

Assessment of serum chromium, magnesium and glucose level among Sudanese patients with type 2 diabetic mellitus

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Abstract: The purpose of this study was to evaluate the difference in serum chromium and magnesium levels between diabetic and control groups, and to determine the correlations between these elements and serum glucose in patients with type 2 diabetes mellitus. Fifty patients suffering from type 2 diabetes and 50 controls were selected randomly. The level of serum chromium, magnesium and fasting plasma glucose were measured and compared between the two groups. Correlations of serum Cr, Mg and glucose were conducted. Serum magnesium was significantly lower in diabetic group compared with the control group (Mean \pm SD): 19.067 ± 2.156 compared to 42.82 ± 2.15 n mol/l ($P = 0.00$). The serum level of Cr (0.11172 ± 0.054664) of the test group was similarly matched with healthy group (0.08094 ± 0.039764), ($p = 0.214$). Significant but negative correlations were shown between Mg and plasma glucose ($P = 0.00$, $r = -3.85$). No significant and negative correlation between Cr and plasma glucose ($P = 0.214$, $r = -0.190$). There is trace element metabolism disorder in patients with type 2 diabetes mellitus (Magnesium) and serum level of Chromium of the test group was similarly matched with healthy group.

Keywords: diabetes mellitus, glucose level, chromium, magnesium

Introduction

Diabetes Mellitus (DM) is a chronic disease characterized by the disorder of the glucose metabolism and associated with a reduced ability of the tissues to respond to insulin (insulin resistance). DM causes high morbidity and mortality derived by chronic micro- and macro-vascular complications (1). Diabetes was reported to be the fifth leading cause of death in the United States (2). DM is now one of the major health problems in the Sudan resulting in 10% of all hospital admissions and mortality. A small population based study in 1993 of a sample of 1284 adult men, showed a prevalence of 3.4% of type 2 diabetes (3). A combination of genetic and environmental risk factors contributed to DM pathogenesis (4). Clinical research suggests that the homeostasis of trace elements can be disrupted by diabetes mellitus. On the other hand, it also suggests

that early imbalances of specific elements may play an important role in upsetting normal glucose and insulin metabolism (5). In fact the deficiency of a single element or certain combinations of elements such as Cr, Mg, and Zn have been shown to predispose a person to glucose intolerance and to promote the development of diabetic complications (6).

Chromium is an essential nutrient involved in the metabolism of glucose and lipids. Suboptimal dietary intake of Cr is associated with diabetes and cardiovascular diseases. It has been reported that Cr and biotin combination reduce insulin resistance, hyperglycemia and lipid profiles in patients with type 2 diabetes (7, 8). A report suggested that Cr decreases the levels of cytokines and oxidative stress in diabetes (9). There are other

reports indicating decreased Mg levels among diabetes patients (10, 11). A population-based study suggested that Mg intake may protect against the development of type 2 diabetes in a Chinese population (12). The lower Mg levels in diabetic subjects could be a consequence of reduced insulin action and increased protein catabolic processes (13).

Hypomagnesaemia seems to be associated with high mortality in critically ill patients with type 2 diabetes (14). The purpose of this study was to evaluate the difference in serum chromium and magnesium levels between diabetic and control groups, and to determine the correlations between these elements and serum glucose in patients with type 2 diabetes mellitus.

Materials and methods

The study was carried out in Omdurman Teaching Hospital in Khartoum State (out patients clinic), Sudan, during the period from October 2014 to February 2015. The study population was comprised of 100 individuals in two groups; 50 with type 2 diabetic mellitus (test group) and 50 healthy volunteers, as a control group. The two groups were age and sex matched. Ethical clearance and permission was obtained from the State Ministry of Health and the appropriate authorities. An informed consent was obtained from all those participating in the study after explaining the objectives of the study. Interview and questionnaire was used to collect personal data. Venous blood samples were withdrawn after an overnight fasting. Serum levels of chromium and magnesium were measured by an Atomic absorption spectrophotometer (GBC

932 Plus). Fasting blood glucose levels were determined by commercial kit, using an enzymatic method (glucose oxidize/ peroxides).

The Statistical Package for Social Science (SPSS version 16) computer software was used for data analysis. Independent ANOVA and correlation tests were used. The significance levels was set at $P < 0.05$.

Results

Demographic features of diabetic patients and controls are summarized in Table 1. There was no significant difference ($P > 0.05$) between the two groups under study. The mean values of the serum Magnesium, Chromium and Fasting blood glucose in the two groups are given in Table 2. There was a highly significant difference ($P = 0.001$) between the means of the serum Magnesium of the test and the control groups (Mean \pm SD): 19.067 ± 2.156 compared to 42.82 ± 2.15 nmol/l in the control group. The means of the fasting plasma glucose levels in the two groups showed a highly significant difference ($P = 0.001$), (Mean \pm SD): 191.01 ± 58.52 versus 94.74 ± 10.81 mg/dl. On the other hand, there was no significant difference ($P = 0.214$) between the mean values of the serum Chromium of the test and the control groups, (Mean \pm SD): 0.8094 ± 0.039764 and 0.11172 ± 0.054664 $\mu\text{g/ml}$, respectively. Table 3 shows a significant but a negative correlation between the Mg and the plasma glucose ($P = 0.001$, $r = - 3.85$), however, it showed no significant negative correlation between Cr and the plasma glucose levels ($P = 0.214$, $r = - 0.190$).

Table 1: demographic features of the two groups

Variable	Test group n = 50	Control group n = 50	P- value
Age (years)	55.48 ± 12.41	53.53 ± 11.43	0.08
Heights (cm)	170.54 ± 9.35	173.24 ± 8.73	0.09
Weight (kg)	75.26 ± 9.85	70.71 ± 9.4	0.04
BMI (kg/m ²)	26.04 ± 3.18	22.6 ± 2.41	0.03

Table 2: The mean values of serum magnesium, chromium and fasting blood glucose among the diabetic patients and control Sudanese individuals

Variable	Test group n=50	Control n = 50	P-value
Magnesium (Mg)	19.067 ± 2.156	42.82 ± 2.15	00.00
Chromium (Cr)	0.8094 ± 0.039764	0.11172 ± 0.054664	.0.21
FBG	191.01 ± 58.52	94.74 ± 10.81	.0.00

Values Are Means ± SD P<0. 05 When Compared To Control

Table 3: The correlation between the serum levels of chromium, Magnesium and Fasting blood glucose among Sudanese diabetic patients

Correlation	Glucose	Cr	Mg
Glucose	1	-0.190	-38.53
P value		0.214	0.00

Discussion

Some trace elements act as antioxidants and prevent membrane per oxidation while others act directly on the glucose metabolism. It is generally agreed that disturbed concentration of Zn, Cr and Mg in the body are often found in patients of diabetes mellitus. Magnesium is an essential ion involved in multiple levels in insulin's secretion, its binding and its activity; and it is also a critical cofactor of many enzymes in carbohydrate metabolism (15). Serum magnesium levels are significantly affected in Sudanese patients with Type 2 diabetic Mellitus (table 2). These findings is in agreement with other studies that reported a significant low serum magnesium levels in diabetic patients when compared with the control group (16, 17). Another study reported an inverse correlation between serum magnesium levels and poor glycolic control and strong association with retinopathy (18).

The mechanism responsible for hypomagnesaemia in patients with diabetes mellitus is not completely known. Osmotic diuresis clearly accounts for apportion of the magnesium loss (19). It is believed that glycosuria which accompanies the diabetic state impairs renal tubular re-absorption of magnesium from glomerular filtrate (20). Among the diabetic Sudanese patients there is no significant differences in the levels of the serum chromium when compared to the non-diabetic. This agrees with the findings from a similar study carried out in Caliber, Nigeria (21). The study demonstrated lower levels of chromium in the lymphocytes of diabetics but there was no differences in the levels in the other blood components of both groups. However, in a study in 2000 carried out in Japanese people, significantly lower levels of Mg and Cr were found in the serum and the

hair of diabetics (22). The present study shows a significant but a negative correlation between Mg and plasma glucose among the diabetic patients, and there is no significant difference between the plasma Cr and the plasma glucose and that the correlation between the two components is negative.

It is concluded that the serum magnesium levels are significantly affected in Type 2

diabetic Sudanese patients. The deficiency of Mg may reduce insulin sensitivity, secretion and may increase risk of secondary complications. Serums levels are not significantly different between the patients and healthy individuals. In order to better understand the role of these trace elements in diabetes further in depth clinical studies are required enrolling large number of patients to allow better conclusions.

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