



## ANALYSIS OF HYPONATREMIA IN NEUROCRITICALLY ILL PATIENTS

<b>Dr. Sachin Bangar*</b>	Associate Professor, Department of General medicine, MGM Medical College and Hospital, Aurangabad*Corresponding Author
<b>Dr. Abhilash Taware</b>	Junior resident, Department of General medicine, MGM Medical College and Hospital, Aurangabad
<b>Dr. Rahul Talekar</b>	Junior resident, Department of General medicine, MGM Medical College and Hospital, Aurangabad
<b>Dr. Abhishek Sharma</b>	Junior resident, Department of General medicine, MGM Medical College and Hospital, Aurangabad

**ABSTRACT** Hyponatremia is a common electrolyte disease that affects the critically ill, particularly those who are neurocritically. Present study assessed clinical & etiological profile of hyponatremia patients in comatose. **Aim-** To study incidence and clinical profile of hyponatremia in comatose patients. **Method-** Present study was undertaken in the Department of General Medicine at MGM Hospital, Aurangabad. Total 136 patients fulfilling inclusion and exclusion criteria were enrolled. Detailed history taking and clinical examination was performed. On the basis of volume status, total 136 cases were divided into three group as Hyponatremic patients with hypovolemia, Hyponatremic patients with Euvolemia, Hyponatremic patients with hypervolemia. **Results-** Majority of cases i.e. 62 (45 %) were found of > 60 years. Male to female ratio was 1.26:1 Neurological symptoms were found in total 67 (50 %) cases, Altered Sensorium in 43 (32 %) cases, Seizure in 14 (10 %) cases and asymptomatic cases were 33 (24 %). In maximum cases i.e. 49 (36 %) diuretics was the cause found followed by panhypopituitarism in 26 (19 %), hypothyroidism in 16 (11 %), dehydration in 13 (9 %) and Addison's disease/adrenal insufficiency in 10 (8 %) cases. Total cases which were on diuretics were 49 (22 %) whereas remaining 87 (78 %) cases were on other medications. **Conclusion-** Hyponatremia is increasingly understood to be a sign of a poor result in a variety of illnesses. Hyponatremia must be promptly diagnosed, the pathophysiology of it must be carefully analyzed, and its severity and effects on the patient's course must be understood in order to be properly managed. Attending clinicians should be warned that treating a patient excessively when they have significant and symptomatic hyponatremia might have the same negative effects as failing to start the appropriate treatment procedures.

**KEYWORDS :** Hyponatremia, comatose, neurocritical

### INTRODUCTION

Hyponatremia is defined as when sodium concentration is reduced to less than 35 mEq/l<sup>1</sup>. It occurs primarily due to imbalance in water homeostasis, antidiuretic hormone (ADH) regulation, and renal handling of filtered sodium. Syndrome of inappropriate ADH secretion (SIADH), a common cause of hyponatremia, is associated with many clinical conditions which includes neoplasia, central nervous system (CNS) disorders, drugs and pulmonary diseases<sup>2</sup>. It is necessary to rule out pseudohyponatremia secondary to hyperglycemia and hyperlipidemia<sup>3</sup>. Urinary sodium, serum and urine electrolytes are important basic investigations needed to arrive at the etiology of hyponatremia. Critically ill patients frequently have a number of risk factors that make them susceptible to hyponatremia, such as reduced free water excretion, frequent use of hypotonic fluids, and a variety of morbid and drug-related diseases. According to its biochemical definition, hyponatremia is the most common electrolyte disturbance seen in the intensive care unit (ICU), affecting up to 24.5% of patients<sup>4</sup>. Even in the presence of mildly lowered sodium plasma (PNa) levels, hyponatremia is known to be closely connected with a changed prognosis in critically ill patients<sup>5,6</sup>. Failure to treat profound, symptomatic, and acute hyponatremia in a timely manner puts the patient at risk for brain herniation, seizures, and hyponatremic encephalopathy, while an excessively quick increase in plasma sodium concentration puts the patient at risk for the dreaded osmotic demyelination syndrome (OD)<sup>7</sup>. Sodium and water abnormalities i.e., Hyponatremia and hypernatremia are common phenomenon observed in hospitalized patients and their prompt recognition & optimal management may reduce in-hospital mortality, symptom severity, less intensive hospital care, decrease duration of hospitalization and associated costs which improves the treatment of underlying comorbid conditions and patients' quality of life. With this perspective present study was undertaken to study incidence and clinical profile of hyponatremia in comatose patients.

### STUDY DESIGN

The Cross Sectional observational was conducted from November 2020 to November 2022 after approval of institutional ethics committee in the Department of General Medicine at MGM Hospital,

Aurangabad. Total 136 patients fulfilling inclusion and exclusion criteria were enrolled. Details of the study was explained to all patients in their own language and written informed consent was obtained from all. Detailed history taking and clinical examination was performed. Details like age, sex, symptoms, associated chronic disease, diuretic use and etiology of hyponatremia was noted in case record form (CRF) in each case. On the basis of volume status total 136 cases were divided into three groups- Group A (N=36): Hyponatremic patients with hypovolemia. Group B (N=60): Hyponatremic patients with Euvolemia. Group C (N=40): Hyponatremic patients with hypervolemia. Hyponatremia is defined as serum sodium concentration < 135 mEq/L. with subdivided into mild (131-135mEq/L), moderate (126-130 mEq/L), severe (<125 mEq/L). In hyperglycemic hyponatremia, the sodium was corrected by following formula Serum sodium + 1.6 x Blood glucose-100/100

### INCLUSION CRITERIA-

All ICU patients of age >18 years of both gender with serum sodium less than 135 mmol/L and Glasgow coma scale less than 8.

### EXCLUSION CRITERIA-

No exclusion criteria.

### STATISTICAL ANALYSIS

Data was entered in MS Excel and analyzed using SPSS software, with chi-square test and odds ratio used to test proportions, p-value <0.05 considered significant, and results presented in visual forms like bar and pie diagrams.

### OBSERVATIONS AND RESULTS

**Table 1: Distribution of Cases according to Age**

Sr. No.	Age group (Years)	Group A N (%)	Group B N (%)	Group C N (%)	Total N (%)
1	≤ 20	3 (2 %)	1 (1 %)	0 (0 %)	4 (3 %)
2	21 to 40	3 (2 %)	13 (10 %)	6 (5 %)	22 (17 %)

3	41 to 60	7 (5 %)	29 (21 %)	12 (9 %)	48 (35 %)
4	> 60	23 (17 %)	17 (12 %)	22 (16 %)	62 (45 %)
To tal		36 (26 %)	60 (44 %)	40 (30 %)	136 (100 %)

Table 1 shows distribution of Cases according to Age. Majority of cases i.e. 62 (45%) were found of > 60 years followed by 48 (35 %) cases from 41 to 60 years. Mean ±SD for age was 52.49 ± 14.87.

**Table 2: Distribution of Cases according to Gender**

Sr.No.	Gender	Group A N (%)	Group B N (%)	Group C N (%)	Total N (%)
1	Male	16 (12 %)	31 (23 %)	29 (21 %)	76 (56 %)
2	Female	20 (14 %)	29 (21 %)	11 (9 %)	60 (44 %)
Total		36 (26 %)	60 (44 %)	40 (30 %)	136 (100 %)

Table 2 shows distribution of Cases according to Gender. Males were 76 (56%) and females were 60 (44 %). Male to female ratio was 1.26:1

**Table 3: Distribution of Cases according to symptoms**

Sr.No.	symptoms	Group A 36 (26 %)	Group B 60 (44 %)	Group C 40 (30 %)	Total N (%)
1	Neurological symptoms (Nausea, vomiting, giddiness, etc..)	24 (18 %)	12 (9 %)	31 (23 %)	67 (50 %)
2	Altered Sensorium	16 (12 %)	8 (6 %)	19 (14 %)	43 (32 %)
3	Seizure	4 (3 %)	3 (2 %)	7 (5 %)	14 (10 %)
4	Asymptomatic	3 (2 %)	26 (19 %)	4 (3 %)	33 (24 %)

Table 3 shows distribution of Cases according to symptoms. Neurological symptoms (Nausea, vomiting, giddiness, etc..) were found in total 67 (50 %) cases, Altered Sensorium in 43 (32 %) cases, Seizure in 14 (10%) cases and asymptomatic cases were 33 (24 %)

**Table 4: Distribution of Cases according to serum sodium levels**

Sr. No.	Serum Sodium levels (mEq/L)	Group A N (%)	Group B N (%)	Group C N (%)	Total N (%)	P value
1	131 to 135 (Mild hyponatremia)	25 (18 %)	42 (31 %)	3 (2 %)	70 (51 %)	<0.000 (01 S)
2	126 to 130 (Moderate hyponatremia)	9 (7 %)	16 (12 %)	31 (23 %)	56 (42 %)	
3	< 125 (Profound hyponatremia)	2 (1 %)	2 (1 %)	6 (4 %)	10 (6 %)	
Total		36 (26 %)	60 (44 %)	40 (30 %)	136 (100 %)	-

Table 4 shows distribution of Cases according to serum sodium levels. Amongst hypovolemic cases mild hyponatremia was found in 25 (18 %), moderate in 9 (7 %) and profound in 2 (1 %) cases. Amongst euvolemic cases mild hyponatremia was found in 42 (31 %), moderate in 16 (12 %) and profound in 2 (1 %) cases. Amongst hypervolemic cases mild hyponatremia was found in 3 (2 %), moderate in 31 (23 %) and profound in 6 (4%) cases.

**Table 5: Distribution of Cases according to Associated Chronic Diseases**

Sr.No.	Associated Chronic Diseases	Group A 36 (26 %)	Group B 60 (44 %)	Group C 40 (30 %)	Total N (%)
1	Psychiatric disorders	1 (1 %)	0 (0 %)	2 (1 %)	3 (2 %)

2	Chronic kidney disease	2 (1 %)	2 (1 %)	3 (2 %)	7 (5 %)
3	Adrenal insufficiency	4 (3 %)	1 (1 %)	5 (4 %)	10 (8 %)
4	Gastrointestinal	4 (3 %)	3 (2 %)	6 (4 %)	13 (9 %)
5	Hypothyroidism	3 (2 %)	6 (4 %)	7 (5 %)	16 (11 %)
6	Respiratory problem	4 (3 %)	6 (4 %)	8 (6 %)	18 (13 %)
7	Cardiac problem	10 (7 %)	9 (7 %)	12 (9 %)	31 (23 %)
8	Diabetes Mellitus	20 (15 %)	13 (9 %)	22 (16 %)	55 (40 %)
9	Others	19 (14 %)	12 (9 %)	27 (20 %)	58 (43 %)

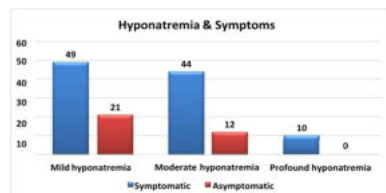
Table 5 shows distribution of Cases according to Associated Chronic Diseases. Psychiatric disorder was present in 3 (2 %) cases, CKD in 7 (5 %), adrenal insufficiency in 10 (8 %), GIT problems in 13 (9 %), hypothyroidism in 16 (11 %), respiratory illness in 18 (13 %), cardiac problems in 31 (23 %) and diabetics were 55 (40%).

**Table 6: Distribution of Cases according to severity of hyponatremia**

Sr. No.	Serum Sodium levels (mEq/L)	Symptomatic N (%)	Asymptomatic N (%)	Total N (%)	P value
1	131 to 135 (Mild hyponatremia)	49 (35 %)	21 (15 %)	70 (50 %)	0.095 (NS)
2	126 to 130 (Moderate hyponatremia)	44 (32 %)	12 (9 %)	56 (41 %)	
3	< 125 (Profound hyponatremia)	10 (7 %)	0 (0 %)	10 (7 %)	
Total		103	33	136 (100 %)	

Table 6 shows distribution of Cases according to severity of hyponatremia and symptoms. Amongst symptomatic cases mild hyponatremia was found in 49 (35 %), moderate in 44 (32 %) and profound in 10 (7 %) cases. Amongst asymptomatic cases mild hyponatremia was found in 21 (15 %), moderate in 12 (9 %) and profound in 0 (0 %) cases. Result found statistically not significant (P=0.095), showing that symptoms occurrence is independent of Grading of hyponatremia

**Graph 1 Distribution of Cases according to severity of hyponatremia**



**Table 7: Distribution of Cases according to Cause of hyponatremia**

Sr.No.	Cause of hyponatremia	Group A N (%)	Group B N (%)	Group C N (%)	Total N (%)
1	SIADH	1 (1 %)	0 (0 %)	6 (4 %)	7 (5 %)
2	Addison's disease / adrenal insufficiency	4 (3 %)	1 (1 %)	5 (4 %)	10 (8 %)
3	Adrenal pituitary	1 (1 %)	0 (0 %)	1 (1 %)	2 (2 %)
4	Cerebral salt wasting Syndrome	0 (0 %)	0 (0 %)	1 (1 %)	1 (1 %)
5	Dehydration	10 (7 %)	3 (2 %)	0 (0 %)	13 (9 %)
6	hypothyroidism	3 (2 %)	6 (4 %)	7 (5 %)	16 (11 %)
9	Dilutional hyponatremia	0 (0 %)	0 (0 %)	2 (1 %)	2 (1 %)
10	Diuretics	0 (0 %)	18 (13 %)	31 (23 %)	49 (36 %)

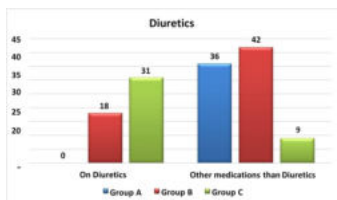
		(%)	(%)	(%)	(%)
12	Panhypopituitarism (Hypothyroid + adrenal insufficiency)	7 (5 %)	7 (5 %)	12 (9 %)	26 (19 %)
14	Pseudohyponatremia	0 (0 %)	0 (0 %)	1 (1 %)	1 (1 %)
15	Renal failure alone	1 (1 %)	0 (0 %)	1 (1 %)	2 (1 %)
16	Renal failure and Ascites (volume overload)	1 (1 %)	0 (0 %)	2 (1 %)	3 (2 %)
17	Renal failure and Liver failure	1 (1 %)	0 (0 %)	1 (1 %)	2 (1 %)
18	Unclear cases	0 (0 %)	2 (1 %)	0 (0 %)	2 (1 %)
Total		36 (26 %)	60 (44 %)	40 (30 %)	136 (100 %)

**Table 8 shows distribution of Cases according to Diuretics use.**

Sr.No.	Diuretics status	Group A N (%)	Group B N (%)	Group C N (%)	Total N (%)
1	On Diuretics	0 (0 %)	18 (13 %)	31 (9 %)	49 (22 %)
2	Other medications than Diuretics	36 (26 %)	42 (31 %)	9 (21 %)	87 (78 %)
Total		36 (26 %)	60 (44 %)	40 (30 %)	136 (100 %)

Total cases which are on diuretics were 49 (22 %) whereas remaining 87 (78 %) cases were on other medications.

**Graph 2 Distribution of Cases according to Diuretic**



**Table 9: Distribution of Cases according to outcome**

Sr.No.	outcome	Group A N (%)	Group B N (%)	Group C N (%)	Total N (%)	P value
1	Survived	35 (25 %)	60 (44 %)	34 (25 %)	129 (94 %)	0.002 (S)
2	Expired	1 (1 %)	0 (0 %)	6 (5 %)	7 (6 %)	
Total		36 (26 %)	60 (44 %)	40 (30 %)	136 (100 %)	

Table 9 shows distribution of Cases according to outcome. Total survived cases were 129 (94%). Result found statistically significant (P=0.002) which shows outcome is varied according to volume status amongst hyponatremia cases.

**DISCUSSION**

In present study majority of cases i. e. 62 (45 %) were found of > 60 years followed by 48 (35 %) cases from 41 to 60 years. Mean ± SD for age was 52.49 ± 14.87. Males were 76 (56 %) and females were 60 (44 %). Male to female ratio was 1.26:1. In similar study by Shyam Kumar Sah et al (2021)8 examined 200 patients & found that majority of patients in between age group 61- 70 years (39.5 %). 70.5 % of total patients were between 51 – 80 years. Mean age being 56.5 years. 78 were female& 122 male.

In present study neurological symptoms (Nausea, vomiting, giddiness, etc..) were found in total 67 (50 %) cases, Altered Sensorium in 43 (32 %) cases, Seizure in 14 (10 %) cases and asymptomatic cases were 33 (24 %). Prakash Babaliche et al (2017)9 studied 100 patients and found that most frequent presenting complaint was vomiting (28 %) followed by confusion (26 %), seizure (9 %), coma (4%). Again, found that 52 % patients were conscious while 48 % were with altered sensorium.

In present study psychiatric disorder was present in 3 (2 %) cases, CKD

in 7 (5%),adrenal insufficiency in 10 (8 %), GIT problems in 13 (9 %), hypothyroidism in 16 (11 %),respiratory illness in 18 (13 %), cardiac problems in 31 (23 %) and diabetics were 55 (40%) In similar study by Shyam Kumar Sah et al (2021)8 who studied 200 patients which shows hypertension was present in 86 (43 %), diabetes mellitus in 47 (23.5 %), heart failure in 23 (11.5 %), chronic liver disease in 17 (8.5 %), chronic kidney disease in 36 (18 %), adrenal insufficiency in 3 (1.5 %) & hypothyroidism in 9 (4.5 %) cases.

In present study amongst hypovolemic cases mild hyponatremia was found in 25 (18%), moderate in 9 (7 %) and profound in 2 (1 %) cases. Amongst euvolemic cases mild hyponatremia was found in 42 (31 %), moderate in 16 (12 %) and profound in 2 (1 %) cases. Amongst hypervolemic cases mild hyponatremia was found in 3 (2 %), moderate in 31 (23 %) and profound in 6 (4 %) cases. In similar study by Shyam Kumar Sah et al (2021)8 out of 200 patients ,71 (35.5 %) patients were Hypovolemic in which 10 patients were mild, 48 were moderate & 13 were severe. 53 (26.5 %) patients were Euvolemic in which 7 were mild, 17 were moderate & 29 were severe. 76 (38 %) patients were Hypervolemic in which 3 were mild, 41 were moderate & 32 were severe.

In present study amongst symptomatic cases mild hyponatremia was found in 49 (35%), moderate in 44 (32 %) and profound in 10 (7 %) cases. Amongst asymptomatic cases mild hyponatremia was found in 21 (15 %), moderate in 12 (9 %) and profound in 0 (0 %) cases. Result found statistically not significant (P=0.095), showing that symptoms occurrence is independent of Grading of hyponatremia. Chowdhary et al (2013)10 studied 70 patients and observed mild hyponatremia in 27.14 %, moderate hyponatremia in 37.14 % & severe hyponatremia in 35.72 %.

In present study in maximum cases i.e. 49 (36 %) diuretics was the cause found followed by panhypopituitarism in 26 (19 %), hypothyroidism in 16 (11 %), dehydration in 13 (9 %)and addison's disease/adrenal insufficiency in 10 (8 %) cases. Prakash Babaliche et al (2017)9 studied 100 patients & observed that SIADH (46%) was the main etiologic factor for causing hyponatremia followed by renal problems (13 %), GI loss (11 %), cardiac problems (10 %), liver cirrhosis (10%) & lastly use of drugs (10 %).

In present study total cases which are on diuretics were 49 (22 %) whereas remaining87 (78 %) cases were on other medications. In similar study by Shyam Kumar Sah et al (2021)8 who studied 200 patients out of which total 28 (14 %) patients were on diuretics & remaining on other medications. Out of 28 patients who were on diuretics 5 had mild hyponatremia, 20 had moderate hyponatremia and 3 had severe hyponatremia.

In present study total survived cases were 129 (94 %). Result found statistically significant (P=0.002) which shows outcome is varied according to volume status amongst hyponatremia cases. In similar study by P. Shashikath Reddy et al (2019)11 who studied 80 patients out of which 12 (15 %) were expired & 68 (85 %) survived. Maximum mortality rate was observed above 75 years of age.

**CONCLUSION**

The intensivist continues to suffer greatly from hyponatremia. It is not just the most common electrolyte problem, but it is also increasingly understood to be a sign of a poor result in a variety of illnesses. Hyponatremia must be promptly diagnosed, the pathophysiology of it must be carefully analyzed, and its severity and effects on the patient's course must be understood in order to be properly managed. Attending clinicians should be warned that treating a patient excessively when they have significant and symptomatic hyponatremia might have the same negative effects as failing to start the appropriate treatment procedures. Fortunately, significant progress has been made in understanding the physiopathology of both hyponatremic encephalopathy and OD, and this knowledge may eventually lead to the development of novel treatments.

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