The Study of Correlation between Serum Magnesium Level and Diabetic Retinopathy in Rural Population.

Dilip Sharma[1], Dnyaneshwar Diwane[2], Ganpat Devpura[3], J P Rishi[4]

[1]Assistant Professor, Department of Medicine, NIMS university, Shobha Nagar, Jaipur.
[2]Post graduate in General Medicine, Department of Medicine, NIMS university, Shobha Nagar, Jaipur.
[3]Professor, Department of Medicine, NIMS university, Shobha Nagar, Jaipur.
[4]Professor and HOD, Department of Medicine, NIMS university, Shobha Nagar, Jaipur.

ABSTRACT

Background: Diabetic retinopathy is one of the leading causes of blindness in the world. Hypomagnesaemia has been reported to occur at an increased frequency among patients with type 2 diabetes mellitus (DM) with retinopathy compared with their counterparts without diabetic retinopathy. The study was done with aimed whether there is any correlation between serum magnesium concentration and diabetic retinopathy in a rural population. **Aim:** This study was carried out to find the correlation between serum magnesium levels in diabetic patients with retinopathy. **Methods:** 100 type 2 DM patients admitted in NIMS Medical Collage Hospital, Jaipur over the period of 8 months between 1st December 2014 to 31th July 2015, were selected for this study. Detailed history, general physical examination, systemic examination, and various investigations like fasting blood sugar (FBS), post prandial blood sugar after 2 hrs (PP_2BS), glycosylated hemoglobin ($HbA1_C$), Blood urea, serum creatinine and urine examination were carried out. Serum magnesium was estimated by Calmagite dye method. Retinopathy was assessed by direct opthalmoscopy. **Results:** Prevalence of hypomagnesaemia in type 2 diabetic was 30% hypomagnesaemia was significantly higher in diabetic with retinopathy compared to diabetic without retinopathy. Serum magnesium level is in uncontrolled DM when compare with control DM. No significant associations existed between serum magnesium concentrations and other factors like age, sex, durations of diabetes, mode of treatment. **Conclusion:** Prevalence of hypomagnesaemia in type 2 diabetics is 30%, And especially more significant in diabetes with retinopathy when comparison to diabetes without retinopathy.

Keywords: Diabetic retinopathy, magnesium, Rural Population.

INTRODUCTION

Diabetes mellitus refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Depending upon the etiology of the DM, factors contributing to hyperglycemia include reduced insulin secretion, decreased glucose utilization, and increased glucose production.[1]

The prevalence of diabetes in India by utilizing the standard WHO criteria for a diabetes diagnosis in adult was found to be 2.4% in rural areas and 4.0-11.6% in urban area.[2]

The metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ systems, leading to microvascular (retinopathy, nephropathy, neuropathy) and macrovascular (coronary heart disease, peripheral arterial disease, cerebrovascular disease) complication.[3]

Name & Address of Corresponding Author
Dr Dnyaneshwar Diwane
Post graduate in General Medicine,
Department of Medicine,
NIMS university, Shobha Nagar, Jaipur, India.
E mail: dnyaneshwardiwane@gmail.com

Magnesium deficiency has been found to be associated with microvascular disease in diabetes. Hypomagnesaemia has been demonstrated in patients with diabetic retinopathy, lower levels of magnesium predicting a greater risk for diabetic retinopathy. Magnesium depletion has also been associated with arrhythmogenesis, vasospasm, increase platelet activity and hypertension.[4,5]

Magnesium is an essential element and has a fundamental role in carbohydrate metabolism in general and in Insulin action in particular. Magnesium is a cofactor in both glucose transport mechanism of the cell membranes and for various intracellular enzymes involved in the carbohydrate oxidation. The concentration of magnesium in serum of healthy people is constant were at 25 to 39% people with diabetic has low concentrations of serum magnesium. 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.[6]

Hence, this study was carried out to find the correlation between serum magnesium levels, $HbA1_C$ and in type 2 DM patients with retinopathy.

MATERIALS AND METHODS

100 randomly selected patients with type 2 DM either on oral hypoglycaemic agents or on insulin treatment admitted to NIMS Medical College and Hospital Jaipur constituted the study population.

Inclusion Criteria: Type 2 diabetes patients with and without diabetic retinopathy were selected.

Exclusion Criteria: Patients taking diuretics, magnesium supplementation, and magnesium containing antacids, malabsorption syndrome,

chronic diarrhoea, renal failure, liver diseases, tuberculosis and thyrotoxicosis were excluded from the study. Detailed history was obtained followed by general physical and systemic examination. ECG findings were recorded. Retinopathy was assessed by direct ophthalmoscopy. Blood samples were collected for measurement of fasting blood glucose and serum magnesium. PP_2BS was measured 2 hours after standard meal. Blood urea, serum creatinine and 24 hrs urinary albumin were estimated. Serum magnesium was estimated by calmagite dye method.[7] $HbA1_C$ estimate was carried out by modified calorimetric method.

Statistical method

Statistical method analysis was done using Chi-square test to compare proportions. Statistical results were considered significant at P value< 0.05.

RESULTS

100 patients with type 2 diabetes (62 men, 38 women) comprised the study group. Hypomagnesaemia (defined as fasting serum magnesium concentration < 1.6 mg/dl) was found in 30% patients (30 patients). Patients with diabetic retinopathy had a significantly higher prevalence of hypomagnesaemia (Mean±SD1.70±0.27) compared to without retinopathy (Mean±SD 1.93±0.35) (39.29% vs 18.18%).The difference was statistically significant (Chi-square = 4.269 with 1 degree of freedom; P = 0.039) [Table 1, Figure 1].

Table 1: Prevalence of hypomagnesaemia and diabetic retinopathy.

Serum Magnesium	Retinopathy (N=56)		No Retinopathy (N=44)	
	No.	%	No.	%
Hypomagnesaemia	22	39.29	8	18.18
Normomagesemia	34	60.71	36	81.82
Mean±SD	1.70±0.27		1.93±0.35	

Chi-square = 4.269 with 1 degree of freedom; P = 0.039

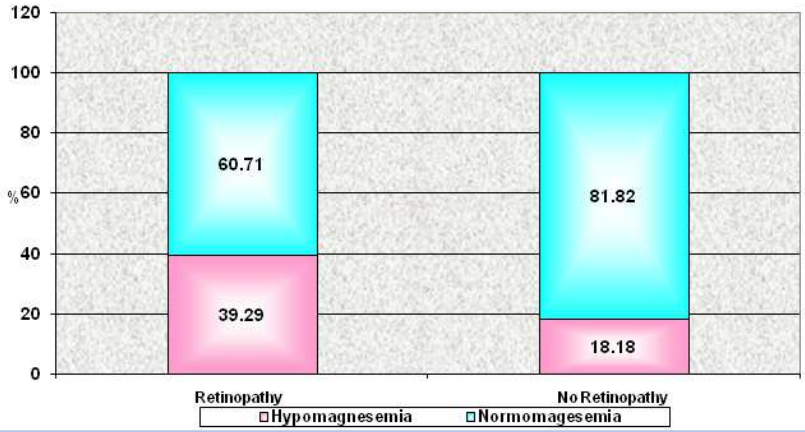

Figure 1: Serum magnesium levels in patients with Retinopathy.

In the present study when serum magnesium levels in diabetic patients with non-proliferative retinopathy (NPDR) was compared to diabetic with proliferative retinopathy (PDR), there was statistically significant (P <0.001) difference observed. Mean serum magnesium was low in diabetic (Mean±SD1.56±0.19) than diabetic with NPDR patients (Mean±SD 1.79±0.28) [Table 2, Figure 2].

Table 2: Serum magnesium in NPDR & PDR patients.

Serum Magnesium	NPDR (N=35)		PDR (N=21)		No Retinopathy (N=44)	
	No.	%	No.	%	No.	%
Hypomagnesaemia	6	17.14	16	76.19	8	18.18
Normomagesemia	29	82.86	5	23.81	36	81.82
Mean±SD	1.79±0.28		1.56±0.19		1.93±0.35	

Chi-square = 27.017 with 2 degrees of freedom; P <0.001

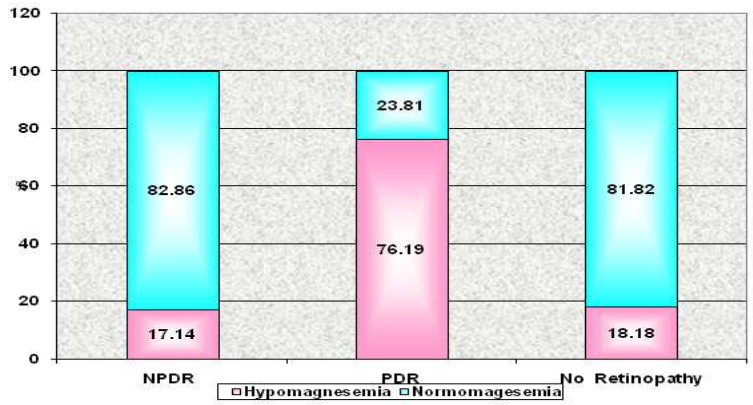

Figure 2: Compare Serum magnesium level in Retinopathy with NPDR and PDR.

Table 3: Prevalence of hypomagnesaemia in control and uncontrolled diabetic patients.

Control of diabetes	Control (HbA_{1c}<7)	Uncontrolled (HbA_{1c}>7)
No. of patients	46	54
Mean±SD	1.98±0.32	1.65±0.25

DISCUSSION

Magnesium is a cofactor in more than 300 cellular enzymatic systems and has a key role in cellular metabolism, the recognition that Mg deficiency or excess may be associated with significant clinical consequences has resulted in an increased interest in the utility of serum Mg measurement.[8] The interrelationship between magnesium and carbohydrate metabolism have regained considerable interest over the last few years. The association between diabetes mellitus and hypomagnesaemia is compelling for its wide-ranging impact on diabetic control and complications. Magnesium depletion has been linked to the development of retinopathy.[9]

In addition, Magnesium is a regulator of ion channels and mitochondrial function and is an important factor in both cellular and humoral immune reactions. Cellular Magnesium deficiency can alter the activity of membrane bound sodium-potassium ATPase that is involved in the maintenance of gradients of sodium, potassium and in glucose transport. It has been suggested that hypomagnesaemia may induce altered cellular glucose transport, reduced pancreatic insulin secretion, defective post receptor, insulin signalling, and/or altered insulin-insulin receptor interactions.[10]

The present study revealed a strong association between diabetic retinopathy and low serum magnesium levels. Patients with diabetic retinopathy and those without retinopathy had a mean serum magnesium level of 1.70±0.27 mg/dl and 1.93±0.35 mg/dl respectively. These observations are similar to Dipankar Kundu, Manish Osta et al. A study showing the serum magnesium level in diabetic retinopathy is 1.38 ± 0.39 mg/dl and those without retinopathy is 2.02 ± 0.29 mg/dl suggesting that hypomagnesaemia is a possible risk factor in the development and progression of diabetic retinopathy.[11] Ishrath Kareem et al also found that serum magnesium levels in patients with diabetic retinopathy were significantly lowered compared to patients without retinopathy.[12] Aradhana Sharma et al also found that serum magnesium levels were significantly lowered in patients with diabetic retinopathy when compared to diabetic patients without retinopathy.[13]

Our study also revealed a significant low serum magnesium level in uncontrolled DM patients (1.65±0.25 mg/dl) as compare to control DM patients (1.98±0.32 mg/dl) [Table 3].

The release of insulin caused by a glucose challenge is partly dependent on adequate magnesium. Insulin, via its interaction with ligand activated tyrosine protein kinase associated receptors, initiates a cascade of biochemical interactions that result in several physiological, biochemical and molecular events that are involved in carbohydrate, lipid and protein metabolism.[14] Although the binding of insulin to its receptor does not appear to be altered by magnesium status, the ability of insulin once bound to receptor to activate tyrosine kinase is reduced in hypomagnesaemia states.[15] As a result reduced peripheral glucose uptake and oxidation are often noted in subjects with hypomagnesaemia. Decrements in the enzymatic activities of several metabolic pathways are seen in DM patients because of the relative magnesium deficiency.[16] Consequently we suggest hypomagnesaemia as a possible risk factor in the development and Progress of diabetic retinopathy. The exact cause of diabetic hypomagnesaemia is still unknown but an increased urinary loss of magnesium may contribute to it. Hypomagnesaemia has been reported to occur at an increased frequency among patients with type of diabetes compared with their counter parts without diabetes.[17] Despite numerous reports linking hypomagnesaemia a

chronic diabetic complications, attention to this issue is poor among clinicians. The precise mechanism for development of microvascular changes is not fully understood, it is possible that hypomagnesaemia inhibits prostacyclin receptor function producing an imbalance between prostacyclin and thromboxane effect, which has marked atherogenic potential, which is responsible for microvascular complaints.

CONCLUSION

Prevalence of hypomagnesaemia in type 2 diabetics is 30%, And especially more significant in diabetes with retinopathy when comparison to diabetes without retinopathy.

Thus we conclude that the estimation of serum magnesium level are helpful to monitor the severity of retinopathy in type of diabetic patients and useful for medical intervention.

Hence further studies on serum magnesium levels and on oral supplementation will be interesting and helpful to prevent late complications of diabetic patients.

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