ORIGINL ARTICLE

Serum Levels of Zinc and Magnesium in Newly Diagnosed Type-2 Diabetic Subjects

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ABSTRACT

Diabetes mellitus is a chronic metabolic disorder which affects carbohydrate, lipid and protein metabolism. There is a strong relation between some specific oligoelements and diabetes mellitus. The study was undertaken to determine serum levels of zinc and magnesium in 60 newly diagnosed uncomplicated type 2 diabetic (group I) and 60 healthy non-diabetic subjects (group II). Serum zinc and magnesium were estimated by Atomic Absorption Spectrophotometer (AAS). The serum zinc and magnesium levels were (72.70±8.43 µg/dl) and (1.85±0.17 mg/dl) respectively in group-1 and (75.92±8.20 µg/dl) and (2.00±0.17 mg/dl) respectively in group-11. The levels were significantly decreased in group-1. Study showed that type 2 diabetes mellitus can result in changes in zinc and magnesium levels and supplementation of both zinc and magnesium may be considered in those cases.

Keywords: Zinc, Magnesium, Type 2 Diabetes Mellitus

Introduction

Diabetes mellitus is a metabolic disorder of multiple etiology characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both. The effects of diabetes mellitus include long-term damage, dysfunction and failure of various organs[1]. Diabetes can lead to heart disease, nerve damage, kidney disease and vision loss. Diabetes mellitus also an important factor of strokes and other blood vessels diseases. Diabetes is indeed a killer disease[2].

Diabetes mellitus is one of the greatest medical problems threatening the world. With the worldwide explosion in its prevalence, type 2 DM has turned into a global epidemic[3]. According to recent estimates the prevalence of diabetes mellitus is 4% worldwide and that indicates 143 million persons are affected which will increase to 300 million by the year 2025[4]. According to Sarah *et al*[5] the existing prevalence of diabetes mellitus is expected to rise up to 4.4% by 2030.

Some trace elements like zinc and magnesium are important for human growth and body's biological functions. They commonly function as cofactors for metabolic reactions and thus support basic cellular reactions required to maintain energy production and life[6]. The importance of the trace elements in the living organism was shown over a century ago. Lamb *et al* in 1958 demonstrated 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 environmental factors in human health over the last few years has aroused renewed interest in trace elements[7].

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[8]. Magnesium may participate in the pathogenesis of diabetic complications and may contribute to the increased risk of sudden death associated with diabetes[9].

Zinc, another trace element, is a component of many enzymes. The function of zinc in the body metabolism is based on its enzymatic affinity, way of a zinc enzyme complex or zinc metalloenzyme[10]. It plays an important role in the maintenance of several tissue functions, including the synthesis, storage and release of insulin. Zinc has been found to enhance the effectiveness of insulin in vitro, and it has been postulated that zinc deficiency may aggravate the insulin resistance in non-insulin dependent diabetes mellitus[11]. In most mammals, insulin is stored as zinc crystals and is likely to secrete in zinc form. Zinc has an important role in modulating the immune system and its dysfunction in diabetes mellitus may be related in part to the status of zinc[12]. Lack or inadequate supply of such nutrients produces a functional impairment or can results in disease. However, 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. In this study, estimation of serum zinc and magnesium in type 2 diabetic patients and comparison of it with that of the apparently healthy non-diabetic persons has been made.

Materials and Methods

This cross sectional study was carried out in the Department of Biochemistry, Mymensingh Medical College in co-operation with the Department of Endocrinology of Mymensingh Medical College, Bangabandhu Sheikh Mujib Medical University and BIRDEM, Dhaka during the period July 2008 to June 2009. A total of 120 subjects aged 50 - 60 years were enrolled for this study. Of them 60 were newly diagnosed type 2 diabetic (group I) and 60 were apparently healthy non- diabetic (group II) subjects. For both case and control, persons having no current medication, intercurrent illness, macro-or microvascular complications and history of-renal failure were selected.

A morning sample was taken after an overnight fasting of at least 12 hrs. From each subject 5 ml fasting blood samples was collected. Serum was separated and kept in eppendorfs after proper labeling. Diabetes mellitus was diagnosed as per ADA (2008)[13] criteria. Estimation were carried out as soon as possible. The fasting samples were used to measure both serum zinc and magnesium levels.

Serum zinc and magnesium were estimated at the central laboratory of Bangladesh Agricultural University, Mymensingh by Atomic Absorption Spectrometry (UNICAM-AA Spectrometer, model no. 969, Spain). Serum glucose was measured by Glucose Oxidase (GOD-PAP) method.

All statistical analysis was done by using Statistical Package for Social Science (SPSS) windows version 13. Results were expressed as mean±SD. Statistical significance of difference between two groups was evaluated by using student's unpaired "t" test and 95% confidence limit was taken as level of significance.

Results

In this study, a total of 120 subjects were enrolled out of which 60 were case and the rest 60 control. As per ADA criteria, OGTT was done in all study subjects. Then serum zinc and magnesium levels were measured in fasting samples of both groups. Serum zinc was expressed in µg/dl while serum magnesium in mg/dl and serum glucose level in mmol/l.

In group I (case) the mean (± SD) FBG levels was 7.19±0.38 and 2hrs after glucose load was 12.23±0.64, while in group II (control) the mean (± SD) FBG levels was 4.32±0.23 and 2 hrs after glucose load was 5.80±0.23 mmol/l respectively (Table-I). In diabetic subjects fasting and 2 hrs after glucose load serum glucose levels were significantly higher than control ($P < 0.001$). The mean ± SD of serum

zinc levels in group I and group II were 72.70± 8.43 and 75.92±8.20 µg/dl respectively (Table II). There was significant decrease ($p < 0.05$) of zinc in group I compared to that in group II. The mean ± SD of serum magnesium levels were 1.85±0.17 and 2.00±0.17 mg/dl in group I and group II respectively (Table II). Serum magnesium also decreased significantly ($p < 0.05$) in group I compared to group II.

Table I: Fasting and 2 hrs after glucose load blood glucose levels of study subjects

Parameter	Group-I N = 60		Group-II n = 60		P value
FBG (mean±SD) mmol/l	7.19	±0.38	4.32	±0.23	< 0.001
Bloog glucose 2 hrs after glucose load (mean±SD) mmol/l	12.23	±0.64	5.80	±0.23	

Table II: Serum zinc and magnesium levels of the study subjects

Biochemical variables	Group I n = 60 mean	± SD	Group II n = 60 mean	± SD	P Value
Zn(µg/dl)	72.70	± 8.43	75.92	± 8.20	< 0.05
Mg(mg/dl)	1.85	± 0.17	2.00	± 0.17	< 0.05

P value was reached by unpaired "t" test.

Discussion

The present study was undertaken to establish an association between the trace elements (zinc and magnesium) and diabetes mellitus. Zinc and magnesium play a vital role in different metabolic processes in body. The present study was an attempt to measure the serum levels of these trace elements in newly diagnosed type-2 diabetic patients and compare those with that of healthy non-diabetic controls.

Zinc acts as a cofactor for insulin, although its exact mechanism in carbohydrate metabolism is yet not clear. In this study, serum zinc levels in type 2 diabetic subjects were found significantly lower ($p < 0.05$) than that of control. The findings are consistent with those of Walter *et al*[14], Walti *et al*[15], Evliaoglu *et al*[16], Nourmohammadi *et al*[17]. According to Nourmohammadi *et al*, the possible reason for decreasing serum zinc concentration in diabetic patients is excessive urinary excretion of zinc especially in patients with diabetic nephropathy, gastrointestinal malabsorption or genetic factors or signs of infection during which zinc acts as a defense mechanism[17]. There is a concurrent hypozincemia and a decrease in tissue zinc stores[10].

But studies by Zargar *et al*[11] in Kashmir and Rusu *et al*[18] in Seria showed that the levels of zinc in diabetic the patients were equal to or higher than that of control groups, which is inconsistent with the findings of the present study. Rusu *et al* attributed the presence of vascular complications to the cause of higher level of serum zinc concentration in diabetic persons. According to them, zinc levels show a moderate but constant increase with obliterative arteriopathy, retinopathy or nephropathy in such case[18]. However, abnormal zinc metabolism has been suggested to play a role in the pathogenesis of diabetes and / its complications[17].

Diabetes mellitus, one of the chronic diseases, is most frequently associated with magnesium deficiency[17]. In this study, serum magnesium concentration in the type 2 diabetic patients was found significantly ($p < 0.001$) lower than that of control group. Similar observations were reported by Meludu and Adeniyi[19], Chinyere et *al*[20], Paolisso *et al*[21], ADA[22]. The reasons of decreased magnesium in type 2 diabetes mellitus are not clear to them but may be due to higher urinary losses or impaired absorption of magnesium as compared to healthy persons. The decrease of serum magnesium may also be due to magnesium depletion caused by osmotic diuresis, and by indirect hormonal effects[18].

Analyzing the findings of the present study, it can be concluded that significant decreases of serum zinc and magnesium occur in type 2 diabetic subjects. Although the small number of samples resists any definitive comment on the normal ranges, it, however, gives an elementary idea on the serum levels of zinc and magnesium in type 2 diabetic patients.

However, the decreased plasma zinc and magnesium in type 2 diabetes mellitus probably reduce sensitivity and may increase risk of secondary complications such as retinopathy, coronary heart disease, ketoacidosis, acidosis, ischemic heart disease, nephropathy and so on. Therefore, an intervention for the increase of dietary intake of zinc and magnesium may be beneficial for these patients.

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