



## RESEARCH ARTICLE

### ELECTROLYTE IMBALANCE IN THE PATIENTS ADMITTED TO THE EMERGENCY DEPARTMENT OF THE TERTIARY CARE HOSPITAL OF SMHS HOSPITAL, SRINAGAR

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#### ABSTRACT

**Background:** Water comprises 45% - 60% of the body weight and total body water being divided into intracellular fluid (ICF) and extracellular fluid (ECF). The principal electrolytes in the ECF are sodium, chloride and bicarbonate, with other ions (such as potassium, calcium and magnesium) in much lower concentrations. In the ICF potassium and magnesium are the primary cations with phosphate and sulfate being the major anions and other ions in lower concentrations.

**Materials and Methods:** A total of 3231 patients over 18 years of age and gender matched participated in the study. Lab investigations like Serum Electrolytes (Na/K), Kidney function test (KFT) and Blood sugar was done on fully automatic Siemens Biochemistry Analyser (Germany) in the casualty lab of Biochemistry, SMHS Hospital Srinagar.

**Results:** Hyponatremia was observed overall in 21.4% patients with 22.2% males and 20.5% females. Hyponatremia was seen in 1.1% of the studied group among whom 0.8% were females and 1.3% were males. Hypokalemia was observed in 32.2% of the patients among whom, 32.8% were females and 31.7% were males. Hyperkalemia was found overall in 8.0% of the patients with 8.4% males and 7.4% females. In this study 59.8% patients were found to have normal levels of potassium with equal percentage of 59% in both males and females.

**Discussion and Conclusion:** Patients admitted to the emergency department with electrolyte imbalance requires close evaluation and frequent lab draws depending on the duration and severity of underlying disease states. This being important not only to monitor the symptomatic improvement or signs of the disease state, but also to track the rate of correction (and prevent over-correction).

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#### INTRODUCTION

Among the most common clinical conditions encountered in the patients admitted to the emergency department of the tertiary care hospital are the disturbances in the fluid and electrolytes that can be very fatal especially in critically ill patients. Maintenance as well as stability of fluid and electrolytes is of particular importance for biochemical and physiological activities of a normal person as well as the management of various clinical conditions encountered in the emergency setting like severe burns, trauma, sepsis, chronic renal failures, cardiovascular events etc. Involved in maintaining homeostasis in the body, various studies have reported that fluid and electrolyte imbalance is associated

with the increased morbidity and mortality in a broad spectrum of patients from asymptomatic to critically ill patients (Liamis et al., 2013 and Lee et al., 2000). Water comprises 45% - 60% of the body weight and is influenced by age and the lean body mass whereas it remains remarkably constant in a healthy person. Total body water being divided into intracellular fluid (ICF) which represents about two-thirds of total body water and extracellular fluid (ECF) which representing one-third is divided into two compartments: (a) plasma water, comprising approximately 25% of ECF, or 5% of body weight; and (b) interstitial fluid, comprising 75% of ECF, or 15% of body weight (<http://www.accessmedicine.com>). Composition of the fluids varies from one compartment to another. The principal electrolytes in the ECF are sodium, chloride and bicarbonate, with other ions (such as potassium, calcium and magnesium) in much lower concentrations.

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In the ICF potassium and magnesium are the primary cations with phosphate and sulfate being the major anions and other ions in lower concentrations. Body fluids such as intestinal and gastric secretions also contain electrolytes. Though diverse in their combinations the elements excreted through the gastrointestinal system are isotonic in nature and have to be compensated necessarily by using isotonic salty fluids (Schwartz *et al.*, 1999). Electrolyte disorders being common in the clinical practice are usually multifactorial in nature. Various pathophysiological factors, such as acid-base abnormalities, gastrointestinal absorption capacity, nutritional status, pharmacological agents and other diseases (mainly renal disease) or acute illness, alone or in combination, play a key role (Liamis *et al.*, 2013). Although mechanisms like hormonal interactions of antidiuretic hormone, aldosterone and parathyroid play important roles in the regulation of fluid and electrolyte balance but kidneys are the principal organs responsible for retention and excretion of electrolytes and fluids in a healthy individual and in the maintenance of homeostasis (Bockenkamp and Vyas, 2003 and ArifKadriBalci *et al.*, 2013). Critically ill patients often experience alterations in distribution, absorption and excretion of fluids and electrolytes and very often they represent the complications from the disease underlying and the severity of imbalance reflects the magnitude of disorder. Thus frequent monitoring and evaluation of the fluid status and concentration of electrolytes is an essential requirement in the course of treatment in such patients. Electrolyte imbalance being a common cause of in-hospital morbidity there is an absolute requirement of their prompt recognition as well as treatment of such abnormalities in critically ill patients so as to avoid any fatal complications in the progression of disease (Kaplan and Kellum, 2010 and Kraft *et al.*, 2005). Various studies have reported about the clinical prevalence of electrolyte imbalance more frequently in elderly and critically ill patients attending the emergency department for various diseases such as chronic renal failures, cardiovascular events, Diabetes mellitus etc. (Ito *et al.*, 1989; Goldberg *et al.*, 2004 and George Liamis *et al.*, 2014). Present study aims to provide the information regarding the pattern of electrolyte abnormalities and to evaluate the characteristics of such patients admitted in the emergency department of SMHS Hospital, Srinagar.

## MATERIALS AND METHODS

The retrospective study was conducted on patients attending the emergency department of SMHS Hospital over a period of four months from October 2017 – Jan 2018 after getting ethical approval. A total of 3231 patients over 18 years of age and gender matched participated in the study. Patients attending the Radiotherapy, chemotherapy and burn wards were excluded. After admission and clinical examination of patients in the emergency department, data was collected from the patients. Complete information of demographic and clinical parameters was recorded. A total of 3.0 ml blood sample was taken in heparinized vials from patients by phlebotomists. After centrifugation at 4000 rpm, the separated serum was analysed for investigations like Serum Electrolytes (Na/K), Kidney function test (KFT) and Blood sugar. Analysis was done on fully automatic Siemens Biochemistry Analyser (Germany) in the casualty lab of Biochemistry, SMHS Hospital Srinagar.

**Statistical Analysis:** The data was statically analysed on SPSS version 20 (Chicago, IL). Categorical data was analysed using Pearson's Chi square and Fisher's exact test.

Association between variables was considered to be statistically significant at  $p < 0.05$ .

## RESULTS

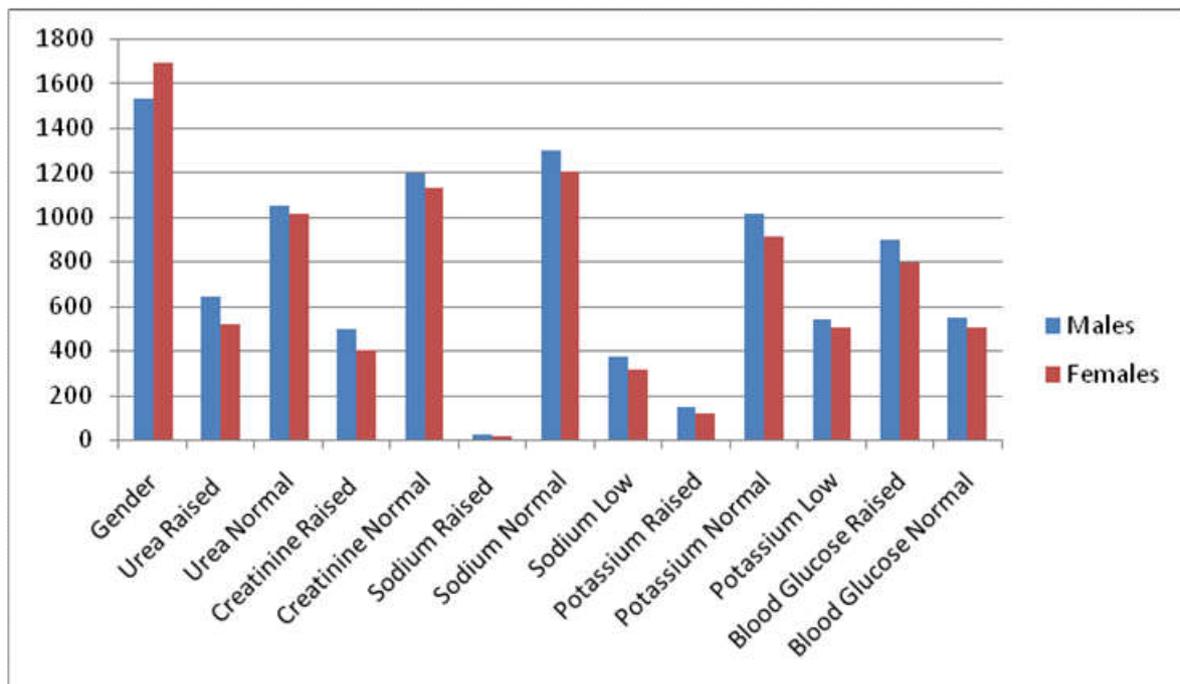
In the present study which comprised of 3231 patients attending the emergency department of S.M.H.S. hospital Srinagar, 1534(47.5%) were females and 1697 (52.5%) were males in the age group above 18 years with a mean age of  $41.75 \pm 19.03$  years and Fishers Exact Test of 0.491. Among the patients, 1696 (52.5%) were diabetic which comprised of 797 (52.0% )females and 899 (53.0% ) males.410(12.7%) patients were pre-diabetic with equal percentage of 12.7% in both males and females within the gender. 1053 (32.6%) were normal with no history of diabetes that included 503(32.8%) females and 550(32.4%) males. It was observed among the studied patients that 1161(35.9%) had raised levels of urea with 518(33.8%) females and 643(37.9%) males. 2070(64.1%) patients were having normal levels of urea which included 1016(66.2%) females and 2070(64.1%) males. Raised levels of Creatinine were found in 897 (27.8%) patients with 496(29.2%) in males and 401 (26.1%) in females. Most of the patients attending the emergency department had normal levels of Creatinine. 2334 (72.2%) subjects had normal Creatinine levels with 1133(73.9%) females and 1201(70.8%) males. Frequency of electrolyte distribution in the study group :Hyponatremia was observed overall in 21.4% patients with 22.2% males and 20.5% females. Hypernatremia was seen in 1.1% of the studied group among whom 0.8% were females and 1.3% were males. Maximum number of patients studied had normal levels of sodium with 1207(78.7%) females and 1299(76.5%) males, and overall percentage of 77.6% (2506) having normal levels of sodium. Hypokalemia was observed in 1041(32.2%) of the patients among whom, 503(32.8%) were females and 538(31.7%) were males. Hyperkalemia was found overall in 257(8.0%) of the patients with 8.4% males and 7.4% females. In this study 59.8% patients were found to have normal levels of potassium with equal percentage of 59% in both males and females. (Table 1, Figure 1).

## DISCUSSION

Being crucial to the functioning of every cell in the body, the electrolytes are tightly regulated which involves considerable energy in order for the homeostasis to be maintained. For the sustenance of the normal physiological functioning of the muscles and nerves the electrolyte gradients are precisely controlled between the intracellular and extracellular compartments of the body. Apart from their regulation of acid-base balance of the body fluids ; maintenance of the osmotic pressure of the body fluids by regulation of water balance, the electrolytes help to preserve the normal neuromuscular irritability by maintaining a state of equilibrium on account of their relative proportion in the ECF and ICF. Disorders of the systems responsible for maintaining the stability of the electrolytes (like kidneys, hormonal activities of antidiuretic hormone, aldosterone and parathyroid hormone) may deteriorate the balance in electrolytes and result in emergencies. Government S.M.H.S. Hospital being a tertiary care hospital provides health services particularly the clinically advanced diseases and complicated patients. So the present study was undertaken to investigate the electrolyte status among the patients admitted to the emergency department of the hospital, keeping in view the clinical importance of this entity.

**Table 1. Demographic profile & electrolyte status of the patients studied**

Parameters	Gender		Total n(%)	Pearson Chi- Square	Fisher's Exact Test	P-Value
	Female	Male				
	1534(47.5%)	1697(52.5%)	3231		0.491	
Blood Glucose (mg/dl)						
H/O Diabetes >110	797(52.0%)	899(53.0%)	1696(52.5%)	1.48		0.685
Pre-Diabetic 100-110	195(12.7%)	215(12.7%)	410(12.7%)			
Normal 70-100	503(32.8%)	550(32.4%)	1053(32.6%)			
Hypoglycemia<70	39(2.5%)	33(1.9%)	72(2.2%)			
Serum Urea (15-40mg/dl)						
Normal	1016(66.2%)	1054(62.1%)	2070(64.1%)		0.008	
Raised	518(33.8%)	643(37.9%)	1161(35.9%)			
Creatinine (0.5-1.3mg/dl)						
Normal	1133(73.9%)	1201(70.8%)	2334(72.2%)		0.028	
Raised	401(26.1%)	496(29.2%)	897(27.8%)			
Sodium (131-150mmol/l)						
Normal	1207(78.7%)	1299(76.5%)	2506(77.6%)	3.04		0.21
Hyponatremia	314(20.5%)	376(22.2%)	690(21.4%)			
Hypernatremia	13(0.8%)	22(1.3%)	35(1.1%)			
Potassium (3.5-4.9 mmol/l)						
Normal	917(59.8%)	1016(59.9%)	1933(59.8%)	1.30		0.52
Hypokalemia	503(32.8%)	538(31.7%)	1041(32.2%)			
Hyperkalemia	114(7.4%)	143(8.4%)	257(8.0%)			

**Figure 1. Demographic profile & electrolyte status of the patients studied**

Most common abnormality seen in the study group was the history of diabetes, overall 52.5% were found to be diabetic with higher number (53%) in males than in females (52%). Electrolyte imbalance in diabetes is primarily a result of elevated blood glucose. With hyperglycemia, the body tries to rid itself of the excess blood glucose by increasing urinary output. Increased urination produces water and electrolyte loss, which then upsets the body's balance of electrolytes. The balance is especially disturbed between sodium and potassium. Since the results of electrolyte imbalance can be severe, managing electrolytes is a major issue in diabetic care. In the present study 35.9% were having raised urea levels with the higher number in males (37.9%) than in the females (33.8%). A raised level of Creatinine was found in 27.8% of the total patients studied with higher number (29.2%) males and 26.1% females.

The most common electrolyte abnormality found in the group studied was hypokalemia and was found in 32.3% of the patients studied. Second most common electrolyte abnormality observed in the patients attending the emergency department of S.M.H.S. Hospital was Hyponatremia (21.4%). Hyperkalemia was found in 8.0% of the patients and the least common electrolyte imbalance found was that of hypernatremia. 1.1% of the patients were found to be having hypernatremia. Disturbances in potassium levels being common may be associated with significant mortality and morbidity. Studies have reported hyperkalaemia as one of the most common and potentially lethal electrolyte abnormality and estimated to occur in approximately 1% -10% of hospitalized patients (Paice *et al.*, 1983; Moore and Bailey, 1989 and Shemer *et al.*, 1983) and the studies limited to the emergency department have reported the rates of Hyperkalemia from 0.36%- 2.6%

(Muschart *et al.*, 2014; Fleet *et al.*, 2012; Ookuma *et al.*, 2015). Major etiologies included renal failure (83%) and potassium increasing drugs (75%) (Muschart *et al.*, 2014). The studies associated with the incidence and outcomes of hypokalemia in the emergency department are limited. In a study reported by Marti *et al.*, 11% had hypokalemia at presentation (Marti *et al.*, 2014). Another common electrolyte disorder encountered in clinical medicine is that of Hyponatremia the prevalence of which ranges from 3 million to 6 million individuals per year in the United States. In the emergency department approximately 3-6% of the adult patients have Hyponatremia and the incidence of hospital-associated Hyponatremia has been reported to be 10%-30% depending on the patient population with severe Hyponatremia accounting for 1% of patients. As has been noted previously such patients have longer stay in the hospital with increased risk of death than the patients with normal serum sodium levels, overall the mortality of Hyponatremia ranges from 3% to 29%. Leading causes of Hyponatremia in the patients of emergency department are the use of diuretics and syndrome of inappropriate antidiuretic hormone secretion (Harring *et al.*, 2014; Henry, 2015 and Olsson *et al.*, 2013).

## Conclusion

Patients admitted to the emergency department with electrolyte imbalance requires close evaluation and frequent lab draws depending on the duration and severity of underlying disease states. This being important not only to monitor the symptomatic improvement or signs of the disease state, but also to track the rate of correction (and prevent over-correction). Most patients undergoing therapy for the electrolyte abnormalities require longer hospital stays depending upon the severity and acuity of different electrolytes and nursing requirements wherein the more critical ones may require admission to the intensive care unit. Patients with milder symptoms respond to the early treatment of electrolyte abnormalities and may be considered for discharge from the department of emergency with close follow-up. The data generated will provide more information for the consultants in the emergency department and will contribute in reducing mortality rates in the emergency department.

## Conflict of Interest

There was not any conflict of interest.

## Acknowledgment

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