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A study on electrolyte abnormalities among ICU patients admitted in a tertiary care hospital of south india

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ABSTRACT

Background

Electrolyte abnormalities are common in patients admitted to intensive care units, which is associated with increased morbidity and mortality. Among the electrolytes sodium, potassium and bicarbonate are the common electrolytes which can produce disturbances in cardiovascular, respiratory, neuromuscular and gastrointestinal systems.

Aims and Objectives

This study is aimed at assessing the prevalence of electrolyte abnormalities among patients admitted in intensive care unit of Tertiary care hospital.

Materials and methods

A retrospective study was done among 198 patients admitted in I.C.U of Tertiary Care Hospital during a period of 1 year from Jan 1st 2015 to Dec 31st 2015. A data containing the socio-demographic variables was prepared. Bio chemical parameters including serum sodium, potassium, bicarbonate were taken into account and the data was analyzed using SPSS 24.0 version.

Results

The electrolyte abnormalities are as follows: Hyponatremia 18.18%, Hypokalemia 8.58%, Hyperkalemia 3.03%. Bicarbonate levels were low in 14.14%. Among the patients with electrolyte abnormalities 12.1% were diabetic, 19.5% were hypertensive, 41.46% were both hypertensive and diabetic and 26.82% were non diabetic and non hypertensive. 63.4% of the patients had sepsis and 29.26% needed ventilator support. In our study group, 9.75% had Acute Kidney Injury, 9.75% had CKD-3, 4.87% had CKD-4 and 26.28% had CKD-5. The prevalence of stroke in our study group was 26.82% and 39% of the population had adverse lipid profile. Mortality rate was 12.2% among the study group with dyselectrolytemia.

Conclusion

Hyponatremia was the most common electrolyte abnormality and Sepsis being the most commonly associated comorbidity. This study emphasizes the importance of early diagnosis and management of electrolyte abnormalities which is quite often missed.

Keywords: *Electrolyte abnormalities, Hyponatremia, Dyselectrolytemia, ICU*

INTRODUCTION

Intensive care patients have a unique set of problems ranging from nutritional, endocrine, metabolic, respiratory and hemodynamic complications. Addressing all these issues and restoring them to normalcy is a herculean task as all these abnormalities are interlinked. One such parameter is the electrolyte abnormalities which is the stepping stone for this study. In early years of 20th century, Gamble [1] and Darrow [2] defined the electrolyte content of various compartments which include extra cellular, intercellular and interstitial fluid compartments.

In a given individual, stability of fluids and electrolytes are the foremost prerequisites for physiological and biochemical activities which gets deranged during a pathological stress, especially with the patients admitted to intensive care unit [3]. The composition of the fluids differs among the various compartments in our body. In the extra cellular fluid (ECF), the prime electrolytes are sodium, chloride and bicarbonate. Others like potassium, calcium and magnesium are present in smaller quantities. The composition of intra cellular fluid (ICF) varies significantly from ECF. The major cations in ICF are potassium and magnesium whereas, the major anions are phosphate and sulphate. Like ECF, ICF has other electrolytes in smaller quantities.

Other body fluids such as intestinal and gastric secretions also contain electrolytes. In spite of heterogeneity in their compositions, the electrolytes excreted via gastrointestinal system are isotonic in nature and their replacement during a

G.I loss should be by isotonic salty fluids [4]. Among the various electrolyte abnormalities encountered in ICU patient's hyponatremia tops the list which is often associated with multi organ failure. The incidence of hyponatremia in an ICU is about 30% of which administration of hypotonic fluids is the foremost factor resulting in hospital acquired hyponatremia [5]. On the other hand, Hypernatremia is less frequent than hyponatremia but carries a very high mortality risk of 40-70% [6]. The most common causes include administration of hypertonic bicarbonate solutions, excessive use of diuretics and renal water loss due to a renal disease [7].

Perhaps one of the most supplemented electrolyte in ICU is potassium. Abnormalities of metabolic, cardiovascular system are more commonly associated with hypokalemia whereas, tachyarrhythmia's and muscle weakness are potentially life threatening [8].

Carbon dioxide and water form carbonic acid which is in equilibrium with hydrogen and bicarbonate ions. A change in the concentration of the reactants on either side will affect the subsequent direction of the reaction. The most common complications in ICU arises due to decreased bicarbonate and decreased pCO₂ (partial pressure of carbon dioxide) leading to metabolic acidosis which can be effectively combated by intravenous supplementation of bicarbonate. The common causes for non anion gap metabolic acidosis include renal pathologies like renal tubular acidosis and renal failure. High anion gap acidosis is seen in Ketoacidosis and Lactic acidosis.

MATERIALS AND METHODS

This Retrospective study was conducted on 198 patients who got admitted in intensive care unit of a Tertiary care hospital over a period of one year. Out of which 41 patients had electrolyte abnormalities whose bio chemical values are taken up for the study. The levels of serum sodium, potassium which were done by the ion selective electrode method and bicarbonate by blood gas analyzer were taken into account. The mode of correction of these electrolyte abnormalities included 0.9% saline, 0.45% saline for hyponatremia, oral and intra venous potassium supplementation for hypokalemia, intravenous

bicarbonate supplementation for low serum bicarbonate levels. Calcium gluconate, Insulin plus glucose, beta-agonists and dialysis were the modes of management for hyperkalemia. The data was collected and analyzed using SPSS 24.0 version.

RESULTS

The results were expressed as mean± SD. Out of 198 patients, 41 (20.7%) had electrolyte abnormalities of which 25 (61%) were males and 16 (29%) were females of which 56% of the total population with dyselectrolytemia were below 45 years.

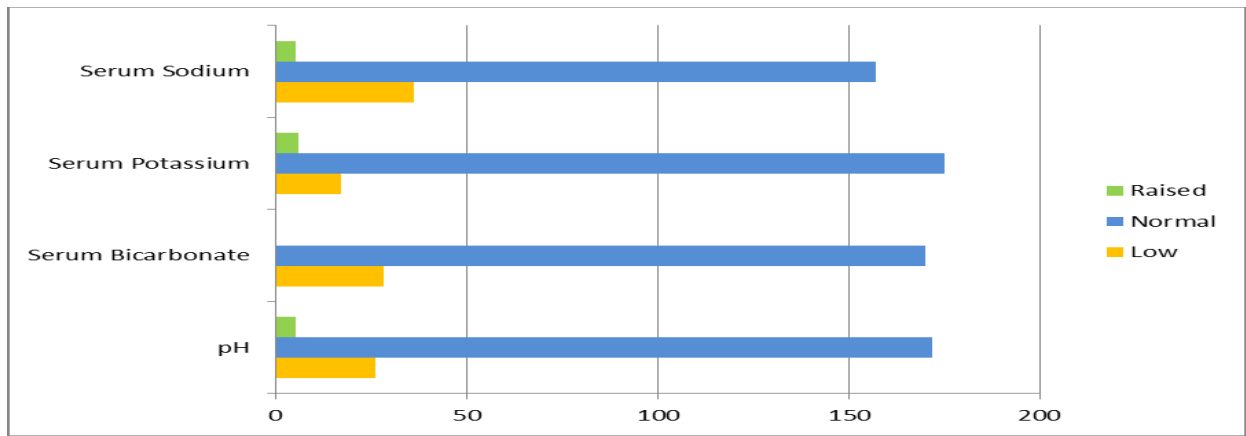


Figure-1: Distribution of electrolyte abnormalities in the study population

Table-1 and Figure-1 depict the demographic profile and status of the electrolytes among the study population. Table-2 and Figure-2 depict the associated co morbidities among the patients with dyselectrolytemia. Frequency distribution of electrolytic abnormalities was found as follows: Hyponatremia 18.18%, Hypernatremia 2.52%, Hypokalemia 8.58%, Hyperkalemia 3.03%. Bicarbonate levels were low in 14.14% of the patients. Among the 41 patients with electrolytic abnormalities 12.1% were only diabetic, 19.5% were only hypertensive, 41.5% were both diabetic

and hypertensive and the remaining 26.9% were non-diabetic and non-hypertensive. Adverse lipid profile was noted in 39%, Altered sensorium in 34.1%, stroke in 26.8%, Sepsis in 63.4% of the population. Among the renal abnormalities 9.75% had Acute kidney injury, 9.75% had CKD stage-3, 4.87% had CKD stage-4 and 26.8% had CKD stage-5. A total of 19.5% of the patients needed dialysis and 29.26% required ventilator support. The mortality among the patients with dyselectrolytemia was 12.2%.

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

Parameters		Mean±SD	N
Serum sodium (mmol/l)	Low	124.03 ± 4.81	36 (18.18%)
	Raised	144.23 ± 1.23	5 (2.52%)
	Normal	136.38 ± 1.05	157 (79.2%)
Serum Potassium (mmol/l)	Low	2.86 ± 0.41	17 (8.58%)
	Raised	5.79 ± 0.23	6 (3.03%)

Serum Bicarbonate (mmol/l)	Normal	4.27 ± 0.61	175 (88.38%)
	Low	15.06 ± 4.28	28 (14.14%)
	Raised	-	-
pH	Normal	7.37 ± 0.02	172 (86.86%)
	Acidosis	7.17 ± 0.1	26 (13.13%)
	Alkalosis	-	-

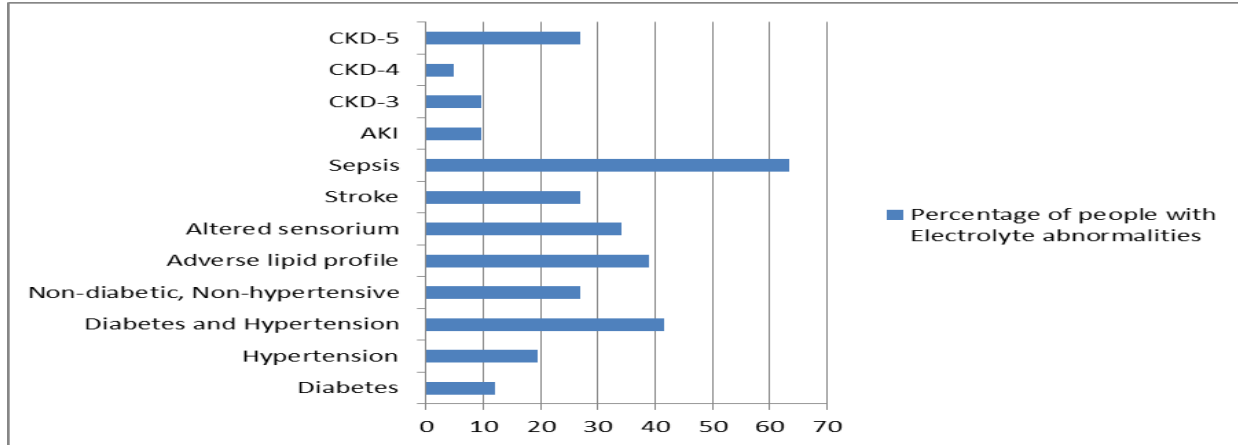


Figure-2: Association of various co-morbidities among the patients with dyselectrolytemia

Table-2: Demographic profile and associated co-morbidities among the patients with electrolyte abnormalities

Associated Co-Morbidities	Number of patients (n=41)
Diabetes	5 (12.1%)
Hypertension	8 (19.5%)
Diabetes and hypertension	17 (41.46%)
Non-diabetic, non-hypertensive	11 (26.82%)
Adverse lipid profile	16 (39%)
Altered sensorium	14 (34.14%)
Stroke	11 (26.82%)
Sepsis	26 (63.41%)
AKI	4 (9.75%)
CKD-3	4 (9.75%)
CKD-4	2 (4.87%)
CKD-5	11 (26.82%)

The most common electrolyte abnormalities were Hyponatremia, reduced bicarbonate levels and Hypokalemia respectively.

DISCUSSION

Adjustment in combination of body fluids is one of the prime aspects of patient care. The importance is doubled when the patient is admitted in ICU – in a way that improper combinations cause severe disorders in all the systems. For example, renal insufficiency causes the

accumulation of fluids, salt, nitrogen metabolites with deranging urea and creatinine levels.

67% of the study population were males and 33% were females of which 56% were below 45 years of age. Markedly varying electrolytic abnormalities were found which might be explained by the fact that most of them are referral cases with improper fluid and electrolyte management hence

explaining a solitary reason in conducting this study.

In a study conducted by Dautd and Hanish [9] on 237 patients, the prevalence of hyponatremia was 6.3%. However, the present study proved three times of the aforesaid rate (18.18%), which might suggest that dyselectrolytemia is more prevalent in developing countries than in developed countries. Higher number of cases of hyponatremia in our study can be explained by associated renal failure (both acute and chronic) and extreme use of fluids without proper rate in administration of electrolytes [9]. The same reason holds true for high incidence of hypokalemia (8.58%) and hyperkalemia (3%). The study by Polderman [10] revealed that incidence of hyponatremia was 8.9% which is in discordance with our study. The study by Najeeb et al [11], showed the

prevalence of decreased bicarbonate levels in 18% of the ICU patients which is in concordance with our study where 85.86% had normal bicarbonate levels and 14.14% had low levels of bicarbonate. In the present study some of the electrolytes like calcium, chloride and magnesium were not included and would be worthwhile to plan a large study including all the major electrolytes.

CONCLUSION

Hyponatremia was the most common electrolyte abnormality and Sepsis being the most commonly associated co-morbidity. This study emphasizes the importance of early diagnosis and management of electrolyte abnormalities which is quite often missed.

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