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STUDY OF SERUM ELECTROLYTES IN PATIENTS WITH STROKE IN VISAKHAPATNAM

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ABSTRACT

Dyselectrolytaemia is one of the most common complications of acute . This study is aimed to check the type of electrolyte abnormality, which is commonly encountered in ischemic and hemorrhagic stroke. So, in this regard we designed a cross-sectional study at King George Hospital Visakhapatnam on 60 acute stroke patients [ischemic stroke (30) & hemorrhagic stroke (30)]. Diagnosis was confirmed by both neurological examination and radiological basis. The study revealed that there is a strong association of hypokalemia and stroke [p=0.016]. 16 [26.7%] hemorrhagic stroke patients and 7 [11.7%] ischemic stroke cases were found predominantly with hypokalemia. Majority of the stroke cases belong to the age group of 45-64 years. Mean age and standard deviation of ischemic stroke cases was found to be 60.3 + 11.15 years, while for hemorrhagic stroke cases, it was found to be 53.03 + 10.40 years, with a statistical difference between the two groups. Mean serum sodium, potassium levels and standard deviation of ischemic stroke cases and hemorrhagic stroke cases was found to be 133.4 + 7.82 mmol/l, 3.7 + 0.66

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mmol/l and 139.3 + 8.82 mmol/l, 3.5 + 0.53 mmol/l respectively. Significant differences were found only in mean serum sodium levels between the groups. The results of this present study clearly show that hypokalemia was the most common dyselectrolytaemia seen in both ischemic stroke and hemorrhagic stroke types, with a significant statistical difference between the two groups. Early detection and management can improve the overall outcome of stroke patients.

Keywords: Hypokalemia, Hyponatremia, Stroke

LIST OF ABBREVATIONS

SIADH - Syndrome of Inappropriate Anti-Diuretic Hormone

BNP - Brain Natriuretic Peptide

ECF - Extracellular Fluid

ICF - Intracellular Fluid

ADH - Anti-diuretic hormones

CNS - Central Nervous System

NaCl, NaHCO3 - Sodium Chloride, Sodium Bicarbonate

ECG - Electrocardiography

OCSP - Oxford Community Stroke Project

TACI - Total anterior circulation infarct

PACI - Partial anterior circulation infarct

LACI - Lacunar Infarct

POCI - Posterior Circulation Infarct

TOAST - Trial of ORG 10172 in Acute Stroke Treatment

ACA - Anterior Cerebral Artery

MCA - Middle Cerebral Artery

PCA - Posterior Cerebral Artery

NIHSS - The National Institutes of Health Stroke Scale

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ATP - Adenosine Triphosphate

ABC - Airway breathing and circulation

BMP - Basic metabolic panel

CBC - Completed blood count

PT - Prothrombin time

APTT - Activated Partial Thromboplastin Time

INR - International Normalized Ratio

CT - Computed Tomography

RtPA - Recombinant Tissue Plasminogen Activator

ECASS - European Cooperative Acute Stroke Study

MRI - Magnetic resonance and imaging

DM - Diabetes mellitus

HTN - Hypertension

MEq/L - Milli Equivalents Per Liter

Na - Sodium

K - Potassium

DMCH - DHARBANGA MEDICAL COLLEGE AND HOSPITAL

BMI - Basal Metabolic Index

INTRODUCTION

Stroke is the most common emergency condition. It is the 2nd leading cause of death worldwide, with an annual mortality rate of 5.5 million. It also has high morbidity and 50% of survivors are chronically disabled [1,2]. Dyselectrolytaemia is one of the most common complications of an acute stroke that needs to be corrected immediately; otherwise, it may lead to death. Hypernatremia, hyponatremia and hypokalemia are the most common types of electrolyte disturbances.

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AIMS AND OBJECTIVES

The main objective of this study is to evaluate serum electrolyte changes in ischemic stroke and hemorrhagic stroke patients.

This study aims to check the type of electrolyte abnormality which is commonly encountered in ischemic and hemorrhagic strokes and compare both groups. The electrolytes included in this study are sodium and potassium. As there are predominant contributions of studies analyzing electrolyte abnormalities in acute stroke reported worldwide, very few studies were published in India. So, in this regard, we designed a cross-sectional study to evaluate serum electrolyte changes in acute stroke in which electrolyte values are taken from case sheets of patients with their prior concern within 24 hours of a stroke attack.

MATERIALS AND METHODS

The plan of this study was designed as a cross-sectional study at King George Hospital. Acute stroke patients who were admitted to the general medicine department were included in this study.

The study was conducted for a period of one year from August 2018 to September 2019. The study was conducted on 60 acute stroke patients, one group included 30 ischemic stroke patients, and another group included 30 hemorrhagic stroke patients. The diagnosis was confirmed by history taking, neurologic examination, and neuroimaging [computed tomography - CT and magnetic resonance imaging – MRI]. The serum sodium level in the range of 135 – 155 mEq/L was defined as normal. Serum potassium level in the range 3.5 –5.5 mEq/L was defined as normal. Values above and below this range are considered abnormal. Serum sodium levels below 135 mEq/L were considered hyponatremia, and above 155 mEq/L were considered hypernatremia. Serum potassium levels below 3.5 mEq/L were considered as hypokalemia, and above 5.5 mEq/L were considered hyperkalemia. These electrolyte values were noted in the patient record.

Inclusion criteria:

• Age: adult patients age 25 – 80 years of both sexes

• Data collection: within 24 hours of admission

• Ischemic and hemorrhagic stroke patients were included.

• Risk factors like hypertension, diabetes mellitus, past history of cardiovascular disease, smoking, and alcohol were included.

Exclusion criteria:

• History of TIA [transient ischemic attack].

• Stroke due to head injury and infection

• History of acute and chronic renal disease

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• Subarachnoid hemorrhage

• Previous steroid or diuretic therapy

• History of carcinomas and paraneoplastic syndromes

Sample size: 60

Data collection:

Serum electrolyte values were taken from the test reports entered on the case sheets

A detailed patient history was taken.

All the data was noted in the Excel sheet

Statistical analysis:

Data were analyzed using statistical package for the social sciences21 version, Unpaired t-test and chi-square test between the serum electrolyte values in ischemic and hemorrhagic stroke patients.

Ethical considerations:

Prior permission was taken from the institutional ethics committee, Andhra Medical College, Visakhapatnam

Written informed consent was taken from each individual in the study

OBSERVATIONS AND RESULTS

TABLE 1: DISTRIBUTION OF STUDY POPULATION BASED ON GENDER

Gender	Ischemic stroke n_1(%)	Haemorrhagic stroke n_2(%)	Total n_1+n_2(%)
Male	17 (28.3)	19 (31.7)	36 (60)
Female	13 (21.7)	11 (18.3)	24 (40)
Total	30 (50)	30 (50)	60 (100)

N1=number of ischemic stroke patients; N2 = number of hemorrhagic stroke patients

The present study was conducted on 60 cases [30 ischemic and 30 hemorrhagic strokes] during the acute period of stroke. Among the 30 ischemic stroke cases, 17 [28.3%] were male and 13 [21.7%] were female. Out of 30 hemorrhagic cases, 19 were male [31.7%] and 11 were f*emale* [18.3%].

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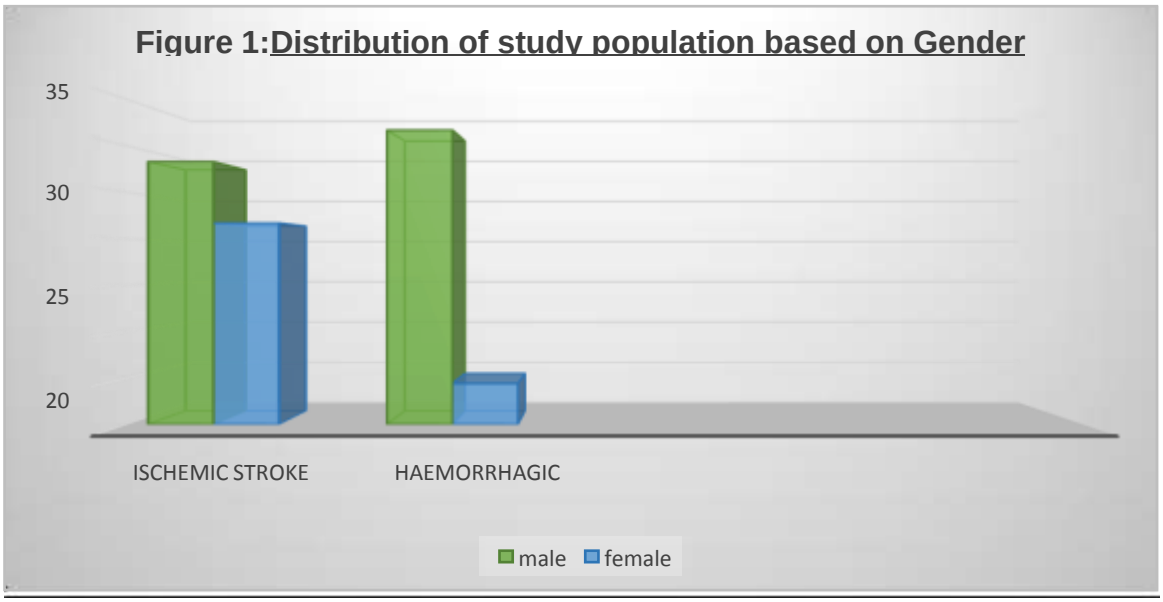

TABLE 2: DISTRIBUTION OF STUDY POPULATION BASED ON AGE

Age	Ischemic stroke n_1(%)	Haemorrhagic stroke n_2(%)	Total n_1+n_2(%)
25-44	2 (3.3)	4 (6.7)	6 (10)
45-64	15 (25)	22 (36.6)	37 (61.6)
65-80	13 (21.7)	4 (6.7)	17 (28.4)
Total	30 (50)	30 (50)	60 (100)

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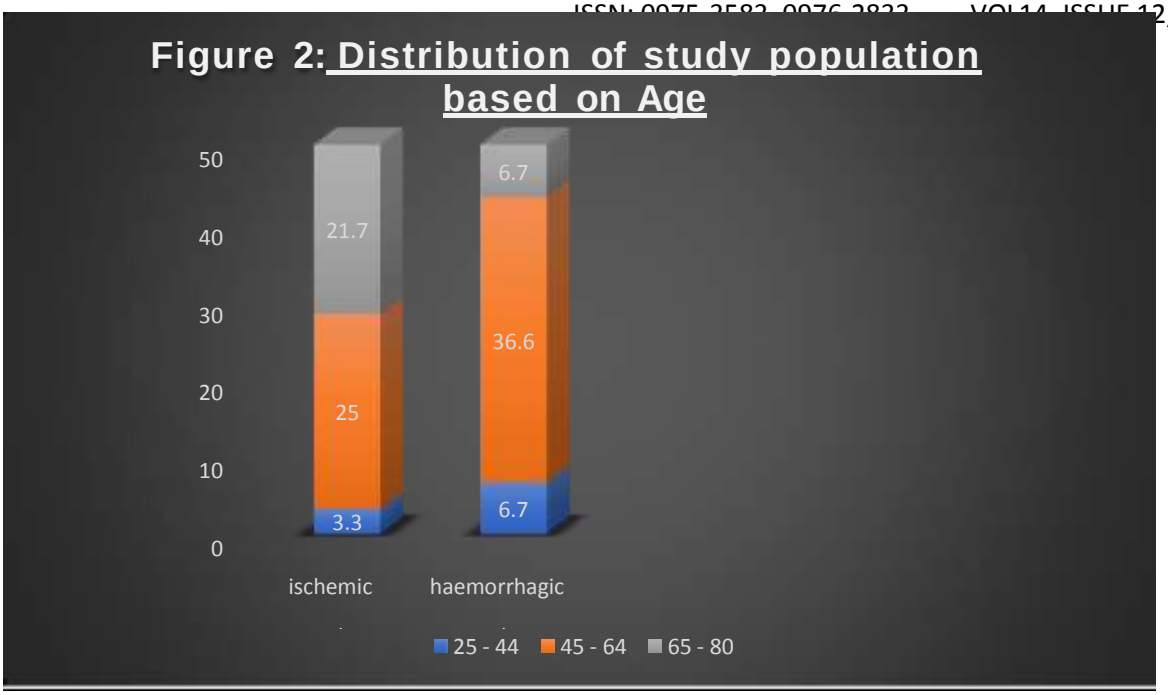

Majority of the stroke cases belong to the age group of 45-64 years, that includes, 15 [25%] ischemic stroke cases and 22 [36.6%] hemorrhagic stroke cases.

TABLE 3: FREQENCY OF SODIUM IMBALANCE IN STROKE PATIENTS

Serum Sodium levels	Ischemic stroke n_1(%)	Haemorrhagic stroke n_2(%)	Total n_1+n_2(%)
Normal S. Sodium (%)	14 (23.3)	21 (35)	35 (58.3)
Hyponatremia (%)	16 (26.7)	8 (13.3)	24 (40)
Hypernatremia (%)	0	1 (1.7)	1 (1.7)
Total	30 (50)	30 (50)	60 (100)

1 = number of ischemic stroke patients; n2 = number of hemorrhagic stroke patients; S = serum; normal serum sodium: [135-145 mmol/l]; hyponatremia: [>145 mmol/l]; x2 [chi-square].
= 3.36; p=0.06

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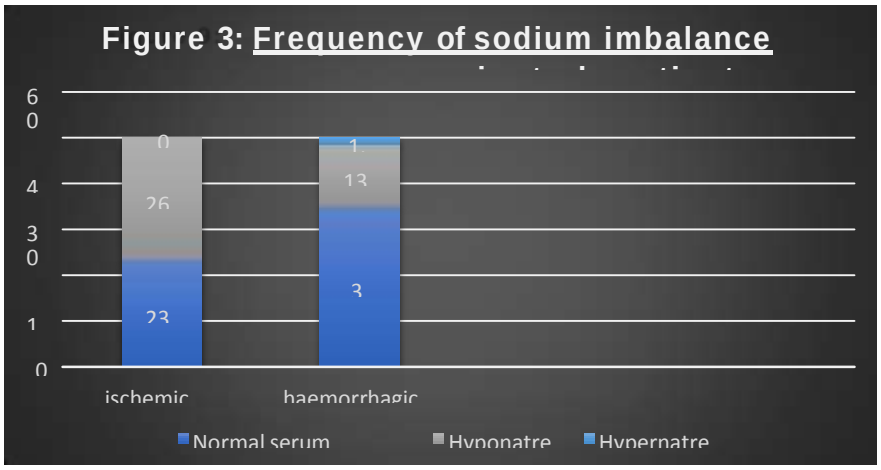

Among 60 acute stroke patients, 16 [26.7%] ischemic stroke cases and 8 [13.3%] hemorrhagic stroke cases were found with low serum sodium levels [hyponatremia]. 1 [1.7%] hemorrhagic stroke case was found with high serum sodium levels [hypernatremia]. Hyponatremia was seen predominantly among ischemic stroke patients compared to hemorrhagic stroke patients, but no significant difference was found between the two groups.

TABLE 4: FREQUENCY OF POTASSIUM IMBALANCE IN STROKE PATIENTS

Serum Potassium levels	Ischemic stroke n_1(%)	Haemorrhagic stroke n_2(%)	Total n_1+n_2(%)
Normal S. Potassium (%)	23 (38.3)	14 (23.3)	37 (61.6)
Hypokalaemia (%)	7 (11.7)	16 (26.7)	23 (38.4)
Hyperkalaemia (%)	0	0	0
Total	30 (50)	30 (50)	60 (100)

N1 = number of ischemic stroke patients; n2 = number of hemorrhagic stroke patients; S= serum; normal serum potassium: [3.5-5 mmol/l]; hypokalemia: [<3.5 mmol/l]; hyperkalemia: [>5 mmol/l]; x2 [chi square] = 5.711; p=0.016.

16 [26.7%] hemorrhagic stroke patients were found predominantly with low potassium levels [hypokalemia] and 7 [11.7%] ischemic stroke cases were found with similar levels, with a significant statistical difference between the two groups. No cases of hyperkalemia were found in both groups.

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Figure 4:Frequency of potassium imbalance in stoke patients

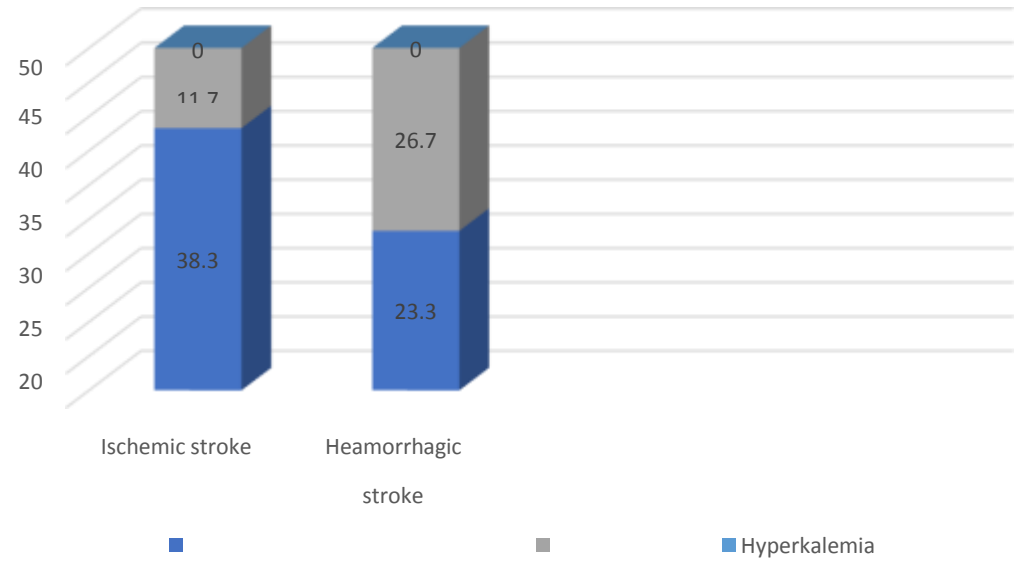

TABLE 5; COMPARISION OF MEAN AGE AND STANDARD DEVIATIONBETWEEN TWO GROUPS

Type of stroke	Mean Age ± SD
Ischemic stroke	60.3 ± 11.15
Haemorrhagic stroke	53.03 ± 10.40

P=0.01

Mean age and standard deviation of ischemic stroke cases was found to be 60.3 ± 11.15 years, while for hemorrhagic stroke cases, it was found to be 53.03 ± 10.40 years, with a statistical difference between the two groups.

TABLE 6; COMPARISION OF MEAN SERUM ELECTROLYTESAND STANDARD DEVIATION

Mean serum electrolytes	Ischemic stroke	Haemorrhagic stroke	P value
Mean Serum Na^+ ± SD	133.4 ± 7.82	139.3 ± 8.82	**0.008***
Mean Serum K^+ ± SD	3.7 ± 0.66	3.5 ± 0.53	0.11

Na+ - Sodium; K+ - Potassium; SD – Standard deviation; * - significant

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Mean serum sodium, potassium levels and standard deviation of ischemic stroke cases and hemorrhagic stroke cases was found to be 133.4 ± 7.82 mmol/l, 3.7 ±

0.66 mmol/l and 139.3 ± 8.82 mmol/l, 3.5 ± 0.53 mmol/l respectively. Significant differences were found only in mean serum sodium levels between the groups.

TABLE 7: ASSOCIATION OF THE TYPE OF STROKE WITH DYELECTROLYTEMIA

Dyselectrolytemia	Ischemic stroke (n=30)		Haemorrhagic stroke(n=30)	
	Frequency	%	Frequency	%
Present	22	36.7%	18	30%
Absent	8	13.3%	12	20%

***X*2 = 0.675; p = 0.413 [not significant]; within parenthesis are percentage**

Out of 30 ischemic stroke patients, 22 [36.7%] were found with dyselectrolytemia, and among 30 hemorrhagic stroke patients, 18 [30%] were found with dyselectrolytemia. No significant difference [p = 0.413] was found between the groups.

TABLE 8: FREQUENCY DISTRIBUTION IN EACH GROUP BASED ON AGE

Age	With Dyselectrolytemia		Total
	Ischemic stroke	Haemorrhagic stroke	
25 -44	1(2.5)	2 (5)	3 (7.5)
45 -64	10 (25)	12 (30)	22 (55)
65 -80	11 (27.5)	4 (10)	15 (37.5)
Total	22 (55)	18 (45)	40 (100)

***X2* = 3.416; df =2; p =1.8123 (not significant); within parenthesis are percentage**

Among the 22 ischemic stroke patients with dyselectrolytemia, 11 [27.5%] were found within the age group of 65 – 80 years and 10 [25%] were found within the age group of 45 – 64 years. Among the 18 hemorrhagic stroke patients with dyselectrolytemia, 12 [30%] were found within the 45 – 64 years age group.

Predominant number of stroke cases with dyseletrolytemia were found between 45 – 64 years age group, in both groups, with no significant difference.

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TABLE 9: ASSOCIATION OF DYSELECTROLYTEMIA WITH OTHER RISK FACTORS IN EACH GROUP

Risk factors	Ischemic stroke		Haemorrhagic stroke		P value
	Dyselectrolytemia		Dyselectrolytemia		
	Present	Absent	Present	Absent	
Diabetics	7	2	3	2	0.480
Hypertensives	13	6	12	7	0.732
h/o Heart disease	3	2	0	1	-
Smokers	6	3	8	1	0.163
Alcoholics	5	3	9	1	1.285

Stroke patients with Dyselectrolytaemia, were found to be associated with other risk factors like diabetes, hypertension, previous history of heart disease, smoking and alcoholism, among which the majority [13 ischemic stroke cases and 12 hemorrhagic stroke cases] were found associated with hypertension, with no statistical significant difference between the two groups.

Discussion

The prevalence of acute stroke in developed countries has reached immense proportions, which indicates a major problem, and its incidence is increasing every day in developing countries. According to the literature, male sex is the strongest risk factor for stroke than females, and some studies showed that hypertension is higher in males than females. In the present study, also a maximum number of males [60%] population was affected when compared with females [40%] population [table 1, fig 1]. Females are less affected, which may be because of the positive effects of estrogen on cerebral circulation [3]. The incidence of stroke rises with increasing age. **Boutaye et al.,** in their study, observed

that the stroke is more prevalent in men than women with ratios varying from 1.3:1 to 2:1 [4]. In **Md. Narse et al.** study male and female ratio in hemorrhagic and ischemic 1:0.62 and 1:0.089, respectively [5]. The study of **Chowdhury et al.** and **Kurtzke** showed that the frequency of stroke is 30% higher in males than females [6]. In this present study, the maximum number of patients [61.6%] belong to middle adulthood i.e., in between 45 – 64 years age group followed by [28.4%] between 65 – 80 years age group [Table 2, fig 2] maybe because of unhealthy diet and lack of exercise. **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 and the maximum number of males [21% & 16%] and female [8% & 6%] were also in the above age group respectively [7]. . In **Manaswini panda et al.** study, electrolyte imbalance was most common among 61-70 years [56.67%] age group, out of 60 cases 41[68%] were males, and 19 [32%] were females [8] In **Manaswini panda et al.** study, they found that

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there was a prevalence of hyponatremia and hypocalcemia in stroke cases .In the present study, hyponatremia was more common among ischemic stroke patients than hemorrhagic patients [Table 4, fig 9], but in their study, they found hyponatremia was more common among hemorrhagic group than the ischemic group. In the present study, no hypernatremia case was noted in both the groups [Table 3, fig 3]. The incidence of hyponatremia was more common among hemorrhagic stroke cases, and in ischemic stroke cases, the incidence of hypocalcemia was more common[8] In this study [Table 4, fig 4], the frequency of potassium imbalance in acute stroke was observed more. 38.4% of cases presented with hypokalemia. In present study, hypokalemia was most common among hemorrhagic stroke patients [26.7%] followed by ischemic stroke patients [11.7%]. Chi-square test revealed a significant statistical difference between the ischemic and hemorrhagic group [p = 0.016]. In **Mahmudur et al.** study also hypokalemia was observed more in hemorrhagic stroke cases [19%] followed by ischemic stroke cases [11%], with a significant association between hypokalemia and hemorrhagic stroke [p = <0.05][7]. In a study done by **Butungeshwar Pradhan et al.** found hypokalemia was very common in hemorrhagic stroke patients [9]. In one study, among the risk factors of stroke, the prevalence of diabetes mellitus was significantly higher among hyponatremic patients [p = 0.001] [10]. Uncontrolled diabetes mellitus can also induce osmotic diuresis and hypovolemic hyponatremia. These patients have higher mortality, worse functional outcomes, more severe disability after stroke, and a higher frequency of recurrent stroke. Likewise, in **Sarfraz A et al.** study having diabetes as a co-morbidity whatsoever but 17 such patients did show an unstable sodium level [11]. In this present study, a total of 10 patients with diabetes had Dyselectrolytaemia, in which 7 were an ischemic stroke, and 3 were hemorrhagic stroke patients. No association of Dyselectrolytaemia with diabetes was found [p=0.480] [table 9]. Stroke incidence increases in both men and women as arterial blood pressure, either systolic or diastolic, increases. Isolated systolic hypertension increases the risk of stroke in the elderly. Successful antihypertensive therapy decreases stroke incidence in asymptomatic persons, hypertensive patients with transient ischemic attacks, and survivors of hypertensive stroke . In **manaswini panda et al.** study, hypertensive patients were commonly presented, which was similar to our present study. Approximately 70% of stroke cases were presented with hypertension [8,12]. In the present study, hypertension was found to be common among 13 ischemic stroke patients and 12 hemorrhagic stroke patients with no significant statistical difference between them [p = 0.732] [Table 9]. Electrolyte levels of the patient should be monitored from the moment the patient arrives because sodium and potassium are the most important electrolytes of the body, and alteration in their values severely affects the body. Hyponatremia is an important cause of persistent altered sensorium in stroke patients. It also leads to various other neurological signs and symptoms like seizures, which can deteriorate the consciousness level of the patient. Hypokalemia is also an important electrolyte disturbance that leads to cardiac arrhythmia and other important changes in the neuronal cell, which finally results in cell death. Hence a quantification of the severity of hyponatremia and hypokalemia needs to be done in order to have a clear vision about what levels can cause such adverse outcomes as mentioned above and deal with the problem in an orderly manner.

SALIENT FEATURES OF THIS STUDY:

· This is a cross-sectional study that includes serum electrolyte changes in ischemic stroke patients and hemorrhagic stroke patients.

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· Many studies have been done on serum electrolyte changes in acute stroke, but this study collected the serum electrolyte values in the first 24 hours of the stroke attack.

· There are many studies published worldwide, but very few studies were published in India. The data from this present study may be useful for further studies.

· In this study, a wide age group was included, i.e., from 25 – 80 years.

· In this present study, the maximum number of patients with electrolyte imbalance belong to the 45 – 64 years age group, unlike other studies, which

Included 51 – 60 and 61-70 years.

· Unlike other studies, hypokalemia was most common among hemorrhagic stroke patients with a significant statistical difference between ischemic stroke patients and hemorrhagic stroke patients.

· Mean age and standard deviation between ischemic stroke patients and hemorrhagic patients showed significant statistical differences. Very few studies had this type of result in India.

LIMITATIONS:

The results of the present study should be interpreted in light of the following limitations

1. No follow-up was done

2. The severity of stroke patients in relation to electrolyte imbalance was not compared between ischemic stroke patients and hemorrhagic stroke patients, for which follow-up should be required.

3. Dyselectrolytaemia in association with the presentation of symptoms in acute stroke patients was not done as our study had taken data within 24 hours of acute stroke

4. In this study, only serum sodium and potassium were included. Serum calcium levels, serum magnesium levels were not included.

However, the main analysis of this present study was focused on finding out the electrolyte status in both ischemic stroke patients and hemorrhagic stroke patients and to check whether there is an association between the type of stroke and the electrolyte imbalance.

RECOMMENDATIONS:

1. A study with a large sample size may yield good results.

2. Electrolyte status may be associated with the severity of stroke outcome.

Therefore, follow-up may be beneficial for prognostic purposes.

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3. As hyponatremia is the most common presentation in acute stroke cases, future studies may focus on it. Hyponatremia can be divided into mild, moderate and severe types and sodium levels in each type can be

Observed in acute ischemic and hemorrhagic stroke patients.

4. Future studies may include the study of serum calcium levels and magnesium levels as they are also varying much in acute stroke patients according to two previous studies.

CONCLUSION

The results of this present study clearly show that hypokalemia was the most common dyselectrolytaemia seen in both ischemic stroke and hemorrhagic stroke types, with a significant statistical difference between the two groups. Hyponatremia was also commonly presented in both groups, but it was not statistically significant. Early detection and management can improve the overall outcome of stroke patients

REFERENCES

1. A. D. Lopez, C. D. Mathers, M. Ezzati, D. T. Jamison, and C. J. Murray,

―Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data, The Lancet 2006, vol. 367, no. 9524, pp. 1747–1757.

2. L. R. Caplan, Caplan's Stroke: A Clinical Approach, Woburn, England, 3rd edition, 2000.

3. Krause DN, Duckles SP, Pelligrino DA. Influence of sexual steroid hormones on cerebrovascular function. *J Appl Physiol*. 2006;101:1252–1261.

4. Boutayeb A, Derouich M, Boutayeb W, Lamlili MEN. Cerebrovascular Diseases and Associated Risk Factors in WHO Eastern Mediterranean Countries, Cardiology and Angiology. 2014 An. Inter. J. 2(1):62-75.

5. Md. Nasree Alam, Jashim Uddin, K M Rahman, Sara Amer Ahmad, M Akther, ―Electrolyte Changes in stroke|, Mymensingh Medical Journal October 2012, 21[4]:594-9.

6. Kurzke JF. Epidemiology of cerebrovascular disease. In :P.Rowland L, editor. Merrtt's Neurology. Philadelphia: LLW;2000:135-76.

7. Mahmudur Rahman Siddiqui, Quazi Tarikul Islam, Md Azharul Haque, Md Jabed Iqbal, Ahmed Hossain, Yousuf Ur Rahman, Md Shahriar Mahbub, Asif Alam Sazzad, ―Electrolytes Status in Different Types of Acute Stroke Patients and Their Correlation with Some Common Clinical Presentation, Journal of Medicine 2012, Vol 13 No 2, 13: 133-137.

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 12, 2023

8. Manaswini panda1,Prathima Kumari sahu 2, Manmath Kumar Mandal 3, Alok Kumar Mohapatra, Subha Soumya dany 5, ―Altered Serum Electrolytes Status in Acute Stroke Patients in Western Odisha, A Predictor of Syndrome of Inappropriate ADH [SIADH] or cerebral Salt Wasting Syndrome [CSWS], Journal of Clinical and Diagnostic Research, 2019 jan, Vol – 13[1]: BC10-BC13.

9. Butungeswar Pradhan, Chakradhar Majhi, Sunilk.Panigrahi, ―Clinical Profiles, Electrolytes Status in Acute Strokes and their Outcome|, International Journal of Advances in Medicine, June 2018;5[3]:492-497.

10. Huang WY, Weng WC, Peng TI, et al.Association of hyponatremia in acute stroke stage with three-year mortality in patients with first-ever ischemic stroke. Cerebrovascular Dis. 2012, 34:55-62.

11. Sarfraz A. Mahesar, Shehzeen F. Memon, Sheema Mustafa, Amina Jved, Sara M. Butt, ―Evaluation of Hyponatremia in Ischemic Stroke Patients in a Teritory Care Hospital of Karachi, Pakistan|, Cureus, January 21, 2019, Cureus 11[1]: e3926.

12. O' Donell MJ, Xavier D, Liu L, Zhang H, Chin SL, Rao-Melacini P, et al. Risk factors for ischemic and intracerebral hemorrhagic stroke in 22 countries (The INTERSTROKE study): A case-control study. The Lancet. 2010;376(9735):112-23.

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