Assessment of Zinc, Copper, Iron and Glycated Hemoglobin in Sudanese Patients with Type 2 Diabetes Mellitus and their First Degree Relatives

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Abstract: *Background: An altered concentration of some trace elements and antioxident minerals such as zinc, copper and iron are found in patients with diabetes mellitus. This study aimed to assess levels of zinc, copper, iron and HbA1c in Sudanese patients with type 2 diabetes mellitus and their first degree relatives, as a predictor of gaining DM in future. Methodology: This was a case control study which was conducted in Khartoum State – Sudan from February 2017 to April 2017. 35 patients with type 2 DM and 35 of their FDR, 35 non diabetic control subjects were recruited. Plasma iron was measured using ferrozine method. Plasma zinc and Copper were measured using atomic absorption spectrophotometry. HbA1c was measured using immunoassay method. Results: An imbalance concentration of the studied trace elements was observed in both patients with type 2 DM and FDR in comparison with control group. The mean of zinc was 0.26±0.44 in diabetic patients, in FDR was 0.33±0.48 while in control was 0.21±0.16, the mean of copper was 0.14±0.05 in diadetic patients, in FDR was 0.16 ± 0.14 while in control was 0.18±0.14, the mean of iron was 97.51 ± 36.36 in diabetic patients, in FDR was 100.83±40.0 while control was 98.0±57.32, HbA1c mean was 11.2 ±2.6 in diabetic patients, in FDR was 6.1±1.1 while in control was 5.9 ± 0.7. HbA1c was negatively correlated with Zn (p. values = 0.380, 0.121), Fe (p.value= 0.849, 0.256) in the patients with type 2 DM and FDR. HbA1c was negatively correlated with Cu in patients with type 2 DM (p.value= 0.414) and positively correlated in FDR (p.value= 0.542). Conclusion: There was no difference in zinc, copper, and iron levels between diabetic patients and their FDR, so they cannot be used as predictor of DM in them.*

Keywords: DM, HbA1c, zinc, copper, iron

1. Introduction

Diabetes mellitus is a group of metabolic disorder characterized by hyperglycemia resulting from insulin secretion, insulin action or both [1].HbA1c is most commonly detected glycosylated hemoglobin used to monitor the control of diabetes for previous 3 months [1].

Trace elements play a major role in many metabolic processes and are curical for many physiological prosses [2]. Impaired metabolism of zinc, copper has been observed as result in higher sensitivity to oxidative damage and development of diabetes and complications of it. Zn is an important trace element that is directly involved in the synthesis, storage and secretion of insulin, also in the conformational integrity of insulin [3].

Iron is a major component of the earth crust. The major importance of iron in the pathophysiology of disease that is iron is easy to oxidized and reduced. This property is essential for metabolic functions but makes iron hazardous because of its ability to participate in the generation of powerful oxidant species [4]. The metabolism of some trace elements are altered in DM and these nutrients might have specific roles in the pathogenesis and developments of this disease [5]. Some study showed a prevalence 3.4% of diabetes in Sudan [6].

This study aimed to compare levels of zinc, copper, iron and HbA1c in Sudanese patients with type 2 DM and their FDR with control subjects, and to evaluate the correlation between these elements and HbA1c.

2. Materials and Methods

This study was a case control study that was carried out in 35 patients with type 2 diabetes mellitus, 35 first degree relatives, and 35 non diabetic control. Renal diseases, hypertension, chronic diseases, anemia, cardiovascular and hepatic problems patients were excluded from this study. Patients were consent to enrolled in this study. 5ml of blood was taken from vein. About 3 ml was centrifugated for 5 minutes to obtain plasma. Whole blood sample are used to measure HbA1c using immunoassay method ichroma standard kit. Iron was measured in heparenized plasma using ferrozine method. Zinc and copper was analysed in heparinized plasma by atomic absorption spectrophotometry.

3. Results

Thirty five patients with type 2 DM, 35FDR, and 35 apparently healthy subjects were recruited as control group were studied. Plasma concentrations of Zn, Cu and Fe and HbA1c were analysed. The mean levels of HbA1c in diabetic patients show significant difference when compared with control group, the mean ± SD of HbA1c = 11.2±2.6, and control 5.9 ± 0.7, with p. value = 0.000. The mean levels of zinc in diabetic patients show in significant difference when compared with control group, the mean ± SD of zinc =0.26±0.44, and control 0.21±0.16, with p.

value = 0.525. The mean levels of copper in diabetic patients show in significant difference when compared with control group, the mean ± SD of copper =0.14±0.05, and control 0.18± 0.14, with p. value = 0.114. The mean levels of iron in diabetic patients show in significant difference when compared with control group, the mean ± SD of iron =97.51 ± 36.36, and control=, 98.0±57.32, with p. value = 0.966. The mean levels of HbA1c in FDR show in significant difference when compared with control group, the mean ± SD of HbA1c =, 6.1±1.1, and control=5.9 ± 0.7, with p. value = 0.189. The mean levels of zinc in FDR show in significant difference when compared with control group, the mean ± SD of zinc =0.33±0.48, and control =0.21±0.16, with p. value =0.193. The mean levels of copper in FDR show in significant difference when compared with control group, the mean ± SD of copper =0.16 ± 0.14, and control =, 0.18± 0.14, with p. value = 0.583. The mean levels of iron in FDR show in significant difference when compared with control group, the mean ± SD of iron =100.83±40.01, and control =98.0±57.32, with p. value =0.812.(Table (1)).

We evaluate the correlations between Zn, Cu, Fe and HbA1c in type 2 DM and FDR groups..In type 2 DM group. an in significant large negative correlation between the HbA1c and plasma levels of Fe (r= -0.033, P. value= 0.849), Zn and Cu show in significant medium negative correlation (r =-0.153, p. value =0.380), (r = -0.143, p. value =0.414) respectively. Also in FDR we found in significant small negative correlation between the HbA1c and plasma levels of Fe (r= -0.197, P. value= 0.256), Zn (r =-0.267, p. value =0.121), in significant large positive correlation between the HbA1c and plasma levels of, Cu(r = 0.107, p. value =0.542).(Table (2)).

Table 1: shows the means and the standard deviation of Fe, Zn, Cu, and HbA1c in patients with type 2 DM, FDR, and controls

		Mean	SD	P value
IRON IN µ g/dl	PATIENTS	97.51	36.36	.966
	CONTROL	98.00	57.32	
	FDR	100.83	40.01	.812
ZINC IN mg/dl	PATIENTS	.26	.44	.525
	CONTROL	.21	.16	
	FDR	.33	.48	.193
CU IN mg/dl	PATIENTS	.14	.05	.114
	CONTROL	.18	.14	
	FDR	.16	.14	.583
AIC%	PATIENTS	11.2	2.6	.000
	CONTROL	5.9	.7	
	FDR	6.1	1.1	.189

Table 2: shows the correlations between Zn, Cu, Fe with HbA1c

		HbA1c		
		control	patient	FDR
Iron µg/dl``	r	.046	-.033	-.197
	p.value	.791	.849	.256
Zinc mg/dl	r	-.218	-.153	-.267
	p.value	.209	.380	.121
Copper mg/dl	r	-.293	-.143	.107
	p.value	.088	.414	.542

4. Discussion

Our study showed that there was in significant difference in levels of zinc, copper and iron between type 2 DM and FDR when compared with control group. HbA1c levels in patients with type 2 diabete mellitus were significantly higher than those of the control group (p.value =0.000) and this is agree with the studies [2, 7]. There was in significant differences in the levels of HbA1c between FDR and control groups, but the amount of HbA1c was less in the control group (p. value 0.189) and this agree with Atari-Hajipirloo S [2].

In this study we observed there are low concentrations of Zn and this also agreed with studies [3, 5]. Also we show low level of iron and this disagrees with studies [4, 5]. We found low levels of of copper and this is disagreeing with studies [2, 5]. In this study also we found that HbA1c levels were negatively correlated with iron, copper and zinc and this disagree with Atari-Hajipirloo S [2].

We recommended doing more studies using other analytes.

5. Conclusion

There was no difference in zinc, copper, and iron levels between diabetic patients and their FDR, so they cannot be used as predictor of DM in them.

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