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Original Research Article

A retrospective study of electrolyte imbalance among elderly patients and its relationship to the outcome and duration of stay in emergency

Kalash Chander*

Department of Medicine, Sub-District Hospital, Kot-Bhalwal, Jammu, Jammu and Kashmir, India

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***Correspondence:**
Dr. Kalash Chander,
E-mail: kalashchander2404@gmail.com

ABSTRACT

Background: Electrolyte imbalance (EI) is a measurable biochemical parameter that determines the clinical manifestations of interactions between various metabolic events like: hydration deficiencies, hormones deficiencies, vascular events, sepsis, etc. The aim of the study was to investigate the frequency of EI among elderly patients who present to the emergency department (ED), with regards to type and severity, and the association with age and sex of the patient, hospital stay, readmission, and mortality.
Method: A hospital based prospective observational study was conducted on randomly selected 190 patients with EI, attending medicine OPD of sub-district hospital Bishnah, district Jammu, J and K, for a period of 6 months.
Results: The median age of all patients was 69 years, with 43.68% patients were females. EIs were mostly mild, the most common EI was hyponatremia (14.74%). The 65 patients suffered from an either kind of severe EI. The 116 (61.05%) patients had no EI, 59 patients had one EI and 15 patients had two or more than two EIs. Median stay for patients with normal to mild/moderate to severe hyponatremia and hypernatremia was 3 and 5 days and 3 and 7 days respectively. Among all admitted patients, there were 20.5% (39) readmissions within 30 days from discharge during the study period.
Conclusions: Increasing severity of EI was associated with longer hospital stay. Health-care personnel should be effectively trained in the diagnosis and management of EIs.

Keywords: EI, Emergency department, Hydration deficiencies, Sepsis

INTRODUCTION

Electrolyte imbalance (EI) is very common among hospitalized patients as well as in general public. EI has an established association with the increased morbidity and mortality of patients. Clinically, dysnatremia, dyskalemia, dyscalcemia, dysmagnesemia and dysphosphatemia are most important indicators of the status of various regulating mechanisms of human body.[1,2] EI is a measurable biochemical parameter that determines the clinical manifestations of interactions between various metabolic events like: hydration deficiencies, hormones deficiencies, vascular events, sepsis, etc.

In an ED, the prevalence of hyponatremia is reported to range from 2.3-44%, while prevalence of hypernatremia is 1.1-4.4%, hypokalemia 10.2-39%, hyperkalemia 0.8-13%.[2,3] EI, especially Na and K, among elderly population, caused during hospital stay, often becomes a life-threatening condition.[4] Majority of such cases can be of chronic kidney disease and use of diuretics.[5] However, orthopedic emergencies and cases of falls among elderly, are presented with hyponatremia and sometimes hypophosphatemia.[6,7] EI is quite prevalent among the elderly, in the form of a comorbidity among patients with diabetes mellitus, acute or chronic renal failures, myocardial infarctions, and other critical issues. However, most previous studies have investigated one or two specific electrolytes in a selected group of patients

with a single disease (e.g., heart or kidney disease), or in patients in a particular risk group (e.g., intensive care patients or patients using diuretics).[8,9] Previous studies have shown an association between EI and increased hospital length of stay and a correlation between hyponatremia and rate of readmission.[10-12]

Although EI is frequently found in clinical practice, there are few studies which have examined frequency and outcomes in among elderly patients admitted to the ED. As very few studies have examined the occurrences of EI among patients, of all ages, admitted with emergencies of various kinds, in a tertiary care hospital, therefore this study was planned to fill the study gap. As the available research data pertains to the imbalances of specific electrolytes and also in relation to specific risk group, our study will be a relevant and useful tool that would provide valuable data in inferences about general electrolyte disturbances in an ED. Therefore, we aimed to investigate the prevalence and severity of sodium and potassium imbalances among all adult patients visiting the ED, as well as imbalances of albumin-corrected calcium, free calcium, magnesium and phosphate levels in patients where these electrolytes were measured. And the aim of the current study was to study EI and its relationship to outcome and duration of stay in the ED of GMC Jammu.

METHODS

This study is a hospital based prospective observational study was conducted on 190 patients with EI, attending medicine OPD of Sub-District Hospital Bishnah, District Jammu, J and K, by way of random sampling technique, over a period of 6 months: i.e., from July 2021 to December 2021.

Inclusion criteria

Patients showing EI, belonging to both genders, with age >50 years; admitted patients and already filed investigations for EI (Na, K, etc.,).

Exclusion criteria

Patients showing no EI or with age ≤50 years; patients under intensive care and patients using diuretics were also excluded.

Sampling method

Five ml of venous sample was collected from anterior cubital vein and after centrifugation serum will be separated for the estimation of electrolytes on Abott Architect fully automatic analyzer.

Age, sex, patient category (medical or surgical), serum-electrolyte values and serum-albumin and glucose levels were registered for each patient studied. Serum-sodium levels were corrected for serum-glucose by lowering the sodium concentration by 2.4 mmol/l for every 5.5 mmol/l increase in glucose to account for the diluting effect of hyperglycemia.[14]

Table 1: The reference range or normal adult laboratory values of serum electrolytes.

Particulars	Reference values
Albumin, serum	3.5-5.0 g/dl (35-50 g/l)
Calcium, serum	9.0-11.0 mg/dl (2.25-2.75 mmol/l)
Sodium, serum	136-146 meq/l (136-146 mmol/l)
Potassium, serum	3.5-4.5 meq/l (3.5-4.5 mmol/l)
Fasting glucose	70-115 mg/dl (3.89-6.38 mmol/l)
Magnesium, serum	1.3-2.1 meq/l (0.65-1.05 mmol/l)
Phosphorus (inorganic), serum	3.0-4.5 mg/dl (1.0-1.5 mmol/l)

Hospital stay was recorded, especially readmission within 30 days post-discharge, and in-hospital, 30-day, and 1-year mortality. Data were extracted from the hospital's department of medical biochemistry database and the patient administrative system.

The study was conducted after taking due approval from institutional ethics committee. The results were analyzed using MS excel software (latest version).

Based on prior studies which have observed EI among similar populations and demographies, and considering the power of study at 85%, margin of error: 5%, minimum sample size came out to be: 189, which was taken as 190 for the betterment of the study. The data were analysed using MS excel 2010 software.

Statistical mean and standard deviation were calculated and resultant data was subjected to chi square test to find out the difference that exists between our observed values and the values we expected, if there were no relationship at all in the population. Categorical data and descriptive statistics were presented as frequencies and percentage. P value was also found out for ascertaining the significance of data. P<0.05 was taken as significant.

RESULTS

The median age of all patients was 69 years. 83 (43.68%) patients were females and only 53 (27.89%) were referred for surgery. Only 40% belonged to the age group of >70 years (Table 2).

EIs were mostly mild, and the most common EI was hyponatremia (glucose-corrected) (14.74%). Hypokalemia, hypercalcemia and dysmagnesemia were also frequent among patients. In total, out of 190 patients studied, 65 patients suffered from an either kind of severe EI. 116 (61.05%) patients had no EI, 59 patients had one EI and 15 patients had two or more than two EIs.

The median serum-glucose level was 6.2 (5.5-7.4) mmol/l, among ED visits with hyperglycemia, s glucose >6.0 mmol. The 14.74% patients had hyponatremia and 11 (5.79%) had hypernatremia (Table 3).

Table 2: Parameters of study participants, (n=190).

Social demographic, clinical and biochemical characteristics	Patients with EI, (n=190) (%)	Chi-square; p value
Gender (male/females)		
Male	107 (56.32)	0.353
Female	83 (43.68)	
Age (years)		
50-70	114 (60.00)	0.031
>70	76 (40.00)	
Hospital stay (mean±SD) in days	11.5±4.8	
≤3	67 (35.26)	0.001*
>3	123 (64.74)	

Table 3: Frequency of EI cases.

EI	Moderate to severe EI, N (%)
Glucose corrected sodium	
Hyponatremia	28 (14.74)
Hypernatremia	11 (5.79)
Potassium	
Hypokalemia	15 (7.89)
Hyperkalemia	23 (12.10)
Calcium (free)	
Hypocalcemia	6 (3.16)
Hypercalcemia	9 (4.74)
Magnesium	
Hypomagnesemia	9 (4.74)
Hypermagnesemia	0 (0)
Phosphate	
Hypophosphatemia	2 (1.05)
Hyperphosphatemia	4 (2.10)

The median hospital stay among admitted patients was 4 days. While 96 (50.53%) of the patients were admitted for 1-3 days, 53 (27.89%) patients were admitted for 4-6 days and 41 (21.58%) were admitted for >6 days. Patients with increasing severity of EI had longer hospital say as compared to the patients with normal electrolyte measurements (Table 4).

Among all admitted patients, there were 20.5% (39) readmissions within 30 days from discharge during the study period. Patients with hyponatremia accounted for 13 (33.33%) of these readmissions (Table 4).

After adjusting for other EIs and comorbidities, hypernatremia, hyperkalemia, hypercalcemia, and hyperphosphatemia were still associated with increased in-hospital mortality.

Table 4: Hospital stays with respect to the degree of severity of the EI.

EI	Median length of hospital stays (days)	
	Among normal to mild cases	Among moderate to severe cases
Glucose corrected sodium		
Hyponatremia	3	5
Hypernatremia	3	7
Potassium		
Hypokalemia	3	7
Hyperkalemia	4	5
Calcium (free)		
Hypocalcemia	3	6
Hypercalcemia	3	6
Magnesium		
Hypomagnesemia	4	6
Hypermagnesemia	NA	NA
Phosphate		
Hypophosphatemia	4	4
Hyperphosphatemia	4	5

DISCUSSION

This is the first study of a non-selected, adult ED patient population describing the prevalence of EI according to type, severity, and associations to outcomes such as hospital stay, readmission, and mortality. Nearly half of the patients exhibited at least one type of EI, but most were mild. Increasing severity of EI was associated with longer hospital stay.

In our patient population, we observed a high prevalence of hyponatremia (14.74% of patients, glucose-corrected sodium) and hypokalemia 15 (7.89%), but a lower prevalence of hypernatremia, hyperkalemia, and albumin-corrected hypocalcemia. These findings are in line with previous prevalence studies Lee et al and Terzian et al in ED which have shown a high prevalence of hyponatremia and hypokalemia.[3,14]

Most of our patients with EI were older (>60 years of age), suggesting that aging is an important determinant for developing EI. Indeed, impairment of renal function and changes in neurohumoral homeostasis during aging are well established. In addition, medical conditions, more prevalent in older people, is likely to contribute to EI in this population.[15]

The values of prevalence of abnormal levels of magnesium and phosphate cannot be termed as representative since these two electrolytes were only measured when indicated by the attending physician. When measured, patients with magnesium and phosphate values in the normal range had a median hospital stay of 4 days, compared with only 2 days among patients with sodium and potassium values in normal range.

A probable explanation for this observation is that magnesium and phosphate levels are often measured in patients with symptoms of malnutrition, weight loss, arrhythmias, renal failure, as well as old age.

Because of the diluting effect of hyperglycemia on sodium concentration, the true value of s-sodium in hyperglycemic patients is glucose-corrected sodium.[13] One previous study demonstrated the superiority of glucose-corrected serum-sodium to predict mortality over measured serum-sodium, and the authors suggested that glucose-corrected serum-sodium should be considered in studies analyzing serum-sodium.[16]

It is well known that dysnatremia is associated with longer hospital stay. According to a recent meta- analysis by Corona et al, investigating 46 studies, mean hospital stay was 3 days longer in hyponatremic patients.[17] In our study, the median stay for patients with normal to mild / moderate to severe hyponatremia and hypernatremia was 3 and 5 days and 3 and 7 days respectively. Results were, however, differently poised for patients with hypokalemia and hyperkalemia. While the median hospital stay is perhaps shorter than expected in patients with severe hyperkalemia, it was noted that most of these patients faced renal failure and thus were transferred to the nearby healthcare facility for dialysis. Hyperkalemia has the potential for causing fatal arrhythmias in patients with kidney disease, cardiovascular disease, and diabetes mellitus, because therapeutic interventions may be required, which can induce or worsen hyperkalemia.[18]

The most common cause of hyperphosphatemia and hypermagnesemia is also chronic kidney disease, which is particularly prevalent in older patients with other co-morbidities including cardiovascular disease.[19] Hyperphosphatemia can be associated with increased all-cause mortality in the general population.[20] Hypermagnesemia, on the other hand, may cause impairment of both cardiac systolic contraction and diastolic relaxation in addition to serious arrhythmia.[21]

This study also has its limitations owing to its sample size, which was predominantly elderly population in late 60s, mostly with co-morbities. We were unable to establish clear link with other potentially confounding variables, including past medical history and treatments or any known history of chronic EIs. Furthermore, since the study was only performed in one hospital, the results could vary between centers, regions, or countries, which limit the generalization and true prevalence.

CONCLUSION

All the findings make this study very productive as imbalances in electrolytes are required to be considered in a combined and associated fashion; all examinations must be done to clarify the clinical scenario for an effective treatment. The results go on to demonstrate that EIs are common in patients admitted to an ED at a local urban hospital, and that patients with EI have an increased risk of prolonged length of stay, readmission, as well as mortality. Thus, EIs increase consumption of health care resources. Health-care personnel should be effectively trained in the diagnosis and management of EIs. Future studies should investigate whether an increased focus on EI detection, follow-up, and treatment can lower the duration of hospital stay, readmission, and mortality.

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