

## Original Article

## Study of Serum Magnesium Levels in Diabetic Retinopathy

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## ABSTRACT

**Background:** Hypomagnesaemia has been reported to occur with increased frequency in patients with type 2 diabetes mellitus; it is frequently overlooked and undertreated. Hypomagnesemia has also been associated with diabetic retinopathy.

**Aims:** The present study was conducted with an objective to evaluate the serum magnesium and fasting blood glucose in type 2 Diabetes mellitus cases and compare them with controls. The present study also attempts to evaluate the possible relationship between diabetic retinopathy and serum magnesium levels.

**Material and Methods:** A total of 120 subjects were included in this study and divided into 3 groups. The study group consisted of 40 patients that are type 2 diabetes and retinopathy and the control groups consisted of 40 patients with type 2 diabetes without retinopathy and 40 healthy subjects respectively. Both cases and controls were subjected to estimation of biochemical parameters.

**Results:** There is significant difference between levels of serum magnesium levels among diabetics without complications and healthy subjects. The mean serum magnesium levels among the above groups are  $1.79 \pm 0.15$  mg/dl and  $2.25 \pm 0.16$  mg/dl respectively ( $p < 0.001$ ). There is also significant difference between levels of serum magnesium levels among diabetic retinopathy patients and diabetics without complications i.e.  $1.62 \pm 0.13$  mg/dl and  $1.79 \pm 0.15$  mg/dl respectively ( $p < 0.001$ ).

**Conclusion:** The serum magnesium levels were significantly lower in patients with diabetic retinopathy compared to diabetics without complications.

**Key words:** Diabetes mellitus, Diabetic retinopathy, Hypomagnesaemia

## INTRODUCTION

Diabetes Mellitus is a metabolic and endocrine disorder characterized by both insulin deficiency and insulin resistance [1]. Most of the cases are diagnosed as Type 2 diabetes. Type 2 diabetes has become a leading cause of morbidity and mortality across the world. Diabetes complications are likely because of its metabolic changes. Chronic complications include majorly retinopathy, nephropathy, and neuropathy [2].

Mineral ions play specific roles in our body. One of the important mineral cation is magnesium (Mg), which is a cofactor in glucose transporting mechanism of

the cell membrane of nearly or more than 300 cellular enzymatic systems [3]. Magnesium is the second most common intracellular cation [4]. Many studies have been shown reduced magnesium concentrations in diabetic adults [5]. Intracellular magnesium is having an important role in insulin action regulation, insulin-mediated glucose uptake, and vascular tone. In diabetic patient's reduced intracellular Mg concentrations results in abnormal tyrosine-kinase activity, post receptorial impairment in insulin action, and insulin resistance worsening [6].

Magnesium (mg) deficiency can be rarely seen in healthy persons, but has been reported in 47% of hospitalized patients [7]. Not only Patients with

diabetes have lower serum Mg levels compared with their counterparts without diabetes, but also the serum Mg levels among the cohort with diabetes had an inverse correlation with the retinopathy [8, 9]. Hypomagnesaemia linked with diabetic retinopathy was reported in two cross-sectional studies that included both insulin-dependent and non-insulin-dependent patients. In this way, Magnesium depletion has been linked development of diabetic retinopathy [10].

Hypomagnesaemia, defined by low serum Mg concentrations, has been reported to occur in 13.5 to 47.7% of regular visit patients with type 2 diabetes while in non-diabetes persons it is reported 2.5 to 15% [11-14].

The purpose of this study was to evaluate the association of hypomagnesemia with diabetic retinopathy.

## MATERIAL AND METHODS

The cross sectional observational study was carried out in the department of internal medicine and department of biochemistry of Basaveshwara Medical College Hospital and Research Centre. The study was conducted after obtaining permission from ethical committee and written consent from the subjects.

A total of 120 subjects were included in this study and divided into 3 groups. The study group consisted of 40 patients that are type 2 diabetes with retinopathy; and the control groups consisted of 40 patients with type-II diabetes without retinopathy and 40 healthy subjects respectively. The subjects in the 3 study groups were age and sex matched.

Patients with acute and chronic diarrhoea/malabsorption states, with thyroid and adrenal dysfunction, history of alcohol intake, history vitamin or mineral supplements in the recent past, recent metabolic acidosis, pregnancy, lactation with serum creatinine  $\geq 1.5$ mg/dl and on drugs known to affect magnesium levels were excluded from the study [11].

The diagnosis of type 2 diabetes mellitus was confirmed by biochemical investigations as per WHO criteria. Diabetic retinopathy was diagnosed by fundus examination.

Biochemical investigations were done in the three study groups. Fasting plasma glucose was estimated by using commercially available kit in automated

analyzer. Magnesium was estimated by calmagite dye method. HbA<sub>1c</sub> was estimated using cation resin method.

**Statistical Analysis:** The Statistical software namely SPSS 15.0 and MedCalc 9.0.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs and tables. Chi-square/ Fisher Exact test and Student t test have been used to find the significance of study parameters between three groups of subjects.

## RESULTS

The comparative controlled study consisting of 40 diabetic retinopathy, 40 diabetics without any complications and 40 non diabetic healthy subjects were considered to investigate the pattern of serum magnesium in the mentioned groups. The average age of the subjects in the 3 groups in as per mentioned order was  $53.63 \pm 7.98$ ,  $52.77 \pm 7.63$  and  $53.13 \pm 6.42$  respectively. Among all the groups the gender distribution was of the same i.e. 60% and 40% males and females respectively.

**Table 1: Age distribution of patients studied**

Age in years	Controls	DM without complications	DM with retinopathy
41-50	16(40%)	16(40%)	16(40%)
51-60	14(35%)	14(35%)	14(35%)
61-70	9(22.5%)	9(22.5%)	9(22.5%)
>70	1(2.5%)	1(2.5%)	1(2.5%)
Total	40(100%)	40(100%)	40(100%)
Mean $\pm$ SD	53.63 $\pm$ 7.98	52.77 $\pm$ 7.63	53.13 $\pm$ 6.42

**Table 2: Gender distribution of patients studied**

Gender	Controls	DM without complications	DM with retinopathy
Female	16(40%)	16(40%)	16(40%)
Male	24(60%)	24(60%)	24(60%)
Total	40(100%)	40(100%)	40(100%)

The average range of FBS in diabetic retinopathy was  $201.45 \pm 47.06$  mg/dl. The mean levels among diabetics without complications were  $191.60 \pm 46.47$  mg/dl; and of healthy subjects were  $100.15 \pm 69.07$  mg/dl.

The average HbA<sub>1c</sub> level in diabetic retinopathy patients was 7.94±0.48%. The average ranges among diabetics without complications and healthy subjects were 7.71±0.49% and 6.01±0.24% respectively.

**Table 3: Serum Magnesium levels in three groups studied**

Serum Mg	Controls	DM without complications	DM with retinopathy
<1.5	0(0%)	0(0%)	4(10%)
1.5-2.0	0	32(80.0%)	36(90.0%)
2.0-2.5	40(100.0%)	8(20.0%)	0
<b>Total</b>	40(100%)	40(100%)	40(100%)

Lower levels of Serum Mg is significantly associated with DM patients with P<0.001

There is significant difference between levels of serum magnesium levels among diabetics without complications and healthy subjects. The mean serum magnesium levels among the above groups are 1.79±0.15 mg/dl and 2.25±0.16 mg/dl respectively (p<0.001).

**Table 4: Comparison of mean levels FBS, HbA<sub>1c</sub> and Serum Mg in three groups studied**

	Controls	DM without complications	DM with retinopathy	P value
<b>FBS (mg/dl)</b>	100.15±9.07	191.60±46.47	197.90±47.61	<0.001**
<b>HbA<sub>1c</sub></b>	6.01±0.24	7.71±0.49	7.88±0.47	<0.001**
<b>Serum Mg</b>	2.25±0.16	1.79±0.15	1.62±0.13	<0.001**

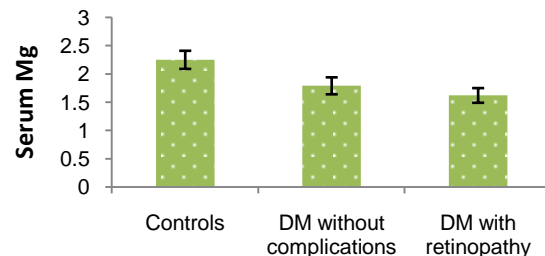
There is also significant difference between levels of serum magnesium levels among diabetic retinopathy patients and diabetics without complications i.e. 1.62±0.13 mg/dl and 1.79±0.15 mg/dl respectively (p<0.001).

## DISCUSSION

The factors for hypomagnesaemia in diabetes comprise decreased dietary intake, increased gastrointestinal loss as result of autonomic dysfunction, and osmotic diuresis due to reduced renal re-absorption and glycosuria. Sometimes the increased as common use of antibiotics and antifungals in diabetic patients can also likely to contribute to renal magnesium wasting[15].The

mechanism for development of microvascular changes is not clearly understood, it is likely to be possible that hypomagnesaemia may inhibits prostacyclin receptor function bringing an imbalance between prostacyclin and thromboxane [15].

**Graph 1: Serum magnesium levels in the three groups studied**



Mirza Sharif et al statistically observed the mean serum magnesium level which was significantly low (P<0.001) in Diabetic patients with retinopathy, when compared with controls. In their study, cases with diabetic retinopathy had serum magnesium level (1.28 + 0.30) of much lower when compared with diabetic patients without retinopathy (1.60 + 0.40) [16].

Hatwal A et al studied the association of hypomagnesaemia with diabetic retinopathy and observed that serum magnesium levels were significantly lower in diabetic retinopathy patients than in those patients without diabetic retinopathy. Their study also found significantly low (P<0.001) serum magnesium levels in diabetic patients with proliferative and non-proliferative retinopathy than those patients without retinopathy [9].

Ishrath Kareem et al found that serum magnesium levels in diabetic retinopathy patients were significantly low when compared to patients without retinopathy [17].

Aradhana Sharma et al also found that serum magnesium levels were significantly lowered in patients with diabetic retinopathy when to diabetic patients without retinopathy [18].

Kundu et al in addition to hypomagnesemia found an association of albuminuria with diabetic retinopathy [19].

In our study, we compared serum magnesium levels between normal subjects and diabetics without retinopathy, serum magnesium levels were found to be significantly (p<0.001) low in diabetic patients.

Serum magnesium levels were also significantly lower in diabetic retinopathy subjects compared to diabetics without retinopathy ( $p < 0.001$ ).

## CONCLUSION

Hypomagnesaemia is likely among patients with type 2 diabetes mellitus. Long term complications especially retinopathy may have hypomagnesemia as a contributing factor. Hence it is prudent that serum magnesium levels are carefully monitored in diabetic patients. Future studies on the role of magnesium supplementation in type 2 diabetes in Indian population are recommended.

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