

Association of serum Magnesium levels with renal function in patients with diabetes mellitus type 2. A cross sectional study in rural population of North Telangana

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ABSTRACT

Introduction: Diabetes mellitus is one of the most common metabolic disorder and leading cause of death and disability in the world. Magnesium deficiency can lead to development of diabetic complications such as nephropathy, retinopathy, thrombosis and hypertension. This is a cross sectional study designed to determine whether there is any association between serum magnesium concentration [Mg²⁺] and the rate of renal function deterioration in patients with diabetes mellitus type 2 (DM2).

Materials & Methods: A cross sectional study was done in randomly chosen 50 Type 2 diabetic patients without renal dysfunction, 50 diabetic with renal dysfunction of age between 40 and 60 years, 50 non diabetic controls with age and sex matched attending our institute during November-February-2018 were included. All patients and controls underwent thorough clinical examination and estimation of serum Magnesium, FBS, PPBS, hemoglobin A(1C), urinary albumin creatinine ratio(UACR), as well as history of hypertension and pharmacy profiles were retrieved.

Results: The mean serum magnesium levels among Type 2 DM with renal dysfunction, Type 2 DM without renal dysfunction and healthy controls were 0.795±0.199mg/dl, 1.319±0.103mg/dl, 2.33±0.28mg/dl respectively.

Conclusion: There was a significant reduction in serum Magnesium [Mg] levels in diabetics compared to the controls. Lower "Mg" is associated with a faster renal function deterioration rate in Type 2 DM patients.

Keywords: Diabetes mellitus(DM), Hypomagnesaemia, urinary albumin Creatinine ratio(UACR), Magnesium(Mg)

INTRODUCTION

Diabetes mellitus is a metabolic disorder, which is classified into different types. These distinct types of DM are caused by a complex interaction of genetic and environmental factors. India leads in the world with its largest number of

diabetes subjects as compared with any other given country. It has been estimated that presently 19.4 million individuals are affected by diabetes and these numbers are expected to increase to 57.2 million by the year 2025 (1/6th of world total)¹.

Those who are suffering with Type 2 DM are at high risk for both microvascular complications i.e retinopathy, nephropathy and neuropathy and macrovascular complications such as cardiovascular comorbidities due to an unhealthy diet and physical inactivity and genetic factors will contribute to the pathophysiological disturbances that are responsible for impaired glucose homeostasis in Type 2 DM.

Magnesium is an important electrolyte which plays a significant role as a co-factor for many enzymes in various metabolic reactions. Magnesium is most abundant divalent intracellular ion next to potassium. Magnesium is the abundant cation in the human body which plays a major role in many biological processes, including energy metabolism and DNA synthesis. Mg and type 2 diabetes have a close relationship. Approximately one-third of patients with type 2 diabetes have hypomagnesemia, mainly caused by enhanced renal excretion². Mg deficiency is associated with poor glycemic control, and Mg supplementation improves insulin sensitivity³. Moreover, there is substantial evidence of associations between hypomagnesemia and various complications of type 2 diabetes, including neuropathy, retinopathy, foot ulcers, and albuminuria⁴⁻⁷. The relationship between Mg deficiency and advanced type 2 diabetic nephropathy, however, remains to be fully elucidated.

MATERIALS & METHODS

Study design: A Cross sectional study was conducted in North Telangana, Karimnagar district on subjects of aged 40-60yrs who have visited Prathima Institute of Medical Sciences during November-2017 to February -2018. All the subjects were divided into two groups based on their urinary albumin creatinine ratio(UACR). The first group consists of 50 type-2 diabetic patients with UACR < 30mg/gr creatinine. The

mean of UACR is 10.24(range:4.05-21.84).

Second group consist of 50 type-2 diabetic patients with UACR >30mg/gr creatinine. The mean of UACR is 255.84(range:108-426).

To compare serum magnesium levels with healthy controls, 50 healthy subjects with age & sex matched were participated in this study.

The following parameters were done in all the subjects:

1. Fasting blood sugar (FBS) and (PLBS) Postprandial blood sugar(GOD-POD method)
2. Fasting serum magnesium levels (Calmagite method), normal 1.5-3.0 mg/dl
3. HbA1c (Immuno-turbidimetric method).
4. Urinary albumin creatinine ratio(UACR) in early morning urine sample.

All cases of Type 2 DM with age40-60yrs and age & sex-matched healthy controls were included and patients receiving magnesium supplements or magnesium-containing antacids, with a history of alcohol abuse, pregnant women, patients with a history of epilepsy and patients on diuretics were excluded in our study.

RESULTS

The results of two groups are expressed as Mean±SD. Unpaired student 't' test was used to obtain the p value in two groups. Table1 shows the comparison of group-I (Type-2 DM without renal dysfunction) with group II (Type-2 DM with renal dysfunction). The value of serum magnesium was significantly decreased in group II (Type-2DM with renal dysfunction) compared with that of group-I (Type-2 DM without renal dysfunction).The serum magnesium levels of group-I is (1.319±0.103) as compared to group II (0.795±0.199)respectively.

Table 1: Serum Magnesium levels in diabetic without renal dysfunction and diabetic with renal dysfunction

Serum magnesium	Type-2 DM without renal dysfunction (group-I)	Type-2 DM with renal dysfunction (group-II)	P value
Mean±SD	1.319±0.103	0.795±0.199	0.0001

Table 2 shows the comparison of group I (healthy controls) with group II (Type-2 DM without renal dysfunction). The value of serum magnesium was significantly decreased in group II(**Type-2DM**without renal dysfunction) compared with that of group-I (healthy controls).the serum magnesium levels of group-I is (2.33±0.28) as compared to group II (1.228±0.157)respectively.

Table 2: Serum Magnesium level in Type-2DM without renal dysfunction and healthy control

Serum magnesium	Healthy controls	Type-2DMwithout renal dysfunction	P value
Mean±SD	2.33±0.28	1.319±0.103	0.0001

Table 1 reveals that the value of serum magnesium is significantly decreased in group II (Type-2 DM with renal dysfunction) compared to group I (Type-2DM without renal dysfunction) with p value 0.0001,which was considered as extremely statistically significant.

Table 2 reveals that the value of serum magnesium is significantly decreased in group II (Type-2DM without renal dysfunction) compared to group I(Healthy controls) with p value 0.0001 which was considered as extremely statistically significant.

DISCUSSION

In this cross sectional study, we found a significant inverse relation of serum magnesium levels with the prevalence of type-2 DM and renal dysfunction. These observations correlate well with some previous studies. Corsonello et al. demonstrated that diabetic patients with microalbuminuria or overt proteinuria showed a significant decrease in serum Mg compared to type2 diabetic patients with normoalbuminuria group⁷. Galli-Tsinopoulou A et al observed that there was an association between hypomagnesemia and poor glycemic control with urine albumin excretion in type1 diabetic patients.

In our study we observed that the mean serum magnesium level was statistically significantly low (p value 0.0001) in type 2 DM with renal dysfunction when compared to type 2 DM without renal dysfunction, we also noted that serum magnesium level in type2 DM without renal dysfunction is statistically significantly low (p value 0.0001) when compared to healthy controls. These results are supported by other studies like Tosiello L et. al, Kao WH et.al.

However on the other hand in another study Zargar et al demonstrated that glycemic control and presence of microalbuminuria did not affect serum magnesium levels, few other studies also have not found any association between serum magnesium levels and microalbuminuria in both type1& type2 DM patients.

The possible mechanism to explain the relation of microvascular complications and microalbuminuria is insulin resistance Mg acts as a mild calcium antagonist. In patients with Mg deficiency, intra cellular calcium is increased which in turn will interrupt the response of skeletal muscle and adipocytes to insulin, which leads to insulin resistance.

Intracellular Mg plays a role in regulating insulin action, insulin – dependent glucose uptake and vascular tone. Deficiency of Mg can also reduce the tyrosine kinase, post receptor signalling activity and eventually it leads to the insulin resistance. Apart from this oxidative stress also plays a major role in path physiology of Diabetes mellitus.

As Mg has the antioxidant property, it could have been utilized as an antioxidant apart from this both insulin resistance and deficiency will affect the tubular absorption of Mg. So we can speculate that there is mutual influence between insulin resistance and hypomagnesaemia, which results in aggravation of insulin resistance which further increases the risk of microvascular complications and proteinuria.

Limitations of our study was the number of participants in three groups were less. we need large scale studies to know the precise relation between Mg and incidence of type- 2 DM and its complications

CONCLUSION

Serum Mg was inversely associated with the prevalence of Type 2DM and its microvascular complication such as renal dysfunction. Further prospective studies are needed to study the role of Mg supplementation in reducing the incidence of microvascular complications in Type 2 DM.

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