

A Cross Sectional Study of Fasting Serum Magnesium Levels In Patients with Type 2 Diabetes Mellitus Attending Chhatrapati Shivaji Subharti Hospital

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I. Introduction

Diabetes is a group of metabolic disease characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycemia of diabetes is associated with long term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart and blood vessels. Several pathogenic processes are involved in the development of diabetes. These range from autoimmune destruction of the beta cells of the pancreas with consequent insulin deficiency to abnormalities that result in resistance to insulin action. (1)

Magnesium is the second most abundant intercellular cation after potassium present in living cells. Of the 21-28 gram of magnesium present in adult human body, 99% is distributed in the intercellular compartment, and only 1% in the extracellular fluid. Magnesium is subdivided into three major compartments of the body; about 65% in the mineral phase of skeleton, 34% in the intercellular space and only 1% in the extracellular fluid. (2) Serum concentration of magnesium ranges from 1.7-2.4mg/dl (0.7-1mmol/l). The plasma concentration in healthy adults remains remarkably constant, whereas 25-39% of diabetics have low concentrations of serum magnesium. (3) Studies have reported serious complications of diabetes leading to hypomagnesemia which depends on various factors, such as age, sex, duration of diabetes, etc. (4) The present study was undertaken with an aim to estimate prevalence of hypomagnesemia in patients with type II diabetes mellitus and to correlate the serum magnesium concentrations with age, sex, duration of diabetes, etc.

Aims And Objectives

To estimate fasting magnesium levels in patients with type 2 Diabetes mellitus and correlate serum magnesium concentrations with Microvascular and Macrovascular complications of type II diabetes mellitus i.e. Retinopathy, Nephropathy and Neuropathy.

II. Material and Methods

Type of study : Cross sectional study

Place of Study : Chhatrapati Shivaji Subharti Hospital
Subharti Medical College, Meerut, U.P.

The results are subjected to appropriate statistical analysis. Before starting the study, all patients were informed about the study and consent was duly taken. All patients were undergone detailed history and clinical examinations to fulfill the inclusion and exclusion criteria.

Sample size: 100 patients

Inclusion Criteria

All diagnosed cases of type II diabetes mellitus attended Chhatrapati Shivaji Subharti Hospital, Meerut.

Exclusion Criteria

1. Patients with chronic renal failure.
2. Acute myocardial infarction in last 6 months.
3. Patients on medicines which cause alteration in serum magnesium level e.g. Aminoglycosides, Amphotericin B, Cyclosporine, Digoxin, Diuretics (loop, thiazides, osmotic).
4. Patients receiving magnesium supplements or magnesium containing antacids.
5. Patients with history of chronic alcohol abuse.
6. Patients with malabsorption or chronic diarrhea.
7. All pregnant women.
8. Patients taking antiepileptic drugs.

III. Methodology:

History and Physical examination

All patients with type II diabetes mellitus who meet the inclusion criteria were evaluated, detailed history including age, gender, duration of diabetes, symptoms suggestive of diabetic neuropathy, retinopathy, nephropathy, associated disease such as hypertension and ischemic heart disease and current use of medication, including anti diabetic drugs was obtained by a standard interview questionnaire, followed by

- Physical and neurological examination,
- Twelve lead electrocardiography,
- Fundus examination of both eyes done by direct ophthalmoscopic examination to confirm diabetic retinopathy,
- Monofilament examination
- Nerve conduction study to confirm the presence of diabetic neuropathy.

Investigation

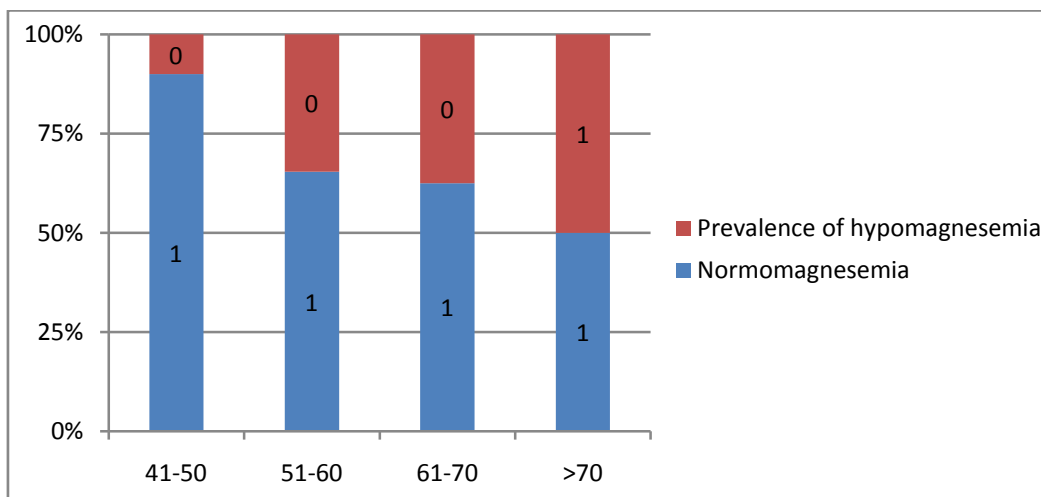
1. Serum magnesium level
2. HbA1c
3. Fasting blood sugar
4. Serum Urea and creatinine level
5. 24 hour urinary albumin/Spot urine protein

IV. Results

Study group comprised of 100 cases with type 2 diabetes mellitus. These cases were further grouped with regards their age, gender, glycemic control, and presence or absence of diabetic complications (diabetic retinopathy, diabetic neuropathy and diabetic nephropathy) Prevalence of hypomagnesemia Out of total 100 cases in the study, 34 were found to have hypoglycemia. Prevalence of hypomagnesemia according to age distribution Majority of the cases (n=52) were in the age group of 51-60 years. Maximum prevalence (50%) of hypomagnesemia with p value 0.21 was found in age group of more than 70 years and minimum prevalence (10%) in less than 50 years.

Table no.1 Prevalence of hypomagnesemia according to age distribution

Age in years	No. of Cases	Prevalence of Hypomagnesemia		p Value
		Frequency	%	
41-50	10	1	10%	0.21
51-60	52	18	34.6%	
61-70	32	12	37.5%	
>70	6	3	50%	
Total	100	34	34	

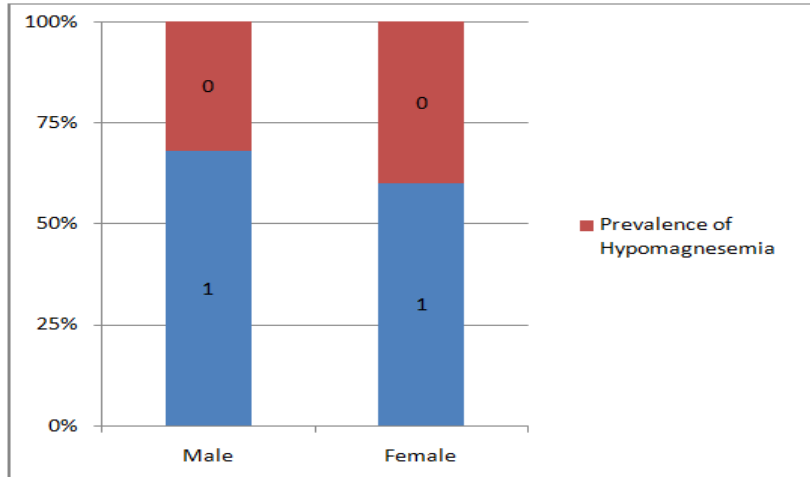


V. Prevalence Of Hypomagnesemia According To Sex

Out of the 100 cases ,75(75%) were males and 25(25%) were females.Twenty four (32%) of the males and ten(40%) of the females were found to have hypomagnesemia.There was no statistically correlation between any of the gender and hypomagnesemia.

Prevalence of Hypomagnesemia according to Sex

Sex	No.of cases	Prevalence of Hypomagnesemia		p Value
		Frequency	%	
Male	75	24	32%	0.27
Female	25	10	40%	
Total	100	34	34%	

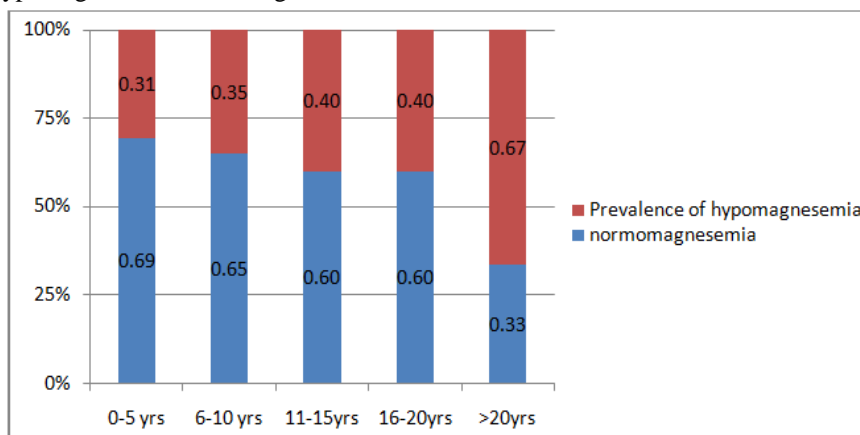


VI. Prevalence Of Hypomagnesemia According To Duration Of Diabetes

Out of all cases, the prevalence of hypomagnesemia was found to be highest(66.6%) in the group having duration of diabetes for more than 20 years with p value 0.87.The lowest prevalence(30.6%) of hypomagnesemia was found in the group with duration of diabetes less than 5 years with p value 0.87 , however majority of the cases (n=62)belongs to the group.Prevalence of Hypomagnesemia according to duration of diabetes

Duration of diabetes in years	No.of Cases	Prevalence of Hypomagnesemia		p Value
		Frequency	%	
0-5	62	19	30.6%	0.87
6-10	20	7	35.0%	
11-15	10	4	40.0%	
16-20	5	2	40.0%	
>20	3	2	66.6%	
Total	100	34	34%	

Prevalence of Hypomagnesemia according to duration of diabetes



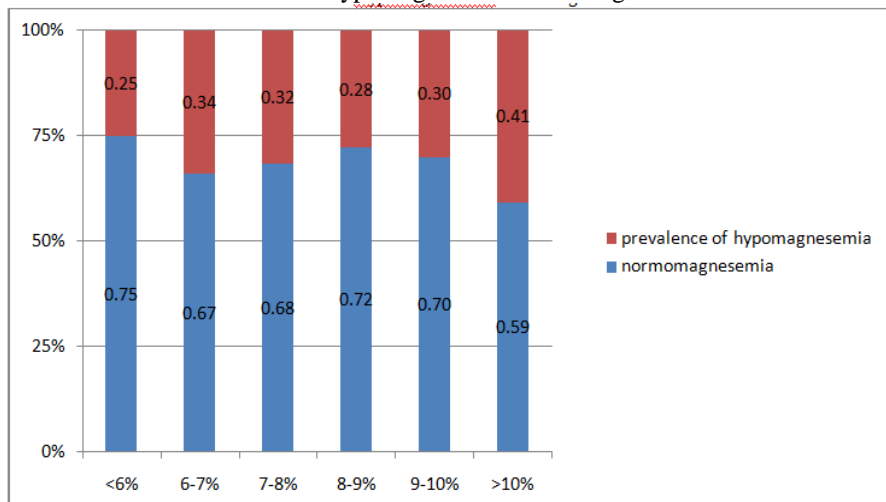
Prevalence of hypomagnesemia according to HbA1C

Out of the 100 cases , the prevalence of hypomagnesemia was found to be highest(40.7%) in the group with HbA1C more than 10% with p value 0.79 .The lowest (25%)prevalence of hypomagnesemia was in the group with HbA1C less than with p value 0.79.

Prevalence of Hypomagnesemia according to HbA1c

HbA1c(%)	No.of Cases	Prevalence of Hypomagnesemia		p Value
		Frequency	%	
<6	4	1	25.0%	0.79
6-7	29	10	34.4%	
7-8	19	6	31.6%	
8-9	11	3	27.7%	
9-10	10	3	30.0%	
>10	27	11	40.7%	

Prevalence of Hypomagnesemia according to HbA1c

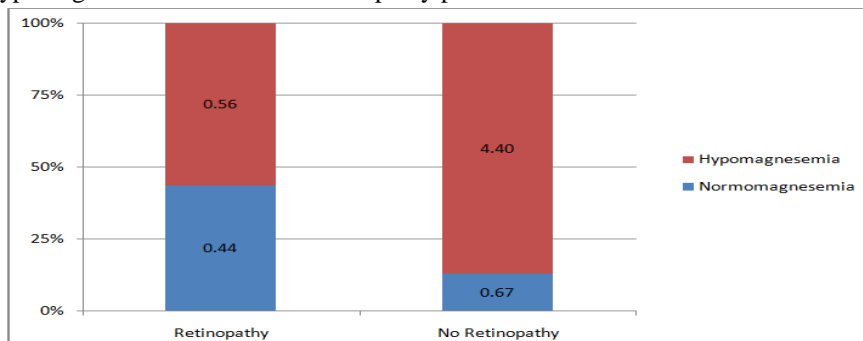


Prevalence of hypomagnesemia in Diabetic Retinopathy patients

Out of the 100 cases , 26 cases had non proliferative diabetic retinopathy, within which 15(57.7%) had hypomagnesemia.6 cases had proliferative diabetic retinopathy and among them 3 (50%) had hypomagnesemia. Thus among the group with retinopathy(non proliferative and proliferative)56.2% of the patient had hypomagnesemia while only 23.5% of the cases without retinopathy had the same. This difference was statistically significant with p valueless than 0.05%

Retinopathy		Total patients	Prevalence of Hypomagnesemia		P Value
			Frequency	%	
Retinopathy	NPDR(nonproliferative)	26	15	57.7%	0.002
	PDR(Proliferative)	6	3	50%	
	Total	32	18	56.2%	
No Retinopathy		68	16	23.5%	

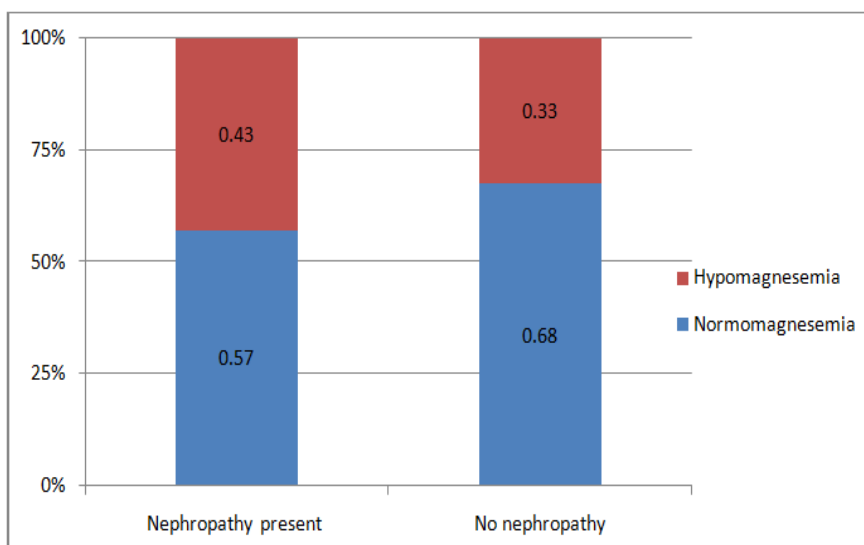
Prevalence of hypomagnesemia in Diabetic Retinopathy patients



Prevalence of hypomagnesemia in Diabetic Nephropathy Patients

Out of the 100 cases,14 were found to have nephropathy while 86 did not have the same.Of the 14 cases who had nephropathy 11were diagnosed with microalbuminuria,36.6% of this group were diagnosed with hypomagnesemia.Three cases from the nephropathy group were diagnosed with macroalbuminuria,66.6% of the cases from this group had hypomagnesemia.Thus the prevalence of hypomagnesemia in cases with nephropathy was found to be 42.8% as opposed to 32.5% of the group with no nephropathy which was statistically significant.

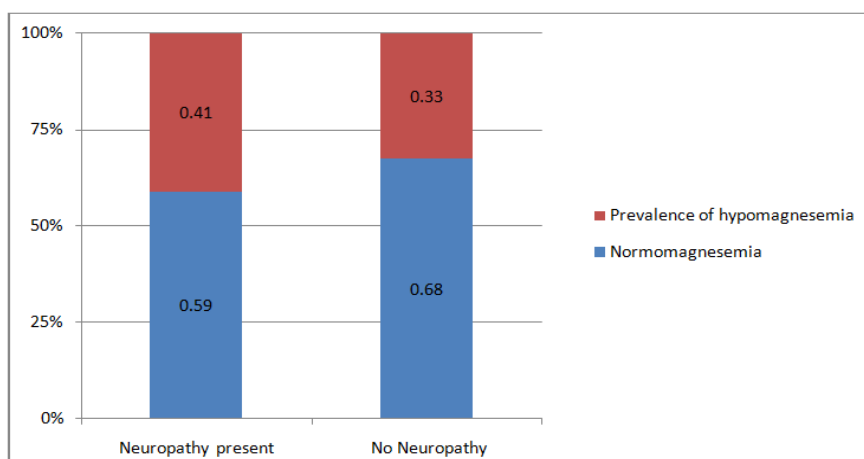
Nephropathy		Total Patients	Prevalence of Hypomagnesemia		P Value
			Frequency	%	
Nephropathy	Microalbuminuria	11	4	36.6%	0.002
	Macroalbuminuria	3	2	66.6%	
	Total	14	6	42.8%	
No Nephropathy		86	28	32.5%	



Prevalence of hypomagnesemia in Diabetic Neuropathy Patients

Out of the 100 cases,17 (17%)cases had diabetic neuropathy while 83(83%) did not have diabetic neuropathy.7 cases (41.1%)of the cases who had neuropathy also had hypomagnesemia,while 27 cases(32.5%) of the cases with no neuropathy were found to have hypomagnesemia.

Neuropathy	No. of cases	Prevalence of hypomagnesemia		P value
		Frequency	%	
Neuropathy present	17	7	41.1%	0.942
No neuropathy	83	27	32.5%	
Total	100	34	34%	



VII. Discussion

The study population were grouped with regard to their age ,gender,duration of diabetes ,glycemic control and presence or absence of diabetic complication The study population comprised of 100 cases of type 2 diabetes mellitus

Prevalence of hypomagnesemia

The prevalence of hypomagnesemia in our study was 34% ,which was in concordance with the studies done by Rude RK et al.(3) in which prevalence of hypomagnesemia was 25-39%.This was also in concordance with the study conducted by Walti MK et al.(5) and by Mohan K et al.(6) which showed prevalence of hypomagnesemia in 37.6% and 35% of the type 2 diabetes mellitus patients respectively .

Study	Rude RK et al	Walti MK et al	Mohan K et al	Present study
Hypomagnesemia(%)	25-39%	37.6%	35%	34%

The variation in hypomagnesemia in different study group might be due to the difference in the definition of hypomagnesemia, techniques in the serum magnesium measurements and the heterogeneity of the selected patients groups. In our study possible causes of hypomagnesemia in the patients with type 2 diabetes mellitus may have been poor oral intake,poor gastrointestinal absorption due to diabetic autonomic gastropathy and also May be renal causes as in the patients with diabetes mellitus ,the ultrafiltrable magnesium load may be enhanced by glomerular hyperfiltration ,recurrent excessive volume repletion after hyperglycemia induced osmotic diuresis,recurrent metabolic acidosis associated with diabetic ketoacidosis and hypalbuminemia.

Hypomagnesemia according to patient's age,sex and duration of diabetes:

In our study,hypomagnesemia was more prevalent in females(40%),compared to males(30%).This was in accordance with studies conducted by Ascaso J F et al. (7) and Sheehan J P et al.(8)have also reported a higher prevalence of hypomagnesemia in women compared to men.Our study had shown that higher prevalence (40.7%) of hypomagnesemia in group with HbA1c>10 with p value =0.79.another studies concludes plasma levels of magnesium have a strong significant negative correlation with HbA1c levels in diabetic group.(9,10).

Hypomagnesemia and diabetic complications:

Previously magnesium deficiency has been found to be associated with diabetic microvascular disease.In the present study too significantly higher prevalence of hypomagnesemia was observed in diabetics with microvascular complications nad serum magnesium levels in diabetics with microvascular complications was comparatively lower than in diabetics with no microvascular complications.(11,12)

Hypomagnesemia was more pronounced in case of advanced retinopathy.Hypomagnesemia seem to be as possible risk factor in development and progress of diabetic retinopathy. In our observation,56.2% patients with diabetic retinopathy were having low magnesium levels as compared to 23.5% patients without diabetic retinopathy and this difference was statistically significant(p value=0.002)

A significant difference was found between patients with nephropathy and no nephropathy,there was higher prevalence of hypomagnesemia in patients with nephropathy.In our study ,11 patients had microalbuminuria and 3 patients had macroalbuminuria.

In summary ,the present study has demonstrated that hypomagnesemia is common in patients of Type 2 diabetes mellitus and magnesium deficiency is conclusively associated with diabetic retinopathy and diabetic nephropathy, so it may be prudent in clinical practice to periodically monitor serum magnesium levels in diabetic patients.If plasma nmagnesium level is low, an intervention t increase dietary intakes of magnesium may be beneficial .However ,the role of magnesium supplements remains to be evaluated.

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