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Original Research Article

PREVALENCE OF HYPOMAGNESEMIA IN TYPE 2 DIABETIC PATIENTS ATTENDING A TERTIARY CARE HOSPITAL IN SOUTH INDIA- A CROSS SECTIONAL STUDY

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Abstract

Background: Type 2 Diabetes Mellitus is one of the most common diseases encountered globally. It is also associated with an increased risk of development of microvascular, macrovascular diseases or both. Magnesium (Mg) is supposed to have some role in glycaemic control in Type 2 diabetes and also with the disease progression. Magnesium depletion is said to have a negative impact on glucose homeostasis and insulin sensitivity in patients with type 2 diabetes. The present study was conducted to estimate serum magnesium levels in type 2 diabetic patients and find any correlation between the two. **Materials and Methods:** The study was conducted in 500 type 2 diabetic patients. Subjects were selected based on inclusion criteria and after attaining written informed consent. Blood sugar (FBS, PPBS and HbA1C) and serum Mg levels of each subject were assessed and correlated. **Result:** The correlation analysis showed that serum magnesium levels were significantly lower in patients with uncontrolled diabetes. **Conclusion:** Our study demonstrated an inverse relationship between HbA1c and serum magnesium levels, hence pointing out that Magnesium levels do affect the Diabetic status of the individuals. Keeping in mind the role of Mg at molecular levels with effect of insulin uptake, correcting Mg levels may prove to play a vital role in improving the Diabetic status of the individual.

INTRODUCTION

Diabetes is seen to be one of the predominant diseases worldwide, and majority of the diabetic cases globally is Type 2 diabetes. It is also seen to be associated with increased risk of development of microvascular, macrovascular diseases or both. It is a combination of metabolic disarrangements with events of hyperglycemia and glucose intolerance occurring as a result of either deficient production of insulin, ineffective insulin action, or both.[1]

Magnesium (Mg) is known to be a cofactor for various enzymes of metabolism,[2] including the enzymes involved in glycolysis. Mg is required for regulation of insulin signalling, post-receptoral action of insulin and in insulin-mediated uptake of glucose.[3] Low serum Mg status has been seen in many Type 2 DM patients.[4]

Few studies have reported that deficiency of Mg may induce an altered state of cellular glucose transport, pancreatic insulin secretion, and defective post receptorial action of insulin.[5-8]

Therefore, Mg is important for glucose homeostasis. It's deficiency can negatively impact the insulin resistance in type 2 DM. Its deficiency in diabetes has been associated with cell inflammation, and oxidative stress, which later results in micro/macro vascular complications.[9] A study done by Sharma et al,[10] showed that poor glycaemic control was associated with hypomagnesemia. Another study done by Ankush et al,[11] found that hypomagnesemia was more pronounced in diabetics with complications. They also found an inverse relationship between serum Mg levels and glycated haemoglobin (HbA1c) in type 2 DM patients.

Though Kerala is known to be the Diabetes capital of India, very few studies have been done to establish correlation between serum magnesium levels and blood glucose levels

Therefore, this study was conducted to see if there is any correlation between serum Mg and glycaemic control in Type 2 DM patients.

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MATERIALS AND METHODS

A total of 500 patients (aged 25 years and above) diagnosed with Type2 DM which is established since 5 years presenting themselves to General Medicine outpatient department of Pushpagiri Institute of Medical Sciences were included in the study. Subjects were divided into 2 groups (controlled and uncontrolled diabetes) Patients on diuretics, less than 25 years of age, Type 1 DM, pregnant women, children, subjects with diarrhoea, vomiting as a presenting or prominent complain, patients with Hungry bone syndrome ,patients with acute pancreatitis, inherited tubular disorders, or any familial hypomagnesemia with hypercalciuria and nephrocalcinosis, patients on any medication other than those prescribed for diabetes. (chemotherapeutic drugs like Cisplatin, Cyclosporin, antibiotics like Amphotericin Aminoglycosides)patients on any medication other than those prescribed for diabetes,and those who did not give consent were excluded from the study.

Under aseptic precautions, 5 ml blood was collected from antecubital vein for serum Mg, fasting blood sugar (FBS), postprandial blood sugar (PPBS), and HbA1c after overnight fasting. Mg levels were assessed by calorimetric estimation. Assessment of blood glucose levels was done by GOD-POD (glucose oxidase peroxidase method), using Biochemistry analyser/colorimeter. The data were analysed using Statistical Package for the Social Sciences and data recorded as mean ± standard deviation and were considered significant when $P \leq 0.05$.
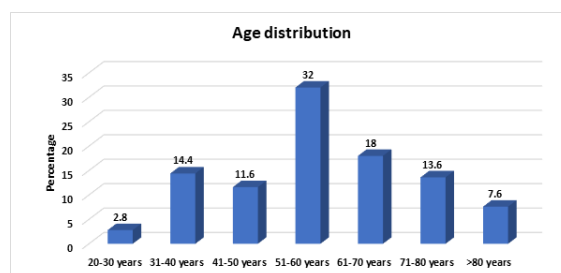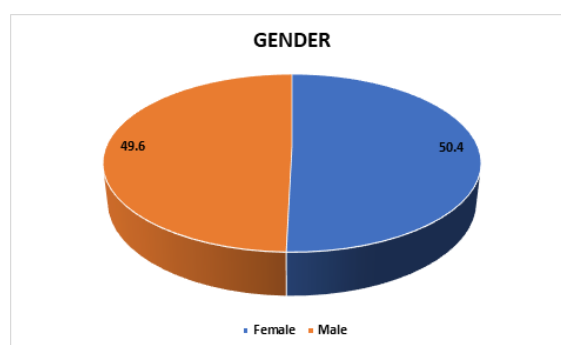
RESULTS

Figure 1: Age distribution

Figure 2: Gender

Table 1: Frequency of distribution of controlled and uncontrolled Diabetes

Diabetes	Frequency	Percent
Uncontrolled Diabetes	336	67.2
Controlled Diabetes	164	32.8
Total	500	100

Table 2: Descriptive statistics of quantitative variables

	Mean±SD	Median (IQR)
AGE	59.09±15.43	60 (48-70)
FBS	134.33±31.63	130 (112-150)
PPBS	199.23±65.98	196 (146-222)
HbA1C	7.308±1.20	7.2 (6.9-7.8)
S.Mg	1.929±0.32	1.9 (1.8-2.1)

Table 3: Age distribution Group Wise

Age groups	Uncontrolled diabetes	Controlled diabetes
20-30 years	4(1.2)	10(6.1)
31-40 years	34(10.1)	38(23.2)
41-50 years	42(12.5)	16(9.8)
51-60 years	106(31.5)	54(32.9)
61-70 years	63(18.8)	27(16.5)
71-80 years	54(16.1)	14(8.5)
>80 years	33(9.8)	5(3)
Total	336(100)	164(100)

Table 4: Gender distribution GroupWise

Gender	Uncontrolled diabetes	Controlled diabetes
Female	162(48.2)	90(54.9)
Male	174(51.8)	74(45.1)
Total	336(100)	164(100)

Table 5: Descriptive statistics of quantitative variables

	Uncontrolled diabetes		Controlled diabetes	
	Mean±SD	Median (IQR)	Mean±SD	Median (IQR)
AGE	61.67±14.87	60(53-72)	53.80±15.24	56(38.25-64)
FBS	140.47±34.30	136(116-160)	121.74±20.18	120(110-132)
PPBS	215.68±64.86	210(184-245)	165.54±54.60	146(132-186.75)
HbA1C	7.74±1.01	7.5(7.2-8)	6.42±1.07	6.8(6.5-6.9)
S.Mg	1.87±0.31	1.9(1.6-2)	2.03±0.31	2(1.9-2.2)

Table 6: Association between HbA1C groups and Serum Mg

HbA1C	N	S.Mg		z value	P value
		Mean	Std. Deviation	-5.724	<0.001
Uncontrolled diabetes	336	1.875	0.3145		
Controlled diabetes	164	2.039	0.3148		
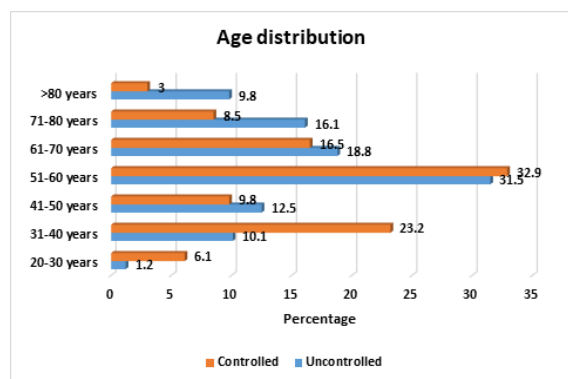
Figure 3:

DISCUSSION

As shown [Table 1] out of 500 participants 336 (67.2%) had uncontrolled diabetes and the remaining 164(32.8%) had controlled diabetes. Among the uncontrolled diabetes patients 162(48.2%) were females and the remaining 174(51.8) were males [Table 4]. And in the case of controlled diabetes participants 90(54.9%) were females and 74(45.1%) were males. Mann Whitney U test was used to find whether there was any statistically significant difference in serum Mg level between two groups. The p value showed that there is a significant association (p<0.001) since p value is less than 0.05 as shown in [Table 6].

There is a lot of difference in opinion about Mg in Diabetes. Some suggest that diabetes itself causes hypomagnesemia, while many have reported that appropriate Mg levels may have a role in reducing the risk of complications in Type 2 DM.[12-15] There are studies that also indicate supplementation of oral Mg in type 2 diabetic patients improved their insulin sensitivity.[16] Magnesium, an essential activator of important enzymes in the body, also plays a role in insulin's secretion and binding. It was seen that low serum Mg may lead to a defective transport of glucose and also cause an alteration in the post-receptorial signaling of insulin.[6-9] It has been proven that high magnesium intake is beneficial in conditions like dyslipidaemia, metabolic syndrome, coronary artery diseases and hypertension.[17-19]

This study was conducted to assess serum Mg levels in type 2 DM patients (controlled and uncontrolled) and its association with glycaemic control. The study showed that serum Mg was notably lower in uncontrolled type 2 DM patients when compared to controls. The results of study were similar to that done by Razeena et al. and Walti et al.[20,21]

In our study, patients with increased levels of HbA1c, had significantly decreased serum Mg levels (P < 0.01). Thus, our study suggests a significant association between serum Mg and HbA1c.Our findings resonate to those done by Corsonello et al,[22] and Corica et al.[23] They too stated that serum ionized Mg decreases together with the increase in plasma HbA1c level.

Saeed et al,[24] and Walter et al,[25] observed that serum Mg was within normal range in both Type 2 diabetic patients and in healthy controls. They have attributed it to that fact that that their exclusion criteria included patients undergoing treatment with diuretics and patients of renal failure .

It was found by Feng J et al and Wang J et al that the dietary intake of magnesium was inadequate even in non diabetics.[26,27] They suggested that probably by increasing the dietary intake, it is possible to prevent against the development of insulin resistance at preliminary level itself. Senthil Manikandan TJ et al found a significant difference in magnesium levels in newly diagnosed uncontrolled diabetics and well controlled diabetics .This can may be used as a potential predictor for the onset of microangiopathies.[28] Kundu et al concluded that low magnesium levels were observed in diabetic patients and it can be used as a predicter of retinopathy.[29]

Though few Indian studies have studied the role of magnesium supplementation in diabetics, more large scales studies from India would help to decide about the dosage and side effects encountered in our population. Current recommendations for dietary intake of magnesium are based on the studies done abroad and extrapolated to the Indian population.

CONCLUSION

Our study demonstrated an inverse relationship between HbA1c and serum magnesium levels.
The limitations of our study were its small sample size, single centre observation, absence of normal controls and no details of their dietary patterns.

Further studies on large scale need to be performed in order to establish this finding and to demonstrate its utility in the management aspects of type 2 diabetes mellitus.

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