

A study of prognostic significance of serum magnesium concentration in type ii diabetes mellitus in a tertiary care hospital in Puducherry

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Abstract

Background: According to the Indian Heart Association, India is projected to be home to 109 million individuals with diabetes by 2035. Type 2 diabetes mellitus (DM2) is often accompanied by alteration of Mg status. Magnesium(Mg) is one of the major intracellular cation and it has been suggested that hypomagnesaemia may induce altered cellular glucose transport, reduced pancreatic insulin secretion, defective postreceptor insulin signaling, and/or altered insulin–insulin receptor interactions. with all these, the study will be undertaken to correlate the levels of serum magnesium and blood glucose in type II diabetic population in our hospital. **Materials and Methods;** In our cross sectional study, totally 90 cases were involved and divided into three groups., Group 1-control, Group 2 – Type 2 DM less than 5 years duration – 30 and Group 3 – Type 2 DM more than 5 years duration – 30. **Methods;** Estimation; Fasting(10 hours) and postprandial (2 hour) blood sugar were estimated by enzymatic method with serum mg by an enzymatic end point method. Urine examination done for sugar and proteinuria. **Statistical Analysis:** by using SPSS package for windows version 17.0. Scientific research committee and ethical committee clearance were obtained. **Observations;** In our study, there was a positive Correlation between the HbA1C, fasting and post prandial blood glucose but no significant correlation with magnesium. The fasting and post prandial blood glucose values are inversely correlated with magnesium. There was a negative correlation between serum mg and HbA1C in all the 3 groups by pearson correlation analysis. Finally, there were no significance r and p-values between the sr.mg and HbA1C. **Conclusion:** To conclude, serum magnesium levels were lower in DM2 patients when compared with non-diabetic controls. Because of this low level of Mg²⁺, which reduces insulin sensitivity and may increase risk of secondary complications like retinopathy, hypertension and dyslipidaemia, and by giving oral Mg supplements appear to be useful in patients with DM2 to restore Mg deficiencies.

Key words; Diabetes mellitus, hypomagnesemia, insulin sensitivity, blood sugar and serum magnesium.

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INTRODUCTION

Globally, an estimated 422 million adults are living with diabetes mellitus(DM), according to the latest 2016 data from the World Health Organization (WHO)¹ According to the Indian Heart Association, India is projected to be home to 109 million individuals with diabetes by 2035.¹ The high incidence is attributed to a combination of genetic susceptibility plus adoption of a high-calorie, low-activity lifestyle by India's growing middle class.³ Magnesium(Mg) is one of the major intracellular cation and is an important cofactor for various enzymes, transporters, and nucleic acids that are

essential for normal cellular function, replication, and energy metabolism.⁴ It has been suggested that hypomagnesaemia may induce altered cellular glucose transport, reduced pancreatic insulin secretion, defective postreceptor insulin signalling, and/or altered insulin–insulin receptor interactions.⁵ Type 2 diabetes mellitus (DM2) is often accompanied by alteration of Mg status. An increased prevalence of Mg deficits have been identified in DM2 patients, especially in those with poorly controlled glycemic profiles, with longer duration of the disease and with the presence of micro- and macrovascular chronic complications.⁶ The possible link between Mg deficiency and reduced insulin sensitivity is the presence of oxidative stress and/or inflammation. Thus, free radicals are often increased in DM2, hypertension, metabolic syndrome and aging, conditions also associated with Mg deficits.⁷ In one retrospective study, an association between low serum Mg levels and a significantly faster rate of renal function deterioration in patients with type 2 diabetes was reported.⁸ Mg has been directly implicated in hypocalcemia, tetany, hypokalemia, arrhythmias, stroke, ischemic heart disease, electrolyte abnormality and bronchial asthma.⁹ So, with all the above aspects, the study will be undertaken to correlate the levels of serum magnesium and blood glucose in type II diabetic population (Men / Women) in our tertiary care hospital.

Objectives

1. To estimate the levels of serum magnesium and blood glucose concentration in Type 2 diabetes mellitus patients.
2. To find out the correlation between serum magnesium and blood glucose levels in Type 2 diabetes mellitus patients.

MATERIALS AND METHODS

Study design: Cross sectional study,

Study area: SVMCH and RC, Ariyur, Puducherry. Study population – 90 cases,

Group 1 - control subjects – 30

Group 2 – Type 2 DM less than 5 years – 30

Group 3 – Type 2 DM more than 5 years – 30. (All new and old cases of Type 2 diabetes mellitus patients, aged between 35 to 60 years attended medicine OP department and diabetology clinic, SVMCH and RC, Ariyur) Study duration: 2 months (July and August 2018).

Inclusion Criteria: All new and old cases of Type 2 diabetes mellitus patients, aged between 35 to 60 years attended medicine OP department and diabetology clinic, at Sri Venkateshwaraa Medical College and Hospital, Ariyur, Puducherry.

Exclusion Criteria: Patients with nephropathy. Patients who suffered coronary artery diseases in last six months. Patients on drug therapy-diuretics. Patients with history of alcoholism. Patients on magnesium supplementation. GIT problems-Malabsorption and Chronic diarrhoea.

Methods

Overnight fasting, venous blood sample (after at least 10 hours) was collected for the measurements of serum magnesium and blood glucose. Estimation of blood glucose; Fasting and postprandial (2 hour) blood sugar (FBS and PPBS) were estimated by Glucose Oxidase-Peroxidase (GOD-POD) enzymatic end point method. Glycated haemoglobin(HbA1C) were estimated by immunoturbidity method. Estimation of Serum Magnesium;-It is an enzymatic end point method. normal fasting is 70-110mg/dl and post prandial is 110-140mg/dl. The normal serum magnesium level is ranging from 1.8 mg /dl to 3.6 mg /dl. Serum magnesium levels < 1.5 mg/dl is considered as low mg level in this study. Urine examination done for benedict test and proteinuria.

Statistical Analysis: The data were collected, recorded and analyzed statistically to determine the significance of different parameters by using SPSS package for windows version 17.0. Scientific research committee and ethical committee clearance were obtained from the concerned committees from our institution.

RESULTS

Table 1: clinical and biochemical characteristics of the subjects

	Group-1 (n=30)	Group-2 (n=30)	Group-3 (n=30)	p value
Age (Year)	52.67±14.6	56.93±10.7	53.63±9.6	0.3473
Gender (F/M)	12/18	16/14	13/17	0.5586
Blood sugar level fasting (70-110 mg /dl)	96.80±10.8	187.83±69.4	197.57±92.4	0.0001*
Blood sugar level - Postprandial (110-140 mg /dl)	122.70±9.5	292.77±77.8	298.53±66.9	0.0001*
HbA1c <6%	4.81±0.5	6.72±3.3	6.72±3.3	0.0090*
Sr. Mg (mg/dl) 1.6-2.6	1.99±0.4	1.94±0.7	2.04±0.9	0.8574

p<0.05 is consider as significant.

Table 2: Correlation between Sr. Mg. with Fasting and PP blood sugar

	Group-1 (n=30)	Fasting-	PP- Blood sugar(mg/dl)
		Blood sugar(mg/dl)	
Group 1	r value	-0.033	0.121
	P value	0.864	0.525
Group 2	r value	0.035	0.274
	p value	0.855	0.142
Group 3	r value	0.001	0.336
	p value	0.998	0.070

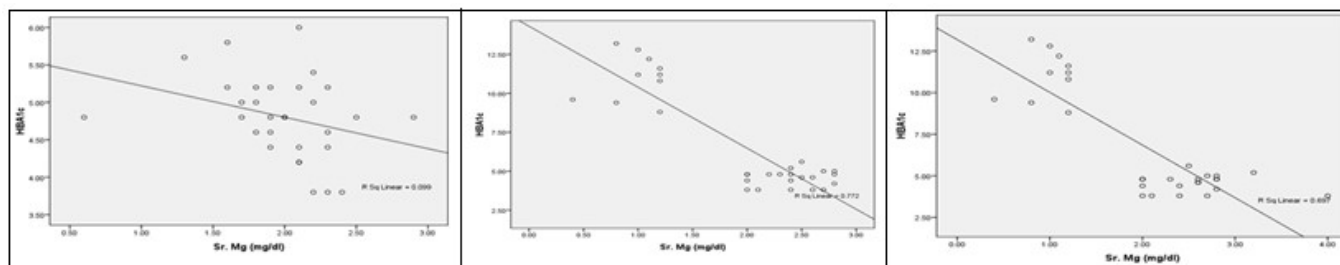


Figure 1

Figure 2

Figure 3

Figure 1: Correlation between Sr. Mg. with HbA1C in group-1; **Figure 2:** Correlation between Sr. Mg. with HbA1C in group-2; **Figure 3:** Correlation between Sr. Mg. with HbA1C in group-3

Table 6: Correlation between HbA1c with Sr. Mg (mg/dl)

Cases	r value	p value
Group 1	-0.314	0.091
Group 2	-0.879	0.001
Group 3	-0.835	0.001

OBSERVATIONS

In our study, mean and std deviation of all the 3 groups were 52±14.6, 56±10.7 and 53.63±9.6 respectively. (Table-1). In gender area, the p-value was 0.55 which was not significant in our study. There was a positive Correlation between the parameters of glycemic status ie-HbA1C, fasting and post prandial blood glucose but no significant correlation with magnesium. (Table - 1). In Table -2, the fasting and post prandial blood glucose values are inversely correlated with magnesium. In Table -3,4,5, there was a negative correlation between serum mg and HbA1C in all the 3 groups by pearson correlation analysis. In Table-6 also there was no significance r and p-values between the sr.mg and HbA1C.

DISCUSSION

Hypomagnesemia is a good prognostic factor in DM2 and associated with various complications. Hence, it is very useful to measure the serum magnesium levels in patients with type DM and probably correlates their relationship with various systemic complications. So, we have selected the patients who attended the medicine and diabetology OPD, participated in our study. Patients with HbA1c < 7.0% were assigned to Group 2 while patients who had HbA1c > 7.0% were assigned to Group 3. Group 1 act as a control. In this study, we observed more number

of cases with low levels of magnesium in group 3 where HbA1c was above 7% when compared to group 2 where HbA1c was less than 7%. But, there was a negative correlation between the parameters of glycemic status and serum magnesium. In another Libyan study, DM2 patients serum magnesium levels were significantly lower than normal control subjects. Serum magnesium of diabetic patients showed significant negative correlations with duration of disease, and glycemic control as measured by HbA1c, and near significant negative correlation with FBS. No significant correlations were found between magnesium level and BMI or age.¹⁰ One more study done by De Valk HW found that patients with severe retinopathy have a lower plasma magnesium level compared to patients without retinopathy and a prospective study has shown the plasma magnesium level to be inversely related to occurrence or progression of retinopathy.¹¹ In a recent Study conducted by Senthil *et al.* stated that a significant inverse relationship between Serum Mg and HbA1C values in south india^[12]. Causes for the low Mg levels in DM2 are, a low Mg intake and an increased Mg urinary loss¹³ and the use of loop and thiazide diuretics, often prescribed in diabetic patients with hypertension and/or cardiovascular diseases, also promote Mg loss¹⁴. Resnick and associates suggest that extracellular and intracellular magnesium

deficiency is typical in chronic, stable, mild DM2 and may be a strong predisposing factor for the development of the excess cardiovascular morbidity associated with diabetes¹⁵. Garland HO in his study speculated on a potential link between the magnesium deficit in diabetes and several diabetic complications including cardiovascular problems and retinopathy^[16] and Sharma *et al.* also observed that those who had low serum magnesium levels were prone for diabetes related complications (hypertension, dyslipidaemia, and retinopathy)^[17]. In a study, done by Supriya *et al.* and Ankush RD *et al.*, they have found out the positive correlation i.e., there was significant decrease in serum magnesium level in type 2 DM as compared to controls^{18,19}.

CONCLUSION

To conclude, in our study, serum magnesium levels were lower in DM2 patients when compared with non-diabetic controls. Because of this low level of Mg²⁺, which reduces insulin sensitivity and may increase risk of secondary complications like retinopathy, hypertension and dyslipidaemia, it may be prudent in clinical practice to periodically investigate plasma Mg²⁺ concentrations in diabetic patients. If plasma Mg²⁺ is low, an intervention to increase dietary intake of magnesium may be beneficial. Oral Mg supplements appear to be useful in persons with DM2 to restore Mg deficiencies, to improve insulin resistance, oxidative stress, and systemic inflammation^[20] and have been shown to improve fasting and postprandial glucose levels and insulin sensitivity in hypomagnesemic DM2 patients.

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