RESEARCH ARTICLE

Serum electrolytes level in type-2 diabetes mellitus patients

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Abstract

Introduction: Type-2 DM is the commonest form of diabetes constituting nearly 90% of the diabetic population in any country. Diabetic nephropathy has become the leading cause of end-stage kidney disease worldwide and is associated with an increased cardiovascular risk. Electrolytes play an important role in intermediary metabolism and cellular function, including enzyme activities and electrical gradients. Serum concentrations of electrolytes have been shown to change with plasma glucose levels. **Objectives:** To evaluate the effects of hyperglycemia on serum electrolytes in type-2 DM patients and to compare it with those of non-diabetic healthy subjects. **Material and Methods:** 50 type-2 DM patients of both sexes having DM for more than 1 year between 40-60 years attending medicine OPD & 50 nondiabetics of both sexes of same age without hypertension, any renal diseases like stones, gestational DM, endocrine disorders, alcohol abuse were recruited. Serum Sodium, Serum Potassium and Serum Calcium level were checked in all participants and compared by using suitable statistical methods (Unpaired student t-test and p value). **Results:** As compare to nondiabetics type-2 DM patients have high Serum Potassium, Serum Calcium and low Serum Sodium. **Conclusion:** Increase in Blood sugar had direct relationship with Serum Potassium and Serum Calcium in type-2 DM patients and inverse relationship with Serum Sodium when compared to the nondiabetic subjects.

INTRODUCTION

Diabetes mellitus is the commonest metabolic abnormality in the world. Type-2 diabetes (NIDDM) is the commonest form of diabetes constituting nearly 90% of the diabetic population in any country (A Ramachandran et al., 1999). India leads the world with largest number of diabetic subjects earning the dubious distinction of being termed the "diabetes capital of the world" (V Mohan et al., 2007). Diabetes once regarded as a single disease entity, but is now seen as a heterogeneous group of diseases, characterized by a state of chronic hyperglycemia, resulting from a diversity of etiologies, environmental and genetic, acting jointly. The underlying cause of diabetes is the defective production or action of insulin, a hormone that controls glucose, fat and amino acid metabolism. Characteristically, diabetes is a long term disease with variable clinical manifestations and progression. Chronic hyperglycemia, from whatever cause, leads to a number of complications – cardiovascular, renal, neurological, ocular and others such as intercurrent infections (K. Park, 2013).

Diabetic nephropathy has become the leading cause of end-stage kidney disease worldwide and is associated with an increased cardiovascular risk (Enyioma N Obineche et al., 2005). Electrolytes play an important role in intermediary metabolism and cellular function, including enzyme activities and electrical gradients. Serum concentrations of

electrolytes have been shown to change with plasma glucose levels. Disturbances in the levels of some electrolytes are associated with DM (Shenqi Wang et al., 2013).

Material and Methods

50 type-2 DM patients of both sexes having DM for more than 1 year between 40-60 years and 50 nondiabetics of both sexes of same age group without hypertension, any renal diseases (like renal stones, glomerulonephritis), gestational DM, endocrine disorders (like cushing's syndrome), alcohol abuse attending medicine OPD were recruited. This study was approved by the institutional ethics committee (IEC) and an informed consent was obtained from the study participants. Detailed history regarding age, sex, age of onset and duration of diabetes, presenting complaints, past history of any other disease, any medications for treatment of diabetes, dosages and regularity of treatment, family history of diabetes, drug history of any nephrotoxic drug like aminoglycosides, personal history like smoking and alcohol consumption were taken. Clinical examination was done to look for any microvascular or macrovascular complications and findings were noted.

For FBS fasting venous blood sample is collected in fluoride bulb. For Serum Sodium, Serum Potassium and Serum Calcium 5 ml venous blood sample is collected in EDTA bulb. For serum separation blood was spun for 10 minutes at 1500 rpm in centrifuge machine. Serum Calcium were estimated by Semi auto analyzer machine and Serum Sodium, Serum Potassium was estimated by Easy lyte machine. FBS was estimated by GOD – POD method. Serum Sodium and Serum Potassium were estimated by Ion selective electrode method and Serum Calcium by Arsenazo method.

Statistical analysis: The results were expressed as mean ± standard deviation. Statistical analysis was done by unpaired student t-test to compare between the groups using Graphpadprism version-5 software. $p < 0.05$ was considered as statistically significant.

Result and Discussion

The duration of DM is presented in Table-1. The observed values of FBS, Serum Sodium, Serum Potassium and Serum Calcium in type-2 DM patients and nondiabetics are provided in Table-2.

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In present study maximum number of type-2 diabetic patients had duration of DM between 1-5 years. The Mean±SD of duration of DM was 7.52±4.07 years. Al-Sharafi BA et al., (2014) have also reported that the maximum number of type-2 diabetics with duration < 5 years.

The present study showed increase in fasting blood sugar level in type-2 diabetics when compared to controls. The Mean±SD of FBS level in diabetic group was 237.74±64.33 mg/dl and in control group, 89.1±7.19 mg/dl. Similar findings were consistent with the study done by Manjunatha goud B K et al., (2011) which shows that the Mean±SD of FBS level in diabetic group was 169.29±138.32 mg/dl and in control group was 83.30±13.15 mg/dl. Similar findings were reported by (S W Masram et al., 2012; Aftab Begum et al., 2014; Olarewaju M Oluba et al., 2011; Tejal J Wagle, 2010 and L Siva et al., 2012).

The present study showed decrease in serum sodium in type-2 diabetics when compared to controls. The Mean±SD of serum sodium in diabetic group was 135.72±5.08 mmol/L and in control group was 139±2.60 mmol/L. In a study done by Shenqi Wang et al., (2013) the serum sodium was significantly lower in diabetics with Mean±SD 141.0±2.4 mmol/L. Similar findings were consistent with the study done by San-E Ishikawa et al., (1999).

Under physiological conditions, most of the sodium is reabsorbed in the proximal tubule of the kidney. Hyperglycemia-induced osmotic diuresis, which can increase excretion, is thought to be a primary mechanism underlying the decreased serum concentrations of sodium. It has been observed that cellular membrane electrolyte transporter Na^+-K^+-ATPase dysfunction in diabetic subjects, can be secondary to hyperglycemia which leads to electrolyte disturbances within cells (Shenqi Wang et al., 2013).

The present study showed increase in serum potassium in type-2 diabetics when compared to controls. The Mean±SD of serum potassium in diabetic group was 5.11±0.78 mmol/L and in control group was 4.22±0.44 mmol/L. In a study done by Shenqi Wang et al., (2013) the serum potassium was significantly higher in diabetics

with Mean±SD 4.26±0.37 mmol/L. Similar findings were consistent with the study done by San-E Ishikawa., (1999) and Abdul Rahman Al-Ajlan., (2007). Hyperosmolality would promote cellular dehydration, thus providing an increase in potassium efflux from the cells (San-E Ishikawa., 1999).

The present study showed increase in serum calcium in type-2 diabetics when compared to controls. The Mean±SD of serum calcium in diabetic group was 10.05±0.79 mg/dl and in control group was 9.44±0.48 mg/dl. These findings are in tune with findings of Shenqi Wang et al., (2013) which shows that serum calcium was significantly higher in diabetics. Similar findings were consistent with the study done by J Levy et al., (1986).

Ca^{2+} is mainly reabsorbed in the proximal tubule. Its reabsorption is coupled to Na^+ absorption, and it appears to compete with Mg^{2+} for transport in the loop of Henle. The Resnick ionic hypothesis suggested that metabolic disorders, such as hypertension, metabolic syndrome, and diabetes, share a common, altered intracellular condition, characterized by decreased Mg^{2+} level and reciprocally elevated free intracellular Ca^{2+} level (Shenqi Wang et al., 2013).

Conclusion:

This study shows highly significant alterations in Blood glucose, Serum Sodium, Serum Potassium and Serum Calcium levels in patients with type-2 DM suggesting renal damage. Screening tests for the complications of diabetes mellitus are strongly recommended at the time of diagnosis not only for early detection of DM but also to prevent the progression to end stage renal disease.

In view of the fact that the present study comprised of a small group of patients, further studies with more number of patients may be required to evaluate our observations. Good control of blood glucose level is absolute requirement to prevent progressive renal impairment.

Conflict of interest: We declare that we have no conflict of interest.

Table: 1 Duration of DM in Type-2 DM patients

Duration(Years)	No. of cases	% of cases
1-5	19	38
6-10	16	32
>10	15	30
Total	**50**	**100**
Mean±SD	**7.52±4.07**	

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Table: 2 Comparison FBS and Serum Electrolytes in type-2 DM patients and non diabetic subjects

Parameters	Type-2 DM cases (n=50)	Non diabetic controls (n=50)	P value
	Mean±SD	Mean±SD	
FBS (mg/dl)	237.74±64.33	89.1±7.19	<0.0001* * *
S.Sodium (mmol/L)	135.72±5.08	139±2.60	<0.0001* * *
S.Potassium (mmol/L)	5.11±0.78	4.22±0.44	<0.0001* * *
S.Calcium (mg/dl)	10.05±0.79	9.44±0.48	<0.0001* * *
*P<0.05-significant			

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