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Research Article

CORRELATION OF SERUM MAGNESIUM, ZINC AND COPPER WITH GLYCATED HEMOGLOBIN (HbA1C) IN T2DM PATIENTS

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ABSTRACT

Background: Diabetes is a long-standing disease characterized by hyper glycemia. This hyper glycemia considered as a primary culprit of diabetic complications and is associated with increased metabolic processes and oxidative stress. The trace elements are important co-factors in these events.

Objectives: In the present study we estimated the serum zinc, magnesium, copper and glycosylated hemoglobin (HbA1c) in patients with type 2 diabetes mellitus and healthy controls. A correlation of serum zinc, magnesium and copper with glycosylated hemoglobin (HbA1c) is done in diabetic subjects.

Material and methods: The present study was carried out in the Department of Biochemistry on 360 subjects in the age group of 35-70 years, attended OP in Hind Institute of Medical Sciences. Among them 180 healthy subjects enrolled as control group remaining 180 T2DM patients were served as case group. Fasting venous blood sample was analysed for fasting blood sugar (FBS), serum zinc, serum magnesium, serum copper and glycated hemoglobin (HbA1c). Statistical analysis was done using student't' test .Pearson's correlation between the study variables was performed to establish the relationship.

Results: The FBS, serum copper and HbA1c levels were significantly elevated in diabetics compared to healthy controls ($p<0.001$). There was significant decrease in the levels of serum zinc and magnesium levels in diabetics compared to the controls ($p<0.001$).There is a positive correlation between serum copper with HbA1c, while there a highly significant negative correlation between serum zinc and magnesium with HbA1c in diabetic patients.

Conclusion: Diabetic patients showed a positive correlation between serum copper with HbA1c and a negative correlation between serum zinc and magnesium with HbA1c.

INTRODUCTION

Diabetes is a long-standing disease characterized by hyper glycemia that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces [1]. The chronic hyperglycemia of diabetes is associated with long term damage, dysfunction and failure of various organs especially the nerves, eyes, kidney, heart and blood vessels [2]. Diabetes is among one of the most common non-communicable diseases (NCDs). It is the fourth leading cause of death in most developing countries [3]. Many hypothesis have been proposed to explain the pathogenesis of type 2 diabetes mellitus that connects the disease to a state of subclinical chronic inflammation. Metabolically triggered inflammation has been proposed as a key step in the pathogenesis of type 2 DM [4]. Insulin resistance is the primary event and is followed by increased dysfunction in the type 2 diabetes. Insulin resistance often accompanies excess visceral adiposity, dyslipidemia, hypertension, impaired fibrinolysis, increased platelet aggregation, vascular inflammation, endothelial dysfunction and premature atherosclerosis [5]

The metabolism of several minerals has been reported to alter in diabetes mellitus and these elements might have specific role in the pathogenesis and progress of the disease. Among these the trace elements-magnesium, zinc and copper are having a great role in glucose homeostasis, insulin secretion, storage and action. Magnesium (Mg) is an essential component in various enzymatic pathways involved in glucose homeostasis. The relationship between hypomagnesemia and insulin resistance, impaired glucose tolerance, as well as decreased insulin secretion has been suggested by recent studies [6-7]. Reduced plasma levels of Mg have been documented in both

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T1DM and T2DM, especially in poorly controlled DM [8] Magnesium deficiency may have some effects on the development of diabetic complications with other risk factors.

Zinc, another essential trace element, is a component of many enzymes, and plays an important role in the maintenance of several tissue functions. Zinc is useful in the synthesis, storage and secretion of insulin. Zinc may improve glycemia therefore a restored zinc status in patients with type 2 diabetes may counteract the deleterious effects of oxidative stress which helps to prevent complications associated with diabetes [9].

Copper is the third most abundant trace element in the body. Its role as a cofactor component of cytochrome oxidases, superoxide dismutase, tyrosinase, uricase, dopamine ß-hydroxylase, lysyl oxidase and ceruloplasmin make it a key micronutrient for oxidative pathways. The loss of this activity may contribute to the characteristic swelling and distortion of mitochondria which can be observed in copper deficiency, particularly in metabolically active tissues such as pancreatic acinar cells, enterocytes, and hepatocytes [10].

The aim of the present study was to compare the status of some minerals of patients with T2DM and to compare with non diabetic healthy subjects and also to assess the association between these elements and glycated hemoglobin (HbA1c).

MATERIAL AND METHODS

Study Participants*:* The present study comprises 180 patients in a age group of 35-70 years suffering with type 2 Diabetes reporting to Rama medical college and Hospital. The criteria for the diagnosis of DM were according to the criteria of the American Diabetes Association (ADA) 2007 guidelines [11]. Age and sex matched 180 healthy subjects served as controls. The controls were free from any major aliment which could affect the parameters under study. . Informed written consent was obtained from all the subjects enrolled for the study. Institutional ethical committee clearance was obtained for the study.

Exclusion criteria: individuals suffering with type 1 DM, Patients on diuretics, receiving magnesium supplements, taking drugs that affect blood glucose levels, cardiac, infectious and inflammatory disease were also excluded

Biochemical analysis- 5ml of blood was collected from anti cubital vein with aseptic precaution in Fasting condition.2 ml blood was transferred to fluoride bulb for sugar estimation and 3ml of blood was collected in plain bulb for the estimation of copper, zinc, magnesium and HbA1c. It was allowed to clot and serum was separated by centrifugation at 3000 rpm for 10 minutes.

The following parameters were studied

1. Fasting blood glucose – GOD-POD, end point colorimetric method.
2. Serum Zinc-NITRO-PAPS method (kit supplied by Tulip diagnostics).
3. Serum Magnesium- XYLIDYL BLUE method (Kit by Tulip Diagnostics).
4. Serum Copper-Di-Br-PAESA method (Kit by Tulip Diagnostics) All the parameters read using semi auto analyser (ERBA CHEM 5).
5. HbA1c was estimated by ion-exchange high-performance liquid chromatography method (ERBA EM 360.)

Statistical Analysis

All the values were expressed as Mean ±SD. The statistical analysis was done using student 't' test for comparison between two groups and a p-value of <0.05 was considered statistically significant.

RESULTS

The present case control study conducted on 360 subjects among them 180 people suffering with type 2 DM were chosen as case study group (group-II) and 180 age and sex matched healthy subjects were served as control group (group-I).

Table 1 Comparison of Biochemical parameters in Control and T2DM patients

Parameters	Control n=180 (mean ± SD)	Case group(T2DM) n=180 (mean ± SD)	P value
AGE	47.36 **±8.50**	51.47 **±9.05**	<0.001*
FBS	83.70 ±14.13	154.45 ±25.24	<0.001*
HbA1C	5.21 ± 0.04%	6.84 ± 0.2%	<0.001*
Mg	2.32 ±0.40	1.49 ±0.42	<0.001*
Zn	93.90 ±12.24	82.70 ±14.13	<0.001*
Cu	108.26 ±12.87	120.04 ±18.31	<0.001*

Values are mean or percentages, as appropriate to calculate p Value,* Highly significant

The descriptive biochemical characters and HbA1C values of control and study group were shown in Table-1. Mean age of the study population was 47.36 **± 8.50** and for control group it was 51.47 **±9.05**. There was a significant difference seen in age of controls and diabetic patients (<0.001). FBS and HbA1C levels were significantly elevated in diabetic population in comparison to healthy controls (P<0.001) (Table 1).

The levels of serum copper showed statistically significant elevation in DM subjects compared to control subjects (P<0.001). The level of serum zinc and serum magnesium was statistically significantly decreased in diabetes mellitus patients compared to healthy controls (P<0.001) (Table -1).

Table 2 Correlation of serum zinc, serum magnesium and serum copper levels with HbA1c in diabetic subjects

Correlation between	Pearson's correlation coefficient (r)	p value
Serum zinc and HbA1c	-0.54	<0.01
Serum magnesium and HbA1c	-0.67	<0.01
Serum copper and HbA1c	+0.45	<0.01

In Diabetic patients the levels of serum zinc and serum magnesium showed a negative correlation with HbA1c which was statistically highly significant (r = -0.54 and r= -0.67, p<0.01).While the levels of serum copper showed a positive correlation with HbA1c which was statistically highly significant (r=+0.45, p<0.01)

DISCUSSION

Diabetes is chronic multifactorial disorder with worldwide prevalence. The metabolic alterations associated with diabetes are the prime culprits' causes for pathophysiological changes in

multiple organs that impose a heavy burden of morbidity and mortality from macro vascular and micro vascular complications [12]. Decline in the physiological functions with age may influence the absorption, metabolism and excretion of micronutrients [13].

Zinc acts as co factor in a variety of "antioxidant" enzymes, particularly superoxide dismutase, catalase and Peroxidase, alterations of zinc metabolism such that adequate zinc is unavailable for these enzymes might be expected to contribute to the tissue damage observed in diabetes [14]. In -vitro studies postulated the effect of Zinc on insulin synthesis, storage and release[15]. It has been reported [16-17] that Zn deficiency is associated with reduced insulin secretion and increased tissue resistance to insulin action. In the present study we found zinc deficiency was more sever in diabetics and zinc levels were inversely correlated with HbA1C. The reason for decreases zinc levels in diabetics compared to controls may be due to increased excretion and this may be due to gastrointestinal malabsorption or due to reduction in renal function associated with disease.[18].

The link between hypomagnesaemia and diabetic retinopathy was reported in previous cross- sectional studies where they found serum Mg levels were lower in diabetic patients when compared with their counterparts without diabetes, and they also proved the serum Mg levels had an inverse correlation with the degree of retinopathy [19].Our study Showed a significant negative correlation of serum magnesium with HbA1c. The reason for significant decreased magnesium in diabetic compared to controls may be due to higher urinary losses or impaired absorption of magnesium. It is believed that there is a association between hypomagnesemia and other diabetic complications including neurological abnormalities and dyslipidaemia [20]

Copper a transitional element has affinity to bind with proteins that have been glycated. Generally, serum concentration of copper and ceruloplasmin is elevated in type 2 diabetes mellitus patients [21]. The increase in the Cu ion in patients with DM might be attributed to hyperglycemia that may stimulate glycation and release of copper ions and this accelerates the oxidative stress so that the formation of AGEs occurs [22]. In addition there is production of highly reactive oxidants that can lead to tissue damage. In the present study we observed the levels of serum copper was significantly increased in diabetics compared to controls, there is a strong positive correlation between copper and HbA1c. Similar results were observed in previous studies.

CONCLUSION

In the present study we found a significant and inverse correlation in the serum levels of zinc and magnesium with HbA1c in diabetics. The serum copper showed a positive correlation with HbA1c in diabetics. These alterations of micro minerals may be one of the factors for reducing the insulin sensitivity and may increase the risk of insulin resistance and secondary complications such as retinopathy, CAD, ketoacidosis.

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References

1. American Diabetes Association. Diagnosis and classification of Diabetes Mellitus. *Diabetes Care* 2005; 28(1):537-42.
2. Kannel WB, McGee D. Diabetes and cardiovascular risk factors: the Framingham study. *Circulation* 1979; 59:8-12
3. Resolution 66/2. Political Declaration of the High-Level Meeting of the General Assembly on the Prevention and Control of Non communicable Diseases. In Sixty-sixth session of the United Nations General Assembly. New York: United Nations; 2011.
4. Pradhan AD, Manson JE, Rifai N, Buring JE, *et al* - Reactive protein, Interleukin 6 and risk of developing type 2 diabetes mellitus. *JAMA* 2001;July:286-93
5. Haue AF, Ekram AS, Islam T, Jahan S, *et al* .Evaluation of serum high sensitivity c-reactive protein (hs-CRP) in type 2 diabetes patients. *J Medicine* 2010; 11:20-30.
6. Walter RM, Uriu-Hare JY, Olin KL, *et al*. Copper, zinc, manganese and magnesium status and complications of diabetes mellitus. *Diabetes Care* 1991; 14:1050-6.
7. Huerta MG, Roemmich JN, Kington ML, *et al*. Magnesium deficiency is associated with insulin resistance in obese children. *Diabetes Care* 2005; 28:1175-81.
8. Wells IC. Evidence that the etiology of the syndrome containing type 2 diabetes mellitus. Results from abnormal magnesium metabolism. *Can J Physiol Pharmacol* 2008; 86:16-24.
9. Winterberg B, Bocchichchio M, Horsdorf TH, *et al*. Zinc in treatment of diabetic patients. *Trace Elem Med* 1989; 6:173-7.
10. Aggett PJ. Physiology and metabolism of essential trace elements an outline. In: Taylor A, ed. Clinics in endocrinology and metabolism. Philadelphia: Saunders, 1985; pp 513-43
11. American Diabetes Association. Standards of medical Care in Diabetes. *Diabetes Care* 2007; 30:4-41.
12. Pasupathi P, Farook J, Chinnaswamy P. Oxidant-antioxidant status, high sensitive C- reactive protein and homocysteine levels in type 2 diabetic patients with and without microalbuminuria, *Int J Biol Med Res* 2010;1(3):04-40
13. Fox CS, Coady S, Sorlie PD *et al*. Increasing cardiovascular disease burden due to diabetes mellitus: The Framingham Heart Study. *Circulation* 2007; 115:1544-50.
14. Black RE. Consequences of zinc deficiency on human health issues in infant and child nutrition. Nestle Nutrition workshop series, pediatric program 2002; 48:97-110.
15. Quarterman J, Mills CF, Humphries CR. The reduced secretion of and sensitivity of insulin in zinc deficient rats. *Biochem Biophys Res Commun* 1966; 25:354-8.

16. Chausmer AB. Zinc, insulin and diabetes. *J Am Coll Nutr* 1998;17:109-15
17. Quraishi I, Collins S, Pestaner JP, *et al*. Role of zinc and zinc transporters in the molecular pathogenesis of diabetes mellitus. *Med Hypotheses* 2005;65:887-92
18. Nosnwu AC, Usoro AO. Glycemic control and serum and urinary levels of zinc and magnesium in diabetes in Calabar, *Nigeria*. 2006;5(1):75-78
19. Hatwal A, Gujral AS, Bhatia RPS, *et al*. Association of hypomagnesemia with diabetic retinopathy. *Acta Ophthalmol* 1989;67:714-16
20. Sales CR, de Fatima Campos Pedroso L. Magnesium and diabetes mellitus: their relation. *Clin Nutr* 2006;25:554-62
21. Martin MC, Bustamante BJ, Gonzales MA *et al*. Serum zinc, copper and insulin in diabetes mellitus. *Biomedicine* 1978; 29:56-58.
22. Massod A, Abou-seif, Abd-Allah Youssef. Evaluation of some biochemical changes in diabetic patients. *Clinica Chimica Act*a 2004; 346:161-70.

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