

Original article:

Study of estimation and comparison of serum Magnesium levels in patients with Type II Diabetes Mellitus and healthy controls and occurrence of complications in relation to serum Magnesium levels

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Abstract:

Introduction: Many studies have shown that both mean serum and intracellular free Magnesium levels are lower in diabetics than in the general population. The Magnesium deficiency may take the form of a chronic latent Magnesium deficit rather than clinical hypomagnesaemia.

Material and methods: This is a unicentric comparative study conducted at Dr. D. Y. Patil Medical College, Pimpri, Pune from July 2015 to September 2017 which includes 50 cases of type II diabetes mellitus and 50 cases of healthy controls.

Institute Ethics Committee clearance was obtained before the start of the study. Informed and written consent was taken from all the cases. Group 1 consists of 50 cases having type II diabetes mellitus while 50 healthy control cases are included in group 2

Results: The Pearson correlation analysis of the Magnesium on the various parameters of group I shows that the serum Magnesium level was related significantly negative with duration of disease ($r = -0.253$, $p < 0.05$), HbA1c ($r = -0.197$, $p < 0.05$) and retinopathy ($r = -0.226$, $p < 0.05$). There was also a significant negative association between Magnesium and fasting blood glucose ($r = -0.182$, $p < 0.05$). In group II, serum Magnesium showed no significant correlation with the different parameters.

Conclusion: This study was conducted to evaluate the levels of serum Magnesium in patients with type II Diabetes Mellitus and compare it with healthy controls and to study the occurrence of complication of diabetes in relation to serum Magnesium levels.

Introduction:

Many studies have shown that both mean serum and intracellular free Magnesium levels are lower in diabetics than in the general population. The Magnesium deficiency may take the form of a chronic latent Magnesium deficit rather than clinical hypomagnesaemia.¹ This feature is clinically important as Magnesium ion is a crucial cofactor for many enzymatic reactions which are involved in many metabolic processes.² Many studies have shown that mean plasma Magnesium levels are lower in patients with any of the type I or type II diabetes mellitus compared with known diabetic controls. Intracellular free Magnesium level of erythrocytes is a more sensitive marker in patients having insulin resistance in diabetes than the level of Magnesium in plasma. Various studies have reported decreased levels of free intracellular Magnesium in erythrocyte in maximum patients of type II diabetes mellitus.

There is increased risk of cardiovascular complications in patients with type II diabetes Mellitus.^{1,3} Many studies have suggested that extracellular and intracellular Magnesium deficiency is seen in chronic, stable and mild type II diabetes mellitus and this may be a strong predisposing factor for the development of excess cardiovascular

morbidity associated with diabetes. They showed that serum Magnesium level and intracellular free Magnesium level in erythrocytes were significantly lower in patients with type II diabetes with mild hyperglycaemia than were in healthy controls ($p < 0.001$).

It is observed that low serum Magnesium concentration is commonly seen in type II diabetes mellitus. Preventing hypomagnesaemia in diabetes mellitus by supplementing Magnesium may be helpful in increasing insulin sensitivity and delaying the development of late diabetic complications. The aim of the study is to compare the serum Magnesium levels in patients with type II diabetes mellitus and known diabetic controls and to assess its impact on complications of diabetes mellitus.

Material and methods:

This is a unicentric comparative study conducted at Dr. D. Y. Patil Medical College, Pimpri, Pune from July 2015 to September 2017 which includes 50 cases of type II diabetes mellitus and 50 cases of healthy controls.

Institute Ethics Committee clearance was obtained before the start of the study. Informed and written consent was taken from all the cases. Group 1 consists of 50 cases having type II diabetes mellitus while 50 healthy control cases are included in group 2.

INCLUSION CRITERIA:

1. Random 50 adult patients with type II diabetes mellitus and known diabetic 50 adult controls.
2. Patients in between the age group of 30 to 70 years in both the groups.

EXCLUSION CRITERIA:

1. Patients with renal failure
2. Pregnant women
3. Lactating women
4. Patients with cerebro-vascular accident
5. Patients on diuretics
6. Alcoholic patients
7. Patients on Magnesium supplements
8. Patients on Magnesium containing antacids
9. Patients having malabsorption syndrome
10. Patients with chronic diarrhoea.

Quantitative data are presented using mean and standard deviation. Comparisons between groups were performed using unpaired t-test according to the results of the normality test.

Results :

The mean serum levels of Magnesium in group I was significantly lower than in group II ($1.67 \pm 0.40\text{mg / dL}$ vs. $2:09 \pm 0.53\text{mg / dL}$) ($p < 0.05$).

Table 1: Serum Magnesium levels in patients

Parameters	Group I		Group II		P-Value
	Average	SD	Average	SD	
Serum Magnesium	1.67	0.40	2:09	0:53	<0.05

Effect of Anti-diabetic therapy for blood Magnesium levels

The mean Serum Magnesium level in the oral, and the insulin and oral + insulin group were $2.04 \pm 0.47\text{mg/dL}$, $1.58 \pm 0.13\text{mg/dL}$, and $1.26 \pm 0.18 \text{mg/dL}$, respectively. Serum Magnesium levels were lower among insulin than with oral treatment group ($p < 0.05$).

Table 2: Effect of Anti-diabetes treatment on Serum Magnesium levels

Parameters	Orally		Insulin		Oral + Insulin	
	Average	SD	Average	SD	Average	SD
S. Magnesium	2:04	0:47	1:58	0:13	1:26	0:18
P-Value			<0.05		<0.05	

Correlation of serum Magnesium and other parameters

The Pearson correlation analysis of the Magnesium on the various parameters of group I shows that the serum Magnesium level was related significantly negative with duration of disease ($r = -0.253$, $p < 0.05$), HbA1c ($r = -0.197$, $p < 0.05$) and retinopathy ($r = -0.226$, $p < 0.05$). There was also a significant negative association between Magnesium and fasting blood glucose ($r = -0.182$, $p < 0.05$). In group II, serum Magnesium showed no significant correlation with the different parameters.

Table 3: Significant correlation of Serum Magnesium and other parameters in group I

Parameter	Correlation	95% Confidence Interval	P-Value
Duration Of DM	-0.253	-0.151 To 0.497	<0.05
Hba1c	0.197	0.051 To 0.853	<0.05
FBS	-0.182	-0.096 To 0.474	<0.05
Nephropathy	0.613	0.312 To 1.647	> 0.05
Retinopathy	-0.226	-0.134 To 0.925	<0.05
Neuropathy	1561	0.728 To 3.985	> 0.05

Discussion:

This is unicentric hospital based study conducted to evaluate and compare the Serum Magnesium levels in patients with type II Diabetes Mellitus and nondiabetic controls and their effect on its complications. Diabetes Mellitus is the common disorder associated with Magnesium deficiency. Many studies have demonstrated Serum Magnesium levels were lower in Diabetes Mellitus in comparison to non-diabetics. The inverse correlation between Serum Magnesium and Fasting glucose, HbA1C are observed.^{4,5}

Factors contributing to hypomagnesemia with diabetes include low Magnesium diet, osmotic diuresis which results in increased loss of Magnesium in urine, decreased sensitivity of intracellular transportation of Magnesium, and thus causes increased extracellular loss of Magnesium⁶, uncontrolled use of loop & thiazide diuretics supporting Magnesium wasting,⁷ diabetic autonomic neuropathies and decreased reabsorption in tubules due to insulin resistance.^{8,3} Repeated use of antibiotics and antifungal agents like Aminoglycosides and Amphotericin in diabetics can also contribute to renal loss of Magnesium.³

In our study of 35 (70%) patients in Group I were in the normal range, while 10 (20%) and 5 (10%) patients with overweight and obese, respectively. Mean BMI of patients was 24.69 kg / m². 34 (68%) patients in Group II were within the normal range, while 12 (24%) and 4 (8%) patients are overweight and obesity respectively. Mean BMI of patients was 24.67 kg / m². BMI between groups of patients were comparable and not statistically significant by chi-square test ($p > 0.05$).

Magnesium is strongly inversely correlated with disease duration ($r = -0.242$, $p = 0.015$) and HbA1c ($r = -0.198$, $p = 0.049$). There was a nearly significant negative association between Magnesium and glucose ($r = -0.174$, $p = 0.084$). No significant correlation was found between serum Mg and age and BMI. In non-diabetic control subjects, serum Magnesium levels have no significant correlation with age, BMI, FBS, or HbA1c seen. A significant negative correlation with disease duration and glycemic control as measured by HbA1c and significant negative correlation with FBS.

Conclusion:

This study was conducted to evaluate the levels of serum Magnesium in patients with type II Diabetes Mellitus and compare it with healthy controls and to study the occurrence of complication of diabetes in relation to serum Magnesium levels.

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