

Original Research Article

Clinical profiles, electrolytes status in acute strokes and their outcome

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ABSTRACT

Background: Intracerebral hemorrhage (ICH) and Ischemic strokes (ISCHS) can occurs along with many metabolic abnormalities in acute stage. Electrolyte disturbances can occurs in acute stage of strokes due to many causes. The aim of the present study is to observe the clinical profiles, electrolytes status in acute stage of strokes and their outcome.

Methods: One hundred stroke patients diagnosed clinically and confirmed by CT or MRI within 24 hours of onset were consecutively selected for the study after fulfillment of inclusion criteria in the indoor department of medicine, VSSIMSAR, Burla, Odisha (India), from Nov 2015 to Nov 2017. Baseline Glasgow Coma Scale (GCS), serum electrolytes were estimated along with other biochemical tests as needed. Glasgow Outcome Scale (GOS) was determined after 5th day of strokes. Data were collected and analyzed.

Results: Hyponatraemia present in 13 (36.11%) of ICH and 6 (2.38%) ISCHS. Hypokalaemia was present in 7 (9.44%) of ICH and 11(17.19%) ISCHS. Hypocalcaemia was present in 3 (8.33%) of ICH and 18(28.12%) ISCHS. (P 0.0001). Hypomagnesaemia in 2(5.56%) ICH and 21 (32.81%) ISCHS. (P 0.0001). Minor GCS in 38 (62.29%), moderate 15 (24.59%) and severe 8(13.12%) patients with dyselectrolytemia versus 31 (79.48%), 5 (12.82%) and 3 (7.7%) with normal electrolytes respectively. GOS was good in 30 (49.18%), poor 18 (29.51%) and GOS 1 (Deaths) 13 (21.31%) versus 32(82.05%), 5(12.82%) and 1(1.3%) in patients with normal electrolytes status. (P 0.03).

Conclusions: E Hyponatraemia and hypoklaemia was very often present in ICH and hypocalcaemia and hypomagnesaemia in ISCHS, Higher rates of morbidity and mortalities was associated with dyselectrolytemia.

Keywords: Electrolytes status, Glasgow coma scale, Glasgow outcome scale, Strokes

INTRODUCTION

A stroke or cerebrovascular accident is an abrupt onset of neurological deficits 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 and is the second most common cause of death in developed and developing countries.^{1,2} Almost 1 in 8 (11.9%) deaths worldwide is caused by stroke.³

Acute management of stroke focused on the prevention of complications of stroke, including cerebral oedema,

raised ICT(intracranial tension),aspiration pneumonia, malnutrition dyselectrolytemia, bowel and bladder dysfunction, deep vein thrombosis(DVT), pulmonary embolism, bed sores, joint abnormalities and muscles contracture.⁴ electrolytes disturbances can occurs due to syndrome of inappropriate antidiuretic hormone(SIADH) or cerebral salt wasting (CSW)syndrome ,elevated brain natriuretic peptide(BNP), inappropriate fluid intake or loss leading to death and seizures.^{4,6} Intracerebral haemorrhage can associated with raised ICT and cause headache and vomiting further leading to dyselectrolytemia in acute phage of stroke.⁷ Development of hyponatraemia can causes further altered sensorium in

stroke patients and when occur abruptly causes convulsions and aggravate cerebral oedema leading to cerebral ischemia causing further brain damage and leads to deaths.⁸ Potassium is associated with inhibition of free radicals formation and modulates arterial vessel tone and vascular smooth muscle cell proliferation.⁹ Serum calcium plays an important role in the pathogenesis of ischemic cell damage. Intracellular accumulation of calcium can leads 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.^{10,11} Magnesium deficiency is associated with vasoconstriction and vascular endothelial cell injury. Thus, acute stroke is a complex pathophysiological state and its management requires the efforts and skills of all the member of the multidisciplinary team.⁵ Electrolyte disturbances may have negative influences on the outcome of acute phase of stroke and timely early detection and correction of dyselectrolytemia may improve outcome of acute stroke. The objective of the present study was to observe the clinical profiles and electrolyte status and outcome in acute strokes.

METHODS

It was a prospective observational, comparative study. Total 100 cases of stroke cases were consecutively selected for the study in the department of medicine admitted with history of acute onset of stroke within 24 hours and diagnosed clinically and confirmed by CT or MRI scan. Stroke patients with history of recent diarrhoea, congestive heart failure, cirrhosis of liver, nephritic syndrome, CKD and Acute kidney injury (AKI), acute and chronic pulmonary diseases i.e. pneumonia, TB, cystic fibrosis, status asthmaticus, carcinoma, hypertriglyceridaemia, severe malnutrition, hyperproteinaemia, severe hyperglycaemia (Fasting glucose >250mg/dl), patients with endocrine diseases like hypothyroidism, patients on glucocorticoids or

mineralocorticoids, CNS infections i.e. meningitis or CNS surgery or on shunt, patients already received mannitol, diuretics and drugs affecting electrolytes, subarachnoid haemorrhage (SAH) and intracerebral haemorrhage (ICH) with intraventricular communication with secondary SAH were excluded from the study. Detail clinical history and physical examinations were done, and baseline Glasgow coma scale was determined and baseline electrolytes i.e. Na⁺, K⁺, Ca⁺⁺, Mg⁺⁺ were estimated by ISE (Ion Selective Electrode) method using Enlite series electrolyte analyzer (Acurex Biomedical Pvt. Ltd.) and serum Mg⁺⁺ was estimated by dry chemistry method using Vitros 250 by Johnson and Johnson Company and routine blood counts and other relevant biochemical tests were done. Patients were treated as per standard medical care and Glasgow outcome scales (GOS) [Jennett and Bond. Assessment of outcome after severe brain damage and were determined on 5th day of inpatient treatment. Data were collected and analyzed.

RESULTS

Total 100 cases were there in the study. They were 58 male and 42 female patients. The mean age was 62.52±8.10 years. Mean age of male was 61.93±9.17 and of female was 63.40±6.15. Maximum male 17% (17) were between 56-60 years and female 12% (12) were between 61-65 years. There were 64 cases of ischemic stroke (ISCHS) and 36 cases of intracerebral haemorrhage (ICH). In ISCHS, middle carotid artery (MCA) was involved in 19% of male and 17% of female, posterior cerebellar artery (PCA) in 9 and 7 male and female respectively and anterior cerebral artery (ACA) in 2 male patients and lacunar infarction in 6 and 4 cases of male and female respectively. In 36 cases of ICH, Capsuloganglionic site involved in 15 male and 11 female cases and thalamic involvement in 5 male and 2 female and brain stem/cerebellum were involved in 2 male and 1 female (Table 1).

Table 1: T types of stroke with gender differences.

Cerebrovascular accident (stroke) types		Male		Female		Total	
		No.	%	No.	%	No.	%
Ischemic Infarct (ISCHS) n=64	MCA	19	19	17	17	36	36
	PCA	9	9	7	7	16	16
	ACA	2	2	0	0	2	2
	LACUNAR	6	6	4	4	10	10
Intracerebral hemorrhage (ICH) n=36	Capsuloganglionic	15	15	11	11	26	26
	Thalamic	5	5	2	2	7	7
	Brain stem/ Cerebellar	2	2	1	1	3	3

Hypertension was present in 71 cases (in ICH 32 and 39 in ISCHS). There was no history of hypertension and are normotensive in 29 (in 29 ISCHS and 6 ICH). Sixty

patients were diabetic, and 38 patients had both diabetes and hypertension. Serum Na⁺ level in ICH was within normal in 23 (63.89%), hyponatraemia present in 13(36.11%) and mean serum sodium level was

130.25±13.54meq/L. In ISCHS hypernatraemia was present in 2 (3.28%), normal in 56(87.5%) and hyponatraemic in 6 (9.38%). The mean serum Na⁺ in ISCHS was 136.45±6.82meq/L (P0.0020) (Table 2). Serum potassium level was normal in 28 (77.78%), hypokalaemia in 7 (19.44%) and hyperkalaemia in 1

(2.78%) in 76 of ICH cases and mean K⁺ level was 3.65±0.48meq/L. In ISCHS normal K⁺ levels was present in 52 (81.28%), hypokalaemia in 11 (17.19%) and hyperkalaemia present in 1 (1.56%). Mean serum potassium level was 3.83±0.40meq/L in ISCHS (P 0.0447) (Table 3).

Table 2: Serum sodium levels in ICH and ISCHS.

Types of stroke	Hypernatraemia		Normal Na ⁺		Hyponatraemia		Mean ± SD (meq/L)	P value
	No.	%	No.	%	No.	%		
ICH n=36	0	0	23	63.89	13	36.11	130.25±13.54	0.002
ISCHS n=64	2	3.28	56	87.5	6	9.38	136.45±6.80	0.002

Table 3: Serum potassium levels in ICH and ISCHS.

Types of Stroke	Hyperkalaemia		Normal K ⁺		Hypokalaemia		Mean ± SD (meq/L)	P value
	No.	%	No.	%	No.	%		
ICH n=36	1	2.78	28	77.78	7	19.44	3.65±0.48	0.0047
ISCHS n=61	1	1.56	52	81.25	11	17.19	3.83±0.40	0.0047

Serum calcium Ca⁺⁺ was within normal in 33 (91.67%), and hypocalcaemia was present in 3 (8.33%) of ICH. Mean serum Ca⁺⁺ was 9.34±0.56 meq/L in ICH. In ISCHS Ca⁺⁺ was normal in 45 (70.31%) cases, hypocalcaemia in 18 (28.12%) and hypercalcaemia in 1 (1.56%) cases and mean Ca⁺⁺ level was 8.77±0.52 meq/L. The serum Ca⁺⁺ was low in ISCHS than in ICH (P< 0.0001) (Table 4). Serum magnesium was normal in

34 (94.44%), hypomagnesaemia in 2 (5.56%) cases and mean serum magnesium was 1.99±0.18mg/dl in ICH and within normal in 42 (65.62%) patients. Hypomagnesaemia was present in 21 (32.81%) and hypermagnesaemia in 1 (2.78%) cases in ISCHS. Mean serum Mg⁺⁺ was 1.67±0.24 in ISCHS cases. The Mg⁺⁺ levels were low in ISCHS than ICH cases (P <0.0001) (Table 5).

Table 4: Serum calcium levels in ICH and ISCHS.

Types of Stroke	Hypercalcaemia		Normal Ca ⁺⁺		Hypocalcaemia		Mean ± SD (mg/dl)	P value
	No.	%	No.	%	No.	%		
ICH n=36	0	0	33	91.67	3	8.33	9.34±0.56	<0.0001
ISCHS n=64	1	1.56	45	70.31	18	28.12	8.77±0.52	<0.0001

Table 5: Serum calcium levels in ICH and ISCHS.

Types of Stroke	Hypermagnesaemia		Normal Mg ⁺⁺		Hypomagnesaemia		Mean ± SD (mg/dl)	P value
	No.	%	No.	%	No.	%		
ICH n=36	0	0	34	94.44	2	5.56	1.99±0.18	<0.0001
ISCHS n=64	1	2.78	42	65.62	21	32.81	1.67±0.28	<0.0001

In dyselectrolytemic patients, GCS was minor (13-15) in 38 (62.29%), moderate (9-12) in 15 (24.59%) and severe (3-8) in 8 (13.12%) cases.

Electrolytes were normal in 39 of stroke patients with minor Glasgow scale in 31 (79.48%), moderate in 5 (12.82%) and severe in 3 (7.7%) patients (Table 6).

Association of history of headache, vomiting, vertigo and seizures were more commonly observed in 61 patients with dyselectrolytemia in comparison to 39 patients without dyselectrolytemia.

Headache and vomiting in 44 (72.13%), more commonly associated with ICH with dyselectrolytemia (P 0.001), than with normal electrolyte status (P 0.001).

Table 6: Dyselectrolytemia and Glasgow coma scale (GCS).

Serum electrolytes	Minor (13-15)		Moderate (9-12)		Severe (3-8)	
	No.	%	No.	%	No.	%
Dyselectrolytemia present (n=64)	38	62.29	15	24.59	8	13.12
Normal Electrolytes	31	79.48	5	12.82	3	7.70

In patients with dyselectrolytemia 30 (49.18%) had good GOS (4-5), 18 (29.61%) had poor GOS (2-3) and 13 (21.31%) had deaths (GOS 1). Where as in patients with normal electrolytes 32 (82.05%) had good GOS, 5(12.82%) had poor GOS and 2 (5.13%) had GOS 1 (deaths) (Table 7). Thus, in 29.61% patients with dyselectrolytemia had poor GOS versus 12.82% had poor GOS with normal electrolyte status. GOS 1 (deaths) was

21.3% in patients with dyselectrolytemia versus 5.13% with normal electrolyte status. (P 0.03) and Chi square value 6.467, indicating that patients with dyselectrolytemia had more deaths than in patients with normal electrolytes with similar GOS.

Deaths were more commonly occurred in patients with diabetes and hypertension with dyselectrolytemia.

Table 7: Dyselectrolytemia and Glasgow Coma Scale (GCS).

Serum electrolytes	Good GOS (4-5)		Poor GOS (2-3)		GOS (1) (Deaths)	
	No.	%	No.	%	No.	%
Dyselectrolytemia present (n=64)	30	49.18	18	29.51	13	21.31
Normal Electrolytes	32	82.05	5	8.2	2	1.3

Chi Square value 6.467. P value-0.03

DISCUSSION

Dyselectrolytemia are quite often associated with acute strokes.¹²⁻¹⁴ In this study 64% patients having ISCHS and 36% had ICH strokes. Hassan MK et al reported incidence of 58.5% as ISCHS strokes and 41.5% ICH strokes and MR Siddiqui et al reported 53% ISCHS and 45% ICH in their series.^{13,14} Hyponatraemia was commonest electrolyte disorder in 36.11% of ICH and 9.38% of ischemic strokes and hypernatraemia in 2 cases (3.26%) cases of ischemic strokes in our study. The baseline mean serum sodium in ICH cases was 130±25.54meq/L and 130.45±6.80meq/L in ISCHS. Wen-yi Huang et al reported hyponatraemia in 11.6% of acute stroke in their study.¹⁵ Rodriques B et al reported in 165 cases.¹⁶ A study by Natarajan K et al reported in 20% cases.¹⁷ Bondopadhyay et al and Siddiqui et al showed that hyponatraemia was common in their series of ICH.^{12,13}

Mean baseline serum potassium level in our study was 3.65±0.48 meq/L in ICH and 3.83±0.40 in ISCHS. Hypokalemia was present in 7 (19.44%) patients with ICH and 11 (17.19%) with ISCHS and hyperkalaemia 1 in each group. Serum K⁺ levels were lower in ICH than in ISCHS in our study. (P 0.0447). Gariballa SE et al reported hypokalaemia in 20% of their stroke cases.¹⁸

Haider A et al reported in 23% and the mean K⁺ levels was 3.79±0.78 meq/L. Hassan MK et al reported in

28.78% and Gao F et al in 17.6% of acute stroke patents and Siddiqui et al reported more frequently in ICH patients.^{13,14,19,20}

In this study 22 patients have serum Ca⁺⁺ disturbances and hypocalcaemia was present in 18 (28.12%) of ISCHS and 3 (8.33%) of ICH. Hypercalcaemia was present in 1 (1.56%) 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 et al reported hypocalcaemia in 26% of ISCHS and mean serum Ca⁺⁺ was 8.6±0.46 mg/dl²¹ and Jong-Chung et al reported mean level of serum Ca⁺⁺ of 8.97±0.58mg/dl in ISCHS.²² Morotti et al reported hypocalcaemia in 10.6% of ICH cases.²³ Hypocalcaemia may results from massive influx of Ca⁺⁺ to ischemic penumbra and triggers ischemic cascade to produce free radicals and results in expansion of infarct size and a vicious circle.

Hypomagnesaemia was present in 21 (32.81%) cases in ISCHS and in 2 (5.66%) of ICH and hypermagnesaemia in 1 (2.7%) 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 our study. (P0.0001). Khan KM et al reported hypomagnesaemia in 32% of ISCHS with a mean serum level of 1.71±0.51mg/dl.²⁴ Aysha G et al reported in 35.5% of stroke cases with a mean level of 1.5mg/dl.²⁵

In dyselectrolytemic 38 (62.29%) patients presented with minor GCS (13-15), 15 (24.59%) with moderate GCS and 8 (13.12%) with severe GCS (3-8). In comparison 31 (79.48%) patients with normal electrolytes had moderate GCS and 3 (7.70%) had severe GCS. Thus, in 37.7% patients having dyselectrolytemia had moderate to severe GCS than 20.52% having normal electrolytes. ($P = 0.03$) and Chi Square value of 6.467.

Headache was commonest followed by vomiting in 44 (72.13%) of dyselectrolytemic patients with ICH ($P = 0.001$) and ($P < 0.01$) and vertigo in 21.31% and seizure in 6.58% ($P > 0.05$), whereas 10 (25.64%), 11 (28.21%), 3 (7.69%) and present with headache, vomiting, vertigo and seizure respectively with normal electrolytes patients. ($P > 0.05$ and $p > 0.05$). Siddiqui MR et al reported headache in 74.07% and vomiting in 73.46% patients with dyselectrolytemia.¹³

In this study 30 (49.5%) patients with dyselectrolytemia had good GCS and 18 (29.51%) had poor GCS and 13 (21.31%) died. Whereas in 32 (82.05%) patients with normal electrolytes had good GCS and had good outcome with GOS (4-5) and 12, 82% had poor outcome with GOS (2-3) and there was 2 deaths (5.13%). Bandopadhyay et al showed that 48% of their acute stroke patients with dyselectrolytemia had good outcome with GOS (4-5) in comparison to 82% of patients with normal electrolytes and 52% had poor outcome GOS (1-3) versus 18% with normal electrolytes.¹² A death rate with dyselectrolytemia was 23% is comparable to our study.

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 comorbidities. Hypocalcaemia and hypomagnesaemia were more common in ISCHS and hyponatraemia were common in ICH strokes in our study. Early detection and correction of electrolyte disturbances may prevent further morbidity and mortality in acute stages of strokes. Further studies are needed to know the important roles of individual electrolyte in acute strokes.

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