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Study of Electrolyte Abnormalities in Acute Stroke and Correlation with Outcome

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Abstract

Background: Intracerebral hemorrhage (ICH) and Ischemic stroke (ISCHS) can occur along with many metabolic abnormalities in acute stage. Electrolyte disturbances can occur in acute stage of stroke due to many causes. The aim of this study was to find out the initial electrolyte abnormalities in acute stroke, to compare serum sodium, potassium, calcium and magnesium levels between patients of ischemic and haemorrhagic stroke, to compare outcome with normal and abnormal initial electrolyte levels.

Methods: It was a prospective observational study consisted of 186 stroke patients meeting inclusion criteria. . Serum sodium, potassium, calcium and magnesium levels were estimated at the time of admission. Data was collected and analysed. Severity of stroke on admission and on day 7/discharge was assessed by NIHSS score. MRS was used to assess outcome on day 7/discharge whichever was earlier.

Results: The mean age in our study patients was 63.2±12.9 years. ISCHS was seen in 62.4% patients and ICH in 37.6% patients. Hyponatremia was seen in 11 (9.5%) ISCHS and 27 (38.6%) ICH patients. Hypernatremia was seen in 6 (5.2%) ISCHS. ($P < 0.001$). Hypokalaemia was seen in 16 (22.9%) ICH and 19 (16.4%) ISCHS patients. Hyperkalaemia was present in 1(1.4%) ICH and 2 (1.7%) patients with ISCHS. ($p<0.024$). Hypocalcaemia was seen in 5 (7.1%) ICH and 35 (30.2%) ISCHS patients. Hypercalcemia in 1 (1.4%) ICH group. Hypomagnesaemia was seen in 3 (4.3%) ICH and 40 (34.5%) ISCHS patients. Severity of stroke as assessed by NIHSS increased from admission to day7/discharge in patients with dyselectrolytemia. However in patients with normal electrolytes, neurological improvement was noted as there was decrease in NIHSS score from admission to day 7/discharge. It was statistically significant with p value <0.001. Poor functional outcome was more among dyselectrolytemic patients compared to patients with normal electrolytes. The difference was statistically significant with p value < o.oo1.

Conclusion: Hyponatremia and hypokalemia were common in ICH and hypocalcaemia and hypomagnesaemia were more common in ISCHS in our

study. Higher rates of morbidity and mortality were associated with dyselectrolytemia.

Keywords: Electrolyte abnormalities, stroke, NIHSS, MRS.

Introduction

A stroke or cerebrovascular accident is an abrupt onset of neurological deficit that is attributable to a focal and at times global loss of main functions due to vascular origin with symptoms lasting more than 24 hours or leading to death[1]. It is the second most common cause of death in developed and developing countries[2.] Stroke is the most common neurological emergency[3]. Stroke is the third most common cause of death in developed nations after ischaemic heart disease and cancer[4]. Stroke is one of the leading causes of death and disability in India. The estimated adjusted prevalence rate of stroke range, 84-262/100,000 in rural and 334-424/100,000 in urban areas. The incidence rate is 119-145/100,000 based on the recent population based studies[5].In addition to experiencing motor disorders, stroke patients treated in hospitals often experience electrolyte disturbances. Patients with electrolyte disturbances have higher mortality compared to patients without electrolyte disturbances[6.] Disorders of sodium and potassium concentration are the commonest electrolyte abnormalities found in cerebrovascular accident (CVA) and may contribute to mortality unless corrected urgently[7]. Hyponatremia, 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[8]. Intracranial haemorrhage can be associated with raised intracranial pressure and causes headache and vomiting further leading to dyselectrolytemia in acute phase of stroke[9]. CSWS (cerebral salt wasting syndrome) is described by the occurrence of excessive sodium excretion in urine, dehydration and resultant hyponatremia, in patients with intracranial disease, trauma and cerebral lesions[10]. Potassium is associated with inhibition of free radical formation and modulates arterial vessel tone and vascular smooth muscle cell proliferation[11].

Low, as well as high, serum potassium is associated with increased mortality in hypertensive subjects[12]. Green DM et al (2002)[13] have reported that low serum potassium is associated with increased risk of stroke among elderly users of diuretics in the Cardiovascular Health Study, and Smith NL et al (2003)[14] have found low serum potassium to be associated with ischemic and haemorrhagic stroke in patients with treated hypertension.

Serum calcium plays an important role in the pathogenesis of ischemic cell damage. Intracellular accumulation of calcium can lead to neuronal cell damage by triggering cycle of cytotoxic events and apoptotic cell death. Calcium influx into the cell via NMDA receptors leads to delayed cell death and excitotoxicity associated with ischemia[15, 16].

Magnesium deficiency is associated with vasoconstriction and vascular endothelial cell injury. Magnesium is one of trace metals which have important influences on brain development and function[17]. Magnesium is an important electrolyte and may have properties which protect the brain by acting as a glutamate receptor antagonist and calcium channel blocker[18]. Stroke patient die off either due to the primary disease or due to complications. 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[19]. Electrolyte disturbances may have negative influences on the outcome of acute phase of stroke and early detection and timely correction of dyselectrolytemia may improve outcome of stroke. This study was be done to identify the common electrolyte disturbances in acute phase of different types of stroke patients and their association with outcome.

Materials And Methods

It was a prospective observational study .Total 186 cases of stroke were included in this study who were admitted in the Postgraduate Department of Medicine and allied specialties, Government Medical College, Srinagar after obtaining the ethical clearance from the Institutional Ethical Committee over a period of one and a half year.

Inclusion criteria

Patients of either sex above 15 years of age with acute stroke admitted within 24 hours of onset and fulfilling WHO definition of stroke and confirmation of stroke with CT or MRI scan of brain.

Exclusion criteria

1. Subarachnoid haemorrhage
2. History of recent diarrhea
3. CCF
4. Cirrhosis of liver
5. Chronic kidney disease
6. Acute kidney injury
7. Patients on glucocorticoids or mineralocorticoids
8. Patients on diuretics or any other drug which effect electrolytes
9. Severe hyperglycemia (greater than 300) and severe hypertriglyceridemia (greater than 400) to exclude pseudohyponatremia

After obtaining the informed consent from all eligible patients, detailed clinical history and physical examination were done and serum sodium, potassium, calcium and magnesium levels were measured at the time of admission. The severity of neurologic impairment was evaluated by the National Institutes of Health Stroke Scale (NIHSS) score, on admission and on day 7 or at discharge, whichever was earlier. The functional status was evaluated by Modified Rankin Scale (MRS) on day 7/discharge, whichever was earlier. Neurological outcomes with neurological improvement defined as four-point decrease in NIHSS during hospitalization or a 0 point status on NIHSS on day 7 or at discharge and neurological deterioration defined as ≥1 point increase in NIHSS during hospitalization. A poor functional outcome was defined as death (MRS 6) or dependency (MRS 2-5).

Results

Total 186 cases were there in this study. 112 were males and 76 patients were females.Maximum patients (47.8%) belonged to 60-69 years of age group. The mean age in our study patients was 63.2±12.9 years. Ischemic stroke (ISCHS) was seen in 116 (62.4%) patients and intracerebral haemorrhage (ICH) in 70 (37.6%) patients. Low serum sodium levels were seen in intracerebral haemorrhage patients in comparison with ischemic stroke (ISCHS) patients. Hyponatremia was seen in 11 (9.5%) ischemic stroke patients and 27 (38.6%) intracerebral haemorrhage patients. Mean serum sodium level in ischemic stroke patients was 137.4±12.29 in comparison with 128.7±14.71 in intracerebral haemorrhage patients. The association between serum sodium levels and type of stroke was statistically significant with a p value of < 0.001.

Table 1: Serum sodium levels as per type of stroke

Table 1: Serum sodium levels as per type of stroke					
Serum sodium levels	ICH		ISCHS		P-value
	No.	%age	No.	%age	
Hyponatremia	27	38.6	11	9.5	<0.001*
Normal sodium	43	61.4	99	85.3	
Hypernatremia	0	0.0	6	5.2	
Total	70	100	116	100	
Mean±SD	128.7±14.71		137.4±12.29		

Statistically Significant Difference (P-value <0.05)

Hypokalaemia was seen in 16 (22.9%) intracerebral haemorrhage patients and 19 (16.4%) ischemic stroke patients. Hyperkalaemia was seen in 1 (1.4%) and 2 (1.7%) patients with intracerebral haemorrhage and ischemic stroke respectively. Mean serum potassium level in intracerebral haemorrhage patients was 3.53±0.53 in comparison with 3.79±0.47 in ischemic stroke patients (p value of < 0.024)

Table 2: Serum potassium levels as per type of stroke					
Serum potassium levels	ICH		ISCHS		P-value
	No.	%age	No.	%age	
Hypokalaemia	16	22.9	19	16.4	0.024*
Normal potassium	53	75.7	95	81.9	
Hyperkalaemia	1	1.4	2	1.7	
Total	70	100	116	100	
Mean±SD	3.53±0.53		3.79±0.47		

**Statistically Significant Difference (P-value <0.05)*

Hypocalcaemia was seen in 5 (7.1%) patients in ICH group and 35 (30.2%) patients in ISCHS group. Normal calcium was seen in 64 (91.4%) patients in ICH group and 81 (69.8%) patients in ISCHS group. Hypercalcaemia was seen in 1 (1.4%) patient in ICH group. The mean serum calcium level in ICH patients

was 9.41±1.76 and in ISCHS group was 8.69±1.35(p value of < 0.002).

Table 3: Serum calcium levels as per type of stroke

Serum calcium levels	ICH		ISCHS		P-value
	No.	%age	No.	%age	
Hypocalcaemia	5	7.1	35	30.2	0.002*
Normal calcium	64	91.4	81	69.8	
Hypercalcaemia	1	1.4	0	0.0	
Total	70	100	116	100	
Mean±SD	9.41±1.76		8.69±1.35		

*Statistically Significant Difference (P-value <0.05)

Hypomagnesaemia was seen in 3 (4.3%) patients in ICH group and 40 (34.5%) patients in ISCHS group. Normal magnesium was seen in 67 (95.7%) patients in ICH group and 74 (63.8%) patients in ISCHS group. Hypermagnesaemia in 2 (1.7%) patients in ISCHS group. The mean serum magnesium level in ICH group was 2.03±0.42 and in ISCHS group was 1.58±0.37. The association between serum magnesium levels and type of stroke was statistically significant with a p value of < 0.001.

Table 4: Serum magnesium levels as per type of stroke

Serum magnesium levels	ICH		ISCHS		P-value
	No.	%age	No.	%age	
Hypomagnesaemia	3	4.3	40	34.5	<0.001*
Normal magnesium	67	95.7	74	63.8	
Hypermagnesaemia	0	0.0	2	1.7	
Total	70	100	116	100	
Mean±SD	2.03±0.42		1.58±0.37		

*Statistically Significant Difference (P-value <0.05)

When patients with dyselectrolytemia and normal electrolytes were compared on the basis of NIHSS score at admission, it was observed that mild (≤4) score was seen in 70 (59.8%) patients and 56 (81.2%) patients in dyselectrolytemia and normal electrolyte groups, respectively. Moderate (5-15) score was seen in 28 (23.9%) patients in dyselectrolytemia group and 10 (14.5%) patients in normal electrolyte group while as severe (>15) score was found in 19 (16.2%) patients in dyselectrolytemia group and 3 (4.3%) patients in normal electrolyte group.

Table 5: Dyselectrolytemia and NIHSS score at admission

NIHS Score	Dyselectrolytemia		Normal Electrolytes		P-value
	No.	%age	No.	%age	
Mild (≤ 4)	70	59.8	56	81.2	0.007*
Moderate (5-15)	28	23.9	10	14.5	
Severe (> 15)	19	16.2	3	4.3	
Total	117	100	69	100	

**Statistically Significant Difference (P-value <0.05)*

When patients with dyselectrolytemia and normal electrolytes were compared on the basis of NIHSS score at discharge /day 7, it was observed that mild (≤4) score was seen in 56 (47.9%) patients and 59 (85.5%) patients in dyselectrolytemia and normal electrolyte groups, respectively. Moderate (5-15) score was seen in 34 (29.1%) patients in dyselectrolytemia group and 8 (11.6%) patients in normal electrolyte group while as severe (>15) score was found in 27 (23.1%) patients in dyselectrolytemia group and 2 (2.9%) patients in normal electrolyte group. This difference was statistically significant with a p value <0.001

Table 6: Dyselectrolytemia and NIHSS score at discharge/D7

NIHS Score	Dyselectrolytemia		Normal Electrolytes		P-value
	No.	%age	No.	%age	
Mild (≤ 4)	56	47.9	59	85.5	<0.001*
Moderate (5-15)	34	29.1	8	11.6	
Severe (> 15)	27	23.1	2	2.9	
Total	117	100	69	100	

**Statistically Significant Difference (P-value <0.05)*

When patients with dyselectrolytemia and normal electrolytes were compared on the basis of MRS score at discharge (day 7), it was observed that 59 (50.4%) patients were independent (0-2) in patients with dyselectrolytemia while as 61 (88.4%) patients were independent (0-2) in normal electrolyte group. 37 (31.6%) patients were dependent (3-5) in dyselectrolytemia group while as only 7 (10.1%) patients were dependent in normal electrolyte group. Death (6) occurred in 21 (17.9%) patients in dyselectrolytemia group and 1 (1.4%) patient with normal electrolytes. It was statistically significant with a p value <0.001.

Table 7: Dyselectrolytemia and MRS score at discharge/D7

MRS Score	Dyselectrolytemia		Normal Electrolytes		P-value
	No.	%age	No.	%age	
Independent (0-2)	59	50.4	61	88.4	
Dependent (3-5)	37	31.6	7	10.1	
Death (6)	21	17.9	1	1.4	
Total	117	100	69	100	<0.001*

*Statistically Significant Difference (P-value <0.05)

Discussion

In our study, majority of patients i.e. 89 (47.8%) belonged to 60-69 years of age group with a mean age of 63.2±12.9 years. Males 112 (60.2%) outnumbered females 74 (39.8%). Our results are comparable with the findings of Panda M et al (2019)[20] where the most common age group was 61-70 years. Surbakti RBR et al (2020)[21] conducted a study in which the most common age group was 56- 70 years with a mean age of 59.85±10.9 years, males constituted 54.5% and females 45.5% in their study. The mean age was 62.52±8.10 years in a study done by Pradhan B et al. (2018)[22]. There were 58% males and 42% females in their study. Out of 186 patients studied, ischemic stroke (ISCHS) was seen in 116 (62.4%) patients and intracerebral haemorrhage (ICH) in 70 (37.6%) patients. Similar results were observed by Pradhan B et al. (2018)[22] with 64% ischemic strokes and 36% haemorrhagic strokes. Hassan MK et al (2013)[23] reported incidence of 58.5% as ISCHS strokes and 41.5% ICH strokes and Siddiqui MR et al (2012)[24] reported 53% ISCHS and 45% ICH in their series. Hyponatremia was most common electrolyte abnormality in our study. Of the total 186 patients, hyponatremia was seen in 38 (20.4%) patients while as 6 (3.2%) patients had hypernatremia. As per type of stroke, hyponatremia was seen in 11 (9.5%) ischemic stroke patients and 27 (38.6%) intracerebral haemorrhage patients. Hypernatremia was seen in 6 (5.2%) ischemic stroke patients. Mean serum sodium levels in ischemic stroke patients was 137.4±12.29 in comparison with 128.7±14.71 in intracerebral haemorrhage patients. The association between serum sodium levels and type of stroke was statistically significant with a p value of < 0.001. Our results are comparable with the findings of Pradhan B et al. (2018)[22]. In their study, hyponatremia was commonest electrolyte disorder in 36.11% of ICH patients and 9.38% of ischemic stroke and hypernatremia was present in 3.26% cases of ischemic stroke. The baseline mean serum sodium in ICH cases was 130±25.54meq/L and 130.45±6.80meq/L in ISCHS. A study conducted by Karunanandham S et al (2018)[25] reported hyponatremia in 38.6% of stroke patients. Bandyopadhyay M et al (2017)[26] and Siddiqui MR et al (2012)[24] showed that hyponatraemia was common in their series of ICH. In our study, hypokalemia was seen in 35 (18.8%) patients while as 3 (1.6%) patients had hyperkalemia. Hypokalemia was seen in 16 (22.9%) ICH patients and 19 (16.4%) ISCHS patients. Hyperkalemia was present in 1(1.4%) ICH patient

and 2 (1.7%) patients with ischemic stroke. Mean serum potassium level in ICH patients was 3.53±0.53 in comparison with 3.79±0.47 in ischemic stroke patients. The association between serum potassium levels and type of stroke was statistically significant with a p value of < 0.024. Our results are comparable with the findings of Pradhan B et al. (2018)[22]. In their study mean baseline serum potassium level was 3.65±0.48 meq/L in ICH and 3.83±0.40 in ISCHS. Hypokalaemia was present in 19.44% patients with ICH and 17.19% patients with ISCHS. Hyperkalaemia was present in 2.78% patients with ICH and 1.56% patients with ISCHS. Serum potassium levels were lower in ICH than in ISCHS in their study (P 0.0447). Siddiqui MR et al (2012)[24] reported hypokalaemia more frequently in ICH patients (19% in ICH and 11% in ISCHS). Hypokalaemia was more common in ICH patients (20%) in comparison with ischemic patients (12%) in a study done by Bandyopadhyay M et al (2017)[26]. Out of total 186 patients, hypocalcaemia was seen in 40 (21.5%) patients while as 1 (0.5%) patient had hypercalcemia. As per type of stroke, hypocalcaemia was seen in 5 (7.1%) patients in ICH group and 35 (30.2%) patients in ISCHS group. Normal calcium was seen in 64 (91.4%) patients in ICH group and 81 (69.8%) patients in ISCHS. Hypercalcemia in 1 (1.4%) patient in ICH group. The mean serum calcium level in ICH group was 9.41±1.76 and in ISCHS group was 8.69±1.35. Our results are comparable with the findings of Pradhan B et al. (2018)[22].In their study, hypocalcaemia was present in 28.12% of ISCHS an8.33% of ICH. Hypercalcemia was present in 1.56% patients of ISCHS. Mean serum Ca++ in ICH was 9.34±0.5mg/dl and 8.77±0.52 mg/dl in ISCHS. Hypocalcaemia was common in ISCHS than ICH. (P0.0001). Gupta A et al (2015)[27] reported hypocalcaemia in 26% of ISCHS and mean serum Ca++ was 8.6±0.46 mg/dl[21]. Panda M et al (2019)[20] found hypocalcemia more in ischemic stroke patients compared to intracerebral haemorrhage patients.

Hypomagnesaemia was seen in 43 (23.1%) patients while as 2 (1.1%) patients had hypermagnesemia in our study. As per type of stroke, hypomagnesaemia was seen in 3 (4.3%) patients in ICH group and 40 patients (34.5%) in ISCHS group. Normal magnesium was seen in 67 (95.7%) ICH patients and 74 (63.8%) ISCHS patients. Hypermagnesemia in 2 (1.7%) ISCHS patients. The mean serum magnesium levels in ICH was 2.03±0.42 and in ISCHS g was 1.58±0.37. Our results are comparable with the findings of Pradhan B et al. (2018)[22]. In their study, hypomagnesemia was present in 32.81% cases in ISCHS and in 5.66% patients of ICH and hypermagnesemia in 2.7% patients in ISCHS. Mean serum Mg++ was 1. 99±0.18 mg/dl in ICH and 1.67±0.24 mg/dl in ISCHS. Serum mg++ level was low in ISCHS than in ICH in this study. (P0.0001). Khan KM et al (2015)[28] reported hypomagnesaemia in 32% of ISCHS with a mean serum level of 1.71±0.51mg/dl. Ghayyur A et al (2017)[29] reported in 35.5% of stroke cases with a mean level of 1.5mg/dl. In this current study, 117 (62.9%) patients had dyselectrolytemia while as 69 (37.1%) patients had normal electrolytes. Our results are comparable with the findings of Pradhan B et al. (2018)[22] wherein dyselectrolytemia was observed in 61% of patients. A study by Aundhakar S et al (2016)[30] found dyselectrolytemia in 67.97% of stroke patients. Similar results were also observed by Bandyopadhyay M et al (2017)[26] with 55% patients having dyselectrolytemia. Hassan MK et al (2013)[23] in their study had dyselectrolytemia in 70% of patients. The severity of stroke in patients with dyselectrolytemia and normal

electrolytes were compared on the basis of NIHSS score at admission.

Out of 117 dyselectrolytemic patients, it was observed that mild NIHSS score (≤4) was seen in 70 (59.8%) patients, moderate NIHSS score (5-15) was seen in 28 (23.9%) patients while as severe NIHSS score (>15) score was found in 19 (16.2%) patients.

Out of 69 patients with normal electrolytes, mild NIHSS score (≤4) was seen in 56 (81.2%) patients, moderate NIHSS score (5-15) was seen in 10 (14.5%) patients while as 3 (4.3%) patients had severe NIHSS score (>15).

In our study, severe stroke was more among dyselectrolytemic patients in comparison to patients with normal electrolytes on admission and the difference was statistically significant with p value <0.001.

Our results were confirmed in a study done by Pradhan B et al. (2018)[22] were on admission, severe stroke was more common among dyselectrolytemia patients compared to patients with normal electrolytes.

When severity of stroke (neurologic impairment) in patients with dyselectrolytemia and normal electrolytes were compared on the basis of NIHSS score at discharge /day 7, out of 117 dyselectrolytemic patients, mild NIHSS score (≤4) was seen in 56 (47.9%) patients, moderate (5-15) score was seen in 34

(29.1%) patients while as severe NIHSS score (>15) was found in 27 (23.1%) patients.

Out of 69 patients with normal electrolytes, mild NIHSS score was present in 59 (85.5%) patients, moderate NIHSS score was present in 8 (11.6%) patients while as severe NIHSS score (>15) was present in 2 (2.9%) patients.

In our study, severity of stroke as assessed by NIHSS increased from admission to day7/discharge in patients with dyselectrolytemia. However in patients with normal electrolytes, neurological improvement was noted as there was decrease in NIHSS score from admission to day 7/discharge.It was statistically significant with p value <0.001. Kasem AZM et al (2018)[31] found that patients presenting with severe CVS (NIHSS >15), had the highest rate of electrolyte disturbances (dysnatremia, dyskalemia, dysmagnesemia). Patients with electrolyte disturbances showed significant deterioration with significant increase in NIHSS on discharge compared to that on admission particularly those with uncorrected hyponatremia, hypernatremia, hypokalaemia, hypocalcaemia and hypomagnesaemia. Lath R et al (2005)[32], Aiyagari V et al (2006)[33], and Siddique MR et al. (2012)[24] found that acute hyponatremia in acute stroke affects the outcome of stroke negatively either in the form of clinical deterioration or death. Similarly, Huang WY et al. (2012)[34] recorded higher mortality rate of hyponatremic CVS patients than normonatremic patients. Rodrigues B et al (2014)[35] found that patients with hyponatremia showed significant deterioration with significant increase in NIHSS on discharge compared to that on admission, prolonged hyponatremia might lead to cerebral oedema, encephalopathy, tissue damage and seizure which could be a part of extension in avascular injures after acute ischemic syndrome. Gariballa SE et al (1997)[36] reported that post stroke hypokalaemia is common and associated with poor outcome (hazard ratio 1.73 (95% CI: 1.03-2.9) for 1mmol/L lower plasma K concentration).

Functional outcome among patients with dyselectrolytemia and patients with normal electrolytes at day7/discharge was assessed by using MRS scale. Out of 117 dyselectrolytemic patients, 59 (50.4%)

patients were independent (MRS score of 0-2), 37 (31.6%) patients were dependent (MRS score of 3-5). Death (MRS grade 6) occurred in 21 (17.9%) patients. Among patients with normal electrolytes, 61(88.4%) were independent (0-2), 7 (10.1%) were dependent (MRS score of 3-5) while as death (MRS grade 6) occurred in 1(1.4%) patient. Poor functional outcome was more among dyselectrolytemic patients compared to patients with normal electrolytes. The difference was statistically significant with p value < o.oo1. Our results are comparable with the study conducted by Pradhan B et al. (2018)[70] were poor outcome was noted among patients with dyselectrolytemia. Death occurred in 21.31% in dyselectrolytemic patients in comparison to 1.3% in patients with normal electrolytes.

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. Hypernatremia and hypokalemia were common in ICH and hypocalcaemia and hypomagnesaemia were more common in ISCHS in our study. Early detection and correction of electrolyte disturbances may prevent further morbidity and mortality in acute stages of strokes.

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