RESEARCH ARTICLE

ELECTROLYTE ABNORMALITIES IN PATIENTS ADMITTED IN EMERGENCY DEPARTMENT OF TERTIARY CARE INSTITUTE: A CROSS SECTIONAL STUDY

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ABSTRACT
Background: Electrolyte disorders are common in patients in the emergency department and have been associated with increased morbidity and mortality. In this respect sodium, potassium and calcium are the most important cations, whose improper adjustment may cause severe disorders in neuromuscular, gastrointestinal, respiratory and cardiovascular systems.
Aims & Objectives: This study intends to assess the prevalence of electrolyte abnormalities in patients hospitalized in emergency department of Government Medical College, Srinagar.
Materials and Methods: A cross–sectional descriptive study was conducted among 11,000 patients admitted in emergency department. Simple stratified sampling was done to select the patients hospitalized in emergency ward. A semi-structured questionnaire containing the socio-demographic variables was prepared. Meanwhile, biochemical test for sodium, potassium, calcium, bicarbonate, serum creatinine, and blood urea were carried out. The data was collected and analyzed using SPSS 11.5 version.
Results: Frequency distribution of electrolyte abnormalities was as follows: Hyponatremia 49%, hypernatremia 7%, hypokalemia 36%, hyperkalemia 16%, hypocalcemia 6% and hypercalcemia 3%. Bicarbonate levels were: low levels 18%, high levels 9%. 21% and 16% of patients had blood urea and creatinine more than the normal range respectively. A total of 42% of patients hospitalized in emergency department had nonsurgical problems and 58% of the patients had surgical problems. The most common electrolyte abnormality was related to variation in serum sodium and potassium levels in the form of hyponatremia and hypokalemia.
Conclusion: The prescription of fluid therapy in emergency is a common clinical event. The foundations that underpin such therapy should be understood by all clinicians involved in the short-term care of patients admitted in emergency. The routine measurement of the renal function tests and electrolytes is thus warranted in all patients hospitalized in emergency departments for the early detection of any possible derangement(s).
Key Words: Electrolyte Abnormalities; Hyponatremia; Hypokalemia; Bicarbonate; Blood Urea; Creatinine

Introduction

The rational intervention into electrolyte abnormalities is best orchestrated by a physician knowledgeable about fluid and electrolyte physiology, who understands the root cause(s) of the derangement, the pathophysiology of the derangement, and the best approach to restoring fluid and electrolyte homeostasis. In the first half of the 20th century, Gamble[1] and Darrow and colleagues[2] defined the electrolyte content of extracellular, intracellular and interstitial fluid compartments. The electrolyte content within each compartment is distinctly different from that of the other.

Stability of fluids and electrolytes are important parameters for physiological and biochemical activities in a normal person. This is the aspect that takes a special importance in pathological states, especially with the patients hospitalized in emergency department. It may cause disorder in the abilities of body systems for the maintenance of newly arising needs under pathological conditions.[3] The composition of fluids varies from one body compartment to another. In extracellular fluid (ECF), the principal electrolytes are sodium, chloride, and bicarbonate. Other electrolytes such as potassium, calcium, and magnesium are also present but in much smaller quantities. The composition of intracellular fluid (ICF) differs significantly from that of ECF. Potassium and magnesium are the primary cations present in ICF, with phosphate and sulphate being the major anions. As in ECF, other electrolytes are present within the cell, but in much smaller concentrations.

Other body fluids such as gastric and intestinal secretions also contain electrolytes. In spite of diversity in their combinations, the elements excreted through the gastrointestinal system are isotonic in nature, and they necessarily should be compensated for by using isotonic salty fluids.[4] Normal and unusual fluid and electrolyte losses must be replaced if homeostasis is to be maintained. Regulating levels of calcium in the body is more complex than the other major electrolytes, because calcium balance can be affected by many factors. Imbalances of this electrolyte are relatively common.

Acute kidney injury (AKI) is a syndrome that is identified with a relatively rapid decrease in renal function, resulting in the accumulation of fluids, crystalloid salts and nitrogen metabolites in the body.[5] A large proportion of patients presenting to the emergency department either have or develop AKI later in the hospital. The scale of the AKI burden in the emergency department is not known. However, the key issue is that even relatively minor acute changes in serum creatinine and blood urea, independent of underlying aetiology, represent significant deterioration of renal function and are associated with poor outcome.[6]

Whereas there are no well-developed data on electrolyte disorders of the patients admitted in emergency, this study intends to provide more information about these abnormalities in order to reduce mortality rates in emergency department.

Materials and Methods

This cross–sectional descriptive study was conducted on 11,000 patients admitted in emergency department for the period of one year in the Government Medical College, Srinagar. Simple stratified sampling was used to select the patients. After having the study explained, verbal informed consent was taken from the patients/attendants of the patients. The estimation of the parameters was carried out immediately. The samples were analyzed for serum total calcium, by the O-Cresolphthalein complexone method[7] and for serum sodium and potassium, by the ion selective electrode method[8], bicarbonate by blood gas analyzer and blood urea and creatinine using Urease and Jaffe's method respectively.[9,10] The data was collected and analyzed using SPSS 11.5 version.

Results

The results are expressed as mean ± SD. Out of 11,000 patients included in the study, 7040 were males and 3960 were females, with mean age of the patients being 41.75 **±** 19.03. Table 1 depicts demographic profile and electrolyte status of the patients under study. Table 2 (Figure 1) and Table 3 depict distribution of patients according to specialities, under which patients were admitted. Frequency distribution of electrolyte abnorm-alllities was found to be as follows: Hyponatremia 49%, hypernatremia 7%; hypokalemia 36%, hyperkalemia 16%; hypocalcemia 6% and hypercalcemia 3%. Bicarbonate levels were: low levels 18%, high levels 9%.

Table-1: Demographic profile & electrolyte status of patients under study

Parameters		Mean ± SD	N
Age		41.75 ± 19.03	11000
Sex	Male		7040 (64%)
	Female		3960 (36%)
Serum Sodium (mmol/L)	Low	127.3 ± 4.82	5390 (49%)
	Raised	147.28 ± 1.79	770 (7%)
	Normal	140.32 ± 3.09	4840 (44%)
Serum Potassium (mmol/L)	Low	2.91 ± 0.32	3960 (36%)
	Raised	5.71 ± 0.72	1760 (16%)
	Normal	4.24 ± 0.42	5280 (48%)
Serum Calcium (mg/dL)	Low	7.11 ± 0.71	660 (6%)
	Raised	11.15 ± 0.78	330 (3%)
	Normal	8.86 ± 0.68	10010 (91%)
Bicarbonate (mmol/L)	Low	15.54 ± 3.98	1980 (18%)
	Raised	33.3 ±2.33	990 (9%)
	Normal	23.7 ± 3.32	8030 (73%)
Blood Urea (mg/dL)	Raised	87.19 ± 29.09	2310 (21%)
	Normal	32.00 ± 7.76	8690 (79%)
Serum Creatinine (mg/dL)	Raised	2.03 ± 0.37	1760 (16%)
	Normal	0.79 ± 0.22	9240 (84%)

Table-2: Distribution of patients according to speciality under which admitted

Department	Number of patients
Surgery (+ Allied specialities)	6380 (58%)
Medicine (+ Allied specialities)	4620 (42%)
Total	**11000 (100%)**

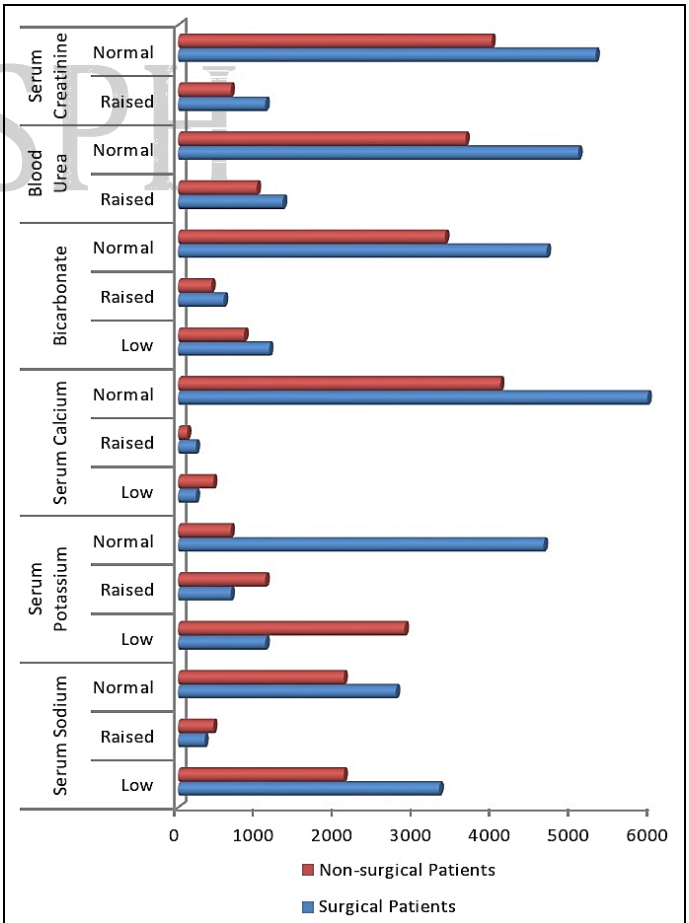

Figure-1: Categorization of patients according to surgical and non-surgical departments

21% showed high blood urea levels and 16% of patients

had creatinine more than the normal range. A total of 42% of patients hospitalized in the emergency department had nonsurgical problems and 58% of the patients had surgical problems. The most common electrolyte abnormality was related to variation in serum sodium and potassium levels in the form of hyponatremia and hypokalemia.

Table-3: Categorization of patients according to surgical and non-surgical departments

Parameters		Surgical Patients	Non-surgical Patients	Total number of patients
Serum Sodium	Low	3300	2090	5390
	Raised	330	440	770
	Normal	2750	2090	4840
Serum Potassium	Low	1100	2860	3960
	Raised	660	1100	1760
	Normal	4620	660	5280
Serum Calcium	Low	220	440	660
	Raised	220	110	330
	Normal	5940	4070	10010
Bicarbonate	Low	1148	832	1980
	Raised	574	416	990
	Normal	4658	3372	8030
Blood Urea	Raised	1320	990	2310
	Normal	5060	3630	8690
Serum Creatinine	Raised	1100	660	1760
	Normal	5280	3960	9240

Discussion

Adjustment of the combination of body fluids is one of the most important aspects of patient care. The importance of this subject is doubled with the patients admitted in emergency department - in a way that their improper combination causes severe disorders in all systems. For example, renal disorder will cause an increase in creatinine and urea levels and accumulation of fluids, salt and nitrogen metabolites.

64% of the patients in this study were males and 36% females. 67% out of them were less than 45 years of age. Markedly varying results of electrolyte disturbances were found, which might be explained by the fact, that most of them were referral cases with lack of proper fluid and electrolyte management; hence explaining the reason for conducting this study.

A study, carried out by Dautd and Hanish[11] on 237 patients, showed that 6.30% of the patients suffered from hyponatremia. However, the present study proved over 8 times of the aforesaid rate (49%), which suggests that dyselectrolytemia might be more prevalent in the developing countries, as compared to developed countries. Further, higher number of cases of hyponatremia can be explained by the following reasons[11]: surgical stress compounded by accumulation of fluids because of concurrent cardiac and renal failure, and extreme use of fluids with improper rate of administration of electrolytes. Higher incidence of hypokalemia (36%) and hyperkalemia (16%) could be explained by the same reasons. The study by Polderman revealed, that incidence of hypernatremia was 8.9% in concordance with our results of 7%.[12] Majority of the patients (73%) showed normal bicarbonate levels, whereas 18% of the patients showed low bicarbonate levels, and these were the patients admitted with medical problems. The highest occurrence of elevated urea and creatinine levels were seen with medicine patients. Lack of reception of proper fluids, using nephrotoxic medications and infections were the major factors associated with acute renal failure. Further, it was found that the incidence of hypocalcemia was 6%, and that of hypercalcemia was 3%. The extensive search did not reveal any literature mentioning the incidence of hyper- or hypocalcemia in patients admitted in emergency department.

In the present study some of the electrolytes such as chloride and magnesium were not included. However, keeping in view the large number of cases that were detected suffering from imbalance in the electrolytes studied, it would be worthwhile to plan a large study including all the major electrolytes.

Conclusion

This study emphasizes the high prevalence of hidden cases of deranged renal functions and electrolyte disorders, very often in combination, among patients admitted to emergency ward. The prescription of fluid therapy in emergency is a common clinical event. The foundations that underpin such therapy should be understood by all clinicians involved in the short-term care of patients admitted in emergency. The routine measurement of the renal function tests and electrolytes is thus warranted in all patients hospitalized in emergency departments for the early detection of any possible derangement(s).

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