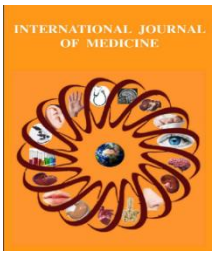

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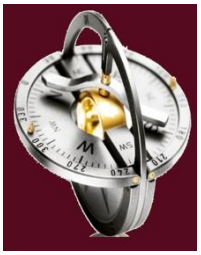

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Original Research

Clinical Profile, Etiological Spectrum and In-Hospital Outcomes of Hyponatremia Among Adult Patients Admitted to a Tertiary Care Hospital in Central India.

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Abstract

Background: Hyponatremia is one of the most frequently encountered electrolyte abnormalities among hospitalized patients and is associated with neurological manifestations, prolonged hospitalization and adverse clinical outcomes. Its etiological spectrum varies considerably according to age, comorbidities, medication exposure and underlying acute illness. *Objectives:* To evaluate the clinical profile and etiological spectrum of hyponatremia among hospitalized adult patients and to determine the association between severity of hyponatremia and in-hospital clinical outcomes. *Materials and Methods:* This hospital-based observational study included 240 adult patients admitted to the Department of General Medicine of a tertiary care hospital with serum sodium <135 mmol/L. Patients were categorized as having mild (130-134 mmol/L), moderate (125-129 mmol/L) or profound/severe (<125 mmol/L) hyponatremia. Demographic characteristics, presenting manifestations, comorbidities, probable etiology, laboratory parameters, intensive care unit (ICU) requirement, duration of hospitalization and in-hospital outcome were recorded. Factors associated with adverse outcomes were assessed using appropriate statistical tests. *Results:* The mean age of the study population was 59.2 ± 15.1 years and 132 (55.0%) patients were males. Mild, moderate and severe hyponatremia were observed in 96 (40.0%), 78 (32.5%) and 66 (27.5%) patients, respectively. Generalized weakness (52.5%), nausea/vomiting (34.6%), altered sensorium (27.1%), dizziness (24.6%) and headache (17.5%) were common presentations. Syndrome of inappropriate antidiuretic hormone secretion (SIADH) was the most frequent probable etiology (27.5%), followed by gastrointestinal fluid loss (18.3%), diuretic-associated hyponatremia (16.7%), heart failure (12.5%), chronic liver disease (8.8%) and renal disorders (7.5%). ICU admission was required in 47 (19.6%) patients. Overall in-hospital mortality was 7.9%. Mortality was significantly higher among patients with severe hyponatremia compared with those with mild or moderate hyponatremia (15.2% vs 4.2% and 6.4%, respectively; $p<0.05$). Severe hyponatremia was also associated with greater ICU requirement and longer hospital stay. *Conclusion:* Hyponatremia in hospitalized adults has a heterogeneous etiological profile and is particularly common among older patients with multiple comorbidities. Increasing severity of hyponatremia is associated with greater ICU requirement, prolonged hospitalization and higher in-hospital mortality. Early etiological evaluation, appropriate treatment of the underlying condition and careful monitoring of serum sodium may contribute to improved clinical outcomes.

Keywords: *Hyponatremia; serum sodium; SIADH; electrolyte imbalance; mortality; intensive care; hospitalized patients.*

INTRODUCTION

Hyponatremia, generally defined as a serum sodium concentration below 135 mmol/L, is the most common disorder of fluid and electrolyte balance encountered in hospitalized patients.[1,2] Its clinical significance extends beyond an isolated biochemical abnormality because disturbances in plasma tonicity may result in neurological manifestations ranging from subtle cognitive changes, nausea and gait disturbances to seizures, cerebral edema, coma and death.[1,3]

The clinical presentation of hyponatremia depends not only on the absolute serum sodium concentration but also on the rapidity of its development, underlying etiology, age and associated medical conditions. Acute reductions in serum sodium may produce severe neurological symptoms, whereas chronic hyponatremia may remain relatively asymptomatic despite considerably low sodium concentrations.[3,4].

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The causes of hyponatremia are heterogeneous. Hypovolemia secondary to gastrointestinal or renal losses, syndrome of inappropriate antidiuretic hormone secretion (SIADH), congestive heart failure, chronic liver disease, renal dysfunction, endocrine abnormalities and medications, particularly thiazide diuretics, are important etiological factors.[1,5] Elderly individuals are particularly susceptible because of age-associated changes in water homeostasis, reduced renal reserve, multiple comorbidities and polypharmacy.[6]

Several studies have demonstrated an association between hyponatremia and adverse outcomes, including increased length of hospital stay, ICU admission, readmission and mortality.[7-9] Even relatively mild reductions in serum sodium have been associated with increased mortality in hospitalized populations.[7] Nevertheless, whether hyponatremia is directly responsible for adverse outcomes or represents a marker of severity of the underlying illness remains an important clinical consideration.

There is a need for institution-specific data regarding the clinical and etiological profile of hyponatremia, particularly from tertiary care hospitals in Central India. Identification of common underlying causes and clinical predictors of poor outcome may help clinicians prioritize evaluation and monitoring.

Therefore, the present study was undertaken to assess the clinical profile, etiological spectrum and in-hospital outcomes of adult patients presenting with hyponatremia at a tertiary care hospital.

AIM AND OBJECTIVES

Aim

To study the clinical profile, etiological spectrum and outcomes of hyponatremia among hospitalized adult patients.

Objectives

1. To determine the demographic and clinical characteristics of hospitalized patients with hyponatremia.
2. To assess the severity and probable etiological spectrum of hyponatremia.
3. To evaluate the association between severity of hyponatremia and ICU requirement, length of hospital stay and mortality.
4. To identify clinical factors associated with adverse in-hospital outcomes.

MATERIALS AND METHODS

Study Design

Hospital-based observational study.

Study Setting

Department of General Medicine, Shri Balaji Institute of Medical Sciences, Raipur, Chhattisgarh, India.

Study Population

Adult patients admitted under the Department of General Medicine and found to have serum sodium concentrations below 135 mmol/L were evaluated.

Sample Size

A total of **240 patients** fulfilling the eligibility criteria were included in the analysis.

Inclusion Criteria

Patients aged ≥18 years, admitted to the Department of General Medicine, with documented serum sodium <135 mmol/L were included.

Exclusion Criteria

Patients with pseudohyponatremia, transient laboratory abnormalities not confirmed on repeat testing, incomplete clinical records, or those unwilling to participate where prospective consent was applicable were excluded.

Classification of Hyponatremia

Based on serum sodium concentration, patients were classified into:

- **Mild:** 130–134 mmol/L
- **Moderate:** 125–129 mmol/L
- **Severe/profound:** <125 mmol/L

Data Collection

Demographic characteristics, presenting symptoms, duration of illness, comorbid conditions, medication history and relevant clinical findings were documented.

Laboratory evaluation included serum sodium, potassium, urea, creatinine, glucose and other investigations considered necessary for determining the underlying cause. Serum and urine osmolality, urinary sodium, thyroid function and cortisol assessment were performed where clinically indicated and available.

Volume status was assessed clinically, and patients were categorized as hypovolemic, euvolemic or hypervolemic. The probable etiology of hyponatremia was determined using clinical history, examination, laboratory findings and associated disease conditions.

The primary outcomes assessed were ICU admission, length of hospital stay and in-hospital mortality.

Statistical Analysis

Data were entered into a spreadsheet and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation or median with interquartile range according to data distribution. Categorical variables were expressed as frequency and percentage.

The chi-square test or Fisher's exact test was used for categorical variables. Continuous variables were compared using Student's t-test, analysis of variance or corresponding non-parametric tests where appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

Baseline Characteristics

A total of 240 patients with hyponatremia were included. The mean age was **59.2 ± 15.1 years**, with the largest proportion belonging to the 61-75-year age group. There were 132 (55.0%) males and 108 (45.0%) females.

Table 1. Baseline characteristics of study participants

Characteristic	Value
Total patients	240
Mean age, years	59.2 ± 15.1
Male	132 (55.0%)
Female	108 (45.0%)
Age <45 years	42 (17.5%)
Age 45-60 years	68 (28.3%)
Age 61-75 years	91 (37.9%)
Age >75 years	39 (16.3%)
Hypertension	112 (46.7%)
Diabetes mellitus	89 (37.1%)
Chronic kidney disease	31 (12.9%)
Heart failure	34 (14.2%)
Chronic liver disease	24 (10.0%)

Hypertension and diabetes mellitus were the most frequently encountered comorbid conditions.

Severity of Hyponatremia

Of the 240 patients, 96 (40.0%) had mild hyponatremia, 78 (32.5%) had moderate hyponatremia and 66 (27.5%) had severe hyponatremia.

Table 2. Distribution according to severity of hyponatremia

Severity	Serum sodium (mmol/L)	n (%)
Mild	130-134	96 (40.0%)
Moderate	125-129	78 (32.5%)
Severe	<125	66 (27.5%)
Total	–	**240 (100%)**

Clinical Presentation

Generalized weakness was the most common symptom and was reported in 126 (52.5%) patients. Neurological manifestations, particularly altered sensorium, were more frequently observed in patients with severe hyponatremia.

Table 3. Common clinical manifestations

Clinical manifestation	n (%)
Generalized weakness	126 (52.5%)
Nausea/vomiting	83 (34.6%)
Altered sensorium/confusion	65 (27.1%)
Dizziness	59 (24.6%)
Headache	42 (17.5%)
Gait instability	27 (11.3%)
Seizures	18 (7.5%)
Reduced consciousness	16 (6.7%)

Seizures and marked reduction in consciousness occurred predominantly among patients with serum sodium concentrations below 125 mmol/L.

Etiological Spectrum

SIADH represented the most frequently identified probable cause, accounting for 66 (27.5%) patients. Gastrointestinal losses and diuretic-associated hyponatremia were also common.

Table 4. Probable etiology of hyponatremia

Etiology	n (%)
SIADH	66 (27.5%)
Gastrointestinal fluid loss	44 (18.3%)
Diuretic-associated	40 (16.7%)
Heart failure	30 (12.5%)
Chronic liver disease	21 (8.8%)
Renal disorders	18 (7.5%)
Endocrine causes	8 (3.3%)
Other/multifactorial causes	13 (5.4%)
Total	**240 (100%)**

Among medication-associated cases, thiazide-containing antihypertensive regimens constituted an important exposure, particularly among elderly patients.

Relationship Between Severity and Clinical Outcomes

ICU requirement increased progressively with increasing severity of hyponatremia.

Table 5. Severity of hyponatremia and clinical outcomes

Outcome	Mild n=96	Moderate n=78	Severe n=66	p-value
ICU admission	8 (8.3%)	14 (17.9%)	25 (37.9%)	<0.001
Mean hospital stay, days	5.8 ± 2.6	7.1 ± 3.2	9.3 ± 4.1	<0.001
In-hospital mortality	4 (4.2%)	5 (6.4%)	10 (15.2%)	0.028

Overall, 47 (19.6%) patients required ICU admission and 19 (7.9%) died during hospitalization.
The mortality rate increased from 4.2% in patients with mild hyponatremia to 15.2% among those with severe hyponatremia.

DISCUSSION

The present study demonstrates that hyponatremia represents an important clinical problem among adults admitted to General Medicine. Older individuals constituted a substantial proportion of affected patients, and hypertension and diabetes were the most frequent accompanying comorbidities.

Hyponatremia is widely recognized as the most common electrolyte disorder encountered in hospitalized patients. Spasovski et al. reported that it may be present in approximately 15-20% of emergency hospital admissions and is also frequently encountered among critically ill patients.[1] The higher proportion of elderly individuals in the present study is clinically plausible because aging is associated with impaired water excretion, reduced renal functional reserve, greater comorbidity burden and increased exposure to medications capable of altering sodium and water balance.

Mild hyponatremia constituted the largest category in the present study. However, more than one-quarter of patients had serum sodium below 125 mmol/L. The clinical consequences of severe hyponatremia were evident from the substantially greater occurrence of altered sensorium, seizures and ICU requirement in this group.

The neurological manifestations of hyponatremia result primarily from movement of water into brain cells following reduction in effective plasma osmolality. The severity of neurological manifestations is influenced by both the magnitude and rate of decline in serum sodium.[3,4] Chronic hyponatremia allows cerebral adaptation and may therefore produce fewer symptoms than an acute reduction to a similar sodium concentration.

SIADH was the most frequently identified probable etiology in our study. SIADH is an important cause of euvolemic hyponatremia and may occur in association with pulmonary diseases, central nervous system disorders, malignancy and various medications.[1,10] Careful assessment of volume status together with serum osmolality, urinary osmolality and urinary sodium remains important for etiological classification.

Diuretic-associated hyponatremia represented another important category. Thiazide diuretics are particularly relevant in elderly hypertensive patients because they impair urinary dilution and may act together with reduced solute intake, excessive water intake and other age-related physiological changes.[11]

An important observation was the relationship between severity of hyponatremia and adverse clinical outcomes. Patients with severe hyponatremia demonstrated significantly higher ICU admission, longer hospital stay and increased mortality.

Waikar et al. demonstrated an association between hyponatremia and increased mortality among hospitalized patients, including individuals with relatively mild reductions in serum sodium.[7] Other large observational analyses have similarly demonstrated that hyponatremia is associated with increased morbidity, length of hospitalization and mortality.[8,9]

It should nevertheless be recognized that the association between hyponatremia and mortality does not necessarily establish a direct causal relationship. Hyponatremia frequently accompanies severe underlying disorders including heart failure, cirrhosis, malignancy, infection and renal dysfunction. Thus, reduced serum sodium may function both as a physiological disturbance requiring treatment and as a marker of underlying disease severity.

The substantially greater ICU requirement among patients with severe hyponatremia observed in our study reinforces the importance of early recognition. Patients presenting with severe neurological manifestations require urgent management while avoiding excessively rapid correction, particularly when hyponatremia is chronic. Overly rapid correction of chronic severe hyponatremia may lead to osmotic demyelination syndrome.[1,3]

Treatment should therefore be individualized according to symptom severity, duration, volume status and underlying cause. Correction of the biochemical abnormality without addressing its etiology may result in recurrence.

The present findings highlight the practical importance of routine electrolyte assessment among elderly and acutely ill medical patients. Particular attention should be given to patients receiving diuretics and those with pulmonary disease, heart failure, liver disease, renal impairment or neurological disorders.

LIMITATIONS

The study has certain limitations. It represents a single-center experience and therefore may not reflect the etiological pattern in other settings. Assessment of volume status has an inherent subjective component. Complete measurement of serum osmolality, urine osmolality, urine sodium, thyroid function and adrenal function may not be available for every patient in routine clinical practice. Furthermore, the observational design cannot establish whether hyponatremia itself causes increased mortality or predominantly reflects the severity of underlying disease.

Future multicenter prospective studies incorporating standardized etiological assessment and serial sodium measurements may provide additional information regarding the prognostic significance of sodium correction and recurrence.

CONCLUSION

Hyponatremia is a common and clinically important electrolyte abnormality among hospitalized adult patients, particularly in older individuals with multiple comorbidities. SIADH, gastrointestinal fluid loss, diuretic use, heart failure and chronic liver disease constitute important underlying causes.

Increasing severity of hyponatremia is associated with a higher requirement for intensive care, longer duration of hospitalization and greater in-hospital mortality. Patients with serum sodium below 125 mmol/L therefore represent a particularly high-risk group requiring careful clinical assessment and monitoring.

Early identification of the underlying cause, rational correction of sodium abnormalities and appropriate management of associated diseases are essential components of effective management.

DECLARATIONS

Informed Consent

To be stated according to the approved study design and Institutional Ethics Committee requirements.

Funding

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Conflict of Interest

The authors declare no conflict of interest.

Authors' Contributions

All authors contributed to the conception and design of the study, interpretation of findings, critical revision of the manuscript and approval of the final manuscript.

Data Availability

Data supporting the findings of the study may be made available from the corresponding author upon reasonable request, subject to institutional and ethical requirements.

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