Original Article

Study of Serum Magnesium Levels in Type 2 Diabetes Mellitus at Tertiary Medical Centre, Karnataka, India

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ABSTRACT

Background: Diabetes and poor glycaemic control alters the metabolism of magnesium (Mg) by increasing their urinary excretion and lowering serum Mg levels. Low serum Mg levels will contribute to the evolution of diabetic complications such as retinopathy, abnormal platelet function, cardiovascular disease and hypertension via reduction in the rate of inositol transport and subsequent intracellular depletion. This study aimed at evaluation of serum Mg levels with Type 2 diabetics and control non diabetic individuals.

Methods: After the Ethical approval, blood samples from recruited subjects (50 diabetics and 50 non diabetics) were collected and estimation of Mg in serum by xylidyl blue method, Fasting blood sugar (FBS) and post prandial blood sugar (PPBS) by Glucose oxidase peroxidase (GOD-PAP) method was done. Descriptive statistics mean and standard deviation, independent sample 't' test, level of significance 5% were used for analysis.

Result: Mean value of FBS in control group of 100.98mg/dL and in case group with 134.80mg/dL. Mean value of PPBS in control group of 108.76mg/dL and in case group with 236.6mg/dL. Mean value of serum Mg in control group was 1.64mmol/L while in case group=1.20mmol/L. Serum magnesium was significantly decreased ($p<0.001$) in diabetics than controls. A negative linear relationship ($p<0.05$) between, Mg and FBS ($r=-0.198$ and $p=0.048$), Mg and PPBS ($r=-0.206$ and $p=0.040$) was found.

Conclusion: The present findings demonstrate the imbalance in levels of serum Mg among the patients of type 2 DM in comparison to controls. Since serum magnesium is easily and inexpensively measured, and as oral magnesium replacement is cheap and safe, there is an argument for screening of diabetic patients for hypomagnesaemia and institution of supplementation if it is detected.

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Introduction

Type 2 diabetes mellitus (DM) is a major growing public health problem that affects over 200 million individuals worldwide. It is on track to become one of the major global public health challenges of the 21st century. India has become the "Diabetic Capital of the World". Thus, there is an urgent need to develop primary prevention strategies aimed at controlling this epidemic.[1,2] Homeostasis of the trace elements such as zinc, copper, iron and magnesium (Mg) has been found to play an important role in the pathogenesis of diabetes and its complications. [1] Mg, one of the important components of many foods such as grains, nuts and green leafy vegetables is an essential cofactor for enzymes involved in glucose metabolism. Deficiency of Mg has been associated with wide variety of clinical conditions, including Type-2 DM. Hence it's expected to have a negative impact on essential biochemical processes. [3, 4]

Mg has received considerable attention for improving insulin sensitivity and preventing diabetes and its complications. [2] Diabetes and poor glycaemic control alters the metabolism of Mg by increasing their urinary excretion and lowering serum Mg levels. This association may reflect a 'vicious cycle' with hyperinsulinemia associated with insulin resistance contributing to extracellular Mg depletion and, in turn, further augmentation of insulin resistance by hypomagnesaemia. Low serum Mg levels may contribute to the evolution of diabetic complications such as retinopathy, abnormal platelet function, cardiovascular disease and hypertension via reduction in the rate of inositol transport and subsequent intracellular depletion. Further, Mg deficiency has been proposed as a novel factor implicated in the pathogenesis of late diabetic complications. [3-8]

The primary prevention of type 2 DM and its complication through diet and lifestyle modifications is of paramount public health importance. In Indian scenario, very few studies are conducted regarding its association between type 2 diabetes and serum magnesium level. Hence this study was taken up to assess the correlation of serum Mg level with fasting and post prandial blood sugar levels in diabetics and non diabetics.

Materials And Methods

Study conducted by obtaining informed consent from the subjects after the institutional ethical approval. It is a prospective study conducted in tertiary hospital of south canara district between May to July 2014. The study group comprised 50 cases of Type 2 DM of either sex and control group of 50 non diabetic subjects of either sex.

Inclusion Criteria

50 cases of type-2 DM, confirmed by biochemical investigations as per WHO criteria. The following table summarizes the 2006 WHO recommendations for the diagnostic criteria for diabetes: (Table-1)

Exclusion Criteria

Patients with Type 1 DM, acute complications such as severe infection, major operations, severe cardiovascular or respiratory diseases.

Under aseptic precautions, 2ml of plain blood is drawn by venepuncture, for estimation of Serum Mg levels. The serum is separated by centrifugation at 1500rpm for 15 minutes and stored at 4° Celsius. Estimation of serum Mg by xylidyl blue method is performed. 2ml of fluoride anticoagulated blood in appropriate vacutainer by venepuncture after 8 hours of fasting, for estimating FBS levels and 2 hours after a standard meal for estimating PPBS levels. Its estimation is done by Glucose oxidase peroxidase (GOD-PAP) method.

Instrument used for measuring the absorbance: Semi auto analyzer.

Statistical Analysis:

- Descriptive statistics mean and standard deviation.
- Independent sample't' test.
- Level of significance 5%

Result

It is a prospective study in which 100 subjects were included. Out of which 50 were Type 2 DM patients confirmed by biochemical investigations as per WHO criteria and 50 were non-diabetic apparently healthy control subjects. The age group of cases and controls were between 20-80 years. (Table 2)

Serum magnesium, FBS and post prandial blood sugar levels was measured in these subjects.

FBS, PPBS and Mg levels are as shown in Table 3. They were significantly higher in cases than in controls.

Independent Sample T-Test

The result was significant showing that, there is difference in mean Mg, FBS, and PPBS between control and diabetic. Serum magnesium was significantly decreased ($p<0.001$) in diabetics than controls. (Table 3)

Correlations

Pearson's correlation coefficient was used to find out the association between magnesium, FBS and PPBS. A significant negative correlation between serum magnesium, FBS and PPBS was observed. (Table 4).

Table 1: 2006 WHO recommendations for the diagnostic criteria for diabetes

	Fasting Blood Glucose (FBS) (mg/dL)	2 hour glucose (mg/dL)
Normal	<110	<140
DM	≥126	≥200

Table 2: Comparison of 2 parameters in two groups (control and case):

Parameters	Groups	
Gender	Control(n=50)	Male = 29 Female = 21
	Case(n=50)	Male = 25 Female = 25
Age (Mean)	Control	46
	Case	53

Table 3: COMPARISON OF 3 PARAMETERS IN TWO GROUPS (CONTROL AND CASE):

Parameters		Mean	Std Deviation	p Value
Fasting Blood Glucose (FBS) (mg/dL)	Control	100.98	11.52	<0.001
	Case	134.80	45.96	
Post Prandial Blood Glucose (PPBS) (mg/dL)	Control	108.76	25.27	<0.001
	Case	236.6	88.10	
Serum magnesium (mmol/L)	Control	1.64	0.778	<0.001
	Case	1.20	0.345	

Table 4: Pearson's Correlation

Pearson Correlation	r Value	p Value
Serum Mg v/s FBS	-0.198	0.048
Serum Mg v/s PPBS	-0.206	0.040

Discussion

Diabetes accounts for a significant part of the morbidity and mortality. Diabetes is estimated to affect 25.6 million American adults and 366 million people worldwide, and the numbers will continue to increase to 552 million by 2030 globally. Therefore, primary prevention of type 2 diabetes through diet and lifestyle modifications is of paramount public health importance. Research over the past two decades has provided evidence of a clinical correlation between diabetes and low magnesium intake which may be a contributing factor in the progression of DM and its complications, [9]

Comparing our study to the study done by Shrabani Mohanty, et al (2013) which showed that FBS in their control group was 81.96mg/dL and 218.62mg/dL in case group. This comparison shows that the FBS value in our case group (134.80mg/dL) was in discordance when compared to theirs (218.62mg/dL). The reason for this might be that most of the diabetics in our study group were probably under strict diabetic diet and hence under control.[10]

PPBS value in control group of our study was found to be 108.76mg/dL and in case group it was 236.6mg/dL. This was in concordance with their study which showed 113.56mg/dL for control group and 285.04mg/dL for case group. [10]

The mean value of serum Mg in our control group was found to be 1.64mmol/L and in case group it was 1.20mmol/L. It is observed that serum Mg was significantly decreased ($p<0.001$) in diabetics than controls which is in concordance with the previous study. [10] Similar such decrease in serum magnesium level in diabetic's patients as compared to controls has been reported by some authors. [2, 10-17] (Table 5).

Correlation of serum Mg level with FBS and PPBS levels in type 2 DM patients and control group was assessed using Pearson's correlation coefficient. A significant negative correlation between serum Mg v/s FBS and serum Mg v/s PPBS was observed in our study.

Mg depletion has a negative impact on glucose homeostasis and insulin sensitivity in diabetic patients as well as on the evolution of complications such as retinopathy, thrombosis and hypertension. Preventing low Mg status in diabetics may therefore be beneficial in the management of the disease. The reasons for the high prevalence of Mg deficiency in diabetes are not clear, but may include increased urinary loss, lower dietary intake, or impaired absorption of Mg compared to healthy individuals. Several studies have reported increased urinary Mg excretion in type 1 and 2 diabetes. [10] Patients with DM had altered

Table 5: Comparison between FBS, PPBS and Mg in various studies with our study:

Studies	Group	FBS	PPBS	Mg
Salem M,et al.[2]	Control	83.13	-	1.37
	Case	264.07	-	0.89
Mahendra B G, et al.[11]	Control	86.8	-	3.36
	Case	107.8	-	1.60
Shrabani Mohanty,et al. [10]	Control	81.96	113.56	1.91
	Case	218.62	285.04	1.58
Dipankar Kundu,et al. [12]	Control	94.52	140	2.62
	Case	165	201	2.02
M Prasad Naidu, et al.[13]	Control	92.8	128.72	2.40
	Case	170.23	265.70	1.80
Mahadeo Mane,et al. [14]	Control	85.57	-	2.26
	Case	112.77	-	1.98
Asha S Khubchandani,et al. [15]	Control	93.80	132.20	2.47
	Case	Without complications:172.00 With complications: 235.44	Without complications:204.80 With complications: 268.48	Without complications:1.94 With complications:1.32
Mirza Sharif Ahmed Baig,et al. [16]	Control	88.13	127.03	2.17
	Case	Without complications:142.97 With complications:187.83	Without complications:230.70 With complications: 317.00	Without complications:1.61 With complications:1.29
A.G. Kulkarni,et al. [17]	Control	93.6	136.32	2.375
	Case	124.1	210.4	1.96
Our Study	Control	100.98	108.76	1.64
	Case	134.80	236.6	1.20

metabolism of Mg, probably due to hyperglycemia. Previous studies showed the impaired metabolism of the elements may contribute to the progression of DM and its complications. [2, 4-7]

Conclusion

The present findings demonstrate the imbalance in levels of serum Mg among the patients of type 2 DM in comparison to controls. Since serum magnesium is easily and inexpensively measured, and as oral magnesium replacement is cheap and safe, there is an argument for screening of diabetic patients for hypomagnesaemia and institution of supplementation if it is detected.

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Conflicts of Interest

Nil

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Competing Interests

None Declared

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