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A STUDY OF SERUM ELECTROLYTES IN PATIENTS OF ISCHEMIC AND HAEMORRHAGIC STROKE

General Medicine

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ABSTRACT

Introduction- Stroke is one of the leading causes of death and disability in India. Disorders of sodium and potassium concentration are the commonest electrolyte abnormalities found in cerebrovascular accident (CVA) and may contribute to mortality unless corrected urgently. **Material Methods-** This cross-sectional study was conducted after taking an informed consent from patients or their relatives on 100 patients of acute stroke who were admitted in Department of Medicine, J.L.N. Medical College and Associated Hospitals, Ajmer (Raj.) over a period of two years after obtaining ethical committee approval. **Results/Observations-** Total 37% of all stroke patients had serum sodium imbalance & 33% had serum potassium imbalance. Hyponatremia (43% cases) and hypokalemia (41% cases) were more common in hemorrhagic stroke patients as compared to ischemic stroke cases (18% cases). Deaths were more in patients with Hyponatremia (50% deaths) and hypokalemia (62% deaths) in ischemic stroke cases as compared to hemorrhagic stroke cases (25% and 30% deaths respectively). Deaths were significantly higher in patients with hypocalcemia (55% deaths) in hemorrhagic stroke cases while no such association was observed in Ischemic stroke cases (30% deaths). There was no significant association of serum Cl-, Mg+2 and P levels with outcome of stroke patients. **Conclusion-** This study reveals that in hemorrhagic stroke, the incidence of electrolyte imbalance was more than ischemic and which were mostly hyponatremia and hypokalemia. Deaths were more in patients with hyponatremia and hypokalemia in ischemic stroke cases. Deaths were significantly higher in patients with hypocalcemia in hemorrhagic stroke cases.

KEYWORDS

Electrolyte imbalance, Hemorrhagic stroke, Ischemic stroke, Hyponatremia, Hypokalemia

INTRODUCTION

Stroke is one of the leading causes of death and disability in India. Disorders of sodium and potassium concentration are the commonest electrolyte abnormalities found in cerebrovascular accident (CVA) and may contribute to mortality unless corrected urgently. The INTERSALT study has shown that in CVA patients there is increased renal excretion of various cations and this also contributes to the serum electrolyte disturbances. Hypernatremia, hyponatremia and hypokalemia was the commonest type of disturbance.[1]

Stroke is a complex disease that requires the efforts and skills of all members of the multidisciplinary team. A coordinated care of the stroke patient results in improved outcomes, decreased lengths of stay, and decreased costs [2]. Stroke patient die of either due to the primary disease or due to complications [3]. Medical management focuses on the prevention of sub acute complications of stroke, including malnutrition, aspiration pneumonia, dyselectrolytemia, UTI, bowel or bladder dysfunction, DVT, pulmonary embolism, contractures, joint abnormalities, and skin breakdown.[4]

Hyponatremia and hypernatremia resulting from inappropriate secretion of antidiuretic hormone (ADH), increase in Brain Natriuretic-peptide (BNP), Atrial Natriuretic peptide and inappropriate fluid intake and loss, can lead to complications like seizures and death[2,5]. It is often precipitated by concomitant use of various drugs like diuretics.

Syndrome of inappropriate ADH secretion (SIADH) is a leading cause of electrolyte disturbance in these patients. SIADH and the consequent hyponatraemia is likely to aggravate the brain edema in CVA.

Most haemorrhagic stroke patients present with headache and vomiting[6]. Vomiting is an important cause of dyselectrolytemia. Complications like dyselectrolytemia are more common in acute phase.[2]

In acute cerebrovascular accidents, there occurs rapid loss of brain potassium and magnesium levels with rapid uptake of sodium and calcium channels. The lower the concentration of magnesium and potassium, the greater the magnitude of cerebral arterial contraction.

Interruption of cerebral blood flow will lead on to ischemic cell death causing ATP depletion and ischemic depolarisation leading to excessive calcium entry which causes vasospasm.

Interruption of cerebral blood flow causes release of excitatory glutamate through NMDA receptors which causes influx of calcium and sodium leading onto production of free radicals and initiation of inflammatory response.

In our country, there are many studies on stroke, its associated conditions and their effect on stroke patient's outcome, but a few studies on electrolytes disturbance in stroke patients has been done in our country, even outside. [7] In this study, I attempted to find out the common electrolytes status (sodium(Na^+), potassium(K^+), calcium(Ca^{+2}), magnesium(Mg^{+2}), chloride(Cl^-) and phosphorus(P)) in different type of acute stroke patients (ischemic and hemorrhagic) and their association with outcome.

MATERIAL AND METHODS

This cross-sectional study was conducted after taking an informed consent from patients or their relatives on 100 patients of acute stroke who were admitted in Department of Medicine, J.L.N. Medical College and Associated Hospitals, Ajmer (Raj.) over a period of two years after obtaining ethical committee approval.

Patients of either sex, 18 years or above of age, with first-ever acute stroke admitted within 48 hours of onset & fulfilling WHO definition of stroke and confirmation of stroke with CT scan of brain, were included in this study.

Patients with history of previous stroke, transient ischemic attack, syncope, and any neurological deficit secondary to head injury i.e., Subdural Hemorrhage (SDH), Epidural Hemorrhage or an Intracerebral Hemorrhage (ICH) or infarction which is caused by an infection/tumor (SOL) etc. or having preexisting severe physical or cognitive disabilities, were excluded from this study.

Patients having electrolyte disturbances because of metabolic cause and drugs were also excluded from study.

Upon admission, a standardized data sheet was used to record

demographic & clinical data specially the clinical presentation at the time of admission. To determine the subtype of stroke, clinical examination followed by CT scan of brain was done. The patients were followed up for outcome up to 2 weeks during their stay in hospital and before discharge from the hospital using Glasgow Outcome Scale.

3 - 5 ml of venous blood sample was collected, within 24 hours of admission, from all the participants under aseptic precaution and serum was be separated. The serum sample was used for analyzing serum electrolytes.

Serum electrolytes were estimated by ISE direct method using RANDOX Imola Chemistry analyzer.

Table No. 1 Association of Serum Electrolyte With Type of Stroke

Variables	Type of stroke	Normal	%	Hypo	%	Hyper	%	Total (%)	Chi-square	p-value LS
Na+	Hemorrhagic	30	53.57	24	42.86	2	3.57	56	7.0037	0.0301
	Ischemic	33	75.00	8	18.18	3	6.82	44		(S)
	Total	63	63.00	32	32.00	5	5.00	100		
K+	Hemorrhagic	32	57.14	23	41.07	1	1.79	56	6.0394	0.04882
	Ischemic	35	79.55	8	18.18	1	2.27	44		(S)
	Total	67	67.00	31	31.00	2	2.00	100		
Cl-	Hemorrhagic	48	85.71	1	1.79	7	12.50	56	2.9347	0.2305
	Ischemic	36	81.82	4	9.09	4	9.09	44		(NS)
	Total	84	84.00	5	5.00	11	11.00	100		
Ca+2	Hemorrhagic	47	83.93	9	16.07	0	0.00	56	0.3427	0.5583
	Ischemic	34	77.27	10	22.73	0	0.00	44		(NS)
	Total	81	81.00	19	19.00	0	0.00	100		
Mg+2	Hemorrhagic	46	82.14	7	12.50	3	5.36	56	1.2974	0.5227
	Ischemic	37	84.09	3	6.82	4	9.09	44		(NS)
	Total	83	83.00	10	10.00	7	7.00	100		
P	Hemorrhagic	56	100.00	0	0.00	0	0.00	56	0.7959	0.3723 (NS)
	Ischemic	42	95.45	2	4.55	0	0.00	44		
	Total	98	98.00	2	2.00	0	0.00	100		

- The above table depicts the association of Serum electrolyte with Type of stroke, where we have found that for the variables Na+ and K+, there was a significant difference among the groups and for the other variables, there was no significant difference found among the groups.
- Total 37% of all stroke patients had serum sodium imbalance & 33% had serum potassium imbalance.
- Electrolytes disturbances in sodium and potassium values were more in hemorrhagic stroke (46% and 43%cases respectively) as compared to ischemic stroke (25%and 20% cases respectively) and this difference was statistically significant.
- Hyponatremia (43% cases) and hypokalemia (41% cases) is more common in hemorrhagic stroke patients as compared to ischemic stroke cases (18% cases).

Table No. 2 Association Between Na+ and Outcome of Stroke

Variables	Outcome	Haemorrhage			Ischemia		
		Total	Death	%	Total	Death	%
Na+	Normal	30	4	13.33	33	11	33.33
	Hypo	24	6	25.00	8	4	50.00
	Hyper	2	1	50.00	3	0	0.00
	Total	56	11	19.64	44	5	11.36
P Value Ls		P = 0.307NS			<0.001S		

- Deaths were significantly more in patients with Hyponatremia (50% deaths) in Ischemic stroke. (p<0.001S)

Table No.3 Association Between K+ and Outcome of Stroke.

Variables	Outcome	Haemorrhage			Ischemia		
		Total	Death	%	Total	Death	%
K+	Normal	32	4	12.5	35	0	0
	Hypo	23	7	30.43	8	5	62.5
	Hyper	1	0	0.00	1	0	0
	Total	56	11	19.64	44	5	11.36
P Value LS		0.226NS			<0.001S		

Deaths were significantly higher in patients of Hypokalemia (62% deaths) in Ischemic stroke. (P<0.001S)

Table No. 4 Association Between Ca+2 and Outcome of Stroke

Variables	Outcome	Haemorrhage			Ischemia		
		Total	Death	Death %	Total	Death	Death %
Ca+2	Normal	47	6	12.77	34	2	5.88
	Hypo	9	5	55.56	10	3	30.00
	Hyper	0	0	0.00	0	0	0.00
	Total	56	11	19.64	44	5	11.36
P Value LS		0.012S			0.122NS		

Deaths were significantly higher in patients with Hypocalcemia(55% deaths) in Hemorrhagic stroke. (P= 0.012S)

- There was no significant association of serum Cl-, Mg+2 and P levels with outcome of stroke patients.

RESULTS AND OBSERVATION

Out of 100 patients, 44 patients were of ischemic stroke and 56 patients were of hemorrhagic stroke.

In our study, maximum number of cases belong to age group of 61 to 70 years.

In ischemic stroke, 61% patients were female and 38% patients were male. In hemorrhagic stroke, 50% patients were female and 50% patients were male.

DISCUSSION

Electrolyte imbalance is well recognized to be one fundamental mechanism leading to cell death during brain injury.

- In our study, maximum number of cases belonged to age group of 61 to 70 years

Stroke incidence rises exponentially with increasing age. Bevan H et al in his study of stroke also found similar picture [8]. A hospital based study done in DMCH showed that only 1% occurred in <20 years and 26% in 20-45 years and majority are above 45 years [9].

- Out of 100 patients, 44 patients were of ischemic stroke and 56 patients were of hemorrhagic stroke.

Higher rate of hemorrhagic stroke in this present hospital based study and previous Alam B et al study in DMCH may be due to the acute admission is more related to the hemorrhagic stroke.[10]

- In our study, electrolytes disturbances in sodium and potassium values were more in hemorrhagic stroke (46% and 43%cases respectively) as compared to ischemic stroke (25%and 20% cases respectively) and this difference was statistically significant.

In a study by Kusuda K et al,[11] found that 52% hemorrhagic stroke (p<0.01) and 26% ischemic stroke patients had dyselectrolytemia (p=>0.05)

- In our study, hyponatremia (43% cases) and hypokalemia (41% cases) were more common in hemorrhagic stroke patients as compared to ischemic stroke cases (18% cases).

In a study by Kusuda K et al,[11] found that 34% acute stroke patients presented with serum sodium imbalance and 44% with serum potassium imbalance. Both hyponatremia and hypokalemia were more common among hemorrhagic stroke patients. All these findings are consistent with this present study.

- Significant association was observed in Ischemic stroke deaths with Hyponatremia and hypokalemia.

- Deaths were significantly higher in patients with Hypocalcemia in Hemorrhagic stroke cases.

Previous studies showed that elevated admission serum calcium level, but not phosphate level, was positively associated with excellent outcome at discharge or 3 months in acute intra-cerebral hemorrhage patients [14]. Appeal et al. showed a relationship between serum calcium and acute stroke [12]. Many studies have demonstrated a relationship between reduced infarct size and serum calcium in the stroke. Other investigators reported that there was no correlation between serum calcium levels and mortality. In another study, subjects with high serum calcium levels were reported to be at increased risk of death [12,13].

- There was no significant association of serum Cl-,Mg+2 and P levels with outcome of stroke patients.

Abbreviations

CVA - Cerebrovascular accident, ADH - antidiuretic hormone, BNP - Brain Natriuretic-peptide, SIADH – Syndrome of inappropriate antidiuretic hormone secretion, Na^{+} - Sodium, K^{+} - Potassium, Cl^{-} - Chloride, Ca^{+2} – Calcium, Mg^{+2} – Magnesium, P – Phosphorus, GCS – Glassgow Coma Scale

CONCLUSION

This study reveals that in hemorrhagic stroke, the incidence of electrolytes imbalance was more than ischemic stroke and which were mostly hyponatremia and hypokalemia. Electrolyte imbalance may also adversely affect outcome of stroke in addition to GCS. Deaths were more in patients with hyponatremia and hypokalemia in ischemic stroke cases. Deaths were significantly higher in patients with hypocalcemia in hemorrhagic stroke cases.

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