



STUDY OF SERUM MAGNESIUM LEVELS IN TYPE 2 DIABETES MELLITUS IN A TERTIARY CARE CENTRE

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ABSTRACT **Background:** Magnesium plays a role in the transfer of glucose across cell membranes and acts as a cofactor for a number of oxidation events in the body. A metabolic and endocrine condition known as Type 2 Diabetes Mellitus is characterised by hyperglycemia linked to insulin resistance and improper insulin production. Individuals with type 2 diabetes have been observed to experience hypomagnesemia more frequently. Magnesium deficiency is a typical electrolyte anomaly in those with type 2 diabetic patients and is associated with the emergence of a number of diabetic problems. **Aim:** The aim of the present study was to evaluate the prevalence of hypomagnesemia in patients with type 2 DM and assess their associations with diabetes microvascular complications. **Materials and Method:** The present study was a Cross sectional study conducted in department of General Medicine, Sree Mookambika Institute of Medical Sciences, Kulasekharam for a period of 6 months (January 2022 to June 2022). The study included 75 type 2 diabetic patients. Serum magnesium levels were measured by the Colorimetric Endpoint Method. The association of serum magnesium levels with complications of diabetes was studied. Results were analysed using SPSS 20.0 version and the association was tested using Chi square test wa done to assess statistical significance. A p value < 0.05 was considered statistically significant. **Results:** Prevalence of hypomagnesemia was 21(28%) in the study subjects. Hypomagnesaemia was more common in females than males. The prevalence of hypomagnesemia increased as diabetes mellitus lasted longer. Increased fasting blood glucose levels showed a significant correlation between hypomagnesemia and poor glycaemic management. A significant association was discovered between hypomagnesemia and ischemic heart disease, diabetic retinopathy, nephropathy, and neuropathy. **Conclusion:** In clinical practice, it may be prudent to routinely monitor and correct plasma magnesium concentrations in diabetic patients, as well as check patients with hypomagnesemia regarding microvascular complications on a more frequent basis.

KEYWORDS : Diabetes Mellitus, Magnesium, Nephropathy, Neuropathy, Retinopathy.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic condition described by hyperglycemia that is caused by abnormalities in insulin secretion, insulin action, or both. Type 2 diabetes is linked to cardiovascular disease, nephropathy, retinopathy, and polyneuropathy, as well as complications such as hyperosmolar coma and ketoacidosis.¹

Magnesium is the fourth most prevalent mineral in human body and is considered a vital electrolyte for all living organisms. Magnesium is a required cofactor for various enzymes involved in glucose metabolism.² It is also required for neuromuscular activity as well as cell permeability, mitochondrial function, ion channel modulation, and is involved in both cellular and humoral immunological responses. It also regulates muscular contraction and vascular tone, as well as neurotransmitter release and cardiac excitability.³

Hypomagnesemia has been found to be more common in persons with type 2 diabetes than in those without diabetes.⁴ The most important component in the development of hypomagnesemia among diabetic patients is probably excessive urine magnesium loss linked with glycosuria. Initially, hypomagnesemia was believed to result from osmotic renal losses through glycosuria, reduced intestinal magnesium absorption, and insulin-induced migration of magnesium from plasma towards red blood cells. Recent research has identified a particular tubular defect in diabetes that results in hypermagnesaemia due to faulty tubular absorption of magnesium.⁵

The insulin post-receptor signaling can be reduced by hypomagnesemia. The sodium k-ATPase channel and the movement of sodium, potassium, and glucose can all be affected by hypomagnesemia.⁶ Independent of insulin release, a relationship exists between serum magnesium concentrations and the uptake of glucose into cells. Worldwide, the prevalence of hypomagnesemia among diabetic patients ranges from 14 to 48%. Both microvascular diseases like retinopathy, neuropathy, and nephropathy as well as macrovascular issues like heart disease, hypertension, and stroke have been demonstrated to be associated with hypomagnesemia.⁷ The significant increase in the incidence of diabetes, as well as the

strong relationship between metabolic regulation of diabetes and disturbed magnesium balance, necessitates the investigation of a probable link between the two. The prevalence of hypomagnesemia can be used to support the necessity for Type 2 DM patients to have their magnesium levels checked. Additionally, it can serve as justification for the earlier supplementation of oral magnesium, which could help prevent or delay diabetes problems.

AIMS AND OBJECTIVES

To evaluate the prevalence of hypomagnesemia in patients with type 2 diabetes mellitus and assess their relationship with diabetes microvascular complications.

MATERIALS AND METHODS

Study Setting: Present study was conducted in Department of General Medicine, Sree Mookambika Institute of Medical Sciences, Kulasekharam

Study Design: Cross sectional study conducted for a period of 6 months from January 2022 to June 2022

Sample Size: 75 cases satisfying the inclusion criteria were included.

Inclusion Criteria

All type 2 diabetic mellitus patients above 18 years of age and were willing to participate in the study.

Exclusion Criteria

Patients with renal failure, on diuretics, malabsorption, chronic diarrhoea, Patients receiving magnesium supplements or magnesium containing antacid and patients not willing to participate in the study.

Clinical details were collected from the patients. Patients were assessed for duration of diabetes, mode of treatment, presence of hypertension, Ischemic heart disease, presence /absence of retinopathy, neuropathy, nephropathy and glycaemic control. Blood samples were collected for Fasting blood sugar (FBS), glycosylated hemoglobin (HbA1c) and Serum magnesium by Colorimetric Endpoint Method. Normal serum magnesium was defined as level of 1.7-2.4 mg/dl. serum magnesium is low when < 1.7 mg/dl and high when >2.4 mg/dl.

Data entered in Excel sheet. Statistical Analysis was carried out using SPSS 20.0 version. Statistical method analysis was done using chi square test and sample variable t test to compare the proportions. Results were considered significant at p value < 0.05.

OBSERVATION AND RESULTS

In the present study the most common age group affected by diabetes was 51 to 60 years seen in 29(38.66%) patients. The mean age of the study population was 53.68±6.38. The age group of patients ranges from 32 to 76 years. Females 43(57.33%) were more common than males 32(42.67%).

Of the 75 diabetic patients included in the present study 21(28%) patients had hypomagnesemia and the remaining 54(72%) had normal magnesium levels. The mean duration of diabetes in the patients with hypomagnesemia was 5.4 years. Among the 21 patients who had hypomagnesemia, 15(71.43%) were females.

Table 1: Correlation Of Serum Magnesium Levels With FBS, HbA1c, Duration Of Diabetes, Mode Of Treatment And Diabetic Comorbidities

	Serum magnesium level		p value
	Low (n = 21)	Normal (n = 54)	
Mean FBS	316±84.34	283±75.42	0.012
HbA1c	10.8±2.4	9.3±2.3	0.001
Duration of diabetes			
< 5 years	3(14.29%)	2(3.70%)	0.001
6– 10 years	5(23.81%)	14(25.93%)	
11-15 years	7(33.33%)	21(38.89%)	
16 – 20 years	4(19.05%)	11(20.37%)	
>20 years	2(9.52%)	6(11.11%)	
Mode of treatment			
Oral hypoglycemic drugs	6(28.57%)	42(77.78%)	0.0005
Insulin	15(71.43%)	12(22.22%)	
Diabetic Retinopathy			
Present	17(80.95%)	8(14.81%)	0.021
Absent	4(19.05%)	46(85.19%)	
Diabetic Neuropathy			
Present	12(57.14%)	1(1.85%)	0.004
Absent	9(42.86%)	53(98.15%)	
Diabetic Nephropathy			
Present	14(66.67%)	5(9.26%)	0.0005
Absent	7(33.33%)	49(90.74%)	
Ischemic heart disease			
Present	11(52.38%)	9(16.67%)	0.001
Absent	10(47.62%)	45(83.33%)	

The mean FBS was higher in patients with hypomagnesemia compared to normomagnesemia patients and showed statistically significant correlation. Hypomagnesemia was significantly associated with poor glycemic control. Prevalence of hypomagnesemia increased with prolonged duration of diabetes mellitus. The proportion of diabetics with hypomagnesemia was more with insulin therapy than with oral hypoglycemic drug therapy. The study showed an increased incidence of diabetic retinopathy, neuropathy and nephropathy and ischemic heart disease in patients with hypomagnesemia compared to normomagnesemia. Patients with diabetic retinopathy, neuropathy and nephropathy and ischemic heart disease had significant association with hypomagnesemia as evidenced by p value less than 0.05. (Table 1)

DISCUSSION

In the present study hypomagnesemia was found in 21(28%) of diabetics. This was little lower than the study done by Khanna D et al.⁸ found that the prevalence of Hypomagnesemia in type 2 diabetics was 42%. While study conducted by Dasgupta A et al.⁹ and Hamarshih M et al.¹⁰ found that the prevalence hypomagnesemia was 11% and 11.33% respectively.

Patients with T2DM have a higher incidence of hypomagnesemia, which appears to be multifactorial. Reduced intake, diabetic gastroparesis, autonomic dysfunction-related diarrhea, glomerular hyperfiltration, increased renal magnesium loss, osmotic diuresis brought on by glycosuria, metabolic acidosis, and decreased renal reabsorption because of insulin resistance are all potential causes. Insulin increases the reabsorption of magnesium from the loop of Henle.¹¹ The prevalence of hypomagnesemia varies widely across studies, which may be a result of differences in the methods used to

measure magnesium, the threshold used to define hypomagnesemia, the diversity of the populations that were chosen as study subjects, and regional dietary customs.¹²

Hypomagnesaemia was more common in females than males in the present study. This was similar to the study conducted by Hamarshih M et al.¹⁰ Hyassat et al.¹³ and Bertinato et al.¹⁴ In their study, they observed that serum magnesium levels were lower in female patients than in male participants. Due to their physiological requirements, menstrual cycle, usage of birth control pills, pregnancy, and lactation, women are more likely to have hypomagnesemia than men, which could potentially explain the gender difference in magnesium concentrations.¹⁵

Mean HbA1c was 11.9% in the hypomagnesemic patients compared with 9.8% in controls (p =0.0016) in the study done by Dasgupta A et al.⁹ this was comparable to the present study.

In the present study, the prevalence of hypomagnesemia in diabetics with microvascular complications was increased. Patients with diabetic retinopathy, neuropathy, nephropathy and ischemic heart disease had significant association with hypomagnesemia as evidenced by p value less than 0.05. Khanna D et al.⁸ found a substantial correlation between hypomagnesemia and diabetic retinopathy, neuropathy, and nephropathy. There was no apparent association for ischemic heart disease, diabetes, or cerebrovascular disease.

In the study conducted by Dasgupta A et al.⁹ it was found that Retinopathy, micro-albuminuria, macroalbuminuria, neuropathy and foot ulceration, were found in 64%, 47%, 17.64%, 82.35% and 58.8%, of hypomagnesemia patients, compared to 45.8% (p =0.118), 38.34% (p =0.704), 15.03% (p =0.566), 82.7% (p =0.976) and 22.55% (p =0.011) without hypomagnesemia. In the hypomagnesemia group, coronary artery disease was more prevalent (17.6% vs. 39%).

In the study conducted by Hamarshih M et al.¹⁰ hypomagnesemia was positively related with diabetic retinopathy as well as poor glycemic control but not with other microvascular sequelae. In their study, 10 Noor MM et al.¹⁶ found no statistically significant correlation between patients gender and age and hypomagnesemia (p>0.05). However, it was discovered that among the study population, hypomagnesemia was substantially correlated with the length of diabetes mellitus (p=0.02).

CONCLUSION

Low serum magnesium levels were much more common in people with diabetes mellitus. The frequency of hypomagnesemia was higher in patients with microvascular diabetes complications. Both diabetic microvascular problems and hypomagnesemia were substantially correlated. Therefore, it is crucial to frequently check the magnesium levels of all type 2 diabetic patients. It is advised to conduct more research on the subject of magnesium supplementation and Type 2 diabetes in the Indian population.

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Conflicts Of Interest: There are no conflicts of interest

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