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Original Research Article

Study of Hyponatremia in Patients of Acute Stroke in a Tertiary Care Hospital

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Abstract

Background: Hyponatremia is a common electrolyte disorder observed in patients of neurological disorders & commonly is stroke patients, the etiology of which is either due to syndrome of in appropriate Antidiuretic hormone secretion (SIADH) or Cerebral salt wasting syndrome (CSWS). The aim of this study was to evaluate the etiology, incidence of hyponatremia in patients of acute stroke admitted to a tertiary care hospital.

Methods: It was a prospective observational study conducted at PRM Medical College & Hospital, Baripada, Mayurbhanj, Odisha, India. 200 patient admitted with acute stroke (<48 hrs of onset) were investigated for hyponatremia (Serum Sodium < 130mmol/L). The data was analysed using chi-square test using SPSS software.

Results: Among 200 stroke patients 76 (38%) had hyponatremia with mean serum sodium level of 126.4mmol/L. Out of 76 patients 50 (65.7%) had SIADH & 18 (23.6%) had CSWS & in 08 (10.5%) cases hyponatremia was of unknown etiology. SIADH was present in 36 cases of ischaemic stroke & 14 cases of hemorrhagic stroke & CSWS was detected in 11 patients of ischemic stroke & 07 cases of hemorrhagic stroke. In hemorrhagic stroke patients with hyponatremia, Right putamen hemorrhage was seen in 42.8% patients with SIADH & Right Thalamus hemorrhage in 57% patients with CSWS. In hyponatremic patients with ischaemic stroke, right middle cerebral artery ischaemia was observed in 52.7% cases with SIADH & left middle cerebral artery ischaemia in 63.6% cases with CSWS. The hospital stay of patients with hyponatremic stroke was more than patients with normal serum sodium level.

Conclusion: In patients with hyponatremia secondary to stroke, ischaemic stroke is a common entity. SIADH remains a more frequently encountered etiology of hyponatremia in comparison to CSWS in stroke patients. The hospital stay of hyponatremic stroke patients was longer, hence monitoring of serum sodium is essential in hospitalized stroke patients. Close monitoring and prompt diagnosis of cause of hyponatremia is essential as their treatment are completely different.

Keywords: stroke, hyponatremia, syndrome of inappropriate ADH secretion, Cerebral salt wasting syndrome.

Introduction

Hyponatremia is a common electrolyte disorder frequently observed in neurological disorders such as stroke, which is usually either due to syndrome of inappropriate secretion of antidiuretic hormone (SIADH) or cerebral salt wasting syndrome (CSWS). Hyponatremia is defined as serum sodium level < 135 mmol/L [1]. SIADH is more common than CSWS [2]. Antidiuretic hormone (ADH) is synthesized in the hypothalamus and stored in posterior pituitary secretory granules. Serum hyperosmolality and effective circulatory volume depletion represent the major stimuli to ADH secretion. In SIADH, there is persistent production of ADH de spite body fluid hypotonicity and an expanded effective circulatory volume so that the negative feedback mechanism that normally controls ADH fails and ADH continues to be released [3]. CSWS was first described by Peter et al [4] in 1950. The exact mechanism of CSWS is not known. CSWS is described by the occurance of excessive sodium excretion in urine, dehydration and resultant hyponatremia in patents with intracranial disease, trauma, & cerebral lesions [2]. We conducted this study in a tertiary care hospital to determine the incidence, etiology and severity of hyponatremia in hospitalized patients of acute stroke.

Materials and Methods

This was a prospective observational study conducted in the department of medicine of a PRM Medical College & Hospital, Baripada, Mayurbhanj, Odisha, India. The study period was from March-2022 to February-2023.

A total number of 200 patients of both genders and the age of 18 years and above presenting within 48 hours of onset of stroke diagnosed by history, clinical examination and appropriate imaging, either computed tomography (CT Scan) or Magnetic Resonance Imaging (MRI) were included in the study. All those patients who had a history of gastro enteritis, head trauma, brain tumor, renal failure, bacterial pneumonia, pulmonary tuberculosis, liver failure, congestive cardiac failure, meningitis, encephalitis, malignancy & patients on drugs that can cause hyponatremia were excluded from the study. Diabetic patients with severe hyperglycemia (>300mg/dl) and hypertriglyceridemia (>400mg/dl) were also excluded from the study to avoid the chance of pseudohyponatremia. Hyponatremia was defined as serum sodium concentration <135mmol/L. All the patients were assessed for volume status, serum sodium, serum osmolality, urine sodium and urine osmolality were measured. The underlying etiology of hyponatremia was categorized as SIADH or CSWS as per the classification mentioned by Saleem et al [2].

The data was analysed using chi-square test using SPSS software. Informed and written consent were obtained from attendants of the patients. Ethical clearance was obtained from institutional ethical committee.

Results

Among the study group 170 (85%) patients were male and 30 (15%) were female. Mean age of the study population was 58.2 $\pm$ 3.6 SD, ranging from 43 to 76 years. 150 patients hadischaemic& 50 had of hemorrhagic stroke. Major co-morbid conditions were hypertension in 44.5% (n=89) & Diabetes mellitus in 36.5% (n=73) cases. Out of 200 patients of stroke, hyponatremia was detected in 38% (n=76) cases. The mean sodium level, of t the hyponatremic patients was 126.4 $\pm$ 2.1mmol/L. Out of 76 patients of hyponatremia, 50 (65.7%) had SIADH (Syndrome of Inappropriate Secretion of Antiduretic Hormone) & 18 (23.6%) patients were detected to have CSWS (Cerebral Salt Wasting Syndrome) as the etiology of hyponatremia. In 08 (10.5%) patients no etiology could be found so they were tagged as hyponatremia of unknown etiology. (Table-1)

Out of all cases of SIADH, 36 (72%) cases were of ischaemic stroke & 14 (28%) cases were of hemorrhagic stroke.Out of 18 cases of CSWS, 11 (61%) patients were of ischaemic stroke & 07 (38.8%) cases were of hemorrhagic stroke (Table-1).

The mean serum sodium level in the ischaemic stroke patients with hyponatoremia was 125 $\pm$ 1.8 mmol/L & that of hemorrhagic groups was 122 $\pm$ 2.1 mmol/L. The site of hemorrhage in stroke patients with hyponatremia are show in (Table-2). Right putamen was the commonest site of hemorrhage in patients with SIADH & Right Thalamus was the most common site of hemorrhage in patients with CSWS. Out of all patients of ischaemicstroke with hyponatremia (n=52), Right middle Cerebral Artery (Rt MCA) ischaemia was most common (n=25, 48%) followed by Left middle cerebral artery (Lt MCA) (n=21, 40.3%) & posterior circulation was least frequently involved (n=6, 11.5%)(Table-3).

Amongst the SIADH patients with ischaemic stroke (n=36), 52.7% (n=19) had Rt MCA involvement, 33.3% (n=12) had Lt MCA involvement & 13.8% (n=5) had posterior circulation involvement (Table-3).

Amongst the CSWS group with ischaemic stroke (n=11), Lt MCA was involved in most cases (n=7, 63.6%) followed by Rt MCA artery (n=4, 36.3%) & no posterior circulation artery was involved (Table-3).Amongst the hyponatremic cases with stroke, 46 (60.5%) cases had mild hyponatremia (serum sodium 130-134 mmol/L), moderate hyponatremia (serum sodium 125-130 mmol/L) in 20 (26.3%) cases and severe hyponatremia (serum sodium <125 mmol/L) was observed in 10 (13.1%) cases (Table-4). Mean hospital stay of patients with hyponatremia was 20 $\pm$ 8.5 days & patients without hyponatremia was 9 $\pm$ 3.2 days which was statistically significant (P=0.04) (Table-5).

Table 1: Causes of Hyponatremiain Stroke Patients (N=76)

Type of stroke	Hyponatremia due to SI-ADH, n=50 (%)	Hyponatremia due to CSWS, n=18 (%)	Hyponatremia due to un-known cause, n=8 (%)
Ischaemic	36 (72)	11 (61)	5 (62.5)
Hemorrhagic	14 (28)	7 (38.8)	3 (37.5)

Table 2: Site of Hemorrhage in Hyponatremic Patients with Hemorrhagic Stroke (N=24)

Site of Hemorrhage	Hyponatremia due to SIADH (n=14)	Hyponatremia due to CSWS (n=7)	Hyponatremia of unknown cause (n=3)
Rt Putamen	6	1	1
Lt Putamen	2	1	-
Rt Thalamus	1	4	1
Lt Thalamus	2	-	-
Rt Cerebellum	1	1	1
Lt Cerebellum	1	-	-
Pons	1	-	-

Table 3: Artery affected in hyponatremic patients with ischaemic stroke (n=52)

Vascular territory involved	Hyponatremia due to SIADH (n=36) (%)	Hyponatremia due to CSWS (n=11) (%)	Hyponatremia of unknown cause (n=5) (%)
Rt Middle Cerebral Artery	19 (52.7)	4 (36.6)	2 (40)
Lt Middle Cerebral Artery	12 (33.3)	7 (63.6)	2 (40)
Posterior Circulation	05 (13.8)	0 (0)	1 (20)

Table 4: Degree of Hyponatremia in stroke patients

Degree of hyponatremia	Level of serum Na^+ (mmol/L)	No. of patient & percentage
Mild	130-134	46 (60.5)
Moderate	125-130	20 (26.3)
Severe	<125	10 (13.1)

Table 5: Duration of Hospital Stay of Stroke Patients

Serum Sodium Status	Mean duration of Hospital Stay (Days)	P Value
With Hyponatremia	20 ± 8.5	0.04
Without Hyponatremia	9 ± 3.2	

Discussion

The present study was conducted in stroke patients to identify the etiology, incidence of hyponatremia either due to SIADH or CSWS.

Among 200 patients of acute stroke, 150 patients had ischaemic type & 50 were of hemorrhagic type. Mean age of the population was 58.2 years. Incidence of stroke was more in males than females (85% vs 15%). Major co-morbid conditions were hypertension and Diabetes Mellitus. A comparable findings were found in similar study by Siva Kumar K et al [5] where mean age was 57.5 years and male female ratio was 86.64% vs 13.36%.

The incidence of hyponatremia in stroke patients in our study was 38%. Similar studies by Saleem et al [2] and Sivakumar K et al [5] found hyponatermia incidence as 35% & 38.6% respectively. In acute central nervous system disease, in hospitalized patients most common electrolyte disturbance observed is hyponatremia. Hyponatremia worsens the existing neurological disorder [6]. In most patients of neurological disease, hyponatremia is dilutional along with hypoosmolal serum which induces cerebral edema [7]. Hyponatemia induced cerebral edema occur primarily with rapid reduction in plasma sodium concentration [2]. Hyponatremia is one of the important causes of persistent altered sensorium in stroke patients. It can give rise to different other neurological symptoms notably seizures which further deteriorates the level of consciousness and outcome [2]. Hyponatremia in stroke is usually of the hypoosmolal type caused either due to SIADH or CSWS [8]. In clinical practice, it is a diagnostic challenge to differentiate between CSWS & SIADH considering the fact that both syndromes share a similar laboratory testing profile [9]. SIADH occurs in three disease groups : central nervous system (CNS) disorders, carcinomas and pulmonary disorders [2]. Patients with SIADH are usually euvolumic and hypertensive CSWS is defined as 'true hyponatremia', which occurs when there is primary loss of sodium into the urine without an increase in total systemic volume [2]. In CSWS, natriuresis is due to disruption in sympathetic neural input signal to kidney & also induced by natriuretic peptides like Atrial Natriuretic Peptide (ANP), Brain Natriuretic Peptide (BNP) &C type Natriuretic Peptide (CNP) and Dendroaspis Natriuretic Peptide (DNP) [10,11,12]. Prevalence of SIADH was higher than CSWS in different studies including the present one. In present study, SIADH & CSWS were found in 65.7% & 23.6% cases respectively. Other similar studies also had comparable findings like Saleem et al [2] (SIADH 67%, CSWS 33%) Ehtesham M et al [7] (SIADH 71.1%, CSWS 29.9%), Shah et al [13] (SIADH 58.5%, CSWS 41.5%). In present study, the mean serum sodium in hemorrhagic stroke group

was lower than ischaemicgroup, the finding is consistent with the study by Pradhan etal [14].

In present study out of all SIADH patients 72% patient had ischaemic stroke & 28% hemorrhagic. Saleem et al [2] observed 35% Ischaemic& 65% hemorrhagic, Sivkumar K et al [5] had 72% Ischaemic & 27.9% hemorrhagic cases. In present study CSWS group had 61% ischaemic& 38.8% hemorrhagic stroke. Saleem et al found 33% ischaemic& 61% hemorrhagic in CSWS group which differs from our observation.

In our study Right putamen hemorrhage was more common (42.8%) in patients with SIADH group & Right Thalamus hemorrhage (57%) was more common in CSWS group. Similar findings (50% & 73.3%) was found by Ehtesham M et al [7] study. The ischemic stroke patients in present study showed predominant Rt MCA involvement in SIADH group (52.7% cases) & predominant Lt MCA involvement in CSWS group (63.6%).

In comparison studies by Saleem et al and Ehtesham M et al showed predominant Lt MCA involvement in SIADH (46% & 46.7% respectively) & predominantly Rt MCA involvement in CSWS group (53% & 55% respectively) which does not match to our study. In present study degree of hyponatremia was mild in 60.5%, moderate in 26.3% & severe in 13.1% cases. Mahesar et al [15] found mild in 64.7%, moderate in 25.5% & severe hyponatremia in 9.8% cases which is comparable to our findings. Our study couldn't detect etiology of hyponatremia in 10.5% cases, in comparision Sivakumar K et al had 25.6% cases of unknown etiology of hyponatremia. In present study patients with hyponatremia had mean hospital stay period was of 20 days which was more than non-hyponatremic patient.

Sivakumar K et al observed mean hospital stay of 21 days which tally with our finding. Hyponatremia due to CSWS improves with volume replacement &treatment with fludrocortisone.

But hyponatremia due to SIADH improves with fluid restriction& vasopressin 2 receptor antagonist administration.

Conclusion

This study shows that hyponatremia was observed in 38% of stroke patients hence it is a common type of electrolyte disorder in patients of stroke. Ischaemic stroke was found to be the commonest type of stroke associated with hyponatremia. SIADH remains frequently detected etiology of hyponatremia in stroke. Hyponatremia should be suspected in any stroke patients in order to achieve early identification & prompt management to prevent further deterioration of neurological status in these patients.

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