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Clinico-etiological profile of hyponatremia and its outcome in patients admitted with different types of fractures in a tertiary care centre

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Introduction

Hyponatremia is defined as a serum sodium concentration less than 135 mEq/L. Hyponatremia may be a risk factor for fracture and is associated with increased mortality. The clinical presentation has a wide spectrum, varying from asymptomatic patients to ones having seizures and coma. Unless addressed meticulously, the prognostic implications are grave and far reaching. Acute severe hyponatremia has substantially high morbidity and mortality. Elderly patients with fractures are particularly susceptible to hyponatremia because of their impaired physiology, multiple comorbidities (such as hypocortisolism, hypothyroidism, hepatic cirrhosis, renal disease, and congestive heart failure), polypharmacy (e.g., antihypertensives, antidepressants, and antiepileptics), hospitalization, perioperative fluid restrictions, and homeostatic stress from the fracture itself and the subsequent surgery. These patients are also at a higher risk of the complications of hyponatremia such as brain injury.

Chronic mild hyponatremia is usually asymptomatic and is traditionally regarded as benign. However, it is associated with a lower bone mineral content and density in nearly all regions of the hip, with more pronounced losses in the trochanteric and femoral neck regions. It can also lead to osteoporosis, abnormal gait patterns, cognitive impairment, bone demineralization, respiratory failure, noncardiogenic pulmonary edema, falls, and fractures. Compared to normonatremic individuals, hyponatremic individuals are known to have a longer time from admission to surgery.

If unrecognized in its first stages and left untreated, hyponatremia has a high rate of mortality. For this reason, an accurate clinical assessment must be made, focusing on fluid status, examining the potential etiology, and conducting the appropriate investigations. Early detection and management alters prognosis drastically.

Hyponatremia is almost always the result of an increase in circulating AVP and/or increased renal sensitivity to AVP, combined with an intake of free water; a notable exception is hyponatremia due to low solute intake. The underlying pathophysiology for the exaggerated or "inappropriate" AVP response differs in patients with hyponatremia as a function of their ECFV.

Disorders of serum Na+ concentration are caused by abnormalities in water homeostasis, leading to changes in the relative ratio of Na+ to body water. Water intake and circulating AVP constitute the two key effectors in the defense of serum osmolality; defects in one or both of these two defense mechanisms cause most cases of hyponatremia and hypernatremia. Notably, volume status modulates the release of AVP by the posterior pituitary, such that hypovolemia is associated with higher circulating levels of the hormone at each level of serum osmolality. Similarly, in "hypervolemic" causes of arterial underfilling, e.g., heart failure and cirrhosis, the associated neurohumoral activation is associated with an increase in circulating AVP, leading to water retention and hyponatremia. Therefore, a key concept in sodium disorders is that the absolute plasma Na+ concentration tells one nothing about the volume status of a given patient, which furthermore must be taken into account in the diagnostic and therapeutic approach.

Review of literature

The falls should now be regarded as a major public health issue [1]. Falls represent the second leading cause of death due to accidental injury after road traffic collisions [2]. Single and repeated falls are a special health concern in the elderly. According to recent European surveys, at least 20% of people aged 65 years or older suffer at least one fall per year [3]. A recent cross sectional study reports an increased risk of osteoporotic fracture among those with serum sodium <132mmol/L [4], while a second cross sectional study demonstrates a doubling in the risk of fracture independent of bone mineral density [5]. SIADH is a reportedly common cause of hyponatremia in EPFF along with excess hypotonic fluid, diuretic and antidepressant therapies [2].

One prospective study reports on the relationship between hyponatremia and fractures [6]. A secondary analysis of the 5208 elderly men and women participating in the Rotterdam Study reported an increased risk of nonvertebral fractures, by about 30%, among those with hyponatremia compared to those without, before and after adjustment for other confounders. However, the relationship between vertebral fractures and hyponatremia was less robust; hyponatremia was associated with a higher likelihood of prevalent but not incident vertebral fractures, and only after adjusting for confounders.

There are several mechanisms by which low serum sodium might contribute to an increase risk of fracture. Hyponatremia, even when mild, might increase the risk of falls and fall related fractures by causing gait instability and attention deficits [1, 15]. One study reported that the threshold for gait deficits associated with hyponatremia was 134 mmol/L and 132 mmol/L for attention deficits [15]. Hyponatremia studies that include models adjusted for BMD still find a significant association between hyponatremia and fracture [17]. Assessment of BMD with DXA in mild hyponatraemic subjects may not represent the best available method to address microstructural skeletal alterations [18]. Study conducted by Kirsten Cumming Graeme E. Hoyle, James D. Hutchison *et al*. Showed a prevalence of 27.04 % of hyponatremia in fragility fractures in elderly patients [19]. Although it had previously been assumed that euvolemic hyponatremia is the commonest type, this study shows that hypovolemic hyponatremia is predominant in fragility fractures [19].

Research question

What is the clinico-etiological profile of hyponatremia and its outcome in patients above 60 years, admitted with fracture in the department of Orthopaedics of Government TD Medical College, Alappuzha?

Primary objective

To study the clinico-etiological profile of hyponatremia and its outcome in patients above 60 years, admitted with fracture in the department of Orthopaedics of Government TD Medical College, Alappuzha.

Materials and methods

Study design

Prospective observation study

Study setting

Department of Orthopaedics, Government TD Medical College, Alappuzha.

Study period

Study period will be six months from the date of ethics committee clearance

Study population

Patients of the age above 60 years, admitted with fracture in the Department of Orthopaedics of Government TD Medical College, Alappuzha, who are detected to have hyponatremia either at the time of admission or during the period of hospital stay.

Sample size

Sample size calculated using the formula:

$$n = \frac{4pq}{d^2}$$

Where, p = prevalence; q = 100 – p; d = 20%p

Study conducted by Kirsten Cumming Graeme E. Hoyle, James D. Hutchison *et al*., Prevalence of hyponatremia in fracture patients was 26. Total number of patients was 127.

(4x 26 x74) / (5.2x5.2) =7696/27.04 =284

Sample size= 300

Inclusion criteria

All patients of the age above 60 years, admitted with fracture with hyponatremia in the Department of Orthopaedics of Government TD Medical College, Alappuzha.

Exclusion criteria

1. Patients not willing to give consent
2. Age < 60 years
3. Associated head injury (CT scan proven)
4. Road traffic accidents

Study variables

- Age
- Gender
- Site of fracture (vertebral/ nonvertebral)
- Type of facture (closed / open)
- Osteoporosis present/not
- Symptoms of hyponatremia present / not?
- Serum sodium levels – mild / moderate / severe (classify)
- Relation of severity of hyponatremia with GCS
- Type of hyponatremia- hypovolemic / euvolemic / hypervolemic
- Sodium correction attained or not
- Number of days required for sodium correction
- Complications of sodium correction, if any
- Effect of sodium correction on outcome
- Surgical procedure done
- Duration of hospital stay
- Final outcome Improved / died

Data collection tool

Proforma of the study

Data collection procedure

All patients satisfying the inclusion criteria, who are admitted in the department of Orthopaedics, during the study period, will be included in the study, after obtaining a written informed consent. Those who are not able to give the consent due to altered sensorium, consent will be taken from the relative.

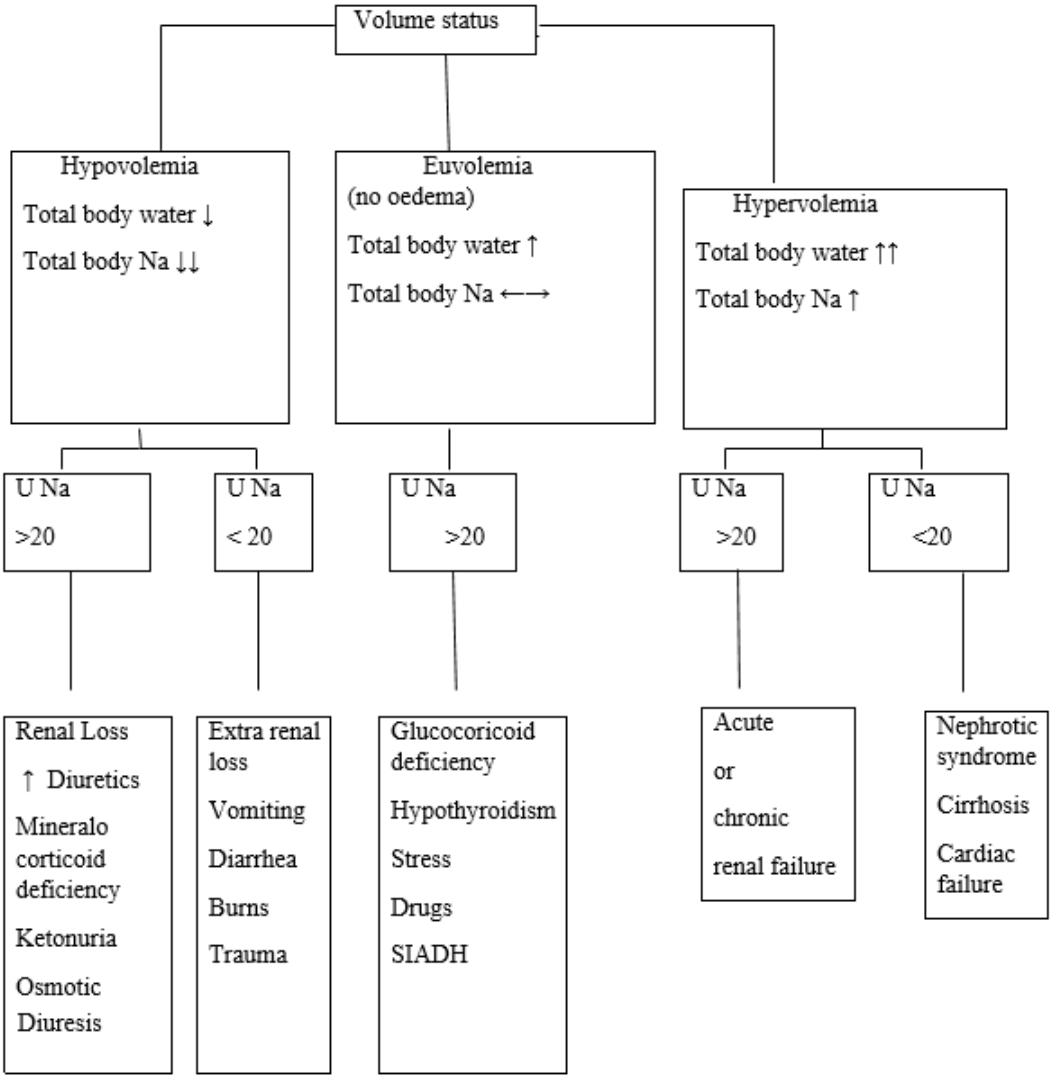
Detailed history and physical examination, including the Glasgow coma scale scoring will be done as per the proforma. Relevant X Rays will be taken according to the site of fracture. Patients will be subdivided diagnostically into three groups, depending on clinical, history and volume status ie; hypovolemic, euvolemic and hypervolemic. Urine sodium assay will be done in all patients.

Patients will be followed up daily. Daily assessment of the Glasgow coma scale (GCS) will be done, to understand the relationship between severity of hyponatremia and GCS. Those who are undergoing surgery also will be included in the study. Blood samples will be sent for CBC, RBS, Urea, Creatinine, Calcium, Potassium and LFT. Serum sodium will be measured upon admission, on alternate days, on the day before surgery and every 48 h thereafter until hospital discharge. Serum Sodium will be classified as mild (134-130), moderate (120-129) and severe (<120).

TSH will be sent for all patients. Relevant X rays will be taken according to the fracture site. Chest X ray and ECG will be taken for all patients. Echocardiogram will be done whenever necessary.

The number of days required for sodium correction will be assessed. The method of sodium correction used in each patients will be assessed (oral / IV, NS / Hypertonic saline). The effect of sodium correction on the GCS will be assessed and the final outcome defined as improved or died, will also be assessed. Complication of sodium correction if occurs, that also will be noted.

Diagnostic approach to hypernatremia



Data analysis

Data will be entered into excel sheet and analysis shall be done using SPSS software.

Quantitative variables will be expressed as mean and standard deviation while Qualitative variables as proportion and percentage.

Ethical consideration

Study will be conducted after getting approval from Institutional Ethics Committee.

A written informed consent will be taken from all participants in the study. If the patient is not in a state to give informed consent, eg: unconscious patient, then the consent will be taken from the close relative staying as bystander and reconsent will be taken, once patient becomes fit for giving consent.

Expected outcome

Hyponatremia will be one of the most common electrolyte imbalances among fracture patents. It will be having varying symptomatology, extending from nausea, vomiting to seizure and even respiratory arrest. Patients with hyponatremia will be showing poor outcome compared to normal.

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