

A Study on Hyponatremia in Critically Ill Geriatric Patients

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Abstract

Background: Hyponatremia is a condition when serum sodium is <135 meq/L and is considered severe when <125mEq/l. It can be due to abnormal sodium or water balance and is the most common electrolyte disorder occurring in critically ill patients and particularly so in the elderly.

Aims: Present study aims to ascertain etiological factors, frequency and outcome of hyponatremia in critically ill geriatric patients and describe its clinical manifestations.

Methods: This observational study was conducted in an intensive care unit of a tertiary care hospital of Rajasthan on 100 geriatric patients over a period of 1 year.

Observation: In this study 62 males and 38 females were admitted with hyponatremia with 25% having mild and 67% moderate hyponatremia; of which 58% were symptomatic having lethargy (34%) and postural dizziness (27%) as the common clinical presentation. Hypertension (57%) and diabetes (43%) were frequent comorbidities while CCF (40%) followed by drugs (16%) were the common etiologies. Fluid restriction (63%) was the major treatment followed by diuretics (23%), normal saline (14%) and hypertonic saline (5%) with an overall mortality of 10% unrelated to the severity of hyponatremia at presentation.

Conclusion: Hyponatremia is a significant cause of morbidity and mortality in critically ill geriatric patients and needs special consideration to decrease the ICU stay and associated morbidity.

Key Words: Hyponatremia, geriatrics, electrolyte disorder, critical care.

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INTRODUCTION

Hyponatremia is defined as a condition that occurs when the level of serum sodium in blood is less than 135meq/L and is considered severe when the serum sodium level is less than 125meq/L. An abnormal sodium level does not necessarily imply abnormal sodium balance, but it can be due to

abnormal water balance as well. Hyponatremia can thus be classified on the basis of serum osmolality, volume status and urinary sodium into hypertonic, isotonic and hypotonic types. Hypotonic hyponatremia is further classified into hypervolemic, euvolemic and hypovolemic as follows:

- Hypovolemic hyponatremia: Decreased total body sodium and decreased total body water. The sodium deficit exceeding water deficit
- Euvolemic hyponatremia: Normal body sodium with increase in total body water
- Hypervolemic hyponatremia: Increase in total body sodium with greater increase in total body water.

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Hyponatremia, an excess of water in relation to the sodium in the extracellular fluid, is the most common electrolyte disorder occurring in critically ill patients and particularly so in the elderly¹. Its symptoms range from nausea, vomiting, muscle weakness, malaise to lethargy, decreased level of consciousness, short term memory loss, headache, seizures and coma. The treatment of hyponatremia depends on the duration of hyponatremia and volume status of the patients. There is serious neurologic sequel if hyponatremia is inappropriately treated. Hyponatremia is important to recognize because of the potential morbidity and mortality and also because its economic impact on the patient and the health care facility is evident by longer duration of stay, higher risk of death and disability and increased cost of care^{2,3,4}. There is a lack of Indian data on clinical spectrum of hyponatremia and whether the presence of hyponatremia on elderly intensive care unit (ICU) admission is independently associated with excess mortality. Therefore, we planned to undertake this prospective follow up study in the elderly critically ill patients at our tertiary care centre.

AIMS AND OBJECTIVES

- To ascertain the etiological factors, frequency and outcome of hyponatremia in elderly patients admitted to the ICU
- To describe the clinical manifestations associated with hyponatremia.
- To correlate with outcome following treatment.

MATERIAL AND METHODS

Source of Data : The study group consists of geriatric patients with a diagnosis of hyponatremia admitted in the intensive care unit (ICU) of Geetanjali Medical College & Hospital (GMCH) between June 2015 to June 2016. The period of study is one year.

Inclusion Criteria

- Patients admitted in intensive care unit (ICU) of GMCH with Serum Sodium level less than 135mEq/l
- Age >60 yrs.

Exclusion Criteria

- Post operative patients

Methodology and Assessment to be Done: Systematic clinical assessment through detailed history and physical examination along with the relevant investigations were performed to ascertain

the cause, clinical manifestations and serum osmolality in patients. The following investigations were performed-

- Complete blood count- Hemoglobin (Hb), Total Leukocyte Count (TLC), Differential Leukocyte Count (DLC) and platelet count.
- Urine routine examination (RE) and microscopic examination (ME) and specific gravity
- Serum sodium- – serum sodium was done 6 hourly in patients with severe hyponatremia on 3% saline infusion. In symptomatic patients not on hypertonic saline serum sodium was done daily till the correction of hyponatremia. In asymptomatic patients it was done every alternate day.
- Serum blood urea nitrogen (BUN) and glucose level – for calculation of serum osmolality

Serum osmolality = 2([Na+] + [K+]) + RBS/ 18 + BUN/2.8 mOsm/L (RBS in mg/dL, BUN in mg/dL)

Patients were divided in following groups depending on their serum osmolality-

- (i) Normal osmolality - 270 – 290 mOsm/L
- (ii) Hyperosmolar - >290 mOsm/L
- (iii) Hypo-osmolar – <270 mOsm/L

Management and outcome assessment: Patients with hyponatremia were classified based on serum sodium levels into following three categories:

Category Serum	Sodium concentration
Mild hyponatremia	130 - 134 meq/L
Moderate hyponatremia	121 - 129 meq/L
Profound hyponatremia	≤120 meq/L

Treatment strategy: Decision on the treatment modality of hyponatremia was based on the cause and severity of hyponatremia and presence of neurological symptoms of hyponatremia.

- **For hypervolemic hyponatremia**
- **Fluid restriction** – defined as total fluid intake in 24 hrs equal to the volume of urine output of previous 24 hrs. It was advised in patients with hypervolemic hyponatremia as caused by CHF, renal disorders and chronic liver disease.
- **Loop diuretic-** loop diuretic was given for excretion of free water.
- **For hypovolemic hyponatremia**

- **Normal saline (0.9% NaCl)** – Normal saline was also given as part fluid therapy as in cases of febrile illnesses, vomiting and diarrhoea.
- **Hypertonic (3%) saline-** hypertonic saline was given in severe hyponatremia patients with neurological symptoms of hyponatremia with aim to increase serum sodium level by 8meq/L in 24 hours
- **For euvolemic hyponatremia**
- **Hypertonic (3%) saline**

Collection of Data: For all patients clinical and demographic details along with final diagnosis and investigations including all the bio chemical tests to ascertain the cause and manifestations were recorded into a computerized data sheet.

Study Design: Observational study

Study Duration: One year

Study Population: Geriatric patients admitted in ICU with hyponatremia

Sample Size: 100 Patients

Sampling Technique: Purposive sampling

Statistical Analysis: Data were recorded on a predesigned proforma and managed in a computerized data sheet. All the entries were double-checked for any possible keyboard error. Data so collected was systematically analyzed. Data are presented as frequency distribution and simple percentages. Descriptive statistics i.e. mean and standard deviation have been calculated for the continuous variables. Categorical variables are expressed as percentages.

RESULTS

1. Sex Distribution

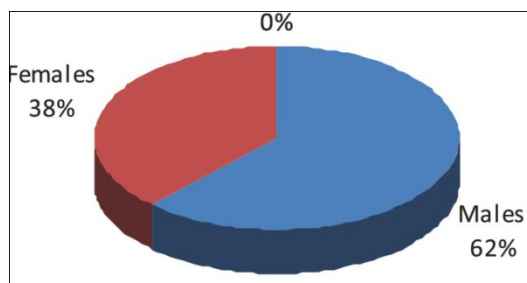


Fig. 1. Sex Ratio (in percentage)

- There were total 100 patients
- Of which 62 (62%) were males
- And 38 females (38%)
- Male and female ratio of 1.6:1
- Elderly males are more commonly affected

2. Age Distribution

- 62% of patients were between 70-80 years & < 10% have been affected between 80-90 years.
- Maximum no. of patients was in age group 75-80 yrs. The oldest patient was 88 years.
- Maximum female patients were between 65-75. There were only 2 patients between 85-90.
- Mean age was 73.5 years.

Table 1 Age Distribution

AGE GROUP	FREQUENCY	PERCENTAGE
61-65	10	10%
66-70	21	21%
71-75	27	27%
76-80	35	35%
81-85	5	5%
85-90	2	2%

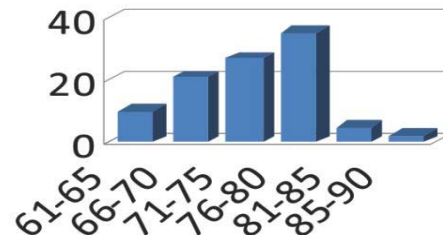


Fig. 2 Age Distribution (in %)

3. Symptoms of Hyponatremia

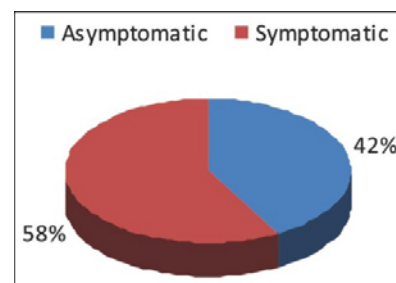


Fig. 3. Symptoms (in %)

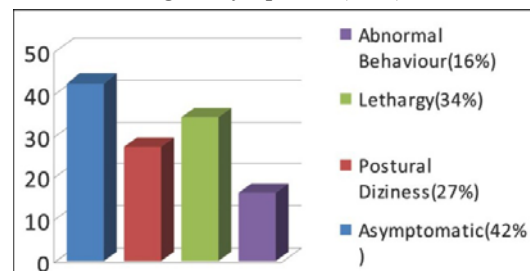


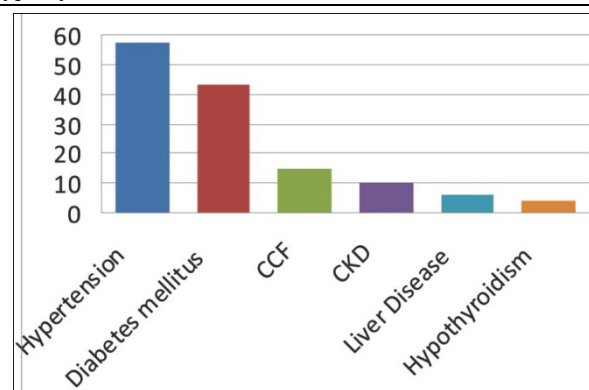
Fig. 4. Symptoms (in %)

Correlation of symptoms and level of serum sodium: 42% (42) patients were asymptomatic with documented hyponatremia. Out of which 4 patients were mild hyponatremia (131-134 meq/L) and 38 patients were moderate hyponatremia (121-130 meq/L). The lowest serum sodium level among asymptomatic patients was 126 meq/L. (Mean- 128 meq/L ; SD-2.5meq/L).

4. Pre-Existing Illness

Table 2. Pre-Existing Illness

	%
Hypertension	57
Diabetes Mellitus	43
Congestive Cardiac Failure (CCF)	15
Chronic Kidney Disease (CCK)	10
Liver Disease	6
Hypothyroidism	4



5. Hydration Status:

Table 3. Diagnosis

	No.	%
Hypervolemic	64	64
Hypovolemic	26	26
Euvolemic	10	10
Total	100	100

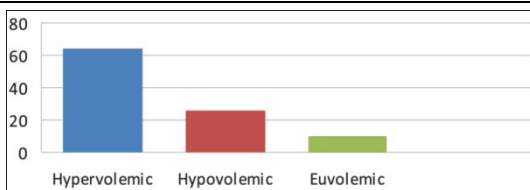


Fig. 6. Hydration status (in %)

6. Etiology of Hyponatremia

In our study most of the patients had multifactorial etiology. Most common etiology for hyponatremia are-

- 40 (40%) due to congestive cardiac failure
- 16 (16%) due to drugs
- 10 (10%) due to cirrhosis of liver
- 4 (4%) due to diabetic ketoacidosis
- 10 (10%) due to renal disorder
- 2 (2%) due to meningitis
- 10 (10%) due to hypothyroidism
- 6 (6%) due to gastroenteritis
- 2 (2%) due to other causes

7. Severity of Hyponatremia:

Table 4. Severity of hyponatremia

Na+ in mmol	No. of patients	(%)
116-120	8	8
121-125	23	23
126-130	44	44
131-135	25	25
Total	100	100%

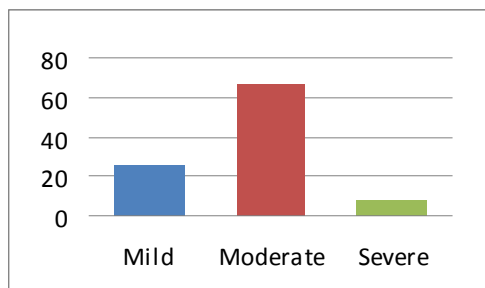


Fig.7 Severity in hyponatremia

8. Treatment

- Fluid restriction was the major treatment given in our study i.e 63%.
- Diuretics were used in 23% of the patients.
- Normal saline was given in 14% of patients.
- Hypertonic saline was given in 5% of our patients.

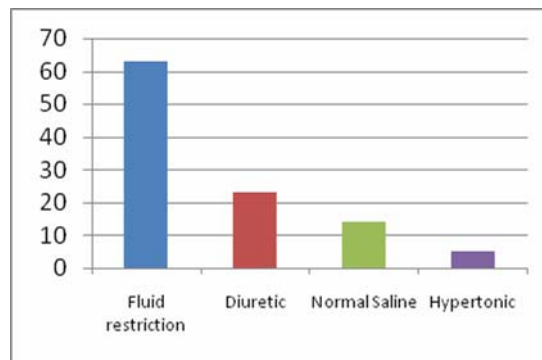


Fig. 8 Treatment

9. Mortality:

Outcome in different levels of hyponatremia-

- The mortality was 10% in this study.
- Among these, 2 (2%) patient belong to mild hyponatremia, 6 (6%) patient belong to moderate hyponatremia and 2 (2%) patient belong to severe hyponatremia.

Table 5. Mortality data

Hyponatremia	No. of patients	Death	Discharge
Mild	25	2	23
Moderate	67	6	61
Severe	8	2	6
Total	100	10	90

DISCUSSION

Hyponatremia is the most common electrolyte disturbance seen in critically ill elderly patients. It has been associated with considerable morbidity and mortality in many chronic diseases, most notably in patients with congestive heart failure⁵ and cirrhosis of liver⁶. In our study incidence of hyponatremia in ICU patients was 22.4% whereas in previous studies, incidence of hyponatremia in hospitalized patients was found to be about 1% to 6%^{7,8,9}. Bennani et al¹⁰ found the incidence of hyponatremia to be 14% in intensive care unit while DeVita et al¹¹ found the incidence in ICU to be 29.6%. In our study 62% of the patients were 70 to 80 yrs old, incidence of hyponatremia has been shown to have direct correlation with age¹² as multiple comorbidities increase with age, treatment of which predisposes a patient to hyponatremia. Use of diuretics is also more common among the elderly patients, which has been a major cause of hyponatremia in hospitalized patients. Hawkins et al noted that increasing age, after adjusting for sex, was independently associated with both hyponatremia at presentation and hospital-acquired hyponatremia¹². In the present study prevalence of hyponatremia was more in male patients with male: female ratio of 1.6:1 (62 males & 38 females).

In this study 58% of the patients had manifestations of hyponatremia at presentation. A major proportion (42%) of the patients in the study did not have evident clinical manifestations of hyponatremia. This can be possibly due to the reason that acute hyponatremia (hyponatremia of 48 hr duration) in which symptoms are ameliorated by the phenomenon of cerebral adaptation to hyponatremic state¹³. Major clinical manifestations of hyponatremia were lethargy (34%) and postural

dizziness (27%) which occurred with equal frequency in both severe and moderate hyponatremia. Altered sensorium (16%) as manifestation of hyponatremia was less. In study of severe hyponatremia by Clayton et al, 36.2% patients had neurological symptoms attributable to the hyponatremia at presentation¹⁴. In another study by Nzerue et al on outcome of hyponatremia in hospitalized patients 52.9% patients had neurological manifestations². These included seizures, reduced consciousness level, confusion unsteadiness and falls. In our study 16% patients had varied neurological manifestations of hyponatremia however none of the patient had seizures. The major pre-existing illnesses present among the patients in our study were hypertension (57%), diabetes mellitus (43%), chronic kidney disease (10%), heart failure (15%) and chronic liver diseases (6%) and hypothyroidism (4%). In our study hypertension was a major risk factor for hyponatremia due to diuretic use in elderly patients. The studies on hyponatremia have not demonstrated direct correlation between hyponatremia and hypertension, although correlation of hyponatremia with age¹² and diuretic use is evident¹⁵. In our study 10(10%) of the patients had hyponatremia due to renal disorders out of which 8 patients had pre-existing renal disease, 2 patient had acute renal failure. Total 10 (10%) patients had liver disorder (6 patients with pre-existing liver disease and 4 had acute viral hepatitis) and another 40 (40%) patients had hyponatremia due to heart failure. Thus 60 patients in our study had renal disorder, heart failure or chronic liver disease. Thus majority of these patients were admitted to the hospital due to non-compliance with treatment and inappropriate fluid intake leading to volume expansion and dilutional hyponatremia. In majority of these patients loop diuretics and fluid restriction was sufficient to correct hyponatremia. In study by Saeed et al, 37% of the patients had hyponatremia due to these disorders (renal disorders 21%, liver disorders 7% and CHF (9%)¹⁶. % patients in our study had pre-existing hypothyroidism. In study by Clayton et al hypothyroidism induced hyponatremia occurred in 3.7%¹⁴. Diuretic use were also the common cause for hyponatremia in our study. Thiazide diuretics are a common cause of severe hyponatraemia¹⁷. Up to a third of elderly patients taking a thiazide at hospital admission are hyponatremic. Severe hyponatremia occurs almost exclusively with thiazide rather than loop diuretics¹⁸. Saeed et al, studied hyponatremia in hospitalized patients and in 19 out of 57 patients (33.3%) it was associated with diuretic use¹⁶. In a study by Huda et al, 14 out of 22 (63.6%) patients of

hyponatremia on diuretics were taking thiazide diuretics¹⁹. Clayton et al concluded in their study that selective serotonin reuptake inhibitors (SSRIs) were a frequent cause of drug induced hyponatremia¹⁴. They had 12 (11.1%) patients out of 108 who were taking SSRI. Van Amelsvoort et al had found that carbamazepine led to hyponatremia in patients with frequency varying from 4.8 to 40%²⁰. However in our study, 4% of the patients were taking SSRIs and 12% were on thiazides. In our study 8% patients had severe hyponatremia. Diuretic use was the most common etiology associated with severe hyponatremia. In study by Clayton et al on severe hyponatremia in a hospitalized patients 25 out of 105 patients had single etiology for severe hyponatremia which included thiazide diuretics¹⁴. In our study 10% of the patient had multiple etiological factors for hyponatremia. In study by Clayton et al 75% of the patients of hyponatremia had multiple etiologies while in study by Nzerue et al only 10.9% of the patients had multiple etiological factors^{14,2}. These studies emphasize the importance of establishing the various factors responsible for hyponatremia in the patient so that relevant corrective measures are taken during the treatment. Treatment of hyponatremia in our study was decided by the severity of hyponatremia, presence of symptoms and the underlying disorders. Patients with clinical evidence of dehydration were treated with normal saline infusion. Patients with dilutional hyponatremia were treated with fluid restriction (intake equal to the urine output in previous 24 h) and/or loop diuretics for promoting excretion of free water. In our study 14% of the patients received normal saline, 63% of the patients were on fluid restriction and 23% patients received loop diuretics. In study by Hoorn et al on severe hyponatremia in hospitalized patients, 29% patients were given normal saline, 9% patients were advised fluid restriction, 10% patients received oral sodium chloride supplementation and 19% patients received no therapy for hyponatremia whereas in study by Nzerue et al 82% of the patients received normal saline, 9% patient were given fluid restriction while 6% patients were treated with other treatment modalities such as withdrawal of drug causing hyponatremia^{21,2}. In our study hypertonic 3% saline was used for the treatment of severe symptomatic hyponatremia. 5% patients were given hypertonic saline infusion. The aim was gradual correction of hyponatremia with increase of serum sodium by 8-12meq/L in 24 hrs. In study by Nzerue et al 3% patients received hypertonic saline while in study by Hoorn et al 5% of the patients received hypertonic saline^{2,21}. The mortality in

patients with severe hyponatremia has been found to be between 20 to 27% in literature^{2,19}. The overall mortality among patients of hyponatremia in our study was 10% and 25% among patients with severe hyponatremia. Mortality was not directly related to hyponatremia but to the severity of the underlying medical condition in the patients. In 2005, Huda et al in their study found that there was 27% mortality among patients of severe hyponatremia¹⁹. In study by Nzerue et al mortality among patients with severe hyponatremia was 20.2%². In our study, congestive cardiac failure and cirrhosis of liver was the most common cause of death Papadakis et al had found that hyponatremia is an independent risk factor for mortality in patients with cirrhosis⁶. A systematic approach to the diagnosis of hyponatremia with the application of simple diagnostic algorithms, using history, clinical examination and laboratory findings to establish mechanism of hyponatremia can significantly improve the assessment and management of hyponatremia in critically ill patients.

CONCLUSION

- 62% patients were between 70-80 yrs.
- Elderly males are more commonly affected with male & female ratio of 1.6:1.
- 58% patients were symptomatic while 42% had no symptoms of hyponatremia.
- 57% of patients had hypertension & 43% of patients had diabetes as co-morbid condition.
- Maximum patient (64%) in our study belong to hypervolemic status.
- Congestive cardiac failure (40%) was the most common etiology of hyponatremia while drugs (16%) was the second most common.
- 25% of our patient had mild hyponatremia, 67% had moderate hyponatremia while 8% had it severe.
- Fluid restriction was the major treatment given in our study (63%) followed by diuretics (23%), normal saline (14%) and hypertonic saline(5%).
- The mortality was 10% in this study. Out of which, 2 (2%) patients belong to mild hyponatremia, 6 (6%) patients belong to moderate hyponatremia and 2 (2%) patients belong to severe hyponatremia

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