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ESTIMATION OF SERUM MAGNESIUM AND ZINC LEVELS IN TYPE-2 DIABETES MELLITUS

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Abstract: Diabetes mellitus is chronic disease characterized by defective insulin production or utilization. Type-2 diabetes mellitus has mainly peripheral insulin resistance as a cause with or without insulin secretary defects. In particular, type-2 diabetes mellitus has been shown to be associated with abnormalities in the metabolism of Zinc, Chromium, Magnesium and Manganese. The serum levels of Zinc and Magnesium are usually low in diabetic patients. The study finding may exhibit the extent of deficiencies of these two trace elements in relation to duration of the disease. It may be utilized to optimize the control of type-2 diabetes mellitus by supplementation of zinc and magnesium. By doing so the metabolic complications of diabetes mellitus can be delayed.

Key words: Serum Magnesium, Serum Zinc, Type 2 diabetes mellitus

INTRODUCTION

Diabetes mellitus is a common complication of chronic pancreatitis, can disturb the metabolism of zinc, copper, magnesium and selenium[1]. Diabetes is estimated to affect about 170 million people worldwide and this represents about 2% of the world's population[2,3]. Speculations on the role of trace elements in human disease were aroused in 1929, when glaser and halpern noticed that yeast extracts potentiate the action of insulin[4]. Earlier works of mertz, *et al.,* in 1959 demonstrating the existence of glucose tolerance factor in yeast with the identification of the active component as trivalent chromium sparked off interest on the status of other trace and macro elements in health and diseases including diabetes[5]. The proposed mechanism of trace elements enhancing insulin action includes activation of insulin receptor sites, serving as cofactors or components for enzyme systems involved in glucose metabolism[6,7], increasing insulin sensitivity and acting as antioxidants preventing tissue per oxidation[8]. Zinc is required for insulin synthesis and storage and insulin is secreted as zinc crystals, it maintains the structural integrity of insulin[9]. Magnesium is a cofactor in the glucose transporting mechanisms of the cell membrane and various enzymes in carbohydrate oxidation. It is also involved at multiple levels in insulin secretion, binding and enhancing the ability of insulin to activate tyrosine kinase[10]. Magnesium deficiencies have been implicated in insulin resistance, carbohydrate intolerance, dyslipidemia and complications of diabetes[11]. Lower serum levels of magnesium and zinc both are affected in patients suffering from type-2 diabetes. It is unknown whether difference in trace elements status is a consequence of diabetes and hyperglycemia or alternatively whether their deficiencies contribute to the expression of the disease.

The objective of this study was to determine the serum levels of zinc and magnesium in diabetic patients and control subjects and their association with glycemic status and duration of diabetes.

MATERIAL AND METHODS

The prospective study was undertaken in clinical laboratory of our institute A total of hundred patients (in patients and outpatients) of our tertiary care institute were included in our study, that consist of 50 patients suffering from Type 2 diabetes mellitus which served as test group and another 50 non diabetic control (age and sex matched from the same population with normal blood sugar).The criteria to diagnose Diabetes mellitus is on the basis of WHO strategy.

Exclusion criteria

The patients suffering from liver disease, kidney disease, and severe congestive heart failure were excluded from the study. Obese or pregnant subjects, subjects with renal complication, hypertension and currently taking nutritional supplements, magnesium containing laxatives, diuretics / alcohol were excluded in both groups.

Collection and processing of blood sample

7ml of fasting venous blood sample was drawn from each subject under aseptic conditions. 2ml of the Sample was dispensed in to fluoride oxalate bottles for plasma glucose estimation. 1ml of the sample was dispensed in to EDTA vial for estimation of glycosylated hemoglobin. The rest of the sample was discharged into a plain vial and allowed to clot. The serum was separated and used for various investigations.

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Following investigations were carried out in all the patients:

1. Fasting blood glucose: glucose oxidase[12] method.
2. Serum Zinc estimation: Colorimetric kit method[13]
3. Serum Magnesium estimation: Colorimetric kit method[14]
4. Glycosylated Hemoglobin estimation: Ion Exchange Resin[15] method.

The result obtained from the above investigations will be analyzed. The results would be expressed as mean±SD of each variable. The comparison will be done by student 't' test on the number of variables of each parameter

RESULT

The present study was undertaken in clinical laboratory of our institute. 50 patients suffering from diabetes mellitus (Type 2) comprised study group. 50 adults of same age group and normal blood sugar level acted as controls. In the study group there were 14 males and 36 females, whereas in the control group there were 20 males and 30 females. Table 1 shows the comparison of serum Zinc and Magnesium levels, fasting blood sugar levels and glycosylated Hb levels between study and control groups. Comparison of serum Magnesium levels & Zinc levels in type 2 diabetes mellitus according to duration of disease have been depicting in table 2.

Table 1: Comparison of serum Zinc and Magnesium levels, fasting blood sugar levels and glycosylated Hb levels between study and control groups.

S.no.	Variables	Group I (control) 50 subjects	Group II (diabetic patients) 50 subjects	P value
1.	Blood glucose (mg/dl)	83.1 ± 13.3	154.3 ± 39.4	p<0.001*
2.	Serum Mg (mg/dl)	2.33±0.37	1.62±0.47	p<0.001*
3.	Serum Zinc(mg/dl)	96.4 ± 8.10	61.9± 11.6	p<0.001*
4.	Glycosylated Hemoglobin (%)	5.45±0.36	9±1.23	p<0.001*

Table 2: Comparison of serum Magnesium & Zinc levels in Type 2 Diabetes mellitus according to duration of disease.

S.no.	Duration of disease (yrs.)	No. of cases	Serum Magnesium (mean ± SD)	Serum Zinc (mean ± SD)	P value
1.	1-3	28	1.5 ± 0.41	59.2 ± 11.4	p<0.05*
2.	4-6	18	1.6 ± 0.37	65.6 ± 10.9	p<0.05*
3.	7 & above	4	1.5±0.77	64.2 ± 10.2	p<0.05*

DISCUSSION

Numerous studies have demonstrated the essential roles of trace elements as chromium, zinc, magnesium, selenium, vanadium, molybdenum and manganese in insulin action and carbohydrate metabolism[16]. In our study, it was observed that mean serum zinc level was significantly low in diabetics as compared to control subjects, which correlates with other studies[17,18] in different parts of the world. The possible explanation for decreased level of zinc observed in diabetics can be due to increased excretion and/or decreased gastrointestinal absorption of zinc. Our study also confirms the finding that the patients with type -2 diabetes mellitus have significantly lower levels of magnesium as compared to controls as reported by several workers in the previous studies[19,20]. Sharma[21] reported an inverse correlation between serum magnesium level and poor glycemic control and a strong association with retinopathy.

In the present study, it was seen that zinc and Magnesium levels were decreased in type 2 diabetic patients. Magnesium depletion is a cause or consequence of type 2 diabetes mellitus remains debatable, but Magnesium depletion has a negative impact on glucose homeostasis and insulin sensitivity in patients with type 2 diabetes mellitus. Zinc also plays a major role in glycemic control of type 2 diabetic patients. If serum magnesium and zinc levels are low, an intervention to increase dietary intake of magnesium and zinc may prove to be beneficiary.

CONCLUSIONS

Decreased levels of Magnesium and zinc is the cause or consequence of diabetes mellitus remains yet to be certained, but its strong association with type 2 diabetes mellitus signifies the role played by magnesium and zinc in glucose disposal. The poor glycemic control and the association with type 2 diabetes mellitus strongly suggest that serum magnesium and zinc estimation should be a part of the screening panel in the risk detection for type 2 diabetic patients. Many workers have documented that the magnesium and zinc supplementation, in addition to the other nutritional treatments, play an important role in delay and prevention of the complication of type 2 diabetes mellitus. When the status of zinc and magnesium is poor in patients with type 2 diabetes mellitus, supplementation of these minerals probably be beneficial.

REFERENCES

1. Quilliot D *et al.*, Evidence that diabetes mellitus favor impaired metabolism of zinc, copper, selenium in chronic pancreatitis. Pancreas: 2001; 22 (3):299-306.

2. Wokoma FS. Diabetes and hypertension in Africa, an overview. Diabet Int 2002; 12:36-40.

3. Unwin N, Sobngwi E, Albert KGMM. Type-2 diabetes: the challenge of preventing a global epidemic. Diabet Int 2001 11:3-8.

4. Glaser E, Halpern G. Insulin action. Biochem 1929; 207:377-83.

5. Mertz W. Effects and metabolism of glucose tolerance factor Nutr Rev 1975; 3:129-35

6. Vincent JB. Quest for the molecular mechanism of chromium action and its relationship to diabetes. Nutr Rev 2000; 58:67-72.

7. Murray RK, Granner PA, Rodwell VW. Metabolism of carbohydrates. In: Harpers Biochemistry, 25th. Appleton and Lange, 2000:190-5.

8. Kruse-Jarres JD, Rukgauer M. Trace elements in diabetes mellitus. Peculiarities and clinical validity of determinations in blood cells. J Trace Elem Med Bio 2000; 14:21-7.

9. Chausmer AB. Zinc, insulin and diabetes. J Am Coll Nutr 1998; 17:109-15.

10. Suarez Z. Decreased insulin sensitivity in skeletal muscle of hypomagnesemic rats. Diabetologia 1993; 36:82.

11. Resnick LM *et al.,* Cellular ions in hypertension, diabetes, and obesity. A nuclear magnetic resonance spectroscopic study. Hypertension 1991; 17:951-7.

12. Trinder P. Determination of Glucose in blood using glucose-oxidase with an alternative oxygen acceptor. Annals Clinical Biochemistry 1969; 6: 24-27

13. Saito M, Makino T. Estimation of zinc in serum by colorimetric assay. Clin Chimica Acta 1998; 120: 127-35.

14. Bohuon C. Determination of magnesium level in serum by colorimetric method. Clin Chimica Acta 1962; 7: 811-17.

15. Goldstein DE, Little RR, Weidmayar HM. Glycated hemoglobin: methodologies and clinical applications. Clin Chem 1986; 32: B64-70

16. Zargar AH *et al.,* Copper, zinc and magnesium levels in type-1 diabetes mellitus. Saudi Med J 2002; 23:539-42.

17. Al-Maroof RA, Al-Sharbatti SS. Serum zinc levels in diabetic patients and effect of zinc supplementation on glycemic control of type-2 diabetics: Saudi Med J 2006; 27:344-50.

18. Anetor JI, Senjobi A, Ajose OA, Agbedana EO. Decreased serum magnesium and zinc levels: artherogenic implications in type-2 diabetes mellitus in Nigerians. Nutr Health 2002; 16:291-300.

19. Schmits Chek HF, Rempis R. Prevalence of Hypomagnesaemia in an unsealed German population of 16,000 individuals. Magnes Res. 2001; 14: 283-290.

20. Ashima B, Kuldip SS, Rajesh P, Jasbir S. Serum magnesium level: A key issue for diabetes mellitus. Journal of JK Science 2011;13,3:132-134

21. Sharma A *et al.,* Serum magnesium: an early predictor of course complications of diabetes mellitus. J Indian Med Assoc 2007.105:16-20.

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