

Low Serum Magnesium Level is one of the Predisposing Factor for Development of Diabetic Retinopathy

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Abstract

Background & Objectives: Hypomagnesaemia can be both a consequence and a cause of diabetic retinopathy.

The aim of our study was to know the relationship between serum magnesium with diabetic retinopathy

Methods: A total of 200 cases from which 40 cases of each type-I, II diabetes mellitus with and without retinopathy were taken for the study after satisfying the inclusion and exclusion criteria. 40 non diabetic patients were taken as controls. All the patients were evaluated in detail and serum magnesium levels were estimated using spectrophotometer

Results: The mean Serum magnesium levels of the control group, type I, II diabetes with out retinopathy, type I, II diabetes with retinopathy were 2.11 ± 0.13 mg/dl, 1.99 ± 0.10 mg/dl, 1.83 ± 0.16 mg/dl, 1.6183 ± 0.09 mg/dl, 1.4965 ± 0.13 mg/dl respectively.

Conclusion: There was significant reduction in serum magnesium levels in diabetics with retinopathy compared to the controls. So hypomagnesaemia is one of the risk factor for development of retinopathy.

KEYWORDS: Diabetes Mellitus; Magnesium, Retinopathy.

Introduction:

Diabetic retinopathy is the result of microvascular retinal changes. Hyperglycemia-induced intramural pericyte death and thickening of the basement membrane lead to incompetence of the vascular walls. These damages change the formation of the blood-retinal barrier and also make the retinal blood vessels become more permeable. (1). The pericyte death is caused when "hyperglycemia persistently activates protein kinase C- δ (PKC- δ , encoded by Prkcd) and p38 mitogen-activated protein kinase (MAPK) to increase the expression of a previously unknown target of PKC- δ signaling, Src homology-2 domain-containing phosphatase-1 (SHP-1), a protein tyrosine phosphatase. This signaling cascade leads to PDGF receptor- dephosphorylation and a reduction in downstream signaling from this receptor, resulting in pericyte apoptosis. (2). Small blood

vessels – such as those in the eye – are especially vulnerable to poor blood sugar (blood glucose) control. An over accumulation of glucose and/or fructose damages the tiny blood vessels in the retina. During the initial stage, called non proliferative diabetic retinopathy (NPDR), most people do not notice any change in their vision. Early changes that are reversible and do not threaten central vision are sometimes termed simplex retinopathy or background retinopathy (3). Some people develop a condition called macular edema. It occurs when the damaged blood vessels leak fluid and lipids onto the macula, this fluid makes the macula swell, which blurs vision. (4). Currently 4 major biochemical pathways have been hypothesized to explain the mechanism of diabetic eye diseases, all starting initially from hyperglycemia induced vascular injury.(5)

Magnesium is the eight common element in the crust of earth (6), fourth most abundant cation in human body and second abundant intracellular cation. It may exist as protein bound, complexed or in free form. It is primarily found within the cell, where it acts as a counter ion for the energy-rich ATP and nuclear acids. It is a cofactor in more than 300 enzymatic reactions. Magnesium critically stabilizes enzymes, including many ATP generating reactions. (6), it is also key component in various reactions that require kinases and important factor in both cellular and humoral immune reactions. (7).

In diabetics there is a direct relationship between serum magnesium level and cellular glucose disposal that is independent of insulin secretion. This change in glucose disposal has been shown to be related to increased sensitivity of the tissues to insulin in the presence of adequate magnesium levels. (8).

Magnesium deficiency has been found to be associated with diabetic micro vascular disease. Low serum magnesium level correlated positively with the velocity of regaining basal vascular tone after hyperemia. Hypomagnesemia has been demonstrated in patients with diabetic retinopathy, with lower magnesium levels predicting a greater risk of severe diabetic retinopathy. (9) Magnesium depletion has been associated with multiple cardiovascular implications: arrhythmogenesis, vasospasm, and hypertension and platelet activity. (10)

Materials and Methods

Sample collection

Forty patients of type-I & type II Diabetes Mellitus without retinopathy which were visited at medical OPDs at Liaquat University Medical Hospital Jamshoro/ Hyderabad sindh and forty patients of type- I & type II Diabetes Mellitus with retinopathy admitted or visited to Eye hospital Liaquat University Hyderabad were included in the study. Also forty control subjects' means having no diabetes and retinopathy admitted during the same period were included under the control group. Five (5) ml of blood collected from each patient included in study by venipuncture using plastic disposable syringes under aseptic measures.

Analytic method

Serum magnesium level was analyzed by polarized Zeeman atomic absorption spectrophotometer HLA-4S hollow cathode lamp Hitachi series no.2000 magnesium kit by Hitachi at 285.2nm wavelength.

Principle: Magnesium is determined by AAS after diluting the specimen 1:50 with a standard solution of lanthanum hydrochloride to eliminate interference from anions including phosphate and protein and metal oxides. The dilution also reduces viscosity

ensuring that absorption rate for aqueous calibrators and specimens are comparable. The specimen is aspirated into an air acetylene flame in which the ground state magnesium ions absorb light from a magnesium hollow lamp (285.2nm). Absorption at 285.2 nm is directly proportional to the ground state magnesium atoms in the flame (11). The statistical software SPSS version 16 were used for data analysis, Chi-square test and ANOVA one way test were used to find out the significant proportions of serum magnesium and levels between patients and controls. Microsoft word and excel have been used to generate the graphs and tables.

Results:

The present study was carried out on 200 subjects. These subjects were divided into five groups, 40 persons without diabetes and retinopathy which were control group, 40 cases of Insulin Dependent Diabetes Mellitus (IDDM) without retinopathy type-I, 40 cases of Non-Insulin Dependent Diabetes Mellitus (NIDDM) without retinopathy type -II, 40 cases of Insulin Dependent Diabetes Mellitus with retinopathy and 40 cases of Non-Insulin Dependent Diabetes Mellitus with retinopathy.

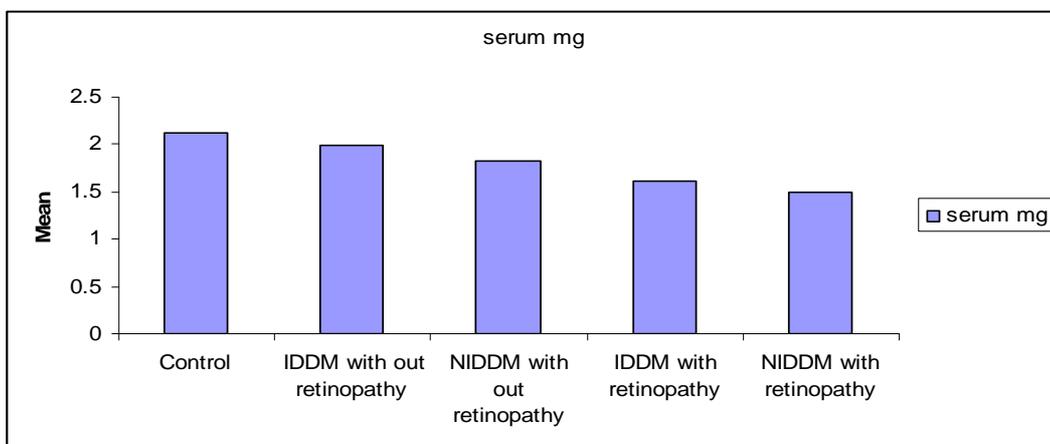
The present study analyses the correlation between serum magnesium, in both types of diabetes mellitus with and without retinopathy. These results were compared with the controls.

Table 1: 01 and graph no: 01 show the levels of serum magnesium (mg/dl) in each group under study. The mean Serum magnesium level of the control group was 2.115 ± 0.13 mg/dl, IDDM without retinopathy cases were 1.991 ± 0.10 mg/dl, NIDDM without retinopathy cases were 1.83 ± 0.16 mg/dl, IDDM with retinopathy cases were 1.61 ± 0.09 mg/dl, NIDDM with retinopathy cases were 1.49 ± 0.135 mg/dl ($p=0.0001$).

Table 1: 1distribution of all parameters in each group under study

	Control group (n = 40)	IDDM without Retinopathy (n = 40)	NIDDM without Retinopathy (n = 40)	IDDM with Retinopathy (n = 40)	NIDDM with Retinopathy (n = 40)	Total	P value
Mg	2.11 +0.13	1.99 ±0.10	1.83 ±0.16	1.61 ±0.09	1.49 ±0.13	1.80 ±0.122	0.01

Figure (1): Shows serum Magnesium levels



The present study shows that there is positive correlation between serum magnesium in diabetic patients and diabetics with retinopathy. The results show that there is significant decline in serum magnesium in diabetic patients but more declines in diabetic with retinopathy that indicate hypomagnesaemia is one of predisposing risk factor for development of retinopathy.

DISCUSSION:

Diabetic Retinopathy is a sight threatening complication of diabetes mellitus and is one of the leading causes of acquired blindness (12) it is due to microangiopathy affecting the retinal arterioles, capillaries and venules. Damage is caused by both microvascular leakage and occlusion.(13) A series of risk factors have been related to the development and progression of retinopathy in diabetic patients like low magnesium level, uncontrolled glycemic index, duration of diabetes etc. (14).

This current study significantly shows that serum magnesium level decrease in diabetic and more decrease in diabetic retinopathy.

Our findings correlate with the study done by:

A) Ishrat kareem et.al. (2004) have shown the presence of hypomagnesaemia in diabetic retinopathy. (14)

B) Phoung- chi T et al (2007), have shown that hypomagnesaemia occur in diabetes especially type II. (15)

C) Zélia Maria da Silva Corrêa1 et al (2003), also have shown that low magnesium level is one of the risk factor of diabetic retinopathy. (8)

D) Criestiane Hermes Sales et al (2006) have shown that low magnesium level cause the macro vascular and micro vascular complication in diabetes. (7)

The exact cause of hypomagnesaemia in diabetes mellitus is not known. Poor dietary intake, impaired absorption of magnesium, increased urinary loss due to hyperglycemia and osmotic diuresis may be the contributory factors. Magnesium is necessary for several enzymes that play an important role in glucose metabolism. (15)

The current study shows that, the mean serum magnesium level of the control group was 2.115 ± 0.13 mg/dl, IDDM without retinopathy cases were 1.991 ± 0.10 mg/dl, NIDDM without retinopathy cases were 1.83 ± 0.16 mg/dl, IDDM with retinopathy cases were 1.61 ± 0.09 mg/dl, NIDDM with retinopathy cases were 1.49 ± 0.135 mg/dl ($p=0.0001$).

This current study significantly shows that serum magnesium level decrease in diabetic and more decrease in diabetic retinopathy as compared to control group but not below the normal level, because diet history of subjects present in this study contain good amount of magnesium.

Conclusion

It is concluded that serum magnesium levels were lower in diabetic retinopathy patients when compared with diabetic patients without retinopathy. The duration of diabetes have important role to development of ocular complains especially retinopathy.

The evaluation of the level of serum magnesium are useful for monitoring the severity of retinopathy in type I and type II diabetic patients.

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