

Study of Serum Electrolytes in Type 2 Diabetes Mellitus Individuals in Rural Tertiary Care Hospital in Kancheepuram District

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To measure the levels of Serum electrolytes (Na⁺, K⁺, Cl⁻) in type II DM individuals and to compare it with healthy controls. **Methods:** A case control study was conducted at Medicine Department, from March 2019 to September 2019. A total of 60 patients, comprised of 30 confirmed type II DM patients as cases and 30 healthy individuals of similar criteria were treated as controls. In both the groups, biochemical measurement of Serum electrolytes (Na⁺, K⁺, Cl⁻), FBS was studied and the results were compared. **Results:** In individuals with Diabetes mellitus sodium and chloride showed insignificant alterations. There was an increase in serum potassium levels which was found to be statistically highly significant (p-value less than or equal to 0.05). The drift of potassium from intracellular space to extracellular space leads to Hyperkalaemia which is due to renal impairment, insulin deficiency or hypertonicity. **Conclusion:** This study concludes that there is significant association of potassium with hyperglycemic crisis in patients with type 2 diabetes mellitus. Thus serum electrolytes has to be routinely monitored in diabetic individuals since electrolyte derangements are markedly found in uncontrolled diabetes.

Keywords: Diabetes Mellitus; Hyperkalaemia; Hyperglycemic.

Diabetes Mellitus is one among the most common metabolic abnormality. More than 62 million individuals are being diagnosed with the disease and it is gaining the status of potential epidemic in India¹.

Altered distribution of electrolytes leads to electrolyte imbalance in patients suffering from diabetes which is due to osmotic fluid shifts induced by hyperglycaemia that is caused by osmotic diuresis. The potassium intake of cells

remains normal whereas there is impairment in the insulin mediated glucose intake².

The redistribution of potassium from the space present intercellularly to space present extracellularly in type II DM patients leads to increase in tonicity of plasma that causes Hyperkalaemia. Dysnatremias are caused by diabetes by means of several underlying mechanisms. One among them is osmotically active substance glucose. Movement of water out of the

cells occurs due to increase in osmolality of serum which is caused by hyperglycaemia. Hypovolemic hyponatremia as a result of osmotic diuresis is also caused by uncontrolled diabetes mellitus. The electrolyte loss in urine will exacerbate the renal sodium wasting in diabetic ketoacidosis²

Controlling the electrical gradient of body fluids, nerve conduction, blood clotting, muscle contraction as well as acid base balance are carried over by electrolytes which are chemical compounds present in the body fluids. Enzyme activities and intermediary metabolism are being carried over by major macro minerals like Sodium, Potassium, Chloride and Calcium. Derangements in the serum electrolyte levels are related with Diabetes Mellitus. Electrolyte derangement that is occurring as a result of complications of diabetes are fatal in severe form and thus requires immediate and urgent management¹. Hence the study was done to assess the levels of serum electrolytes among type II diabetic individuals in comparison with healthy controls.

AIMS AND OBJECTIVES

To measure the Serum electrolytes levels of Sodium (Na⁺), Potassium (K⁺) and Chloride (Cl⁻) in type II DM individuals.

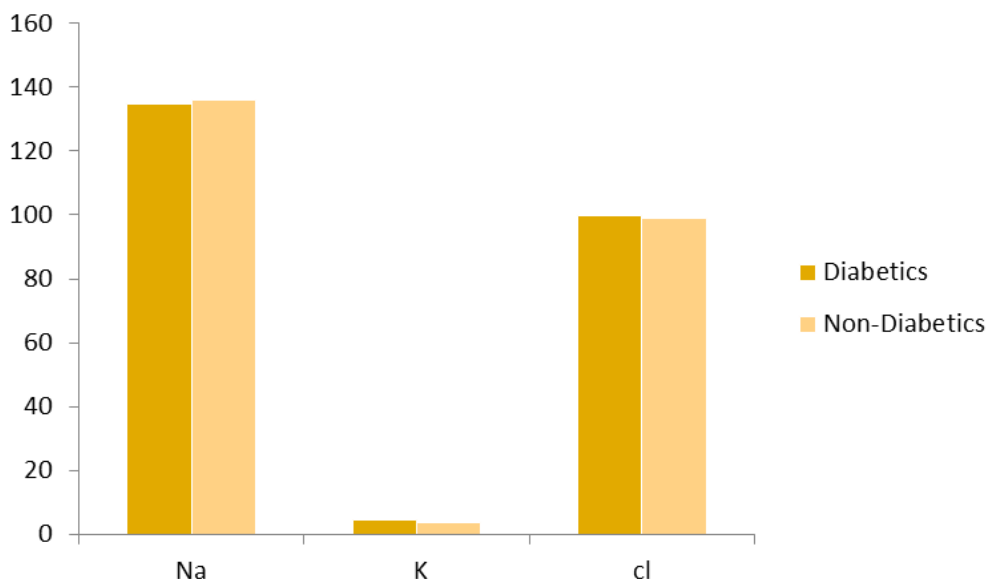
MATERIALS AND METHODS

This study includes 30 type II DM individuals as cases and 30 healthy individuals of similar criteria were treated as controls from Department of Medicine, KIMS& RC.

METHODOLOGY

- **Study design :** Case control study
- **Study setting:** Department of Biochemistry and General Medicine, KIMS& RC.
- **Study duration:** March 2019 -September 2019
- **Study population:** Patients attending OP and IP in age group of 40 to 60 years in Department of Medicine .

	Diabetes	Controls	p-value
Sodium (Na)	134.67 ± 5.94	135.87 ± 7.08	0.480
Potassium (K)	4.49 ± 0.62	3.86 ± 0.61	< 0.000
Chloride (Cl)	99.63 ± 8.70	98.8 ± 8.4	0.707



Comparison between mean values of electrolytes between DM and Non-DM Individuals

• **Sample size and sampling:** 60 patients

• **Inclusion & Exclusion criteria:**

Inclusion criteria: Individuals with Type 2 Diabetes mellitus.

Exclusion criteria: Individuals with thyroid dysfunction, metabolic syndrome

• **Study instruments:** Biochemical analysis of Fasting Blood Glucose by enzymatic method in fully automated analyser, Electrolytes (sodium, potassium and chloride) by spot-chem electrolyte analyser.

• **Data collection:** Written consent from patients, Fasting and electrolyte samples as per SOP.

• **Data analysis:** The data was analyzed by SPSS software.

RESULTS

This study includes 60 individuals in which 30 were cases (diabetic) and 30 were controls (non-diabetic) with matched age and sex.

Above table includes Sodium, potassium and chloride levels in both cases and control groups in which mean of diabetic individuals sodium levels were found to be less compared with non-diabetic individuals but it is not statistically significant ($P > 0.05$).

It was found that the mean of chloride and potassium levels was slightly higher when compared with controls in which chloride is not statistically significant ($P > 0.05$) and potassium is found statistically significant ($p < 0.05$).

DISCUSSION

The association between serum electrolytes and blood glucose involves multiple factors that includes age and other associated conditions³. Hyperglycaemia in diabetes results in shifting of water from the intracellular to extracellular space thereby diluting the sodium present extracellularly leading to lowered serum sodium levels⁴. Changes in renin angiotensin system in diabetes also leads to alteration in serum sodium concentration. In this study there is no statistical significance in the levels of serum sodium.

Hypovolemic – hyponatremia as a result of osmotic diuresis is caused due to uncontrolled diabetes mellitus. Osmotic diuresis leads to loss of water as well as solutes⁵. Subsequent changes in

sodium levels present in the serum and osmolarity of serum has a strong association between solutes and water. Hyponatremia can also occur in diabetic patients that results due to loss of hypotonic fluid in urine which in turn occurs because of osmotic diuretic sequelae of glycosuria⁶.

The drift of potassium to extracellular space leads to Hyperkalaemia which is due to renal impairment, insulin deficiency or hypertonicity. In this study hyperkalaemia is noted in diabetes patients and is significant compared to healthy individuals.

The cellular uptake of potassium is found to be normal whereas there is impairment in the insulin-mediated absorption of glucose. This situation is homogenous with divergence of intracellular pathways that follows insulin receptor activation⁷.

Intracellular dehydration leads to efflux of potassium from the cell that occurs as result of osmotically induced movement of water transcellularly which acts as desirable gradient for potassium efflux⁸. Insulin deficiency, rhabdomyolysis, hypertonicity and acidosis are examples of shift induced hyperkalaemia in type 2 diabetic individuals. Chronic kidney disease causing decreased glomerular filtration in potassium levels as well as many drugs like renin-inhibitors, angiotensin-converting enzyme inhibitors, beta blockers, potassium-sparing diuretics interfering potassium excretion are associated with Hyperkalaemia. The syndrome of hyporeninaemic hypoaldosteronism leads to decreased tubular secretion of potassium which is one of the common cause for chronic hyperkalaemia. There is high risk for hyperkalaemia in elderly diabetic individuals who are on drugs that are known to interfere with homeostasis of potassium, hence careful monitoring of potassium levels are required in such individuals⁹.

Elevated chloride level occurs in type 2 diabetic individuals occurs as result of diabetic ketoacidosis. Decrease in pH of blood is caused by ketoacids which in turn disturbs the acid base balance resulting in increased chloride levels. In this study there is no statistical significance in the chloride levels.

In our study, we found statistical significant difference in potassium levels between the controls and diabetic group. Hyperkalaemia was evident in

the diabetic group. This finding was also seen in study conducted by Datchinamoorthi, et al¹ which proved that diabetic individuals were more prone to increased levels of chloride and hyperkalaemia. Sodium and chloride showed no statistical significance in this study. Ogunleye, et al. in his study in 2016 have shown that diabetic individuals had decreased levels of calcium, sulphur, magnesium, phosphorous, potassium, sodium and chloride as compared to non-diabetic individuals. Loss of these electrolytes results due to increased excretion of these electrolytes in urine or as result of decreased absorption, which in turn leads to deficiency of elements or marginal states of elements in diabetic individuals¹⁰

CONCLUSION

This study concludes that there is significant association of potassium with hyperglycaemic crisis in type 2 diabetic individuals. It is also concluded that for monitoring the prognosis of type II DM individuals, the assessment of electrolyte related derangements are very helpful^{11,12,13}. It is also observed that the risk of diabetic complications may be as a result of significant role of electrolyte imbalance. Thus serum electrolytes has to be routinely monitored in diabetic individuals since electrolyte derangements are markedly found in uncontrolled diabetes^{14,15}.

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