Estimation of Serum Electrolytes in Diabetes Patients of Saudi Region

Noura Al Jameil

Department of clinical laboratory sciences, College of applied medical sciences, King Saud University, Riyadh.
nouraaljameil@gmail.com

Abstract: Background: The incidence of diabetes is increasing rapidly with interference in electrolytes sodium (Na^+), potassium (K^+) and chloride (Cl^-). The aim of the study is to estimate the electrolytes disturbance in Diabetes patients.Material and Methods: Total of 188 subjects were included in the study, out of which two groups were formed; 94 type 2diabetes patients and 94 controls. The subjects were selected from the outpatient department of King Abdul Aziz University Hospital, Riyadh. Biochemical analysis for fasting glucose, HbA1C, Na^+, K^+, Cl^- was performed by the ROCHE module Cobas 6000 (C-501 and C-601) analyzer, and kits were procured by ROCHE. Student *t* test was done to find out the difference between the two paired groups at 0.05 level of significance, followed by Pearson's correlation to know the correlation between electrolytes and glycemic control parameters, and the correlation coefficient (r) values were represented at 0.05 & 0.10 level of significance. Results: Diabetes patients Were of mean age 51.6 ± 14.7 years. In diabetes group serum Na^+ level was observed significantly decreased (129.3±5.1) while Cl^-mean was increased (116±5.5), K^+ showed no significant alterations. Both the electrolytes (Na^+, Cl^-) differ significantly in diabetes and control group, at 0.05 level of significance. In both the sexes Na^+ & Cl^- were significantly associated with fasting glucose and HbA1C, respectively. Discussion: The study demonstrated significant association of Na^+, Cl^- with type 2 diabetes patients and K^+ insignificant with diabetes control.
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1. Introduction

Diabetes mellitus (DM) is characterized by chronic hyperglycemia which results from defective insulin action and secretion. The consequences of diabetes are numerous, ranging from metabolic imbalance, blood vessel degeneration, causing dilutional effect on electrolyte concentration and offset the proportion of electrolytes[1, 2, 3]. Electrolytes plays an important role in many process like acid base balance, controlling body fluids, blood clotting, muscle contractions. The disturbed electrolyte distribution may affect the course of diabetes and its management[4]. The relation between blood glucose and electrolytes is complex and is related to number of other factors like age and associated conditions[5]. The study is conducted to investigate the electrolytes disturbance in type 2 diabetes patients in Saudi Region.

2. Material and Methods

Patients and Sample Collection

The study was carried out at College of Applied Medical Sciences, and the subjects were selected from the outpatient department of King Abdul Aziz University Hospital, Riyadh. A total of 188 subjects were studied. An informed consent was taken from all patients and institutional ethical committee approved the study. All the studied subjects were categorized into two groups; diabetes and controls, according to American Diabetes Association of fasting glucose ≥7mmol/l and physician diagnosis. Age of all subjects ranged between 32-80 years. Patients diagnosed mainly with type 2 DM less than 3 years and with conditions like renal disease, other chronic illness, alcohol intake, pregnancy were excluded from the study. After overnight fasting, 8ml of venous blood sample was collected in clean glass tubes, of which 1 ml of sample was taken in an EDTA coated tube for the estimation of HbA1c. For further biochemical investigations serum was separated by centrifugation at 3000 rpm for 10 minutes and kept at -20° C until analysis.

Chemical and techniques

Serum analysis for fasting glucose,Na^+,K^+ and Cl^- was performed by the automatic analyzer, ROCHE module Cobas 6000 (C-501 and C-601), and kits were procured by ROCHE. HbA1c was estimated by direct enzymatic method [6]. Reference ranges of various parameters according to the kits manufacturer are as follows; HbA1c (5.5%), Na^+ (137-145mmol/l), K^+ (3.5-5.1mmol/l), Cl^- (95-105mmol/l).

Statistical Analysis

Data were represented as mean ± SD values. Statistical analysis was done by using student *t* test to find out the difference between the two paired groups at 0.05 level of significance. Pearson's correlation was performed to know the correlation, and the

correlation coefficient (r) values were represented at 0.05& 0.10 level of significance.

3. Results

In the present study total of 94 diabetes patients were recruited. Table 1 reveals the studied characteristics between two groups. Mean age of diabetes patients was 51.6 ± 14.7 years with mean of duration of the disease 7.1±2.4 years. Male preponderance with 50 (53.1%) was observed in diabetes group than females 44(46.8%). Na^+ level in diseased group was observed significantly decreased (129.3±5.1) while Cl^- mean was increased (116±5.5). Both the electrolytes (Na^+, Cl^-) differ significantly in diabetes and control group, at 0.05 level of significance.

Table 1. Mean±SD values of characteristics between two groups.

	Diabetes n=94	Controls n=94	P Value
Age (years)	51.6±14.7	39.8±9.3	P<0.05
Male (n)	50(53.1%)	68 (72.3%)	--
Female (n)	44 (46.8%)	26 (27.6%)	--
Duration of disease	7.1±2.4	NA	--
Fasting glucose	10.8±4.04	3.9±0.2	P<0.05
HbA1C	8.8±1.9	4.5±0.4	P<0.05
Na^+	129.3±5.1	139±1.2	P<0.05
K^+	4.4±0.4	4.5±0.4	NS
Cl^-	116.0±5.5	99.7±0.04	P<0.05

NS Non-significant

Table 2 showed the established correlation between electrolytes and fasting glucose, HbA1C. Na^+ was observed inversely associated with fasting glucose (r=-0.244) and HbA1C (r=0.-210); while Cl^- was positively associated (r=0.21) with fasting glucose significantly at 0.05 level. K^+ showed an insignificant association with the glycemic control parameters [fasting glucose (r=0.01), HbA1C (r=0.02)].

Table 2. Correlation coefficient between Na^+, K^+, $Cl^-$and fasting glucose, HbA1C

	Na^+	
	r	P Value
Fasting glucose	-0.244	0.017*
HbA1C	-0.210	0.042*
	K^+	
	r	P Value
Fasting glucose	0.012	NS
HbA1C	0.02	NS
	Cl^-	
	r	P Value
Fasting glucose	0.21	0.04*
HbA1C	0.15	NS

r Correlation coefficient, NS Non significant, * p value is significant at 0.05 level

Table 3 presented that Na^+ level in females were more significantly (P < 0.05) associated with fasting glucose than males (P<0.10). In both the sexes K^+ showed insignificant relationship with the glycemic control parameters. In males, Cl^- (P<0.05) was found positively and more significantly correlated with HbA1C than females (P<0.10).

Table 3. Correlation between electrolytes, fasting glucose, HbA1C in diabetes patients according to gender

		Fasting Glucose		HbA1C	
		r	P	r	P
Males (n=50)	Na^+	-0.2471	0.083*	-0.1985	0.167 NS
	K^+	0.046	0.751 NS	0.0623	0.667 NS
	Cl^-	0.0274	0.850 NS	0.429	0.001**
Females (n=44)	Na^+	-0.4917	0.0007**	-0.221	0.147 NS
	K^+	0.0175	0.910 NS	0.080	0.601 NS
	Cl^-	0.0892	0.5647 NS	0.2834	0.062*

r Correlation coefficient, * P Value is significant at 0.10 level, ** P value is significant at 0.05 level, NS Non-Significant

4. Discussions

Electrolyte imbalance occurs in diabetes patients from insulin deficiency, hyperglycemia and hyperketonemia[7]. The present study has observed altered electrolyte levels in diabetes patients of Saudi region. Significant hyponatraemia was observed in diabetes group and the study is in agreement with Ajlan[8] and Saito et.al.[9]. Females showed more significant relation (P<0.05) between Na^+ and fasting glucose than males (P<0.01). Only 12.7% of diabetes patients showed normal Na^+ levels out of which 7 were males and 5 were females. There are not enough studies have been performed to relate the electrolytes with HbA1C. Our study demonstrated the significant negative correlation of Na^+ with HbA1C, which is consistent with the finding of Khalid et.al.[10], Wang et.al.[11]. Physiologically Na^+ is reabsorbed in proximal tubule of kidney and excessive urination due to hyperglycemia is known to be the mechanical cause of decreased Na^+ concentration[12].

K^+ levels does not differ significantly between diabetes and control group and also insignificantly associated with glycemic control parameters, which is unlike to Saito et. al.[9]. A study by Ugwuja et.al.[13] reported low serum K^+ in diabetics than controls. Wang et.al.[11] reported only 0.6% of diabetes had hypokalemia and 1.2% of diabetes subjects had hyperkalemia. Also it has been observed that K^+ levels are irrespective with the degree of diabetes control, but its high and low levels have profound effect on neurotransmission and cardiac function[14, 15].

Elevated serum Cl^- levels were found in diabetes patients and this might be due to diabetic ketoacidosis. Ketoacidosis cause reduction in blood pH which further disturbs acid base balance and leads to the elevation of chloride. Despite of Na^+, Cl^- levels in males were found more significantly correlated (P<0.05) to HbA1C.

The present work conclude with reduced Na^+ especially in females and elevated Cl^- levels more significantly in males, having type 2 diabetes; While serum K^+ showed non-significant association with fasting glucose and HbA1C in both the sexes.

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Corresponding Author:
Dr. Noura Al-Jameil
Department Clinical Laboratory Sciences
College of Applied Medical Sciences
King Saud University, Riyadh, KSA.
E-mail: nouraaljameil@gmail.com

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