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Original Article

PREVALENCE AND IMPACT OF HYPONATREMIA IN ICU PATIENTS: A COMPREHENSIVE STUDY

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ABSTRACT

Objective: Hyponatremia is the most frequently reported electrolyte disorder in hospitalized patients worldwide and occasionally in outpatients. Hyponatremia term is used when serum sodium concentration is less than 135meq/l. Therefore, the present study aimed to evaluate hyponatremia patients in ICU admission and its associated comorbidities.

Methods: The study was conducted after getting due approval from the Institutional Ethics Committee. It was a cross-sectional, descriptive study comprised of 99 participants from medical and surgical ICUs of a tertiary care hospital.

Results: The frequency of hyponatremia on ICU admission was 41.41 % of all ICU admissions *P*<0.0001. Females comprised 29.2% of hyponatremic patients and 39.6% of the normal serum sodium group. The mean age of patients with hyponatremia was 34.12±21.71 years.

Conclusion: From this study, we can conclude that the prevalence of hyponatremia in exceptionally high in ICU-admitted patients and is associated with comorbidities such as T2DM, HTN, and CKD, in line with previous studies. Large multicentric studies are recommended to bring out the association with different variables.

Keywords: Hyponatraemia, Isovolemia, Hypovolemia, Hypervolemia

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INTRODUCTION

Hyponatremia is the most frequently reported electrolyte disorder in hospitalized patients worldwide and occasionally in outpatients. Hyponatremia term is used when serum sodium concentration is less than 135meq/l. About 3.4 to 39.4 percent of people in hospital admissions suffer from hyponatremia and it is higher in ICU setups [1]. Sodium is the main extracellular cation that establishes osmolality. Most of the body sodium is present in plasma extracellular fluids, 40% in bone, and the rest 2.5 % in cells and organs. Sodium is vital for life and contributes to nerve conduction, helps in the maintenance of blood pressure and plasma osmolality.

Hyponatremia may lead to morbidity and mortality depending on the severity. Hyponatremia patients present with a wide range of clinical features, from malaise, nausea, headache, seizures, lethargy, unconsciousness to even coma and death [2, 3]. Hyponatremia occurrence and complications are seen mostly in patients with several comorbidities.

Hyponatremia could be classified into hypotonic, isotonic, and hypertonic based on volume status, urinary sodium, and serum osmolality. Serum Osmolality is defined as particle or solute concentration present in body fluids. Osmolality is expressed as milli osmoles per kilogram (mOsm/kg).

The further classification of hypotonic hyponatremia is hypervolemic, euvolemic and hypovolemic. Hypovolemic hyponatremia is defined when total body sodium and total body water are decreased. Euvolemic hyponatremia is normal body sodium with an increase in total body water. Hypervolemic hyponatremia is an increase in total body sodium and increases in total body water [4].

There is an urgent need to identify hyponatremia early so that adequate treatment can be started. If treatment of hyponatremia treatment is delayed and not proper, it could lead to serious consequences and ultimately can cause morbidity and mortality [5].

There are very few studies reported on hyponatremia in ICU patients in India. Therefore, the present study aimed to evaluate hyponatremia patients in ICU admission and its associated comorbidities.

MATERIALS AND METHODS

The study was conducted after getting due approval from the Institutional Ethics Committee. It was a cross-sectional, descriptive study comprised of 99 participants from medical and surgical ICUs of a tertiary care hospital. The clinical parameters, biochemical and hematological parameters, and complete history of the patient were taken after due written informed consent. The volume status was determined using the clinical parameters. The laboratory parameters like Serum Sodium, Serum potassium, Serum urea, and serum glucose levels of the participants were analyzed using the Siemens autoanalyzer dimensions EXL-200. Serum sodium and potassium levels were measured using Siemens Ion-selective electrode analyzer. Hyponatremia was defined as serum sodium levels<136 mmol/l. The patients who were admitted in ICU with normal serum Sodium levels, i. e. 136-145 mmol/l, and the patients with Serum Sodium levels less than 136 mmol/l were included in the study. The patients with Serum Sodium levels above 145 mmol/l were excluded from the study. Patients with paraproteinemia and hyperlipidaemias (to avoid pseudo-hyponatremia) were also excluded from the study. The subjects found to have hyponatremia (<136 mmol/l) were then divided into three:

1. Mild hyponatremia: 125 mmol/l-135 mmol/l
2. Moderate hyponatremia: 110 mmol/l-124 mmol/l
3. Severe hyponatremia:<110 mmol/l

Fluid movement between the intravascular and extravascular compartments was determined by the osmotic pressure. The solute concentration known as osmolality is expressed in millimoles per kilogram of water. The serum osmolality was calculated using the formula:

$$\text{Posm} = 1.86 \times \text{Na}\left(\frac{\text{mmol}}{\text{L}}\right) + \frac{\text{Glu}\left(\frac{\text{mg}}{\text{dl}}\right)}{18} + \frac{\text{BUN}\left(\frac{\text{mg}}{\text{dl}}\right)}{2.8} + 9$$

Plasma osmolality reference range was 275-295mOsm/kg. Using the serum osmolality levels obtained, the hyponatremia patients were classified into three for the determination of etiological factors contributing to hyponatremia.

1. Ser osmolality 275-295 mOsm/kg: Isotonic hyponatremia
2. Ser osmolality<275 mOsm/kg: Hypotonic hyponatremia
3. Ser osmolality>275 mOsm/kg: Hypertonic hyponatremia

The volume status of all patients was also assessed to ascertain whether they were euvolemic, hypovolemic, or hypervolemic.

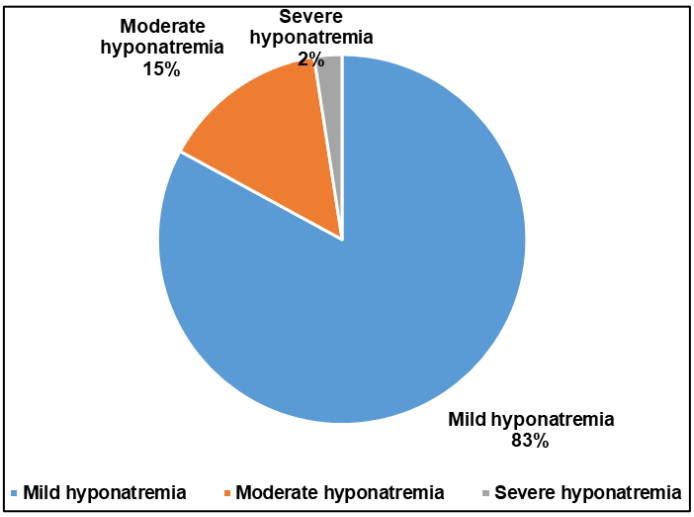

Fig. 1: Hyponatremia among the patients in our study

Table 1: Baseline characteristics of study participants

Variables	Hyponatremia	Normal Serum Sodium
Number of patients	41 (41.41%)	58 (58.58%)
Age (mean±SD)	34.12±21.71	61.09±11.28
Female Sex number (%)	12 (29.2)	23 (39.6)
Reason for ICU admission (%)		
Operative	5 (12.1)	18 (31.03)
Non-Operative	36 (87.8)	40 (68.9)
Serum Sodium level-mmol/l (mean±SD)	128.8±6.18	138.2±2.56 (p<0.0001)
Serum potassium level-mmol/l (mean±SD)	4.05±0.72	3.9±0.59 (p=0.73)
BUN (mean±SD)	14.43±14.50	25.25±23.59 (p=0.65)

Table 2: Volume status of hyponatremic patients

Patients	Hyponatremic	Percentage (%)	P-value
Euvolemic	13	31.70	0.75
Hypovolemic	27	65.85	0.0003
Hypervolemic	1	2.43	

Table 3: Hyponatremia among the patients

Hyponatremia	No. of patients	Percentage (%)
Mild	34	82.92
Moderate	6	14.63
Severe	1	2.43

Table 4: Comorbidities associated with the hyponatremia patients

Disease-associated	Number of patients	Percentage (%)
Type 2 diabetes mellitus (T2DM)	6	14.63
Hypertension (HTN)	5	12.19
Both T2DM and HTN	5	12.19
Chronic kidney disease (CKD)	4	9.75
Acute Kidney Injury	4	9.75
Others	12	29.26
NA	5	12.19
Total	41	100

The tabulation of data done in Microsoft Excel 2013 and GraphPad Prism 8 software was used to analyze the data. The demographic and biochemical parameters were demonstrated as mean±standard deviation (SD). Assessment of normal distribution was done using the Shapiro-Wilk test. For the parametric data, t-test, and non-parametric data, the Mann-Whitney U test was used to evaluate the differences between the two groups. To assess the association between the study parameters, the Spearman correlation matrix was evaluated. A probability (p) value<0.05 was significant.

RESULTS

A total of 99 patients were included in the present study. The baseline characteristic of participants is given in table 1. 58 participants were found to have normal Serum sodium (58, 58.58%). The frequency of hyponatremia on ICU admission was 41.41 % of all ICU admissions *P*<0.0001. Females comprised 29.2% of hyponatremic patients and 39.6% of the normal serum sodium group. The mean age of patients with hyponatremia was 34.12±21.71 y.

The largest group of hyponatremic patients were hypovolemic; 27 (65.85%) followed by euvolemic; 13 (31.70%) and hypervolemic; 1 (2.43%). Hypovolemia was significantly associated with hyponatremia (p<0.0003) (table 2).

Among all hyponatremic participants, 1 (2.43 %) was with severe hyponatremia, 6 (14.63%) were with moderate hyponatremia, 34 (82.92%) were with mild hyponatremia as illustrated in table 3 and fig. 1.

Among the study subjects, 6 (14.63%) were with T2DM, 5 (12.19%) were with HTN, 8 (11.42%) and 5 (12.19%) were with both T2DM and HTN, 4 (9.75%) were with CKD, 4 (9.75%) were with AKI and 12 (29.26%) were associated with other disorder like cirrhosis of liver, malaria, pneumonia, encephalopathy, seizures, sepsis, and rest 5 patients were having no comorbidities (table 4).

DISCUSSION

Hyponatremia is the cause for considerable morbidity and mortality in critically ill patients, especially those with chronic liver and heart diseases. It is also associated with increased healthcare costs and resource utilization [6, 7]. Hyponatremia is found in 1-6% hospitalized cases, whereas the incidence is much higher at 24.7% in the elderly [7, 8]. In our study, 41 out of 99 patients admitted in the ICU were suffering from hyponatremia, of which 83% were of mild variety. Five out of these hyponatremic patients were admitted due to operative causes. We found that the patients admitted due to medical causes were in the older age group compared to surgical cases. Hyponatremia is known to develop in postoperative patients in about 4.4% cases [9]. Although most patients did not suffer from altered volume status, hyperglycemia, hypovolemia, and renal failure are some of the other conditions frequently associated with hyponatremic status [9]. Another study reported that those who developed hyponatremia in post-operative conditions were more in the older age group and mostly suffering from abdominal pathology [10]. In our study, 65.85% patients were hypovolemic. Eight patients (19.5%) suffered from renal disease, acute or chronic, whereas 39% patients had either or both of T2DM and HTN. Other existing comorbidities included rheumatoid arthritis, fatty liver, pleural effusion, and infectious cause. This is in line with previous studies which reported HTN (68%), diabetes (46%), and chronic kidney disease (19%) as the major pre-existing illnesses in hyponatremic patients [7]. Furthermore, the patients were diagnosed with a myriad of etiologies, ranging from septic shock to disseminated tuberculosis, burn injury, and paralytic ileus. This emphasizes the value of considering and identifying the various factors that may be responsible for hyponatremia [11, 12].

Interestingly, neither potassium nor urea or creatinine had a significant correlation with sodium levels. Another interesting point is SIADH, which is a common cause for hyponatremia, was not present in our study population. Dietary intake is another factor that may contribute to in-hospital hyponatremia, especially in Indian settings [13]. This fits with our study, where only one patient receiving total parenteral nutrition had hyponatremia while rest of the patients had oral feeding or feeding through Ryle's tube.

There are certain limitations in our study. The presenting symptoms of the patients could not be recorded. This is crucial as vomiting is a known stimuli for the release of antidiuretic hormone and is associated with a variety of etiologies, and hence, can predispose to a hyponatremic state. Secondly, the survival data could have validated the findings of our study but could not be recorded.

From this study, we can conclude that the prevalence of hyponatremia in exceptionally high in ICU-admitted patients and is associated with comorbidities such as T2DM, HTN, and CKD, in line with previous studies. Large multicentric studies are recommended to bring out the association with different variables.

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AUTHORS CONTRIBUTIONS

All the authors have contributed equally

CONFLICT OF INTERESTS

Declared none

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