

ESTIMATION OF SERUM MAGNESIUM LEVELS AND ITS CORRELATION AMONG PATIENTS WITH DIABETIC RETINOPATHY

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ABSTRACT

Objective: To find the correlation of serum magnesium levels in diabetic patients with and without retinopathy.

Methods: Hospital Based Cross-Sectional study was conducted on diabetic patients who attend the ophthalmology outpatient department in a medical college and hospital, Puducherry. Patients were divided into two groups with and without diabetic retinopathy. After obtaining institutional ethical committee approval and consent from the patient, anthropometry measurements were taken, followed by the comparison of serum magnesium level estimation in both groups. All parameters are presented as mean±standard deviation (mean±SD). The data was entered and analysed by using Epi info (version 6.04d) software package.

Results: The mean (SD) value of serum magnesium was 1.14 (0.17) and 1.42 (0.15), in cases and controls, respectively. Our results showed that the serum magnesium levels were significantly decreased ($p < 0.05$) among patients with diabetic retinopathy as compared to patients without diabetic retinopathy.

Conclusion: The strong association between serum magnesium levels and severity of type II Diabetes mellitus indicates a role for early prediction and appropriate therapeutic modifications to avoid end-stage disease complications.

Keywords: Diabetic retinopathy, Microvascular complications, Magnesium

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INTRODUCTION

Diabetes mellitus and its long-term complications is the major cause of morbidity and mortality among Indian population making India the diabetic capital of the world. After several years of living with the disease and poor glycemic control, patients invariably end up with macro and microvascular complications. Worldwide diabetic retinopathy is the leading cause of new-onset blindness. Magnesium is the fourth most common cation and second most common intracellular cation that has a significant role as a co factor in more than 320 enzymatic reactions. Carbohydrate oxidation, insulin secretion, binding, activity and glucose transporting mechanism in the cell membrane requires magnesium as a co-factor [1].

Diabetes causes damage to the eyes, kidneys, nerves, myocardium causing retinopathy, nephropathy, neuropathy and coronary artery disease, respectively, which are all major part of public health concern and develop due to chronic high blood sugar levels. Hypomagnesemia is considered to be a marker of poor glycaemic control, yet there is a poor attention to this issue among clinicians [2, 3].

The possible metabolic factor involved in the pathogenesis of micro and macrovascular complications of diabetes may be magnesium and its oral supplementation restores serum magnesium levels and improves chronic complications of diabetes mellitus [4]. Carbohydrate metabolism and magnesium has a correlation which has been a major field of interest over the past few decades and its deficiency has been studied in relation to the development of retinopathy [5].

There is very strong evidence to suggest a link between hypomagnesemia and the reduction of tyrosine-kinase activity at the insulin receptor level, leading to insulin resistance and impairment of insulin action. Literature suggests evidence of better glycaemic control with higher concentrations of magnesium. Since progression to micro and macrovascular complications of diabetes can be controlled with a good glycaemic control [6] appropriate

management of same can be initiated at an early stage with better knowledge of multiple factors affecting glucose homeostasis.

Hence this work was undertaken to evaluate the correlation of serum magnesium levels in diabetic patients with and without retinopathy as a matter of fact to emphasize on the importance of serum magnesium levels.

MATERIALS AND METHODS

Study area and setting

The study was conducted in patients who attend the ophthalmology outpatient department in a medical college and hospital, Puducherry after obtaining ethical approval from the Institutional Ethics Committee (IEC No. 44/2014)

Study design

Hospital-Based Cross-Sectional study

Sample size

Sample size was calculated using open EPI software using the difference between means for diabetic patients with (1.87 ± 0.62) and without (1.93 ± 0.54) retinopathy [1] and power of 80% with ratio of two groups to be 1:1 for 95% CI, the reported sample size was 32 and inflated to 40.

Inclusion criteria

Patients above 30 y of age with diabetes mellitus who attended ophthalmology outpatient department on the given day for various ailments who consented to participate in the study.

Exclusion criteria

Diabetic patients whose fundus view was inconclusive of a change clearly and any patient who refused to give consent for participation in the study were excluded from the study.

Data collection

After obtaining informed consent, information on individual's identity and medical history was collected. Anthropometric measurements like height, weight and blood pressure were measured. Fundus examination was done to group the patients into 2 groups (Diabetics with and without retinopathy). Blood samples were collected to measure serum magnesium.

Height

Height was measured to the nearest 0.1 cm while the patient is standing in an erect position with bare feet on flat floor against a vertical scale with heels touching the wall and head straight [6].

Body weight

Body weight was measured with minimal clothing and without shoes, standing motionless on a weighing scale recorded to the nearest 0.1 kg [7].

Blood pressure

Blood pressure was measured three times by the principal investigator with a time interval of two mins for each recording. After giving five mins rest to the participant in a quiet room, blood pressure was measured in sitting posture by mercury sphygmomanometer between 10 am to 11 am. The pressure at which Korotkoff's sound first heard (Phase I) was taken as systolic blood pressure and the pressure at which these sounds disappeared (Phase V) was taken as diastolic blood pressure. The average of three readings will be taken as correct systolic and diastolic blood pressure [7-9].

Estimation of serum magnesium

Calmagite method was used to assess serum magnesium levels following standardization in our laboratory by the semi-auto analyzer.

Ethical issues

Ethical principles such as respect for the persons, beneficence and justice were adhered. Clearance from the Institutional Review Board was obtained prior to the beginning of the study. Blood samples collected for the study purpose were drawn under strict aseptic precautions by the investigator after obtaining informed consent. Any respondent newly diagnosed with any disease or disorder was notified and proper referral to the concerned specialist was done. S/he could then make the decision to participate or not in the study. No information was withheld from the respondent.

Analysis of quantitative data

The data was entered and analysed by using Epi info (version 6.04d) software package. All parameters were presented as mean±standard deviation (mean±SD). Chi-square test was used to compare proportions for the groups. Unpaired t-test was used to compare the groups with and without diabetic retinopathy. ANOVA was used to compare the groups for continuous variables like serum magnesium levels

RESULTS

In the present study, a total of 40 patients were enrolled, among them 25 patients were cases (with diabetic retinopathy) and 15 patients were controls (without diabetic retinopathy).

The mean (SD) height of the cases was 1.60m (8.68), and for the controls, it was 1.63m (7.30). The mean (SD) weight was 64.88 kg (13.41) and 62.26 kg (12.49), for cases and controls, respectively.

Table 1: Patients cases and controls, respectively

Parameters	Diabetic retinopathy (Cases n= 25)		No diabetic retinopathy (Controls n= 15)	
	Mean	Standard deviation	Mean	Standard deviation
Height	1.60	8.68	1.63	7.30
Weight	64.88	13.41	62.26	12.49
Systolic Bp	129.52	14.73	130.00	11.18
Diastolic Bp	78.64	14.58	81.07	11.49
Sr. Magnesium	1.14	0.17	1.42	0.15

The mean (SD) systolic pressure values recorded were 129.52 mmHg (14.73) and 130 mmHg (11.18) for cases and controls, respectively. The mean (SD) diastolic pressure value recorded among the cases was 78.64 mmHg (14.58), and for the controls, it was 81.07 mmHg (11.49).

Table 2: Correlation between serum magnesium levels and diabetic retinopathy

Parameter	Diabetic retinopathy		t value	df	Test of significance (p value)
	Present (n=25)	Absent (n=15)			
Serum magnesium	1.14	1.42	-4.904	38	0.001

The mean (SD) value of serum magnesium was 1.14 (0.17) and 1.42 (0.15), for cases and controls, respectively.

Our results showed that the serum magnesium levels were significantly decreased ($p < 0.05$) among patients with Diabetic retinopathy as compared to patients without diabetic retinopathy.

DISCUSSION

In the present study, a total of 40 patients were enrolled; among them, 25 patients were cases (with diabetic retinopathy) and 15 patients were controls (without diabetic retinopathy). The mean (SD) height of the cases was 1.60m (8.68), and for the controls, it was 1.63m (7.30). The mean (SD) weight was 64.88 kg (13.41) and 62.26 kg (12.49), for cases and controls, respectively. The mean (SD) systolic pressure values recorded were 129.52 mmHg (14.73) and 130 mmHg (11.18) for cases and controls, respectively. The mean (SD) diastolic pressure value recorded among the cases was 78.64 mmHg (14.58), and for the controls, it was 81.07 mmHg (11.49). The mean (SD) value of serum magnesium was 1.14 (0.17) and 1.42 (0.15), for cases and controls, respectively.

Our results showed that the serum magnesium levels were significantly decreased ($p < 0.05$) among patients with diabetic retinopathy as compared to patients without diabetic retinopathy.

A similar cross-sectional observational study by Kiran P. Chauhan *et al.*, on 111 individuals done to assess the correlation between serum magnesium concentration and diabetic retinopathy in rural populations concluded that low serum magnesium levels are present in type II diabetes mellitus in general and more significant in patients with retinopathy, in comparison to normal healthy subjects [1].

Dipankar Kundu *et al.*, did a cross-sectional study on 90 individuals to study the correlation between serum magnesium levels, HbA1C and urinary protein levels in diabetic patients with and without retinopathy and concluded that hypomagnesemia and albuminuria individually or in conjunction serve as indicators for dysglycemia and could be used as a marker for the risk of development of diabetic retinopathy [2].

A cross-sectional study by Nazar S. Haddad *et al.* on 136 patients with diabetes mellitus to assess magnesium level in relation to the stages of diabetic retinopathy came to a conclusion that serum magnesium level decreased in patients with diabetic retinopathy, with the lowest level being observed in patients with advanced retinopathy and maculopathy [4].

Mirza Sharif Ahmed Baig *et al.*, in their cross-sectional study on 60 patients with type II diabetes mellitus, studied the correlation between levels of serum magnesium and severity of retinopathy and stated an inverse relationship between serum magnesium and severity of diabetic retinopathy [5].

Hamid Nasri *et al.*, did a cross-sectional study among 122 patients to investigate if and how, in diabetes mellitus patients, serum magnesium concentration influences serum lipids. The study also determined kidney function tests on diabetic patients with altered kidney function and not yet on dialysis. The study inferred that in diabetic patients, kidney functional status plays a key role in the regulation of serum lipoprotein levels rather than other factors like serum magnesium levels [6].

Alice Penrose Miller *et al.*, did a study on 86 individuals with and without diabetes to study the serum magnesium concentration in patients with HbA1C levels below or above 7% and concluded that there was no relationship between HbA1C values and serum magnesium concentrations [10].

The above-quoted studies rightly mention the significance of magnesium levels among the diabetic population.

A regular screening for fundus changes in individuals with diabetic retinopathy and good glycaemic control are the important checks to prevent the advancement of Diabetic Retinopathy and to improve the quality of vision in diabetics [11, 12]. Diagnosis and earlier commencement of treatment and improving insulin regimes may decrease the incidence of long-term complications and significantly increase the life span of the diabetic population, and lessen load on healthcare systems [13].

Hypomagnesaemia is considered to be one of the novel indicators of end-stage renal disease, thereby could be a potent indicator influencing long-term macro and micro complications of the disease [14]. In spite of various studies conducted in the same discipline and moderate knowledge on the effect of magnesium on metabolism in diabetic individuals, there is not enough emphasis on magnesium supplementation in the same group of individuals.

Limitations of the study include small sample size, unequal distribution among cases and controls and non-correlation of magnesium level with other renal parameters suggestive of diabetic nephropathy.

CONCLUSION

The study helped to determine the association between serum magnesium levels in patients with and without diabetic retinopathy. Hypomagnesaemia is commonly associated with both diabetic retinopathy and nephropathy and is observed even in the early stages of diabetic retinopathy. The strong association between serum magnesium levels and severity of type II DM indicates a role for early prediction and appropriate therapeutic modifications to avoid end-stage disease complications.

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AUTHORS CONTRIBUTIONS

All the authors shared equal contributions.

CONFLICT OF INTERESTS

Declared none

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