

Estimation of Serum Electrolytes in non Insulin Dependent (type 2) Diabetic Patients in Bangladesh

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Abstract- Diabetes is a group of disorders characterized by high glucose levels. The incidence of diabetes is increasing rapidly with interference in electrolytes sodium (Na^+), potassium (K^+) and chloride (Cl^-). The aim of the study was to estimate the electrolytes disturbance in non insulin dependent Diabetes Mellitus. Total of 102 subjects were included in the study, out of which two groups were formed; 52 diabetes mellitus and 50 healthy volunteer as controls. Biochemical analysis for Na^+ , K^+ , Cl^- was performed by the Biolyte 2000 automatic electrolyte analyzer. The random glucose levels were estimated by direct enzymatic method using Randox kit. Student t-test was done to find out the difference between the two paired groups and Pearson's correlation was calculated to know the correlations between electrolytes and random glucose levels. In diabetes mellitus serum Na^+ and Cl^- levels were observed significantly increased ($p < 0.001$, respectively) while K^+ showed no significant ($p > 0.05$) alterations. There was no significant correlation found between random glucose levels and electrolytes in this study. The study demonstrated significant association of Na^+ and Cl^- with type 2 diabetes mellitus. So, electrolytes should be measured during the treatment of type 2 diabetes mellitus.

Index Terms— Electrolytes, Estimation, Diabetes mellitus, Insulin, Random glucose

I. INTRODUCTION

Diabetes mellitus (DM) is characterized by chronic hyperglycemia which results from defective insulin action and secretion. High glucose levels may cause eye, kidney, and nerve complications and it is an increased risk for cardiovascular disease. The complications of diabetes are metabolic imbalance, blood vessel degeneration, effect on electrolyte concentration and offset the proportion of electrolytes [1-3]. Electrolytes play an important role in maintaining acid-base balance, blood clotting, control body fluid and 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]. Several scientists have estimated the electrolytes levels in diabetes mellitus in several countries and showed the association between electrolytes

levels and diabetes [6-10]. The study was conducted to investigate the electrolytes disturbance in type 2 diabetes mellitus in Bangladeshi population.

II. MATERIAL AND METHODS

a. Study subjects

Study was a case-control study conducted on 102 subjects. The case group comprises 52 diabetic patients (25 men, 27 women; mean age 45.2 ± 10.0). The diabetic patients were recruited from the outpatient department of BIRDEM (Bangladesh Institute of Research & Rehabilitation in Diabetes, Endocrine and Metabolic Disorders) Hospital, Dhaka. The patients were diagnosed as suffering from diabetes according to American Diabetes Association of random glucose ≥ 11.1 mmol/L and physician diagnosis, and treated using different therapeutic regimens. Patients diagnosed mainly with type 2 DM less than 4 years and with conditions like renal disease, other chronic illness, alcohol intake, pregnancy were excluded from the study. A total of 50 healthy controls (25 men, 25 women; mean age 43.4 ± 9.0) with no history of diabetes were recruited from different hospitals of Dhaka city where they came for regular health check up.

All participants were given an explanation of the nature of the study and informed consent was obtained. They completed a structured questionnaire covering information on age, gender, medical and family history of chronic diseases. This study was approved by the ethical committee of Bangladesh Medical Research Council (BMRC) under the guidelines of Ministry of Health and Family Welfare. All the analyses were done in the Department of Biochemistry and Molecular Biology, University of Dhaka, Dhaka-1000, Bangladesh.

b. Sample Collection

About 7.0 mL of venous blood was drawn from each individual following all aseptic precautions with the help of a trained person, using a disposable syringe. 2.0 mL of blood sample was taken in an EDTA coated tube for the estimation of random glucose level. For further biochemical investigations serum was separated by centrifugation at 3000 rpm for 10 minutes and kept at -20°C until analysis.

c. Clinical Analysis

Serum analysis for Na^+ , K^+ and Cl^- was performed by the Biolyte 2000 (Biocare corporation) automatic electrolyte analyzer, and kits were procured by Biocare corporation. Plasma glucose level was estimated by direct enzymatic method using Randox kit [11].

d. Statistical Analysis

All the results were expressed as mean \pm SEM. The statistical analysis of the data was carried out with Statistical Package of Social Science (SPSS), version 17 and Graph pad Prism version-5. The comparisons between two groups were tested by unpaired t-test. A 95% confidence interval was used. p values less than 0.05 were considered as statistically significant. Correlation between two continuous outcomes among DM was evaluated using Pearson correlation coefficient.

III. RESULTS

Statistically significant differences among patients and controls are indicated in Table 1 and in Figure 1 along with their significant values.

As shown in Table 1 the random glucose level were significantly ($p < 0.001$) higher among the DM compared to the controls. The Sodium and Chlorine levels were also significantly ($p < 0.001$, respectively) higher in DM when compared to the healthy controls. On the other hand, the Potassium levels were not significantly ($p > 0.05$) different among patients and controls.

Table 1: Random glucose and electrolytes levels in study subjects

Parameters	Control (n=50)	Diabetes (n=52)	p value
Glucose (mmol/L)	6.80 ± 0.1	12.8 ± 0.2	0.001
Na^+ (mmol/L)	141.2 ± 0.5	152.4 ± 1.1	0.001
K^+ (mmol/L)	4.69 ± 0.1	4.85 ± 0.1	0.35
Cl^- (mmol/L)	101.6 ± 0.5	109.3 ± 1.1	0.001

Results are expressed as mean \pm SEM. Unpaired t-test was done as the test of significant. $p < 0.05$ was taken as the level of statistical significant.

Figure 1 shows the correlations of random glucose levels with Sodium, Potassium and Chlorine levels. The glucose level is positively correlated ($r = 0.013$, $p > 0.05$; $r = 0.13$, $p > 0.05$, respectively) with Sodium and Chlorine levels but not statistically significant. On the other hand, Potassium level is negatively correlated ($r = -0.10$, $p > 0.05$) with glucose level but not statistically significant.

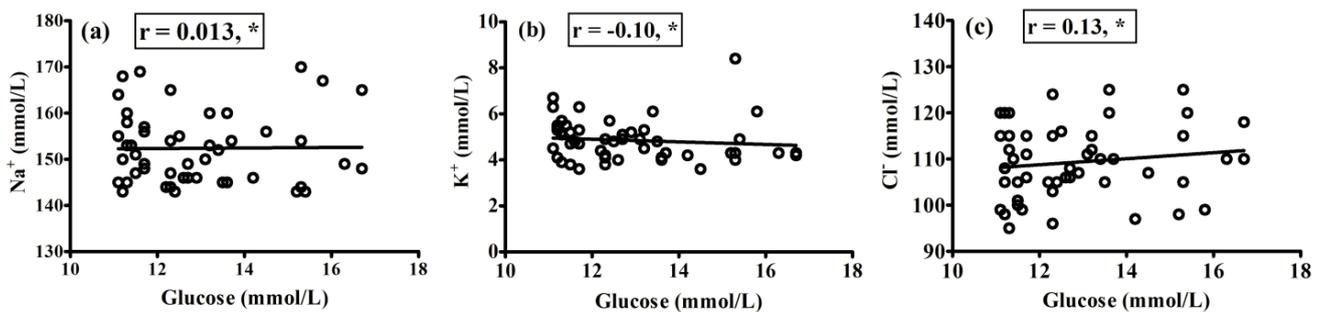


Figure 1 Correlations of glucose levels with Na^+ (a), K^+ (b) and Cl^- (c) levels. r ; correlation coefficient, *; $p > 0.05$.

IV. DISCUSSION

Diabetes is a group of disorders characterized by high glucose levels. Electrolyte imbalance occurs in diabetes patients from insulin deficiency, hyperglycemia and hyperketonemia [12]. In our present study we have observed altered electrolyte levels in diabetes patients of Bangladesh. In our present study we have found significantly increased levels of Sodium in diabetes group (Table 1). McDonnell et al. and Kavelaars et al. reported high sodium level in hyperosmolarity of diabetes mellitus [8, 9]. Kavelaars et al. (2001) also reported high sodium level in diabetes mellitus [9]. Nitzan and Zelmanovski showed hypernatraemia in glucose intolerant rats [13]. On the other hand, there were some contradictory findings. Al-Jameil and Khalid et al. recently reported hyponatraemia in diabetes mellitus [6, 7].

Potassium levels were insignificantly different between the patients and control (Table 1), which is in agreement with Al-Jameil [6]. McDonnell et al. also reported insignificant difference in potassium levels in diabetes mellitus [8]. Ugwuja et al. reported low serum K⁺ in diabetics than controls [14]. Wang et al. reported only 0.6% of diabetes had hypokalemia and 1.2% of diabetes subjects had hyperkalemia [15]. It has been observed that Potassium levels are irrespective with the degree of diabetes control, but its high and low levels have profound effect on neurotransmission and cardiac function [16, 17].

Elevated serum Chlorine 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. Al-Jameil showed increased levels of Chlorine in diabetes mellitus compared to control [6]. In our present study, we have found increased level of Chlorine in diabetes mellitus (Table 1).

In our recent study we have calculated the correlation of random glucose levels with Sodium, Potassium and Chlorine levels. There were insignificantly positive correlations of glucose levels with Sodium and Chlorine levels while negative correlation with Potassium levels (Fig. 1). Al-Jameil reported negative correlation with Sodium and positive correlation with Chlorine [6].

In conclusion, present study showed that Sodium and Chlorine significantly increased in diabetes mellitus. As electrolytes imbalance is correlated with various chronic diseases electrolytes measurement is essential in diabetes mellitus to decrease the risks. Treatment of electrolytes imbalance in diabetes mellitus should include by the physician. However, our study has a small sample size resulting in low power to detect minor to modest associations, therefore further study with large sample size is required.

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Conflict of interest

No competing financial interests exist.

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