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Plasma Zinc and Magnesium Levels in Type 2 Diabetic Patients in Gorgan City (South East of Caspian Sea-Iran)

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In this study the plasma level of zinc and Magnesium were determined in 50 type 2 diabetic patients and 50 healthy people. The sampling of type 2 diabetic patients were randomized. Diabetic patients studied were without any complications. Samples were analyzed using Randox kit with Spectrophotometric method. The plasma zinc (116.78±5.51 μg dL^{-1}) and Magnesium (1.55±0.12 meq L^{-1}) levels significantly decreased in type 2 diabetic patients ($p<0.001$) when compared with control groups (146.86±9.06 μg dL^{-1}, 1.84±0.10 meq L^{-1}, respectively). It is concluded that type 2 diabetes mellitus can result in changes in Zinc and Magnesium levels. The decreased plasma Zn and Mg that we demonstrated in this study in patients with type 2 diabetes mellitus probably reduce insulin sensitivity and may increase risk of secondary complications, it maybe prudent in clinical practice to periodically monitor plasma Zn and Mg concentrations in type 2 diabetic patients. If plasma Zn and Mg were decreased, an intervention to increase of dietary intake of Zn and Mg may be beneficial for these patients.

Key words: Zinc, magnesium-type 2 diabetes mellitus

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INTRODUCTION

Diabetes mellitus is a heterogenous disease characterized by an absolute or relative deficiency of insulin as well as insulin resistance. Some trace elements like zinc and magnesium are important for human growth and body's biological functions. They most commonly function as coenzymes and cofactor for metabolic reactions and thus help support basic cellular reactions (i.e., glycolysis, the citric acid cycle, lipid and amino acid metabolism) required to maintain energy production and life (Shils *et al*., 1999). The relationship between trace elements and carbohydrate metabolism have regained consideration interest over the last few years. The importance of the trace elements in living organisms was shown over a century ago. Lamb *et al.* (1958) demonsterated the existence of a number of a trace-metal-containing enzymes (metalloenzymes) of importance to the structural and functional integrity of the living cells. Growing concern with enviromental factors in human health over the last few years has aroused renewed interest in trace elements (Lamb *et al*., 1958).

Magnesium is an important element for health and disease. Magnesium, the second most abundant intracellular cation, has been identified as a cofactor in over 300 enzymatic reactions, involving energy metabolism and protein and nucleic acid synthesis (de Walk, 1999). Magnesium may participate in the pathogenesis of diabetes complications and may contribute to the increased risk of sudden death associated with diabetes (Franz and Bantle, 1999).

The function of zinc in the body metabolism is based on its enzymatic affinity, way of a zinc enzyme complex or zinc metalloenzyme. In humans and animals, diabetes maybe results in disturbance of this vital trace elements (Kinlaw *et al*., 1983). In most mammals, insulin is stored as zinc crystals and is likely secreted in zinc form zinc has important role in modulating the immune system and its dysfunction in diabetes mellitus may be related in part to the status of zinc (Mocchegianai *et al*., 1989). Lack or inadequate supply of such nutrients produces a functional impairment or can results in disease. The clinical significance and evaluation of zinc and Magnesium in regard to different diseases including diabetes mellitus remain conflicting as well as controversial and many questions still remain unanswered. Numerous authors have evaluated trace element levels and status in diabetic subjects yet, often inconsistent and contradictory results have been resulted (Walter *et al*., 1991; Zargar *et al*., 1998; El-Yazigi *et al*., 1991). The concept behind this study is to determine the plasma levels of zinc and magnesium in type 2 diabetic patients and compared with control groups in diabetes center of Golestan University of Medical Sciences.

Table 1: Characteristic of the diabetic patients and control groups

Characteristic	Diabtic patients	Control groups
No. of subjects	50	50
Age (years)	48.47±6.87	47.66±5.68
Sex	Male = 20	Male = 22
	Female = 30	Female = 28
Duration of diabetes (years)	2.78±0.74	-
Fast blood sugar (mg dL^{-1})	204.54±32.42	85.62±8.31
Glycated haemoglobin (%)	10.67±1.06	6.31±0.83

MATERIALS AND METHODS

The sampling of type 2 diabetic patients were randomized which carried out on 50 type 2 diabetic patients. Patients were chosen from the patients referred to the Department of Diabetes Center in 5th Azar hospital in Gorgan University of Medical Sciences (2005) and also 50 healthy people for comparing of patients with them were chosen. Diabetic patients studied had no evidence of vascular complications including hypertension, coronary artery disease and etc., Healthy people was defined as an absence of major medical illness, no hospital admissions, no current medication and a subjective perception of good health as determined by health questionnaire. Neither of diabetic patients and healthy people received any medication during this study. Characteristics of diabetic patients and control groups are shown in the Table 1. Blood samples were obtained after an overnight fasting from the diabetic patients and control groups, in a heparinized tubes. Plasma is separated as soon as blood was taken. The plasma Fast Blood Sugar (FBS) and glycated haemoglobin (HbA1c) were determined for diabetic patients and control groups, using laboratory kits and spectrophotometry technique (model JENWAY 6105 UV/VIS) and plasma zinc (Zn) and Magnesium (Mg) were analyzed Randox kit (Homster and Zak, 1985; Young, 1990) with Spectrophotometry method in the Laboratory of Biochemistry (Faculty of Medicine). Plasma FBS and HbA1c were determined with (Barnrnham and Trinder, 1972) and (Boer *et al*., 1992) methods, respectively. The findings were given to software SPSS-10 and analyzed by student' t-test analytical method. $p<0.05$ was significant.

RESULTS AND DISCUSSION

In the present study we determined the plasma levels of Zinc and Magnesium in 50 type 2 diabetes mellitus patients (20 men and 30 women) and 50 control groups (22 men and 28 women). Table 2 shows that plasma levels of

Table 2: Plasma zinc and magnesium concenterations of type 2 diabetic patients and control groups

	Diabetic patients	Control groups	p-value
	n = 50	n = 50	
Zinc (μg dL^{-1})	116.78±5.51	146.86±9.06	<0.001
Magnesium (meq L^{-1})	1.55±0.12	1.84±0.10	<0.001

Zn an Mg were significantly decreased in type 2 diabetes mellitus when compared with control groups ($p<0.001$).

There are varying reports on changes in plasma zinc and Mg in type 2 diabetic patients. Some of the studies showed no significant differences while some other showed a decrease. There are a few reports describing difference in plasma Zn and Mg between type 2 diabetic patients and healthy control.

Patients with type 2 diabetes mellitus have an increased mortality and morbidity compared with control groups and are more likely to coroner artery disease, cerebrovascular and peripheral vascular disease (Kannel and McGee, 1979). The results of some studies showed that plasma Zn and Mg in type 2 diabetes mellitus patients were decreased (Walter *et al*., 1991; Walti *et al*., 2003; Evliaoglu *et al*., 2002) and no significant differences (Walter *et al*., 1991; Zargar *et al*., 1998; Evliaoglu *et al*., 2002) when compared to control groups. The results of this study are in agreement with the results of some studies that plasma Zn and Mg levels in type 2 diabetic patients were significantly decreased (Walter *et al*., 1991; Walti *et al*., 2003; Evliaoglu *et al*., 2002) when compared with control groups. But the results of this study are not in agreement with the findings of other studies (Walter *et al*., 1991; Zargar *et al*., 1998). Possible explanation for this situation is that there is loss of a large amount of Zn from the body via urine. The source of the Zn that is excreted remains incompletely resolved. There is a concurrent hypozincemia and a decrease in tissue Zn stores, but it is not clear if this is a results of the hyperzincuria or an independent event related to the effect of insulin or hypergcemia on loss of Zn from the tissue stores with a resultant loss of Zn to the plasma from where it is excreted with a net loss of total body Zn and eventual hypozincemia.

The reasons why Mg decreasing occurs in diabetes are not clear but may include higher urinary losses or impaired absorption of Mg compared with healthy persons (Walti *et al*., 2003). Several studies reported increased urinary Mg excretion in type 1 and type 2 diabetes (Sjogren *et al*., 1988; McNair *et al*., 1982; Fujii *et al*., 1982; Johnnson *et al*., 1982; Brown *et al*., 1999; Roffi *et al*., 1994), whereas other studies found no significant differences in Mg excretion between diabetic patients and healthy control groups (Sjogren *et al*., 1986; El-Yazigi *et al*., 1993). Increased urinary Mg excretion due to hyperglycemia and osmotic diuresis may contribute to hypomagnesaemia in diabetes (McNair *et al*., 1982; Fujii *et al*., 1982; Johnnson *et al*., 1982). Several authors have suggested that impaired intestinal absorption might contribute to the low Mg status in diabetic patients (Dulach and Rayssiguier, 1983; Sheehan, 1991; Tosiello, 1996). The decreased plasma Zn and Mg that we demonsterated in this study in patients with type 2 diabetes mellitus probably reduce insulin sensitivity and may increase risk of secondary complications, it maybe prudent in clinical practice to periodically monitor plasma Zn and Mg concenterations in type 2 diabetic patients. If plasma Zn and Mg were decreased, an intervantion to increase of dietery intake of Zn and Mg may be bnefical for these patients.

REFERENCES

Barnrnham, D. and Trinder, 1972. An improved colour reagent for the determination of blood glucose by the oxidase system. Analyst, 97: 142-145.

Boer, G.S., R.R. Little, N. Garrett, W. Brown, D.E. Goldstein and M.H. Nahm, 1992. Standardization of glycohemoglobin determinations in the clinical laboratory: Three years of experience. Clin. Chem., 38: 2414-2418.

Brown, I.R., A.M. McBain, J. Chalmers, I.W. Campbell, E.R. Brown and M.J. Lewis, 1999. Sex difference relationship of calcium and magnesium excretion to glycaemic control in type 1 diabetes mellitus. Clin. Chim. Acta, 283: 119-128.

de Walk, H., 1999. Magnesium in diabetes mellitus. J. Med., 54: 139-146.

Durlach, J. and Y. Rayssiguier, 1983. Donnes nouvelles sur les relations entre magnesium et hydrates de carbone. (New data on the relationship between magnesium and carbohydrates). Magnesium, 2: 192-224.

El-Yazigi, A., N. Hannan and D.A. Raines, 1991. Urinary excretion of chromium, copper and magnesium in diabetes mellitus and associated disorders. Diabetes Res., 18: 129-134.

El-Yazigi, A., N. Hannan and D.A. Raines, 1993. Effect of diabetic state and related disorders on the urinary excretion of magnesium and zinc in patients. Diabetes Res., 22: 67-75.

Evliaoglu, O., N. Kilicaslan, N. Uzuncan, B. Karaca, A. Kocaclebi, N. Yensel and S. Inci, 2002. Serum levels of Cu, Zinc, Mg in type 1and 2 diabetic patients 17. Turk. National Biochem. Cong., pp: 285-286.

Franz, M.J. and J.P. Bantle, 1999. Eds: American Diabetes Association Guide to Medical Nutrition Therapy for Diabetes. Alexandria Va., Am. diabetes Assoc.

Fujii, S., T. Takemura, M. Wada, T. Akai and K. Okuda, 1982. Magnesium levels in plasma, erythrocyte and urine in patients with diabetes mellitus. Horm Metab. Res., 14: 161-162.

Homster, R. and B. Zak, 1985. Spectrophotometric investigation of sensitive complexing agents for the determination of Zinc in serum. Clin. Chem., 31: 1310-1313.

Johnnson, G., B.G. Danielson, S. Ljunghall and L. Wibell, 1982. Evidence for a disturbed magnesium metabolism in diabetes mellitus. Magnes Bull., 2: 178-180.

Kannel, W.B. and D.L. McGee, 1979. Diabetes and cardiovascular disease. The framingham study. JAMA., pp: 2035-2038.

Kinlaw, W.B., A.S. Levine and J.E. Morley *et al*., 1983. Abnormal zinc metabolism in type 2 diabetes mellitus. Am. J. Med., 75: 273-277.

Lamb, C.A., O.G. Bentley and J.M. Beattle, 1958. Trace elements. In, proceedings of the conference held at the Ohio Agricultural Experiment Station, Wooster, Ohio. Academic Press-Inc. N.Y. and London, pp: 1-13.

McNair, P., M.S. Christensen, C. Christensen, S. Madsbad and I. Transbol, 1982. Renal hypomagnesaemia in human diabetes mellitus: Tis relation to glucose homeostasis. Eur. J. Clin. Invest., 12: 81-85.

Mocchegianai, E., M. Boemi, P. Fumelli and N. Fabris, 1989. Zinc-dependent low thymic hormone level in type 1 diabetes. Diabetes, 38: 932-937.

Roffi, M., C. Kanaka, P.E. Mullis, E. Peheim, M.G. Bianchetti, 1994. Hypermagnesiuria in children with newly diagnosed insulin-dependent diabetes mellitus. Am. J. Nephrol., 14: 201-206.

Sheehan, J.P., 1991. Magnesium deficiency and diabetes mellitus. Magnes. Trace Elem., 10: 215-219.

Shils, M.E., J.A. Olson, M. Shike and A.C. Ross, 1999. Modern Nutrition in Health and disease. 9th Edn. Philadelphia Pa., Lea and Febiger.

Sjogren, A., C.H. Floren and A. Nilsson, 1986. Magnesium deficiency in IDDM related to level of glycosylated hemoglobin. Diabetes, 35: 459-463.

Sjogren, A., C.H. Floren and A. Nilsson, 1988. Magnesium, potassium and zinc deficiency in subjects with type 2 diabetes mellitus. Acta Med. Scan., 224: 461-466.

Tosiello, L., 1996. Hypomagnesemia and diabetes mellitus. A review of clinical implications. Arch. Intl. Med., 156: 1143-1148.

Walter, R.M., J.Y. Uriu-Hare and K.L. Olin *et al*., 1991. Copper, zinc, magnesium status and complications of diabetes mellitus. Diabetes Care, 14: 1050-1056.

Walti, M.K., M.B. Zimmerman, G.A. Spinas and R.F. Hurrell, 2003. Low plasma magnesium in type 2 diabetes. Swiss Med. WKLY., 133: 289-292.

Young, D., 1990. Effects of Drugs on Clinical Laboratory Tests. 3rd Edn., 3: 237-239.

Zargar, A.H., N.A. Shah and S.R. Massodi *et al*., 1998. Copper, zinc and magnesium levels in non insulin dependent diabetes mellitus. Postgard. Med. J., 74: 665-668.