World Journal of Pharmaceutical Sciences
ISSN (Print): 2321-3310; ISSN (Online): 2321-3086
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Available online at: http://www.wjpsonline.org/
Original Article

A Study of serum magnesium levels in patients suffering from diabetic retinopathy

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Received: 12-09-2015 / Revised: 28-10-2015 / Accepted: 27-11-2015

ABSTRACT

Magnesium homeostasis has been hypothesized to be a link between insulin resistance type 2 diabetes mellitus, hypertension and CAD. Type 2 diabetes has become a leading cause of morbidity and mortality world over. This study was under taken to evaluate the relationship between serum magnesium and diabetic patients without and with diabetic retinopathy. We found significantly low levels of serum magnesium in diabetic patients without retinopathy when compared to controls. Further significantly low levels of serum magnesium were found in patients with diabetic retinopathy when compared with diabetic patients without retinopathy. Hence it is concluded that the lower levels of serum magnesium may have a bearing on the complication and morbidity in patients of DM, and estimation of serum levels of Sr.magnesium may be helpful to monitor the severity of diabetic retinopathy in diabetic patients.

Keywords: Diabetes Mellitus, Diabetic Retinopathy, Hypomagnesemia

INTRODUCTION

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 [1]. Magnesium is an important intracellular cation that is distributed into three major compartments: mineral phase of bones (65%), intracellular space (34%) and extracellular fluid (1%) [2]. About one third of the circulating magnesium is bound to plasma proteins, with the remaining two third free and presumably biologically available. In several studies reduced magnesium concentrations have been observed in diabetic adults [3-7].

Magnesium, the fourth most common cation in the body, has been the recent focus of much clinical and scholarly interest. Previously underappreciated, this ion is now established as a central electrolyte in a large number of cellular metabolic reactions, including DNA and protein synthesis, neurotransmission, and hormone receptor binding. It is a component of GTPase and a cofactor for Na+/ K +-ATPase, adenylate cyclase, and phosphofructokinase. Magnesium also is necessary for the production of parathyroid hormone. Accordingly, magnesium deficiency has an effect on multiple body functions.

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 [8]. Although it is generally believed that strict metabolic control delays the development of late complications in diabetes mellitus [9], it has not been demonstrated conclusively that such controls holds back the development of diabetic retinopathy [10].

Hence this work was undertaken to evaluate the relationship between serum magnesium and diabetic patients without and with diabetic retinopathy.

MATERIAL AND METHODS

The study included total 60 patients of type 2 diabetes mellitus between 40 – 70 years, which were divided into following groups:
Control group: Included 30 healthy, age and sex matched individuals.

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Group I: Included 30 patients of type 2 diabetes without Retinopathy. Group II: Included 30 patients of type 2 diabetes with Retinopathy.

The diagnosis of type 2 diabetes mellitus was established with the recommended criteria's of American diabetes Association.

Inclusion Criteria: Patients in the age group of 40 – 70 years with type 2 diabetes without and with diabetic retinopathy were selected.

Exclusion Criteria: Patients taking diuretics, magnesium supplementation, and magnesium containing antacids, malabsorption syndrome, chronic diarrhea, renal failure, liver diseases, tuberculosis and thyrotoxicosis were excluded from the study. Informed consent was taken from patient and control subjects. A prestructured and pretested proforma was used to collect the data. Baseline data including age and sex, detailed medical history including conventional risk factors, clinical examinations and relevant investigations including fundoscopy, ECG, echocardiogram, nerve conduction test, etc were included as part of the methodology.

Fasting venous blood samples were collected from cases and controls and the samples were centrifuged, serum was separated and stored at 4 C. Serum magnesium was estimated by Calmagite dye method [11] by using auto-analyzer. Magnesium reacts with the blue dye, calmagite, in alkaline medium to form red colored complex which is measured at 530-550nm. The intensity of the color formed is directly proportional to the amount of magnesium in the sample. Protein interference and dye precipitation are avoided including the 9-ethylene oxide adduct of p-nonylphenol (Bion NE9) and Polyvinyl pyrrolidone (Bion pup). Calcium interference is avoided by preferential combination with EDTA and heavy metal interference is prevented by Potassium cyanide. The reference range for serum magnesium concentration does not vary significantly for age or sex and is closely maintained within a range of 1.7-2.4mg/dl. PPBS were estimated 2 hours after breakfast. Urine sample was analyzed for protein and sugar.

Statistical Methods: Student `t' test /Chi-square test has been used to find the significance of homogeneity of study characteristics between three groups of patients. Analysis of variance has been used to find the significance of study parameters between three groups. Results were expressed as mean + SD. Probability values of P< 0.05 were considered to indicate statistical significance.

Statistical software: MedCalc 9.0.1and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS AND DISCUSSION

Table 1: serum magnesium in the three study groups

Studyparameters	Controls	DMwithout Retinopathy	DMwith Retinopathy
Sr.Mgmg/dl	2.16±0.34	1.60±0.40**	1.28±0.30**

Results are presented in mean□sd P<0.001 Highly Significant

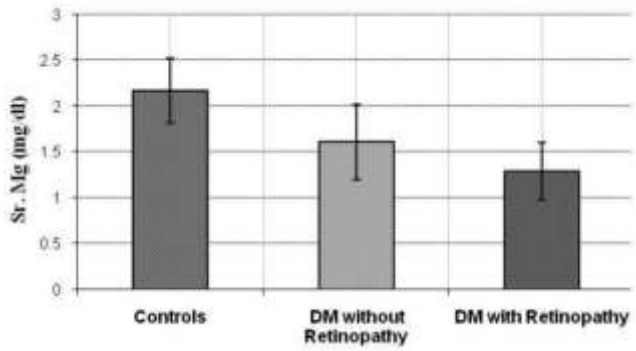

Fig: Sr. Magnesium in three study groups

The magnesium ion has been shown to play an important role in the metabolism of carbohydrates by activating various enzyme systems and helping insulin for its action. In this study it was observed that the mean serum magnesium level was statistically significantly low (P<0.001) in Diabetic patients without retinopathy when compared with controls. This indicates the association of hypomagnesaemia with diabetes mellitus. These results are in accordance with the observation of Tosiello L [12], Kao WH [13], and Chamber E C [14].

In our study, serum magnesium level in cases with diabetic retinopathy (1.28 + 0.30) was much lower when compared with diabetic patients without retinopathy (1.60 + 0.40). Hatwal A et al studied the association of hypomagnesaemia with diabetic retinopathy and found that serum magnesium levels were significantly lower in diabetic retinopathy than in those without diabetic retinopathy. Ishrath Kareem et al found that serum magnesium levels in patients with diabetic retinopathy were significantly lowered compared to patients without retinopathy [15]. 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

[16]. In our opinion 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 [17]. 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 [18]. As a result reduced peripheral glucose uptake and oxidation are often noted in subjects with hypomagnesaemia. Decrements in the enzymatic activities of several metabalic pathways are seen in DM patients as a result of the relative magnesium deficiency [19]. consequently we suggest hypomagnesaemia as a possible risk factor in the development and progress of deabetic retinopathy. The exact cause of diabetic hypomagnesaemia is still unknown but an increased urinary loss of magnesium may contribute to it. Hypomagnessmia has been repated to occur at an increased frequency among patients with type of diabetes compared with their counter parts without diabetes [20]. Despite numerous reports linking hypomagresaemia a chroric diabetic complications, attention to this issue is poor among qinicians. The precise mechanism for development of microvascular changes is not fully uderstood, it is possible that hypomagnesaemia inhibits prostacyclin receptor function producing an imbalance between prostacyclin and thromboxare effect which has marked atherogenic poterial which is responsible for microvasular complainants. Thus we conclude that the estimation of serum magnesium level are helpful to monitor the severity of retiropathy in type of diabetic patients and also useful for hope medical intervision. Here further studies on serum magnisium levles and on oral supplementation will be interesting and helpful to prevent late complications of diabetic patients.

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