Original Article

Estimation of Serum Zinc Level in Patients with Type 2 Diabetes Mellitus

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ABSTRACT:

Background: The study was designed to evaluate the serum zinc levels in patients with type 2 diabetes mellitus and to compare them with controls.

Methods: This cross-sectional study was carried out in the Department of Biochemistry, Mymensingh Medical College, Mymensingh, from January 2020 to December 2020. A total of 120 subjects were included in this study. Among them, 60 were diagnosed with type 2 diabetes mellitus and denoted as cases (Group-I), and 60 were normal healthy individuals denoted as controls (Group-II). All statistical analyses were done using SPSS version 21.

Results: The mean ± SD of serum zinc levels were 104.15 ± 8.03 µg/dl in Group-I (cases) and 110.72 ± 9.11 µg/dl in Group-II (controls). A highly significant ($p<0.001$) decrease in serum zinc levels was observed in type 2 diabetes mellitus patients (cases) compared to normal healthy individuals.

Conclusion: A significant alteration in serum zinc levels was observed in type 2 diabetes mellitus patients.

Key words: Serum zinc, Type 2 diabetes mellitus.

INTRODUCTION

Diabetes mellitus is a clinical syndrome characterized by hyperglycemia caused by absolute or relative deficiency of insulin. Lack of insulin affects the metabolism of carbohydrate, protein and fat and also causes significant disturbance of water and electrolyte homeostasis; death may result from acute metabolic decompensation.[1] Diabetes mellitus has emerged as a major non-communicable disease globally as well as regionally. It is one of the most challenging health problems in the 21st century and it is among leading causes of death in most developed economies but alarming also in developing economies. Diabetes causes substantial health costs because of complications often associated with it.[2] The effects of diabetes mellitus include long-term damage, dysfunction and failure of various organs. It may present with characteristic symptoms such as thirst, polyuria, blurring of vision, and weight loss. People with diabetes are at increased risk of cardiovascular, peripheral vascular and cerebrovascular disease.[3]

Type 2 diabetes accounts for about 90% of all diagnosed cases of diabetes.[4] The most important risk factors for type 2 diabetes are high calorie diet, aging sedentary lifestyle and obesity. In addition to known risk factors, the role of different micronutrients increase incidence of diabetes has been proposed.[5] Global prevalence of diabetes mellitus was about 463 million (9.3%) in 2019 and is predicted to rise to 578 million (10.2%) in 2030 and 700 million (10.9%) by 2045. The prevalence is higher in urban (10.8%) than rural (7.2%) areas, and in high-income (10.4%) than low-income countries (4.0%).[6] In Bangladesh, the estimated prevalence of diabetes among adults was 9.7% in 2011 and the number is projected to be 13.7 million by 2045.[7] Bangladesh, which

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is still fighting with communicable disease, is already overburdened with non-communicable disease. Diabetes is already the tenth most expensive disease here in terms of total healthcare cost allocated for the illness. The pandemic of diabetes has progressed in association with rapid cultural transformations, growing urbanization, dietary changes, decreased physical activity and other unhealthy lifestyles.[8]

Trace elements such as zinc, copper, iron etc. participate in tissue and cellular and subcellular functions; these include immune regulation by humoral and cellular mechanisms, nerve conductions, muscle contractions, membrane potential regulations, mitochondrial activity, and enzyme reactions.[9] Zinc plays an important role in synthesis, storage and secretion of insulin in response to carbohydrate intake and plays an important role in energy production. It also maintains the structural integrity of insulin.[10] The decreased zinc concentration in blood, affects the ability of the islet cells of pancreas to produce and secrete insulin that may lead to the development of insulin resistance responsible for incidence of type 2 diabetes.[11]

So, the present study is carried out to see the change of serum zinc level in type 2 diabetes mellitus patients. The findings of the study will provide information to the health–policy planners and the clinical practitioners about the importance of routine monitoring of fasting serum glucose, serum zinc levels in diabetic patients. Thus, this study can reinforce further the needs for investigation of these parameters in diabetic patients during the daily clinical practice.

METHODS

This cross-sectional study was carried out in the Department of Biochemistry, Mymensingh Medical College, and the subjects were collected from the Department of Endocrinology, Mymensingh Medical College Hospital during the period of January 2020 to December 2020. For these a total 120 subjects were participated. Subjects were classified into case (group I) and control (group II). Out of them 60 type 2 diabetes mellitus patients with age ranging from 35 to 65 years were selected as case (group Ⅰ) and 60 apparently healthy people of same age group were selected as control (group Ⅱ). Subjects having stroke, myocardial infarction, Chronic renal failure, severe infection, major surgery were excluded from the study.

Informed written consent was taken from each study subject and ethical approval for the study was obtained from the Ethical Committee of Mymensingh Medical College and Hospital.

Height, Body weight and Blood pressure were measured and Body Mass Index (BMI) was calculated. Serum glucose was measured by enzymatic colorimetric method or Glucose Oxidase (GOD-POD) method. Serum zinc was determined by colorimetric method with 2- (5- Bromo-2-pyridyl-azo) - 5 -[-N-propyl-N-(3-sulfopropyl amino]-phenol. Data were analyzed with the help of SPSS version 21. Quantitative data were expressed as mean and standard deviation and comparison between groups was done by Student's unpaired 't' test.

RESULTS

In this study, the age of the subjects was ranged from 35 to 65 years. Mean ± SD age of cases (Gr-I) and controls (Gr-II) were 49.67 ± 8.88 and 49.05±8.45 years respectively, which showed no significant difference ($p>0.05$). Mean ± SD BMI of cases and controls were 24.83±2.17 kg/m^2 and 24.46±3.09 kg/m^2 respectively, which

showed no significant difference (p>0.05); as shown in Table I.

Table I: Demographic features of study subjects.

Demographic features	Group I (case) Mean± SD	Group II (control) Mean± SD	p value
Age (years)	49.67±8.9	49.05±8.5	0.697
BMI (kg/m^2)	24.83±2.2	24.46±3.1	0.874

Data were expressed as mean and standard deviation and comparison between groups were done by Student's unpaired 't' test.

Figure I show the level of serum zinc level in study subjects. The study revealed that mean ± SD of serum zinc levels were 104.15 ± 8.03 and 110.72 ± 9.11 µg/dl in Group-I (case) and Group-Ⅱ (control) respectively. A highly significant (p<0.001) decrease in serum zinc levels were observed in type 2 diabetes mellitus patients (case) when compared to that of the normal healthy persons.

Data were expressed as mean and standard deviation and comparison between groups were done by Student's unpaired't' test.

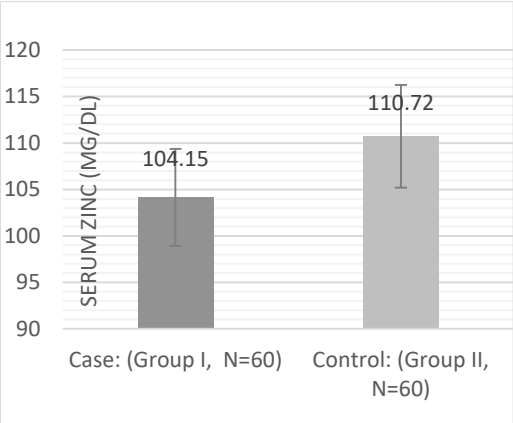

Figure I: Comparison of mean serum zinc levels in the study population

DISCUSSION

Diabetes mellitus is a group of metabolic disorders characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both.[12] The effects of diabetes mellitus include long-term damage, dysfunction and failure of various organs.[3] Type 2 diabetes accounts for about 90% of all diagnosed cases of diabetes.[13] Bangladesh, which is still fighting with communicable disease, is already overburdened with non-communicable disease.[7]

The present study showed, highly significant decrease in serum zinc in type 2 diabetes mellitus patients when compared to that of control group. This finding is supported by the studies of the following authors.[14-21]

Zinc plays an important role in synthesis, storage and secretion of insulin in response to carbohydrate intake and plays an important role in energy production. It also maintains the structural integrity of insulin. The decreased zinc concentration in blood affects the ability of the islet cells of pancreas to produce and secrete insulin that may lead to the development of insulin resistance responsible for incidence of type 2 diabetes. Oxidative stress plays an important role in the development of diabetic complications. Zinc not only has an antioxidant effect, but also constitutes a key constituent of many antioxidants. It inhibits the damage associated with lipid peroxidation and prevents the formation of free radicals. These findings recommend that zinc deficiency may be related with the development of diabetic complications.[14]

Similar to other chronic disorders, diabetes mellitus also increases the excretion of minerals. Hyperglycemia in diabetes is usually associated with hyperzincuria and increased urinary loss of zinc, which is

responsible for decreases in total body zinc.[15]

Hyperglycemia is the basis for hyperzincuria; other data suggested that there is also a defect in zinc absorption associated with hyperglycemia. Zinc-deficient diet resulted in decreased ability of the pancreas to secrete insulin in response to glucose load, suggesting that zinc deficiency also reduced the ability of the pancreas to respond appropriately. In many developing countries, zinc deficiency is due to low consumption of animal sources foods, which are rich in zinc, besides the high intake of cereals and legumes, which contain substantial amounts of phytate (myoinositol hexaphosphate), a compound known to inhibit zinc absorption.[17]

However, contradictory finding was also found where there was no significant difference in the serum zinc level between type 2 diabetes mellitus patients and healthy individuals.[22] Another conflicting study stated that there was increased level of serum zinc in type 2 diabetes mellitus patients compared with healthy one.[23] Possible reasons for the difference in findings can be attributed to the difference in duration of diabetes, controlling glucose levels and zinc excretion in urine and also the amount of zinc in the diet in different areas.

This study was done within the context of the facilities available to us. Our sample size was small due to limitation of time and fund. Furthermore, parameters were measured only once, thus changes over time and other aspects (physical and biochemical parameters) could not be evaluated.

CONCLUSION

Significant decrease in serum zinc levels is observed in type 2 diabetes mellitus patients compared to the control group. These findings emphasize that close biochemical monitoring of serum zinc levels is required in the follow-up of patients with type 2 diabetes mellitus during their management. It is also recommended that a large-scale prospective study be conducted using advanced technology to further investigate alterations in biochemical parameters, including other trace elements and organ function tests, to reach a more conclusive understanding.

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