Original Article

A comparative study of serum magnesium in type II diabetes mellitus patients and non diabetics and its correlation with HbA1c

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Abstract

Background: Magnesium (Mg) deficiency is a common problem in diabetic patients. Deficiency of Mg may increase the incidence of diabetes mellitus (DM). In this study, our aim was to evaluate level of serum magnesium in type 2 DM patients and non diabetic individuals and its correlation with HbA1C. **Material and Method:** 140 patients of type 2 diabetes mellitus in patients and out patients of tertiary care hospital between were included in the study. Also 140 non diabetic age and sex matched patients or relatives of patients attending opd during the same period were included in the study under the control group. **Results:** The mean age of cases was 57.06 ± 12.77 years while age of controls was 56.67 ± 12.7 years. This small difference was statistically not significant. There was no significant difference between mean serum Mg^{2+} values of male and female patients. ('p' = 0.18). The mean serum Mg^{2+} level in controls was 1.96 ± 0.18 mg/dl, which was significantly higher than the mean Mg^{2+} level of cases (1.69 ± 0.29 mg/dl). This difference was statistically significant. ('p'< 0.001).Patients with low serum Mg^{2+} levels had a poor glycemic control (Raised level of HbA1C), while patients with normal serum Mg^{2+} levels had a good glycemic control (Normal HbA1C). This was statistically significant. ('p'< 0.05). **Conclusion:** There is negative correlation between serum magnesium level and HbA1C of diabetes mellitus type 2. Serum magnesium levels are significantly low in patients with type 2 DM compare to non diabetic individuals

Key Words: Diabetes mellitus type2, serum magnesium, HbA1c.

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INTRODUCTION

Diabetes mellitus is the most common endocrine disorder, encountered in practice. The incidence of diabetes is increasing at a rapid pace and is evolving into an epidemic. The worldwide prevalence of diabetes mellitus has risen dramatically over the past two decades, from an estimated 30 million cases in 1985 to 177 million cases in 2000. Based on current trends more than 360 million individuals will have diabetes by year 2030. Mg2+ is an essential ion for human health, as it is involved in virtually every mechanism in the cell, including energy homeostasis, protein synthesis, and DNA stability.[1] Considering these divergent functions, it can be appreciated that serum Mg2+ levels are tightly regulated between 0.7 and 1.05 mmol/L in healthy individuals. However, impaired intestinal Mg2+ absorption or renal Mg2+ wasting can lead to hypomagnesemia. A wide range of genetic and environmental factors can affect the Mg2+-deficient state, which have previously been extensively reviewed.[1] Hypomagnesemia has long been known to be associated with diabetes mellitus. Magnesium is an essential cofactor in both glucose transporting mechanisms of cell membranes and more than 300 enzymes in carbohydrate metabolism. Thus the association of diabetes and hypomagnesaemia is significant for its wide ranging impact on diabetic control,

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glycosuria, atherosclerosis, dyslipidemia, metabolic, microvascular and macrovascular complications. Magnesium supplementation has been found to be safe and effective for improvement of diabetic complications. Studies have shown that magnesium levels are lower in patients with diabetes compared with non diabetic controls[2].

MATERIALS AND METHODS

It is a case control study. 140 clinically diagnosed and confirmed cases of Type 2 DM without any complications attending the medicine outpatient department of tertiary care center were taken as cases. 140 age and sex matched healthy subjects as controls. Study duration was one year. Informed consent was taken from the subjects. Patients were diagnosed as Type 2 DM on the basis of Clinical history and WHO criteria. Age group between 30 years to 70 years was included in the study. Patients of diabetes having complications, Pregnant and lactating women, subjects currently taking nutritional supplements, magnesium containing laxatives, diuretics/alcohol were excluded in both groups. A sample of 3 ml venous blood was collected in both fasting and post prandial state. FBS and PPBS were estimated by using Glucose oxidase peroxidase method. Serum magnesium was estimated by Xylidyl Blue method. Estimations were done using semi auto analyser Stat Fax 3300. Glycated hemoglobin was estimated using Nycocard Reader II. Data was expressed in terms of mean ± SD. Chi- square test was applied to estimate the difference between the two groups of population. Unpaired 't'-test was used to study the changes in serum magnesium levels. Pearson correlation between the study variables is performed to establish the relationship. P value <0.05 was considered significant.

RESULTS

This was a comparative case control study conducted on 140 patients with clinically diagnosed type 2 diabetes mellitus and 140 healthy controls. Serum magnesium was estimated, analyzed and correlated with HbA1c. The results are expressed as mean ± standard deviation.

Table 1: Age distribution of cases and controls

Age in years	Cases		Controls	
	No	%	No	%
<30	1	0.7	1	0.7
30-40	19	13.6	20	14.3
41-50	25	17.9	25	17.9
51-60	37	26.4	38	27.1
61-70	39	27.9	39	27.9
71-80	18	12.9	16	11.4
>80	1	0.7	1	0.7
Total	**140**	**100.0**	**140**	**100.0**
Mean ± SD	**57.06±12.77**		**56.67±12.70**	

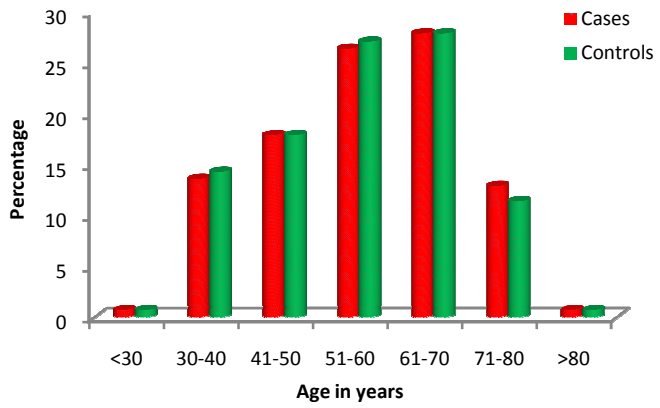

Figure 1:

The age distribution of cases and controls is depicted in Table 1. The mean age (in years) of 140 cases was 57.06±12.77and that of 140 controls was 56.67±12.70Samples are age matched with P=0.800, Student t test.

Table 2: Gender distribution of cases and controls

Gender	Cases (n=140)	Percent	Controls (n=140)	Percent
Male	96	68.57%	97	69.28%
Female	44	31.42%	43	30.71%
Total	**140**	**100%**	**140**	**100%**

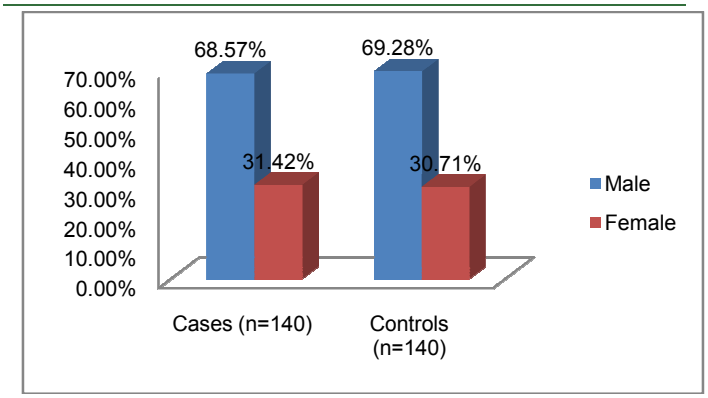

Figure 2: Gender distribution among the study population

Out of 140 cases, 96 (68.57%) were males and 44 (31.42%) were females. Out of 140 controls 97 (69.28%) were males and 43 (30.71%) were females and it was not significant. ('p' = 0.4) (Table 2)

Table 3: Comparison of serum magnesium levels between controls and cases

Serum Magnesium	Controls mg/dL	Cases mg/dL
OBS. VALUES (MIN. - MAX.)	1.5 to 2.4	1.2 to 2.6
Mean	1.96	1.69
SD	0.17	0.28
SE	0.01	0.02

Test: Unpaired ' t' test, **Result:** p<0.0001

Comment: There is highly significant difference in mean values of serum magnesium levels as observed in diabetic and nondiabetic individuals. In the present study the values below 1.6 mg/dl are considered as low.

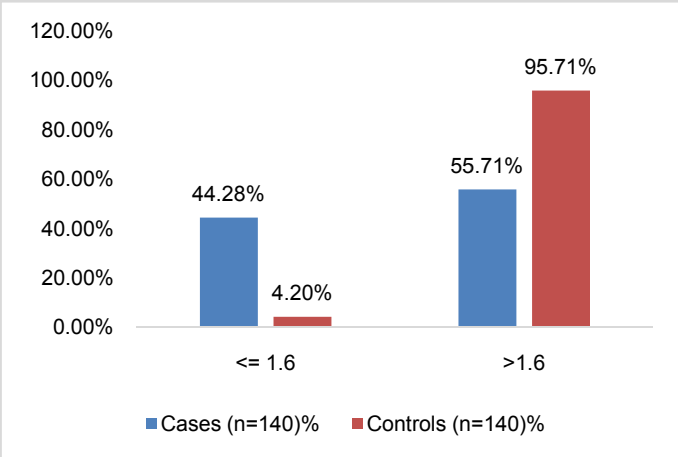

Figure 3: Comparison of serum Mg++ level in case and control population

Table 4: Correlation of serum magnesium with HbA1c in diabetes mellitus type 2

HbA1c	Low Sr. Mg^{2+} (≤1.6 mg/dl)	Normal Sr. Mg^{2+} (>1.6 mg/dl)	Total
≤7	6	25	31
>7	56	53	109
Total	**62**	**78**	**140**

Association of poor glycemic control with low serum magnesium level was found to be statistically significant. It shows negative correlation between glycosylated Hb and serum magnesium levels as r= -0.32 (X^2=8.774, R.R.= 0.3767 ; 'p'=0.0031)

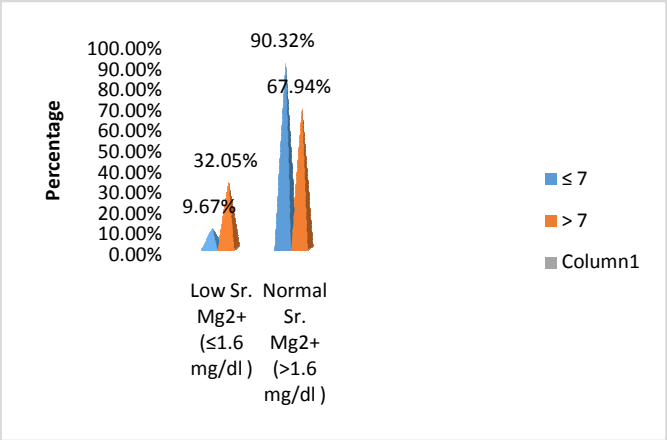

Figure 4

DISCUSSION

Diabetes mellitus is a complex and multifactorial disease indulging severe insulin dysfunction in conjunction with gross abnormalitiesin glucose homeostasis, lipid and protein metabolism. Many trace elements are important for human metabolic function. Numerous studies have demonstrated the essential roles of elements such as magnesium carbohydrate metabolism10. In view of this, the present study had been taken up to assess clinical utility of promising biochemical marker like serum magnesium which is inexpensive and can be of some diagnostic and prognostic significance. In this case control study, we have compared the above biochemical parameter in 140 cases with type 2 diabetes mellitus and 140 apparently healthy age and sex matched normal controls. The significance of the parameter between the two groups and its correlation with HbA1c is analyzed and discussed. In our study the mean HbA1c values were 9.26±2.19in cases and 5.2±0.52 in controls which is statistically highly significant (p <0.0001). In cases HbA1c values were higher which correlated well with the clinical diagnosis. The almost universal involvement of magnesium in a wide variety of cellular processes critical to glucose metabolism, insulin action and cardiovascular functions has been well appreciated[3]. The incidence of subclinical magnesium deficiency is common in diabetes and cardiovascular disorders[3]. Lima *et al*[4] studied 128 subjects with type 2 diabetes after oral magnesium supplementation for metabolic control where magnesium tended to increase plasma, cellular and urine magnesium and caused a significant fall in serum fructosamine level and concluded that magnesium depletion is common in poorly controlled patients of type 2 diabetes mellitus. V.K. Srivastava *et al*[5] mentioned that the hyperglycemia in cases was inversely related to hypomagnesemia and its restoration towards normal by insulin therapy restored the normal serum magnesium concentration. Alzaida A *et al*[6] documented decreased cellular uptake of magnesium which isnormally stimulated by insulin. Paolisso *et al*[7] stated that there was a direct relationship between intracellular magnesium concentration and total body glucose metabolism thus implicating magnesium deficiency in the insulin resistance of aging. and glucose intolerance. The Health Professionals Follow-Up Study and the Nurse's Health Study showed that subjects in the highest quintile of magnesium intake had a 33% lower risk of developing type 2 diabetes mellitus (T2DM) than those in the lowest quintile of magnesium intake.[8] A recent meta-analysis found that of the 13 selected studies, 9 showed a statistically significant inverse association between magnesium intake and diabetes risk and concluded that decreased magnesium intake is significantly associated with risk of type 2 diabetes in a dose-response manner.[9] Some studies have shown that oral supplementation with MgCl2 solution restores serum magnesium levels improving insulin sensitivity and

metabolic control in type 2 diabetic patients with decreased serum magnesium levels[10].

CONCLUSIONS

Serum magnesium levels are significantly low in diabetes mellitus type 2 as against age and sex matched non-diabetic individuals. Age and sex has no significant influence on serum magnesium levels in diabetes. Poor glycemic control is significantly associated with low serum magnesium levels.

REFERENCES

1. De Baaij JHF, Hoenderop JGJ, Bindels RJM. Magnesium in man: implications for health and disease. Physiol Rev 2015;95:1–46
2. Dasgupta A, Sarma D, Saikia UK. Hypomagnesemia in type 2 diabetes mellitus. Indian J Endocr Metab 2012; 16:1000-3.
3. Asha S Khubchandani, Hiren Sanghani, Study of Serum Magnesium and HbA1C in Diabetic Patients along withChanges in their Lipid Profiles. Indian Journal of Clinical Practice, Vol. 23, No. 11, April 2013.717-19
4. Maria De Lourdes Lima, T. Cruz, Judith Pousada : The effect of Magnesium suppiementation in increasing doses on the control of type 2 diabetes.Diabetes care, 1998 Vol 21 (5) : 682 - 83.
5. V.K.Srivastava, A.K.Chauhan, V.LLahiri The significance of serum magnesium in diabetes mellitus. Indian Journal of Medical Sciences, May 1993 47(5): Page 119-122.
6. Alzaida A, Dinneen SF, Moyer TP, Rizza RA, Effects of insulin on plasma magnesium in non-insulin dependent diabetes mellitus: evidence for insulin resistance. J Clin Endocrinol Metab 1995: 80: 1376 - 1381.
7. Paolisso G. Sgambato S, Pizza G, Passariello N. Vaccicchio M, D' onofrio F. Improved insulin response and action by chronic magnesium administration in aged NIDDM subjects. Diabetes care 1989: 12: 265 – 269.
8. Lopez-Ridaura R, Willett WC, Rimm EB, Liu S, Stampfer MJ, Manson JE, *et al*. Magnesium intake and risk of type 2 diabetes in men and women. Diabetes Care. 2004; 27:134–40.
9. Dong JY, Xun P, He K, Qin LQ. Magnesium intake and risk of type 2 diabetes meta-analysis of prospective cohort studies. Diabetes Care. 2011; 34:2116–22.
10. Rodrı´guez-Mora´n M, Guerrero-Romero F. Oral magnesium supplementation improves insulin sensitivity and metabolic control in type 2 diabetic subjects. Diabetes Care 2003; 26(4):1147–52

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