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Evaluate the role of vascular complications in type 2 diabetes mellitus patients influenced by serum magnesium levels

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ABSTRACT

Aim: Evaluate the role of vascular complications in type 2 diabetes mellitus patients influenced by serum magnesium levels.

Methods: A comparative observational study was carried out in the department of medicine. 100 patients were included in this study. Of them 50 subjects were diabetics with vascular complications including coronary artery disease, peripheral vascular disease, diabetic nephropathy, diabetic neuropathy, diabetic retinopathy and 50 subjects were diabetics without vascular complications. Type 2 DM patients aged between 30 – 80 years and with History of T2DM for >5years were included.

Results: In the present study 100 subjects were included. Of them 50 subjects had DM without Complications and 50 subjects had DM with Complications. Mean age of DM subjects without complications was 56.87 ± 5.36 years and in subjects with complications was 55.75 ± 5.23 years. In both groups majority were males. Mean Serum magnesium among subjects without complications was 2.12 ± 0.21 mg (8% had hypomagnesemia) and in subjects with complications was 1.86 ± 0.44 mg (60% had hypomagnesemia). In our study there was significant difference in mean Serum magnesium levels with respect to type of vascular complications. Mg levels were significantly low in subjects with Nephropathy compared to other complications (1.82 ± 0.21 mg).

Conclusion: We concluded that hypomagnesermia is associated with vascular complications especially retinopathy and nephropathy.

INTRODUCTION

The term diabetes mellitus (DM, derived from Greek words meaning - Siphon and sweet) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia which results from reduced insulin secretion and/or action, decreased glucose utilization, and increased glucose production. Incidence of diabetes is increasing worldwide due to population ageing and growth, obesity, unhealthy diets and sedentary life style. Microvascular and macrovascular complications of diabetes increase as a function of the duration of hyperglycemia. So, a reduction of chronic hyperglycemia prevents or delays these complications.[1]

Magnesium is an essential element and has a fundamental role in carbohydrate metabolism in general and in the insulin action in particular. Magnesium is a cofactor inboth glucose transport mechanism of the cell membranes and for various intracellular enzymes involved in

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carbohydrate oxidation.[2,3] Magnesium is involved in multiple levels in insulin secretion, binding and activity. Cellular magnesium deficiency can alter the activity of the membrane bound Na+K+ ATPase, which is involved in the maintenance of gradients of sodium and potassium and in glucose transport.

The concentrations of magnesium in serum of healthy people are remarkably constant, whereas 25-39% of diabetics have low concentrations of serum magnesium.[4-6] Hypomagnesemia in diabetics can be due to: osmotic renal losses from glycosuria, decreased intestinal magnesium absorption and redistribution of magnesium from plasma to red blood cells caused by insulin effect. Mc Nair P et al indicated that the net tubular reabsorption (in the thick ascending loop of Henle or more distally) of magnesium is decreased in diabetic patients in presence of hyperglycemia, leading to hypermagnesuria and hypomagnesemia.[7]Magnesium depletion has a negative impact on glucose homeostasis and insulin sensitivity in patients with type 2 diabetes as well as on the evolution of complications such as retinopathy, arterial atherosclerosis and nephropathy.[7-11] Moreover, low serum magnesium is a strong, independent predictor of development of type 2 diabetes. In the atherosclerosis risk in communities (ARIC) Study, a dose response inverse relation between serum magnesium concentrations and the incidence of type 2 diabetes was observed amongst white participants.[12]

MATERIAL AND METHODS

A comparative observational study was carried out in the department of medicine 100 patients were included in this study. Of them 50 subjects were diabetics with vascular complications including coronary artery disease, peripheral vascular disease, diabetic nephropathy, diabetic neuropathy, diabetic retinopathy and 50 subjects were diabetics without vascular complications. Type 2 DM patients aged between 30 – 80 years and with History of T2DM for >5years were included. Subjects with acute MI, Chronic kidney disease due to causes other than diabetes mellitus, Patients on loop diuretics, aminoglycosides and patients on drugs containing magnesium supplements were excluded.

METHODOLOGY

Data was collected in a pretested proforma meeting the objectives of the study, which included age, sex, IP and OP number, relevant present, past, personal history and through clinical examination was done. Detailed history, general physical examination, systemic examination, and various investigations like FBS, PPBS,HbA1C, blood urea, serum creatinine and urine examination were carried out from non - heparinized venous blood sample. ECG findings were noted. Retinopathy was assessed by fundoscopy. 2D echo, arterial Doppler, ENMG were done in selected cases.Serum Magnesium levels were measured by Xylidyl blue method

STATISTICAL ANALYSIS

Data was analyzed using SPSS version 21.0 **(**IBM SPSS Statistics, Somers NY, USA). Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance for qualitative data. P value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

RESULTS

In the present study 100 subjects were included. Of them 50 subjects had DM without Complications and 50 subjects had DM with Complications. Mean age of DM subjects without

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complications was 56.87 ± 5.36 years and in subjects with complications was 55.75 ± 5.23 years. In both groups majority were males. There was no significant difference in age and gender distribution b/w 2 groups. There was significant difference in duration of diabetes, Treatment received fundoscopy findings and ECHO findings b/w two groups. No difference was observed in HTN, Smoking and alcohol.

Table 1: Demographic and clinical profile distribution of subjects

		Group				P value
		DM without Complications		DM with Complications		
		n	%	n	%	
Age (yrs)	Mean ± SD	56.87 ± 5.36		55.75 ± 5.23		
Sex	Female	20	40%	21	42%	
	Male	30	60%	29	58%	
Duration of diabetes (yrs)		9.22 ± 2.76		10.67 ± 3.91		0.03*
HTNHTN HTN		13	26%	20	40%	0.07
Smoking		10	20%	12	24%	0.8
Alcohol		10	20%	9	18%	0.6
Treatment	Insulin	2	4%	4	2%	0.04*
	Insulin & OHA	9	18%	20	40%	
	OHA	39	78%	29	58%	
Fundoscopy	Normal	50	100	26	52	<0.001*
	NPDR	0	0%	16	32%	
	PDR	0	0%	5	10%	
2D Echo 2D ECHO	IHD	0	0%	10	2%	<0.001*
	No IHD	50	100%	40	80%	

Table 2: Laboratory profile distribution of subjects

	Group				**P value**
	DM without Complications (n =50)		DM with Complications (n = 50)		
	Mean	**SD**	**Mean**	**SD**	
Hb%	10.71	1.75	10.87	2.75	0.211
FBS	155.54	21.87	178.12	55.32	0.001*
PPBS	210.22	15.36	254.27	77.69	0.001*
HbA1C	8.36	1.55	9.65	1.74	0.007*
Urea	28.12	3.69	55.87	45.69	<0.001*
Creatinine	0.89	0.16	2.79	3.22	<0.001*
Urine albumin present (%)	0	0%	16	32%	<0.001*
Magnesium	2.12	0.21	1.86	0.44	<0.001*
Hypomagnesemia	4	8	30	60%	<0.001*

In the study there was significant difference in mean FBS, PPBS, HbA1c, Urea, creatinine, urine albumin between two groups. Mean values were high in subjects with complications compared to without complications. Mean Serum magnesium among subjects without complications was 2.12 ± 0.21 mg (8% had hypomagnesemia) and in subjects with complications was 1.86 ± 0.44 mg

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(60% had hypomagnesemia). There was significant reduction in serum magnesium among DM subjects with complications compared to subjects without complications (Table 2).

Table 3: Mean Magnesium levels in relation to vascular complications among study group

Vascular complications		Mg			P value
		n	Mean	SD	
Microvascular	Retinopathy	25	1.85	0.31	0.03*
	Nephropathy	16	1.82	0.21	
	Neuropathy	10	1.90	0.35	
Macrovascular	CAD	10	1.86	0.34	
	PVD	8	1.93	0.36	

In our study there was significant difference in mean Serum magnesium levels with respect to type of vascular complications. Mg levels were significantly low in subjects with Nephropathy compared to other complications (1.82 ± 0.21 mg) [Table 3

DISCUSSION

The reasons for the high prevalence of magnesium deficiency in diabetes are not clear, but may include increased urinary loss, lower dietary intake, or impaired absorption of magnesium compared to healthy individuals. Recently a specific tubular defect in magnesium reabsorption in thick ascending loop of Henle is postulated. This defect results in reduction in tubular reabsorption of magnesium and consequently hypomagnesemia. Increased urinary magnesium excretion due to hyperglycemia and osmotic diuresis may contribute to hypomagnesemia in diabetes. Insulin treatment has been shown to correct renal magnesium loss in diabetics.[13] Over the past two decades, there has been a staggering amount of clinical evidence showing a significant association between hypomagnesaemia and T2DM. The study was conducted to find out the prevalence of hypomagnesaemia in patients with T2DM and to correlate the serum magnesium concentrations with micro vascular and macro vascular complications of diabetes. Demographic profile of the study subjects and prevalence of hypomagnesemia this study consisted of subjects in the age group ranging from 30-80 years. Of them 50 subjects had DM without Complications and 50 subjects had DM with Complications. Mean age of DM subjects without complications was 56.87 ± 5.36 years and in subjects with complications was 55.75 ± 5.23 years. In both groups majority were males. There was no significant difference in age and gender distribution b/w 2 groups. Mean Serum magnesium among subjects without complications was 2.12 ± 0.21 mg (8% had hypomagnesemia) and in subjects with complications was 1.86 ± 0.44 mg (60% had hypomagnesemia).This was statistically significant (p value = <0.001), which supports the association hypomagnesaemia and diabetic complications.Similar observations were made by previous studies. Several studies have indicated the positive correlation of low serum Mg levels with the incidence of various diabetic complications.[14-16] A recent meta- analysis found that of the 13 selected studies, 9 showed a statistically significant inverse association between magnesium intake and diabetes risk and complications concluded that decreased magnesium intake is significantly associated with risk of type 2 diabetes and vascular complications.[17]

Among the 100 subjects, 51 had microvascular and 18 had macrovascular complications alone. 5 subjects had a combination of both micro and macrovascular complication. There was a significant overlap. Hypomagnesemia was present in 34 subjects; 30 among cases and 4 among

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controls. This was statically significant (p value= 0.01).Serum magnesium levels in subjects with macrovascular complications were 1.91 ± .31 (p value = 0.5) and in those with macrovascular complications were 1.86 ± 0.37 (p value <0.0001) respectively. In a study by Arundhati Dasgupta et al[18], hypomagnesemia was associated with poorer glycemic control, retinopathyand nephropathy. Corsonello et al. demonstrated that diabetic patients with microalbuminuria or clinical proteinuria showed a significant decrease in serum ionized magnesium compared with normoalbuminuria group.[19] 10 subjects had CAD and mean magnesium values were 1.86 ± 0.34 and 8 subjects had PVD and mean magnesium values were 1.93 ± 0.36. Hypomagnesaemia was present in 10 and 9 subjects respectively. Low circulating magnesium levels have been related to elevated blood pressure, dyslipidemia, increased inflammatory burden, oxidative stress, carotid wall thickness, and coronary heart disease[20,21] Atherosclerosis Risk in Communities (ARIC) Study, a multicenter, prospective cohort study lasting 4 to 7 years and involving 13,922 middle-aged adults who were free of coronary heart disease at baseline, showed an inverse association between serum magnesium and the risk for coronary heart disease among men with diabetes.[22] In our study, however, incidence of coronary artery disease and PVD was not statistically significant in the hypomagnesemia patients. This may be due to less number of CAD and PVD in the case group.Hypomagnesaemia is associated with vascular complications of diabetes mellitus. This is statically significant (p value = 0.03).

CONCLUSION

We conclude that hypomagnesermia is associated with vascular complications especially retinopathy and nephropathy. So it may be prudent in clinical practice to periodically monitor plasma magnesium concentrations in diabeticpatients.

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