Research Article

Comparative study of serum magnesium and copper levels in type 2 diabetes mellitus patients and non diabetic healthy subjects

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Abstract

Diabetes mellitus is a common complication of chronic pancreatitis, can disturb the metabolism of zinc, copper, magnesium and selenium[1]. The serum magnesium and copper levels were estimated in sixty patients admitted in medicine department in GMC, Nagpur and in non diabetic healthy subjects. The result of study showed that serum copper were increased and magnesium level were decreased significantly in diabetic group compared to non-diabetic group. Thus it is concluded that these changes play an important role in the pathogenesis of type 2 DM by the involvement of these elements in the oxidative stress and may have a contributory role in the progression of DM and later development of complications.

Keywords: Hypomagnesemia, Copper, Type 2 diabetes mellitus, Oxidative Stress.

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INTRODUCTION

Type 2 DM is an endocrinological disease associated with hyperglycaemia characterised by both insulin resistance and defective insulin secretion[2]. A relationship between DM and minerals is frequently reported. Alteration in the metabolism of trace elements like copper, and magnesium is associated with DM[3]. Magnesium is an essential element involved in glucose homeostasis. It is a cofactor for various enzymes in carbohydrate metabolism. It is also involved at multiple levels in insulin secretion, binding and activity. Reduced level of magnesium has been documented in type 2 DM[3-6]. Hypomagnesemia may have negative impact on glucose homeostasis and insulin sensitivity in type 2 DM patients[7]. Hypomagnesemia may also have some effect in the development of diabetic complications with other risk factors[8]. Oxidative stress contributes to the pathogenesis of many diseases including DM. Previous studies have shown that copper causes oxidative stress[2,3,5,6]. Copper acts as a pro-oxidant and may participate in metal catalysed formation of free radicals[3]. The increased production of free radicals is likely to be associated with development of type 2 DM. Keeping in mind the above facts, the aim of the present study was to evaluate the serum levels of magnesium and copper in type 2 DM and compare it with controls.

MATERIAL AND METHOD

The present study was conducted in department of biochemistry in government medical college, Nagpur for the duration of one and half years.

Study design

Hospital based cross sectional study with comparison groups.

Study population

Sixty type 2 diabetic patients and sixty healthy non diabetic subjects.

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Inclusion criteria

A total of sixty patients (aged 30-70 years) with type-2 DM recruited from department of Medicine. The diagnosis of type-2 DM was confirmed by biochemical investigations as per WHO criteria.

Exclusion criteria

Patients were excluded when diagnosed with type 1 DM, acute complications such as severe infection, major operations, trauma, GI disorders, severe cardiovascular respiratory diseases, pregnant and breast feeding women. Patients taking supplements such as antioxidants, vitamins, minerals were also excluded.

Collection of blood sample

5ml 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. The rest of the sample was discharged into a plain vial and allowed to clot. The serum was separated and used for various investigations.

Table 1: Parameters were estimated with methods as follows

Sr. No.	Parameter	Method
1	Blood Glucose	GOD - POD Method [9]
2	Serum Magnesium	Calmagite Colorimetric Method[10]
3	Serum Copper	Colorimetric kit method[11]

Statistical analysis

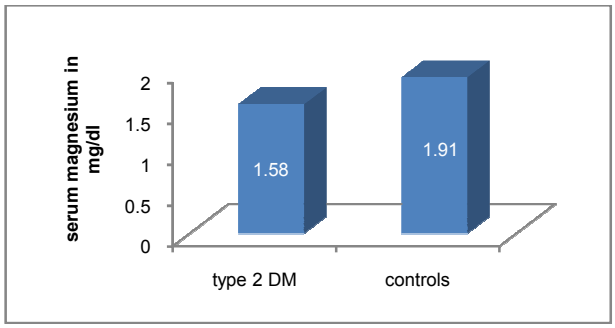
All the values were expressed as mean ± SD. p value<0.05 was considered as statistically significant, that<0.001 was considered as highly significant. Data was analysed by using the SPSS version 15.0.

RESULT

Table 2: Comparison of parameters in two groups (Cases and Controls)

Parameters	Cases (n=60)	Controls(n=60)	p value
Age (mean± SD)	54.36+11.25	51.81+10.25	0.131
Fasting blood glucose(FBS) (mg/dL)	192.92+102.75	98.36+17.90	<0.001*
Post prandial blood glucose (PPBS) (mg/dL)	261.24+109.05	140.00+35.16	<0.001*
Serum Magnesium (mg/dL)	1.58+0.28	1.91+0.22	<0.001*
Serum Copper (mg/dL)	156.32+17.99	104.62+25.99	<0.001*

*Highly significant



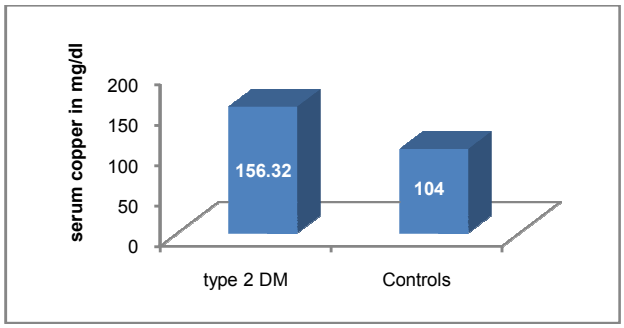


Figure 1: Levels of serum Magnesium in cases and controls (mg/dL) **Figure 2:** Levels of serum Copper in cases and controls (mg/dL)

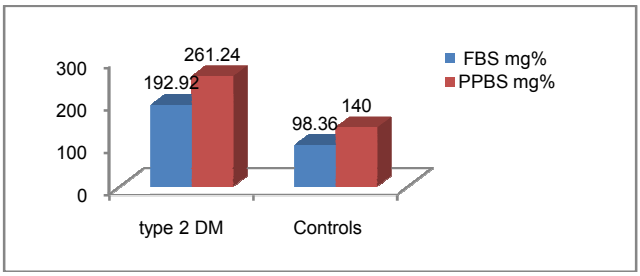


Figure 3: Levels of FBS and PPBS in cases and controls (mg/dL)

DISUCUSSION

Type 2 DM is a major global health problem that affects 200 million individual worldwide[8]. It is characterised by insulin resistance in peripheral tissues and an insulin secretory defect of beta cells of the pancreas[12]. The relationship of DM with minerals has been reported[2,3,4,6]. Among these minerals copper and magnesium are of particular interest. In our study we obtained a significant decrease in serum magnesium and increase in serum copper level in patients having type 2 DM as compared to controls.

Serum Magnesium

Magnesium is a cofactor for several enzymes involved in carbohydrate metabolism[13]. Serum magnesium level in

type 2 DM patients in our study was decreased significantly ($p<0.001$) compared to healthy subjects. Magnesium is important for the effectiveness of insulin. It is involved at multiple levels in insulin secretion, binding and its activity. A reduction of magnesium in the cells strengthens insulin resistance[14,15]. Magnesium deficiency decreases insulin sensitivity via alteration of the insulin receptor associated tyrosine kinase in type 2 DM patients[13]. The cause of hypomagnesemia may be attributed to osmotic renal loss from glycosuria and also decrease in net tubular reabsorption of magnesium[16]. The other finding of our study was a significant ($p < 0.001$) increase in serum copper level in type 2 DM as compared to controls.

Serum copper

It is well known that copper plays a vital role in oxidative stress[2,3]. Copper in its free form is a potent cytotoxic element because of its redox chemistry. It readily participates in Fenton and Heiber Weiss reactions to generate reactive oxygen species[17,18]. A high level of copper enhances the toxic effect of metal dependent free radicals. Moreover the increase in copper levels in patients with type 2 DM might also be attributed to hyperglycaemia, which stimulates glycation and causes release of copper ions from copper binding sites of proteins. The release of copper ions into blood further accelerates the oxidative stress[1]. Results of our study corroborated with the studies conducted by Schlienger *et al*,[19] and Sarkar A *et al*,[2]

CONCLUSION

In conclusion the present findings demonstrate the imbalance in levels of serum magnesium and serum copper among the patients of type 2 DM in comparison to controls. These changes may play an important role in the pathogenesis of type 2 DM by the involvement of these elements in the oxidative stress. This suggests that the impaired metabolism of these minerals may have a contributory role in the progression of DM and later development of complications.

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