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Original Research Paper

Clinical Biochemistry

SERUM MAGNESIUM AND ZINC LEVELS IN DIABETES MELLITUS

Dr. Sucheta Ghule

Dr. Tejal Kurhade

Dr. Shilpa Shende

Dr. Jitendra Singh

KEYWORDS :

INTRODUCTION

Diabetes mellitus refers to common metabolic disorder causing hyperglycemia with complex ideology of genetics and environmental factors .Due to diabetes there are pathological changes in multiple organs in long standing disease causing end stage renal disease, blindness, non traumatic lower knee amputation etc.(1)Diabetes is the third leading cause of death after heart disease and cancer in many countries including India.(2)Diabetes type 1 is a complete or partial insulin deficiency as it is not secreted by beta cells of pancreas which is of juvenile onset .whereas type2 is of adult onset and heterogenous group of disorder characterized by variable degree of insulin resistance, impaired insulin secretion and increased glucose production. Several minor and trace elements like magnesium and zinc are important for several metabolic reactions that balance the physiological reactions. Many enzymes require minerals as cofactors or coenzymes. Magnesium is the second most common intracellular cation and serves as a cofactor for more than 300 enzymes which is important for bone ,teeth .Magnesium is important for proper neuromuscular function, deficiency of which leads to neuromuscular instability.It is important for synthesis of proteins, nucleic acids,cell cycle progression and maintenance of membrane integrity and ion homeostasis.(4) After ingestion of glucose, it is taken inside the cell by glucose receptor and converted to glucose 6 phosphate by hexokinase or glucokinase which require magnesium as a cofactor. (6) Magnesium is important for glucose homeostasis, peripheral insulin action and also for insulin secretion from pancreas. Hypomagnesemia has found to decrease the tyrosine kinase activity which is important for proper insulin action (in rats), thus it may contribute to insulin resistance found in type 2 Diabetes mellitus. Thus magnesium plays important role in insulin secretion from pancreas, insulin receptor binding , glucose utilization and further metabolism of glucose via it,s role as a cofactor for various kinases enzymes.(12)Further many studies have shown that hypomagnesemia lead to microvascular, neurovascular , and renal complications of diabetes mellitus .Several studies have reported hypomagnesemia in diabetes mellites or hyperglycemias and its complications like retinopathy(12)

Zinc is an essential intracellular mineral in the body which is cofactor for carbonic anhydrase. Superoxide dismutase, alcohol dehydrogenase, DNA polymerase, RNA polymerase, alkaline phosphatase , and carboxypeptidase etc. ,(2)Zinc is essential for synthesis,storage and secretion of insulin from beta cells of pancreas. It is a important antioxidative mineral, it maintains the integrity of cell membrane, important for wound healing ,and has a central role in genetic expression It stabilizes the structure of DNA and RNA . Chronic hyperglycemia decrease the serum zinc levels by urinary excretion of zinc in type 2 diabetes mellitus. Decreased zinc levels increases the risk of retinopathy , coronary artery disease and several other complications as zinc is important antioxidative mineral in body being the part of superoxide dismutase. Several studies have reported decreased serum zinc levels in hyperglycemic patients. Alternatively decreased zinc levels may also precipitate hyperglycemias due to decrease in insulin secretion and action.

The present is planned to estimate the alteration in the levels of serum Zinc and Magnesium in type 2 diabetis mellitus with of without complications and compare their levels with the normal age sex matches healthy individuals.

MATERIALS AND METHOD

A case control study was carried out on 130 Diabetic patients (GROUP -A) belonging to adult age group, attending diabetis OPD of Indira Gandhi Government Medical College Nagpur, with diagnosis of Type 2 Diabetes, sample size after approval of Ethical Committee. The study was carried out in CCL department of Biochemistry, IGGMC Nagpur. The diagnosis of diabetes Mellitus was confirmed by fasting and post meal blood Glucose according to ADA. Routine investigations like Hb%, Peripheral smear (P.S.), ESR, LFT, RFT were performed. Control group consisted of 50 age sex matched healthy volunteers. The selection of volunteers was done from the healthy hospital staff employees and their relatives, who were willing to participate in the study. Exclusion criteria were pregnant women, children below 25yrs, old age population with other aliments etc. 5ml fasting samples were collected from cases and age matched controls. The samples were centrifuged and serum was separated. The estimations of Magnesium, Zinc, Calcium and Phosphorus were done within 24 hrs. .All the cases having bone disorders, ,immune - compromised diseases were excluded from the study. Samples were analysed for Estimation of Magnesium was done by standard Kit provided by Transasia , ERBA using Xylidil blue to form colored compound in alkaline medium. Estimation of Zinc was using the principle, Zinc reacts with 5BRPAPS (2-5 bromo2 pyridylate5NpropylN sulphopropyramidalphenol) to give red colored complex ,intensity of which is read by spectrophotometry in semiautoanalyzer. Estimation of Phosphorus was done by standard Kit provided by Transasia, ERBA using ammonium molybdate which reacts with inorganic phosphorus in strong acidic media to form reduced phosphomolybdate. Estimation of serum Calcium was done by by standard Kit provided by Transasia, ERBA using Arsonazo . The results were tabulated for the statistical evaluation which was done on Microsoft windows 7 excel sheet by stepwise calculation of mean(M),standard deviation(SD), standard error of mean(SEM), and p- value was calculated by students t-test. (10) The level of significance was calculated between the serum magnesium, Zinc, Calcium and Phosphorus levels.

RESULTS

Table No1: Age Distribution Of Cases

Age group in year	No of cases	% of total cases
25 - 34	20	3.3
35 – 44	60	37.2

45 - 54	25	14.6
55 and above	30	

Table No. 2: Mean Glucose Levels In Cases And Controls

Parameter	Mean values in cases mg%	Mean values in controls mg%
Fasting Glucose	140mg%	805.6mg%
Magnesium	1.82±0.19	2.04±11.6*
Zinc	32.88±20.3	60.2±10.66mg%**

*-significant ($p<0.01$)
**-Highly significant ($p<0.001$)

DISCUSSION

In Our study we have found significantly decreased levels of serum zinc in patients with diabetes-mellitus than normal age sex matched healthy individuals. Similar results were found by Hemanth Gowda and Harish Rangareddy in 2021(4) in South Indian urban population. Serum zinc levels was found to be 93.44+_46.99 microgram/dl,and121.74+_37.15 micrograms/dl in patients with diabetes-mellitus than normal age sex matched healthy individuals respectively. They have correlated the decreased levels of serum zinc leveis to increased renal excretion due to hyperglycemia. Similarly Hossneara Eva, Quazi Shamima Akthar et al in 2016,(11) have found significanthy decreased levels of serum zinc and Magnesium levels in patients with diabetes mellitus than those of normal healthy adults of same age group, who have correlated it with the insufficient dietary intake of these minerals. Prevalance of decreased magnesium levels in type 2 diabetic patients has been studied by Yeluri Sheshgiri and Dharam Rao who have attributed the decreased magnesium levels to either decreased dietary intake, impaired magnesium absorption, increased renal loss. They have also postulated that hypomagnesemia may be due to the renal tubular defect in loop of henle.In past studies done by Nagase N who have found decreased serum magnesium levels in diabetic patients than in normal healthy adults , have postulated that decreased magnesium levels are due to poorly controlled diabetics and hypomagnesemia is also the cause of insulin resistance. (12 0f art8) Some researchers have correlated serum glycated hemoglobin with serum magnesium and zinc in long standing diabetics (15) They have found that there is significantly decreased levels of serum magnesium and zinc in patients with diabetes who have poor glycemic control. In the study conducted by Yuvraj Badhe(12) , Chaitanya Bhujbal etal it has been found the glycated hemoglobin was not properly correlating with hypomagnesemia and hypozincemia .Rather duration of the disease is more crucial component for hypomagnesemia and hypozincemia. They have also found that serum magnesium and zinc levels are not correlated with poor glycemic control rather than with the duration of disease. In the study conducted by Dhedi etal (17) in 2020 on 440 participants, serum zinc levels were significantly low in cases with poor diabetic control as well as they found that serum zinc levels are decreasing with the increase in duration of disease. Magnesium and Zinc elements that play vital role in several biochemical reactions and are also associated with insulin (15)Protein tyrosine phosphatase 1B which is a regulator of the active phosphorylation of insulin receptor is inhibited by zinc ions. Zinc is also required for the activity of superoxide dismutase an antioxidant enzyme. Zinc also has insulin like effect in inhibiting the glycogen regulating enzyme GSK3,activation of proteins in post-receptors like PI3 kinase, Akt (7, 12 0f 7,3,11 of 7)Zinc also maintains the structural integrity of insulin and cell membrane .Zinc has a important role in clearing of free radicals being a cofactor of antioxidant enzymes which leads to free radical injuries in deficiency of zinc inhibiting lipid peroxidation. (18,16).Zinc has a role in stabilization of proteins, DNA, RNA, binding of insulin receptors, steroid hormone receptors, and several transcriptional factors to DNA and RNA (21).Hence in diabetic patients the excretion of zinc leads to hypozincemia, and again deficiency of zinc also leads to disturbed glucose metabolism leading to hyperglycemia which is a metabolic interdependency. Other clinical effects of zinc deficiency due to renal , dietary or any other reason like impaired immune function ,spermatogenesis, hypogonadism, acrodermatitic enteropathica, hair loss skin rashes etc.

Magnesium form a key complex with ATP and is an important cofactor for various enzymes(more than 300) ,transportors etc required for energy metabolism and replication .The conc of magnesium is clasely maintained in the range of 1.5-2 mEq/lit.The vary first step for utilization of glucose and entry of glucose into cytosol is convertion of glucose to glucose 6 phosphatase requires glucokinase or hexokinase which requires magnesium as a cofactor. Moreover magnesium is required for secretion and action of insulin receptors amongst the several other factors. Serum magnesium which has been postulated to be excreted in long standing diabetics, due to hyperglycemia it is decreased in diabetics and the other way hypomagnesemia may be due to any cause either dietary, excretory, or due to malabsorption causes altered glucose metabolism contributing to hyperglycemia. Considering the other potential deficiency symptoms of serum magnesium ,like altered neuromuscular function,muscle weakness vertigo, ataxia, cardiac arrythmias in severe deficiency, ECG changes like prolonged PR and QT intervals. Flattening of T wave and effects of magnesium in bone metabolism diabetic patients should be screened for serum magnesium. (harrison 2372-2374)Hence our study suggests the screening for serum magnesium and Zinc and should be supplemented accordingly if required .

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