t'-test).

(b) Serum Potassium

Time	Mean±SD (Range) in mEq/L	Normal	Hypo	Hyper
Day 1	3.69±0.65 (2.08-6.12)	63 (61.8%)	36 (35.3%)	3 (2.9%)
Day 3	3.82±0.57 (2.48-5.12)	73 (71.6%)	29 (28.4%)	0
Day 5	3.90±0.84* (2.10-6.12)	65 (63.7%)	34 (33.3%)	3 (2.9%)
Day 7	4.21±0.66* (2.14-5.21)	90 (88.2%)	12 (11.8%)	0

*Difference significant as compared to Day 1 (Paired t'-test)

On day 1, serum sodium levels ranged from 118.16 to 162.44 mEq/L with a mean of 135.25±12.43 mEq/L. Mean Serum sodium levels were observed to be 138.09±9.63, 139.40±9.38 and 140.25±8.34 mEq/L respectively on day 3, 5 and 7 after

admission. Though mean S. sodium levels were higher at all the subsequent intervals as compared to day 1 values yet the difference from day 1 was significant statistically only on day 7.

DISCUSSION

Electrolyte imbalance is a commonly observed phenomenon in acute stroke patients and is often associated with poor outcome47-61. Successful management of electrolyte disturbances could avert the poor outcomes too. Among different electrolytes cation sodium and potassium play a crucial role in causing electrolyte imbalance. Keeping in view the stated importance of electrolyte imbalance, the present study was carried out with an aim to find out the incidence of electrolyte imbalance in acute stroke patients admitted to our facility and to find out association of these disturbances on the outcome.

For this purpose, a total of 102 acute stroke patients aged 52-78 years (Mean age: 61.82±5.65 years; 65.7% males) were enrolled in the study. This study o report a higher risk of stroke among males as compared to females and an increasing incidence with increasing age. In present study, majority of patients (n=65; 63.7%) had ischemic stroke. A total of 37 (36.3%) had haemorrhagic stroke. Nevertheless a dominance of ischemic stroke patients over hemorrhagic stroke patients has been reported in many studies. The observation in present study also showed a dominance of ischemic stroke patients. MCA (81.4%) and PCA (13.7%) were the most commonly involved segments. ACA was involved in only 5 (4.9%) cases. MCA is most commonly involved ACA and PCA are less commonly involved as observed in present study.

In present study, on the day of admission, mean serum sodium level was 135.25±12.43 mEq/l. Majority (n=56; 54.9%) were hyponatremic followed by hypernatremic (n=24; 23.5%) and normal (n=22; 21.6%) respectively. Mean serum sodium levels and prevalence of sodium disorders.

In present study, on the day of admission, mean serum potassium level was 3.69±0.65 mEq/l. Majority had normal (n=63; 61.8%) followed by hypokalemia (n=36; 35.3%) and only 3 (2.9%) had hyperkalemia. Although, problem of serum potassium levels has been studied less frequently as compared to problem of serum sodium levels in acute stroke patients.

In present study, at admission serum sodium levels did not show a significant association with age, gender, stroke type, haematological and biochemical parameters (except SGOT). ACA was exclusively related with hypernatremia. Mean SGOT levels were significantly lower in hyponatremic group as compared to normal and hypernatremic groups. Mortality rate and longer hospital stay (>14 days) was significantly higher in hyponatremic and hypernatremic groups as compared to that in normal group. Similarly, at admission serum potassium levels did not show a significant association with age, gender, stroke type, haematological and biochemical parameters. With respect to territory, involvement of ACA was significantly associated with hyperkalemia. Mortality rate was significantly higher in hypokalemic as compared to that in normal and hyperkalemic groups. No significant association of hospital stay was observed with serum potassium status.

The findings of present study elaborated that there is high incidence of electrolyte imbalance in acute stroke patients and it could be associated with the clinical outcome too. Further studies to explore the issue further are recommended.

CANCLUSION

Majority of patients (n=65; 63.7%) had ischemic stroke. A total of 37 (36.3%) had haemorrhagic stroke. MCA (81.4%) and PCA (13.7%) were the most commonly involved segments. ACA was involved in only 5 (4.9%) cases. Mean serum sodium and potassium levels were 135.25±12.43 mEq/l and 3.69±0.65 mEq/l respectively. With respect to serum sodium status, majority (n=56; 54.9%) were hyponatremic followed by hypernatremic (n=24; 23.5%) and normal (n=22; 21.6%) respectively. With respect to serum potassium levels, majority had normal (n=63; 61.8%) followed by hypokalemia (n=36; 35.3%) and only 3 (2.9%) had hyperkalemia. Serum sodium levels did not show a significant association with age, gender, stroke type, haematological and biochemical parameters (except SGOT). ACA was exclusively related with hypernatremia. Serum potassium levels did not show a significant association with age, gender, stroke type, haematological and biochemical parameters. With respect to territory, involvement of ACA was significantly associated with hyperkalemia. Mortality rate was significantly higher in hypokalemic as compared to that in normal and hyperkalemic groups. No significant association of hospital stay was observed with serum potassium status. Present study shows that monitoring and maintaining serum electrolyte in normal range have important role in better outcome in acute stroke.

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