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Hypomagnesemia And Its Association With Diabetic Nephropathy.

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Abstract

INTRODUCTION: Magnesium (Mg) is the fourth most abundant cation in the human body and plays a key role in many fundamental biological processes including metabolism and DNA synthesis. ***AIM:*** The aim of the study is to assess association of Hypomagnesemia with Diabetic nephropathy. ***METHODOLOGY:*** This cross sectional study was carried out in The Department of General Medicine, MG Medical College and Research Centre, Jaipur. This study was conducted from june2023 to oct 2024. ***RESULT:*** Out of 150 cases 111 cases have normal magnesium level and 39 found to have hypomagnesemia. Out of 150 cases 102 cases have Normoalbuminuria, 39 cases have Microalbuminuria and 9 cases have Overt proteinuria. Out of 39 cases in hypomagnesemia group 7 have Normoalbuminuria, 23 cases have Microalbuminuria and 9 cases have Overt proteinuria whereas out of 111 cases in normal magnesium level group 95 have Normoalbuminuria, 16 cases have Microalbuminuria and none of the case have Overt proteinuria i.e. the prevalence of Microalbuminuria and Overt proteinuria was statistically higher in hypomagnesemia group as compared to normal magnesium level group. ***CONCLUSION:*** Hypomagnesemia is significantly associated with poor glycemic control and increased prevalence of diabetic complications in patients with Type 2 Diabetes Mellitus.

Keywords: Hypomagnesemia, Glycemic control, Diabetic nephropathy.

INTRODUCTION

Type 2 diabetes makes 90% of diabetes cases. Its worldwide prevalence may be 439 million by 2030. According to the International Diabetes Federation and WHO, its prevalence is 10% and over 19% of world's diabetics are Indians.1,2 Magnesium (Mg) is the fourth most abundant cation in the human body and plays a key role in many fundamental biological processes including metabolism and DNA synthesis. Mg deficiency has been shown to cause endothelial cell dysfunction, inflammation, and oxidative stress, which are major contributors to atherosclerosis. 3

Magnesium (Mg) has an important role in the actions of enzymes and is the fourth abundant cation in the human body. Magnesium is a cofactor of various enzymes in carbohydrate oxidation and used in the glucose-transporting mechanism of the cell membrane. It is also involved at multiple levels in insulin secretion, binding and activity.4 The incidence of subclinical magnesium deficiency is common in diabetes and cardiovascular disorders. Magnesium deficiency has recently been related with age-related diseases through free-radical mechanisms. The existence of oxidative stress has been well documented in diabetes and late diabetic complications.5

Mg also plays an important role in the phosphorylation reactions of glucose and its metabolism. Mg and Type 2 Diabetes mellitus (DM) have a close relationship. Its deficiency has been implicated in insulin resistance, carbohydrate intolerance, and complications of diabetes. Approximately one-third of subjects with Type 2 DM have hypomagnesemia mainly caused by enhanced renal excretion. Mg deficiency is associated with poor glycemic control and Mg supplementation improves insulin sensitivity .6 It is claimed that there is an inverse relationship between Mg intake and incidence of diabetes mellitus (DM).7Mg deficiency is common in diabetic patients. The incidence of hypomagnesemia varies between 11 and 47.7%.Compared with the control group, incidence of hypomagnesemia in newly diagnosed diabetes is 10.5-fold and in patients with previously diagnosed diabetes is 8.5-fold more common.

In type 2 diabetes, patients with microalbuminuria or clinical proteinuria showed a significant decrease in serum ionized magnesium levels. A significant negative correlation between serum ionized magnesium and HbA1c and triglycerides, in both microalbuminuria and clinical proteinuria groups, was observed.8

Mg has received considerable attention for its potential role in improving insulin sensitivity and preventing diabetes and its complications. However, results are inconsistent among the studies. There is substantial evidence of associations between hypomagnesemia and various complications of Type 2 DM such as foot ulcers, and albuminuria. Observations in Caucasian diabetics have linked hypomagnesemia as being an additional risk factor for the development of diabetic complications, but this correlation was not observed in black African diabetics. Hypomagnesemia has been reported in 25%–38% of type 2 diabetic and to be associated with increased morbidity and mortality. However, most reports are inconclusive. Hence, hypomagnesemia in diabetes is frequently overlooked.9. This study was performed to find association of serum Mg with diabetic control and complications in the Indian population.

AIM

The aim of the study is to assess the association of Hypomagnesemia with Diabetic nephropathy.

METHODOLOGY

This cross-sectional observational study was conducted in the Department of General Medicine at Mahatma Gandhi Medical College and Research Centre over a period extending from June 2023 to October 2024. The study population included patients with known Type 2 Diabetes Mellitus who attended the outpatient department, casualty, or were admitted to various wards of the institution. A total of 150 cases were enrolled in the study. The sample size was calculated using a 95% confidence interval with an absolute allowable error of 10%. Patients diagnosed with Type 2 Diabetes Mellitus in the Medicine Department of Mahatma Gandhi Hospital, Jaipur, and aged between 18 and 75 years were included in the study. Patients with chronic diarrhea, malabsorption, renal failure, those receiving diuretics, magnesium supplements or magnesium-containing antacids, and pregnant females were excluded from the study.

RESULTS

Table 1: Baseline characteristics of participants

Parameter	Mean	SD
Age(years)	59.04	8.70
Duration of DM (years)	8.49	2.85
Magnesium level (mg/dL)	1.73	.31

The above table shows that the mean age of cases was 59.04±8.70 years, mean magnesium level in cases was 1.73±.31 mg/dl and mean duration of DM in cases was 8.49±2.85 years.

Table 2: Association with Glycemic Control

Parameter	Magnesium Status			P Value
	Low	Normal	Total	
	Mean (SD)	Mean (SD)	Mean (SD)	
FBS (mg/dl)	181.13±15.79	129.57±18.89	142.97±29.02	<.001
PPBS (mg/dl)	268.21±46.46	197.88±32.93	216.17±48.05	<.001
HBA1C (%)	11.05±1.55	7.89±1.20	8.71±1.90	<.001

The mean FBS in hypomagnesemia group and Normo-magnesemia group was 181.13±15.79 mg/dl and 129.57±18.89 mg/dl .The mean PPBS in hypomagnesemia group and Normo-magnesemia group was 268.21±46.46 mg/dl and 197.88±32.93mg/dl respectively .Above table shows that mean HBA1C was significantly higher in the hypomagnesemia group as compared to normal magnesium level group (11.05±1.55 versus 7.89±1.20 %).

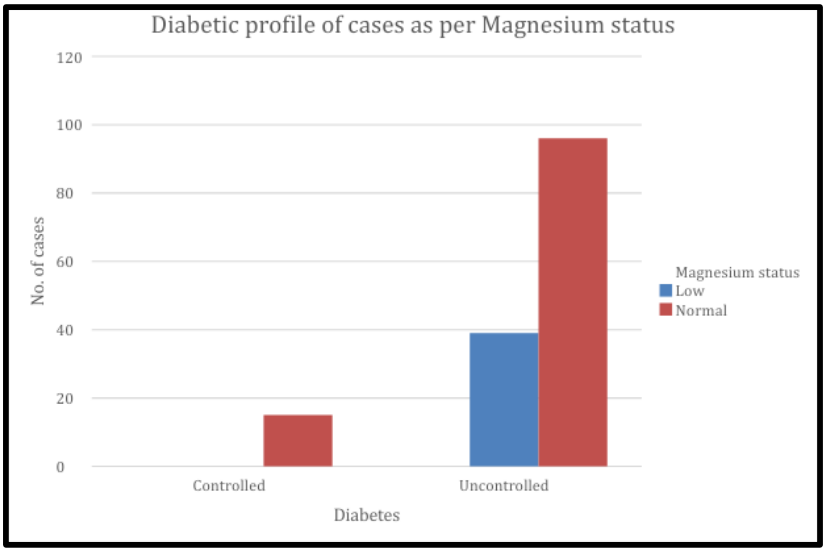

Figure 1:Glycemic control profile of cases as per Magnesium status

The prevalence of uncontrolled diabetes was significantly higher in the hypomagnesemia group as compared to the normo-magnesemia group(100% versus 86.5% respectively).

Table 3:Association with Metabolic Risk Factors

Parameter	**Magnesium Status**						**P Value**
	Low		**Normal**		**Total**		
BMI (Kg/m2)	**No.**	**%**	**No.**	**%**	**No.**	**%**	24.73±3.35
BMI (Kg/m2)	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	<.001
	29.25	2.70	24.73	3.35	25.90	3.75	

The above table shows Mean BMI was significantly higher in the hypomagnesemia group as compared to the normo-magnesemia group (29.25±2.70 versus 24.73±3.35 Kg/m2 respectively).

Table 4:Biochemical Correlation

Sodium (mEq/L)	139.26±1.77	140.19±2.61	139.95±2.45	.013
Potassium (mEq/L)	3.68±0.07	4.19±0.46	4.06±0.45	<0.001
Magnesium level (mg/dL)	1.25±.13	1.90±.12	1.73±.31	<.001

The mean sodium was comparable in hypomagnesemia group as compared to normal magnesium level group (139.26±1.77 versus 140.19±2.61 mEq/L respectively) and mean potassium was lower in hypomagnesemia group as compared to normal magnesium level group (3.68±0.07 versus 4.19±0.46 mEq/L respectively).

Table 5: Duration of DM profile of cases as per Magnesium status

Parameter	**Magnesium Status**			**P Value**
	Low	**Normal**	**Total**	
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	
Duration of DM (years)	9.87±2.57	8.00±2.80	8.49±2.85	<.001

The above table shows that mean Duration of DM was significantly higher in the hypomagnesemia group as compared to normal magnesium level group (9.87±2.57 versus 8.00±2.80 years respectively).

Table 6: Association with Diabetic Complications

Parameter	**Magnesium Status**						**P Value**
	Low		**Normal**		**Total**		
	No.	**%**	**No.**	**%**	**No.**	**%**	
Mean UACR (µg/g)	Mean	SD	Mean	SD	Mean	SD	<.001
	82.18	82.23	24.84	**10.88**	39.75	49.48	

Above table shows that the mean UACR was significantly higher in hypomagnesemia group as compared to normal magnesium level group (82.18±82.23 versus 24.84±10.88 µg/g respectively).The mean serum magnesium level was significantly lower in the hypomagnesemia group as compared to the normo- magnesemia group (1.25±.13 versus 1.90±.12 mg/dL respectively).

DISCUSSION

In present study the 2 groups were comparable on parameters of age distribution.Similarly Rao and Shariff et al. (2015)10in their study found that the 2 groups- hypomagnesemia group and Normo-magnesemia group were comparable on parameter of age distribution which is in agreement with results of present study.

In present study the prevalence of hypomagnesemia in DM was 26%(39/150). Moradiya K, Muley et al.(2021)11 in their study found that the prevalence of hypomagnesemia in DM was 37.68%.

In present study we found that mean HBA1C was significantly higher in hypomagnesemia group as compared to normo-magnesemia group.Similarly Arpaci D et al.(2015)12 in their study found that mean HBA1C was significantly higher in hypomagnesemia group as compared to normo- magnesemia group which is in agreement with results of present study.

In the present study the prevalence of Microalbuminuria and Overt proteinuria was statistically higher in the hypomagnesemia group as compared to the Normo-magnesemia group. Similarly Rao Moradiya K, Muley et al.(2021)11 in their study found that the prevalence of , Microalbuminuria and Overt proteinuria was statistically higher in hypomagnesemia group as compared to In a study conducted by Corsonello et al.13, diabetic subjects with microalbuminuria or clinical proteinuria showed a significant decrease in serum ionized Mg with respect to normoalbuminuria group.

Similarly, we also found a negative correlation between Mg level and urine protein excretion.14
Zargar et al 15 suggested that glycemic control and presence of diabetic complications did not affect serum Mg levels. Other studies also have not found any association between Mg and diabetic complications in Type 1 and Type 2 diabetes16. According to other hypotheses, oxidative stress is important in complications of diabetes.The antioxidative capacity of Mg has also been reported .Corica et al.17 have found an association of hypomagnesemia with high waist circumferences, high blood pressure, MA and overt proteinuria.

CONCLUSION

Serum Mg was found to be inversely associated with the prevalence of Microalbuminuria. Hypomagnesemia was found to be associated with poor glycemic control. Further studies with large sample size are required to prove a definite role of hypomagnesemia in diabetic complications. Large-scale clinical trials are needed in order to determine whether the correction of Mg deficiency could be effective to reduce the incidence of diabetic complications and to further elucidate the association between serum Mg and diabetic complications.

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