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Evaluation of Serum Electrolyte Levels in Type 2 Diabetes Mellitus

KEYWORDS: Serum electrolytes, Type 2 Diabetes Mellitus, ,Correlation coefficient

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ABSTRACT **Aim**: *The aim of the study was to evaluate the serum electrolyte levels in type 2 Diabetes Mellitus and compared with age matched healthy control.* **Study Design**: *This Hospital Based case control study was carried out on 200 subject attending outpatient Department of JMCH for a period of one year from November 2014 to October 2015. .Among 200 subjects (100 case and 100 control) in the age group of 35-70 year were selected randomly for study. Biochemical analysis of FBS , Serum electrolytes (Na+,K+ ,Cl -and Ca2+) done in both groups..* **Result**: *Serum Na + was significantly low and serum Cl- ,Ca2+ were significantly increased in type 2 DM compared to control. Insignificant high value of serum K+ was observed in case compared to control. serum Na+ was negatively correlated (correlation coefficient -0.03) and serum Cl – and K+ were positively correlated (r=0.17 and 0.01 respectively) with FBS in type 2 DM. Conclusion: Electrolyte metabolism is disturbed in type 2 DM and proper glycemic control and evaluation of electrolyte levels can reduce the fatalities associated with electrolyte dearrangement in type 2 DM.*

Introduction

Diabetes Mellitus is one of the commonest metabolic abnormality and gaining the status of potential epidemic in India with more than 62million diabetic individuals currently diagnosed with disease.[1,2] Prevalence of Diabetes is predicted to double globally from 171 million in 2000 to 366 million in 2030 with maximum increase in India. [3]

Diabetes Mellitus results occurs from a diverse etiologies, environmental and genetic factors jointly play an important role in occurrence of diabetes. In Diabetes, body loses its ability to produce insulin or insulin that is produced may not be efficient for it action resulting in Hyperglycemia .Defective insulin production causes altered metabolism of carbohydrate, fat and amino acids. Chronic hyperglycemia in Diabetes leads development of cardiovascular, renal, neurological , ocular complications and increases risk of suffering from intercurrent infections.[4] Type 2 diabetes (NIDDM) is the commonest form of diabetes constituting nearly 90% of diabetic population in any country.[5] Insulin resistance and pancreatic beta islet cell failure are the main causes of occurrence of type 2 DM resulting in development of chronic hyperglycemia.[6] Electrolytes are the chemical compounds present in body fluid and takes part in some of the important body processes like controlling the electrical gradient of body fluids, acid base balance ,nerve conduction blood clotting and muscle contraction.[7] Sodium ,Potassium ,Calcium and Chloride are some of the major macro minerals present in body taking part in intermediatory metabolism and enzyme activities. [8] Disturbances in serum electrolyte levels are found to be associated with Diabetes Mellitus.[9]Electrolyte derangement resulting from acute or chronic complications of diabetes, are comparatively fatal in severe form and requires urgent management.[10]

Variations in the Serum Electrolyte values in type 2DM were shown in various published studies[11,12] .Considering the above facts, the study entitled "Evaluation of Serum Electrolyte levels in type 2 Diabetes Mellitus" was aimed to evaluate the serum electrolyte values in type 2 diabetes patient.

Materials and Methods

This Hospital Based case control study was conducted in Jorhat Medical College from November 2014 to October 2015 .100 subjects of diagnosed type 2 DM patients of both sexes having diabetes for more than three year were selected as case and 100 non diabetic age matched subjects were selected randomly as control .Age range for both groups were between 35-70 years. Among 100 type 2DM patients 55 were males and 45 were females. Among 100 controls 66 were males and 34 were females. Type 2 DM patients were diagnosed as per guidelines of American Diabetes Association for diagnosis of Diabetes Mellitus having fasting blood sugar ≥126mg/dl (7.0mmol/L) or a 2hour plasma glucose level of 200 mg /dl or higher during a 75 gm OGTT or a random plasma glucose of 200 mg/dl(11.1 mmol/L) or higher in a patient with classic symptoms of hyperglycemia or hyperglycemic crisis.[13] Lactating mothers ,patient having past h/o myocardial infarction, stroke ,surgery ,or taking any other medications effecting the levels of electrolytes,h/o taking glucocorticoids, oral contraceptives,high dose thiazide diuretics and pregnant women and type 1 diabetic patient were excluded from the study. **Sample collection** 5 ml of venous blood collected from antecubital vein from each of the subjects .The whole blood samples were allowed to clot and for serum separation blood sample was centrifuged at 4000 rpm for 15 minutes.

Analysis of the Sample After performing quality control test for Fasting blood sugar, serum electrolytes (Na^+,K^+,Cl^- and Ca^{2+}) as per instructional guidelines for quality control run in dry chemistry analyzer ' vitrous 250' serum samples were analysed as per specified method for the tests. Normal reference range for different parameters in our laboratory are 70-110mg/dl for FBS, 137-145mmol/L for serum sodium, 3.5-5.mmol/L for serum potassium ,98-110mmol/L for Serum chloride and 8.4-10.2mg/dl for serum calcium.

Analysis of data Data were analyzed statistically using Sta-

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tistical Package for Social Science (SPSS) for windows, version 13.0;SPSS Inc.Chicago,IL,USA). Student's *t* test was performed to find out differences between diabetic and control group .The p value<0.001 was considered as statistically very highly significant.

Results

Estimated values were expressed as mean ±SD. The mean age of type 2 DM group was 45.4±7.41 while the mean age of control group was 39.02±3.01.The estimated values of FBS and serum electrolytes in both type 2 diabetic group and control group were shown in table 1 .The Fasting blood sugar level in diabetic group was 191.52±56.65mg/dl while in the control group FBS level was 96.34±17.66 mg/dl. The serum Na^+ level in diabetic group was 80.80±5.05 mmol/L and in control group serum Na^+ level was 137.65.±4.50 mmol/L with p value of0 .0001 . Serum K^+ level in the diabetic group was 3.98±0.58 mmol /L and serum potassium level in control group was 4.13 ±0.774 mmol/L with p value of 0.1244 .The serum Cl^- level in diabetic group was 124.79±8.79mmol /L while control group serum Cl^-level was 100.29±7.64 mmol/L with p value.0001. The serum Ca^{2+}level in the diabetic group was 10.5±0.49mg/dl while in control group level of serum $Ca^{2+}$was 9.99.±0.38 mg/dl with a p value of 0.0001.Table 2 showed the correlation of serum electrolytes with fasting glucose in type 2 diabetes mellitus patients. Serum glucose level is negatively correlated with Sodium (r= -0.03, p value=.0001) and positively correlated with chloride (r=0.17 p value =.0001) and calcium(r=0.01,p value=.0001).Serum glucose level is also positively correlated with potassium (r=0.13) but this correlation is statically insignificant(p value=0.124). Table 3 showed the correlation between electrolytes and FBS in both male and female type 2 Diabetes patient. In male type 2 Diabetes patient Fasting blood sugar was negatively correlated with serum Na^+ with a r (correlation coefficient) of -0.05 and this correlation was statistically significant with p value of .0001.Fasting Blood sugar was positively correlated with serum $Cl^-$and serumCa^{2+} in male diabetes patient with correlation coefficient of 0.05 and 0.03 respectively. Fasting blood sugar was also positively correlated with serum potassium with r of 0.18 but this correlation was statistically insignificant. with p value of .2994.In female type 2 diabetes patient serum fasting blood sugar level was negatively correlated with serum Na^+(r=-0.01 p value=.0001) and positively correlated with serum Cl^-(r=0.10,p =.0001) ,serum Ca^{2+}(r=0.14, p value=.0001).Positive correlation between fasting blood glucose and serum K^+

was observed in female type2 diabetes group with correlation coefficient of 0.05 but this correlation was statically insignificant(p value=.04

Table 1: Comparison of different parameters between type 2 DM and control group

	Type2 Diabetes mellitus n=100	Control n=100	p value
Age(year)	45.4±7.41	39.02±3.01	p value<.0001
Male(n)	55(55%)	66(66%)	-
Female(n)	45(45%)	34(34%)	-
Fasting blood sugar (mg/dl)	191.52±56.65	96.34±17.66	.0001
Serum sodium (mmol/L)	80.80±5.05	137.65±4.50	.0001
Serum potassium (mmol/L))	3.98±0.58	4.13±0.774	0.1244
Serum chloride(mmol/L)	124.79±8.79	100.29±7.64	.0001
Serum calcium(mg/dl)	10.51±.49	9.99±.38	.0001

Table 2: Correlation between electrolytes and Fasting blood glucose level in type 2 DM patient :

	Na^+	
	r	p value
Fasting blood sugar	-0.03	.0001
	Ka^+	
Fasting blood sugar	0.13	0.124
	Cl^-	
Fasting blood sugar	0.17	.0001
	Ca^{2+}	
Fasting blood sugar	0.01	.0001

r :Correlation coefficient

Table 3: Correlation between electrolytes and Fasting blood sugar in male and female type 2 diabetes mellitus

		Fasting blood sugar	
		r	p
Male n=55	Na^+	-0.05	<.0001
	K^+	0.18	0.2994
	Cl^-	.05	<.0001
	Ca^{2+}	0.07	<.0001
Female n=45	Na^+	-0.01	<.0001
	K^+	0.05	.0437
	Cl^-	0.10	<.0001
	Ca^{2+}	0.14	<.0001

Discussion

Diabetic patients are more prone to develop electrolyte disturbances and acid base disorders because of disease state itself and associated disruption of blood glucose homeostasis. Use of antidiabetic drugs also leads to development of electrolyte disturbances.[14] In our study serum Na^+ level in diabetic group was significantly reduced compared to control group. Similar findings were observed with previous published studies. [9] Hyperglycemia in diabetes causes shifting of water from intracellular space to extracellular space diluting the extracellular Na^+ leading to lower serum Na^+ level. [14] Alteration in rennin angiotensin system in diabetes leads to change in serum sodium concentration. [15] No significant change in serum K^+ level had been observed between the diabetic group and control group . Similar findings were reported in previous published study[16]. A previous published study reported of getting 0.6% hypokalemic and 1.2% hyperkalemic diabetes subjects .[17] It has been observed that K^+ levels are irrespective with degree of diabetes control ,but its high and low levels have profound effect on neurotransmission and cardiac function. [18,19] The serum Cl^- value in the diabetic group was significantly increased compared to control group. . Diabetic ketoacidosis may be responsible for elevated chloride level in type 2 diabetes patient. Keto acids reduce blood pH disturbing acid base balance and leads to elevation of chloride. Similar findings was observed in a previous published study.[20] The serum Ca^{2+} level in diabetic group was significantly increased compared

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to control . Ca^{2+} reabsorption in proximal tubule is associated with Na^{+} reabsorption and Ca^{2+} competes with Mg^{2+} for transport in the loop of Henle. According to the Resnick ionic hypothesis certain metabolic disorders such as hypertension ,metabolic syndrome ,and diabetes share a common intracellular condition in which decreased level of Mg^{2+} is associated with elevated free intracellular calcium^{2+} level.[8]

Conclusion:

The present study showed low serum Na^{+} along with high serum Cl^{-} and Ca^{2+} level reflecting dearranged electrolyte metabolism with progression of chronicity in disease process..Therefore early detection of diabetic complication by proper evaluation of serum electrolyte level along with good glycemic control reduces the fatalities resulting from electrolyte imbalance.

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