

Relation between serum electrolytes & serum creatinine levels in diabetes mellitus

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Abstract

Aim: Diabetes mellitus with altered renal function is associated with the disturbed pattern in serum electrolytes. There arises a need to evaluate the serum electrolytes in diabetic patients according to the stage of the renal function. The main of the study is to study the serum electrolytes in diabetic patients depending on the serum creatinine levels.

Materials and Method: The study was conducted in a retrospective way by going through the records of the patients diagnosed as type 2 diabetics. Fasting blood sugar, serum creatinine and serum electrolytes [Na⁺, K⁺, Cl⁻] values were noted down and patients were separated into three groups depending on the serum creatinine values. Group 1 [n=104] included patients with serum creatinine <1.5mg/dl, Group 2 [n=77] included patients with creatinine 1.5-3 mg/dl and Group 3 [n=19] with creatinine > 3 mg/dl.

Results: Among 200 diabetic patients 52% were in group 1 and only 9.5% patients were in group 3. Serum sodium was observed normal in 61% of group 1 patients, even then 39% of group 1 diabetics had altered serum sodium levels. 69% of group 3 diabetics had hyponatremia. Moreover 74% of diabetics of group 3 had hyperkalemia. Hypochloremia is also common in the group 3 diabetics of raised creatinine.

Conclusion: It was observed that serum electrolytes were even altered in diabetic patients with normal creatinine belonging to group 1. The abnormality of serum electrolytes like hyponatremia, hyperkalemia and hypochloremia were common in diabetic patients as the renal function start deteriorating. Thus it indicates the need for the evaluation of the serum electrolytes in diabetic patients.

Keywords: Diabetes Mellitus, Serum Electrolytes, Hyponatremia, Hyperkalemia, Hypochloremia.

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Introduction

Morbidity to mortality may happen with serum electrolyte disturbances and they may occur even in asymptomatic patients with no associated symptoms. The electrolyte disturbance may even underlie among the diabetic patients with the normal renal function.⁽¹⁾ The common diseases which are commonly leading to the electrolyte imbalance are diabetes mellitus with renal function, multi drug regimen, acid base disorders and mal-absorption.⁽²⁾ The acid base disorders are more common with the diabetic patients and which may lead to the renal disorders and henceforth the electrolyte disorders.^(3,4) The common risk factors for the electrolyte imbalance are the vomiting, diuretic usage, alcoholism, hypertension and renal dysfunction.⁽⁵⁾ Even though these are common causes of electrolyte imbalance, there arises a need to evaluate the electrolyte picture in diabetic patients. Hence this study was conducted to analyse the electrolyte profile in the diabetic patients depending on the renal functional capacity which was measured based on the serum creatinine value of the diabetic patients.

Materials and Method

This study was conducted tracing the medical records of 234 patients in a retrospective aspect. Both outpatients and inpatients were included in the study of Narayana medical college hospital. The basic medical history along with drug history was collected. The values of the parameters like FBG [fasting blood

glucose], PPBS [post prandial blood glucose] serum creatinine and Na⁺, K⁺, Cl⁻ were collected from the medical records of the patients. Those with incomplete medical records of 34 patients were excluded from the study and finally only 200 patients were included in the study. They were categorised into three groups based upon the serum creatinine values. Group 1 included diabetics with serum creatinine <1.5mg/dl, group 2 with serum creatinine 1.5-3mg/dl and group 3 with serum creatinine >3 mg/dl. The electrolyte pattern in all the group of patients were analysed and recorded. Sodium value of >150 mEq/L was considered as hypernatremia and <135 mEq/L as hyponatremia. Potassium levels > 5mEq/L as hyperkalemia and <3.5 mEq/L as hypokalemia. Regarding chloride values >109 mEq/L as hyperchloremia and <96 mEq/L as hypochloremia. Statistical analysis was done with SPSS version 21. Mean, SD and percentages were calculated.

Results

In the study the age group of the patients were of 50-70 years. Most of the patients were males and of Type 2 diabetes mellitus, which have been tabulated in the Table 1 as seen below. They were categorised into groups and most of them belonged to group 1 [52%] and least patients in group 3 [9.5%] of raised serum creatinine as shown in the Table 2 & Fig. 1. Sodium levels were normal among 61% of group 1 diabetics and hyponatremia was observed among 40% of the group 2 and higher percentage of 69% among group 3

diabetics and it was depicted in Table 3 & Fig. 2. As it was analysed 52% of diabetics of normal renal function had normal potassium values, but higher percentages of group 2 and group 3 of abnormal renal function had hyperkalemia as shown in Table 4 & Fig. 3. Even hyponatremia was also common among the group 3 diabetics as described in Table 5 & Fig. 4. As we analyse the data in detail we come to know that group 1 diabetics even with normal renal function had abnormal sodium levels [39%] and abnormal potassium levels [38%].

Table 1: Pattern of the study population

	Group1 [n=104]	Group [n=77]	Group3 [n=19]
Age	55±2.3	65±4.8	61±5.6
Male	68	46	11
Female	36	31	8
Type 1 DM	7	5	2
Type 2 DM	97	72	17

Table 2: No: patients and their percentage in each group

	No. Patients [n=200]	Percentage %
Group 1 [creatinine <1.5mg/dl]	104	52%
Group 2 [creatinine 1.5-3.0mg/dl]	77	38.5%
Group 3 [creatinine >3mg/dl]	19	9.5%

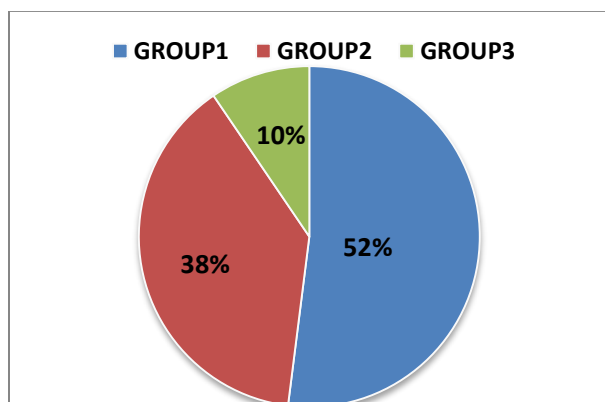


Fig. 1: Percentage patients in each group

Table 3: Percentage of patients with normal and abnormal sodium levels [hypernatremia and hyponatremia]

Groups	Normal sodium	Hypernatremia	Hyponatremia
Group 1	61%	29%	10%
Group 2	37%	23%	40%
Group 3	13%	18%	69%

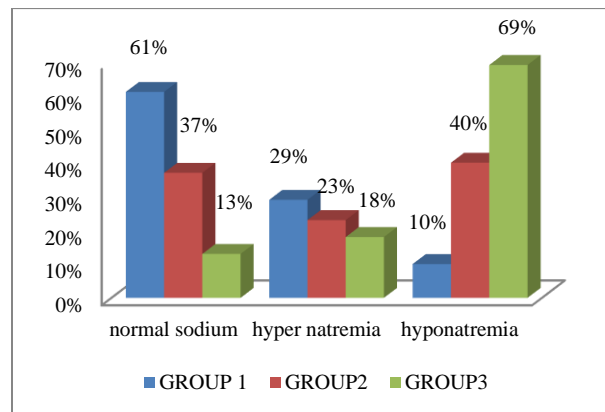


Table 4: Shows the percentage of patients with normal and abnormal potassium levels [hyperkalemia and hypokalemia]

Groups	Normal potaasium	Hyperkalemia	Hypokalemia
Group 1	52%	31%	17%
Group 2	38%	51%	11%
Group 3	18%	74%	8%

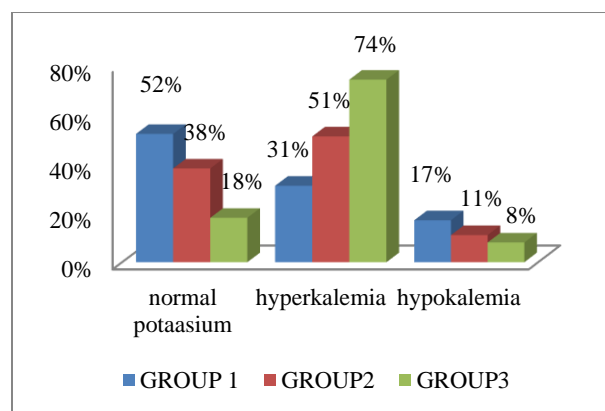
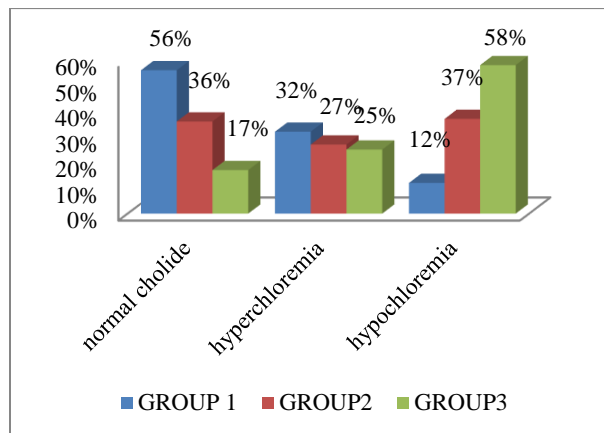


Fig. 3: Percentage of patients with normal and abnormal potassium levels [hyperkalemia and hypokalemia]

Table 5: Percentage of patients with normal and abnormal chloride levels [hyperchloremia and hypochloremia]

Groups	Normal chloride	Hyperchloremia	Hypochloremia
Group 1	56%	32%	12%
Group 2	36%	27%	37%
Group 3	17%	25%	58%

**Fig. 4: Percentage of patients with normal and abnormal chloride levels [hyperchloremia and hypochloremia]**

Discussion

Electrolyte disorders are commonly seen in drug intake, gastrointestinal absorption, associated renal diseases, acute illness, hyper tension and diabetes mellitus. The cause is multifactorial and involves many pathophysiological conditions including the acid base abnormalities. The electrolyte derangement is also seen in patients from asymptomatic to critically ill patients.⁽⁶⁾ The metabolic disorder associated with these causes being the diabetes mellitus involves the different patterns of electrolyte disorders.⁽⁷⁾ Diabetes basically in later stages leads to the derangement of the renal function called the diabetic nephropathy and further progression of the disease leads to the end stage renal disease [ESRD].⁽⁸⁾ The micro vascular complication of the diabetes, loss of podocytes and epithelial dysfunction cause the diabetic kidney disease [DKD].⁽⁹⁾ The association of diabetes with the electrolyte disorders has been explained in many studies.⁽¹⁰⁻¹³⁾ Hyperkalemia is more common in diabetic patients than the healthy people, as the reduced glomerular filtration of potassium and decreased excretion of potassium is seen in diabetics.⁽¹⁴⁾ Hyporeninemic hypoaldosteronism is associated with the decreased renal tubular excretion of potassium and is more commonly seen in diabetic patients with impaired renal function. Hyperkalemia is more common in the group 3 patients as there is more impairment of the renal function as compared to the

normal patients.⁽¹⁵⁻¹⁷⁾ Dilutional hyponatremia occurs in the diabetic patients due to hyperglycemia. The excess glucose being more active osmotically absorbs more fluid from the cells into the serum and leads to the dilutional hyponatremia of diabetics.⁽¹⁸⁾ The interaction between the insulin and vasopressin and the altered vasopressin increases the reabsorption of hypotonic fluid by increasing the aquaporin expression.⁽¹⁹⁻²⁰⁾ The hyperlipidemia in diabetic patients causes a < 80% reduction of water fraction of serum. This leads to an artificial reduction of serum sodium measured per liter of serum, causing pseudohyponatremia. In diabetic patients there will be impaired insulin mediated glucose metabolism and glucagon dependent glucose release, which leads to the hypernatremia. Hypokalemia is seen due to the redistribution of potassium from the extra cellular compartment to the intracellular. There is loss of K⁺ due to motility disorders in GIT and osmotic diuresis in diabetic patients.^(21,22) In DKA K⁺ will be shifted from cell to the intravascular space and causes the shift hyperkalemia without alteration in the total body potassium.⁽²³⁾ In elderly diabetics the common cause of hyperkalemia is hyporeninemic hypoaldosteronism.⁽²⁴⁾

Conclusion

Electrolyte abnormalities are commonly associated with renal dysfunction and acid base disorders. In diabetes mellitus patients with normal renal function also had electrolyte abnormalities as we have observed in this study. Moreover in diabetic patients of normal renal function hypernatremia, hyperkalemia and hyperchloremia are more common. As the renal function deteriorates the electrolyte picture turns towards hyponatremia and hypochloremia. But only hyperkalemia is common among diabetics with normal or abnormal renal function. Hence the detailed analysis of the electrolyte profile in diabetic patients is better irrespective of their serum creatinine levels.

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