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General Medicine

KEY WORDS: Serum Magnesium , Diabetic Neuropathy , Diabetic Retinopathy , Diabetic Nephropathy , Diabetic Cardiomyopathy

ASSOCIATION OF SERUM MAGNESIUM WITH COMPLICATIONS OF TYPE 2 DIABETES MELLITUS

Dr. Rawal Deep Hemanshu Binda Resident, Department of General Medicine and Therapeutics

ABSTRACT

AIM AND OBJECTIVE- To determine the serum magnesium levels in normotensive Type 2 diabetes mellitus patients with and without diabetic complications.

METHOD- The study was conducted on 75 normotensive type 2 Diabetic patients admitted whose relevant investigations were done according to the complication in General Ward of Medicine at GMCH, Udaipur, Rajasthan.

RESULT AND CONCLUSION-. Hypomagnesemia was seen in diabetic retinopathy as well as neuropathy.

INTRODUCTION :

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion and action, or both.

The chronic hyperglycemia, dyslipidemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels.1 The chronic vascular complications of diabetes are microvascular (retinopathy, neuropathy, nephropathy) and macrovascular complications (coronary artery disease (CAD), peripheral arterial disease (PAD), cerebrovascular disease) 2.

Type 2 diabetes mellitus (DMT2) is often accompanied by alteration of magnesium status. An increased prevalence of magnesium deficits have been identified in DM2 patients, especially in those with poorly controlled glycemic profiles, with longer duration of the disease and with the presence of micro- and macrovascular chronic complications3-5. Laboratory tests with a high sensitivity and specificity and easy to perform to allow an accurate clinical assessment of magnesium status are missing. Patients are considered frankly hypomagnesemic with serum magnesium concentrations ≤ 0.61 mmol/L or 1.5 mg/dL6. Magnesium concentrations ≤ 0.75 mmol/L or 1.8 mg/dL may be considered as preclinical hypomagnesemia7.

AIMS AND OBJECTIVES

1. To determine the serum magnesium levels in normotensive Type 2 DM patients with and without complications.
2. To find out significant serum magnesium level in different individual diabetic complications like retinopathy, cardiovascular complications, neuropathy and nephropathy.

MATERIAL AND METHODS

The study was conducted on 75 normotensive type 2 Diabetic patients admitted in General Ward of Medicine at GMCH, Udaipur,
Rajasthan.

Sample size :

75 cases who were known cases of Type 2 diabetes or newly diagnosed diabetics were taken for the study.

Type of study: Observational study.

INCLUSION CRITERIA

The total sample of 75 patients were taken and divided randomly as per the following.

Group 1- DM type 2 without complications.
Group 2- DM type 2 with Retinopathy.
Group 3- DM type 2 with Cardiac complications such as coronary artery disease , myocardial infarction and cardiomyopathy.
Group 4- DM type 2 with Neuropathy.
Group 5- DM type 2 with Nephropathy.

Exclusion criteria: Patients with:

a) Gestational diabetes mellitus.
b) Steroid induced Diabetes
c) Who are not willing to participate in the study
d) Who are under intensive care.
e) Patients with more than one complication of diabetes mellitus.
f) Patients whose age is less than 18 years.

Methodology

Method of data collection:

Consecutively 75 selected type 2 diabetes mellitus patients were subjected to detailed history, through clinical examination and informed consent was obtained from all subjects for participating in the study.

Diabetic profile: FBS, PPBS (2-hr),HbA1C

Renal function test:

S.creatinine, Blood urea, eGFR.

S.Magnesium .

Complete Urine Examination.

Other tests:

Electrocardiogram (ECG), 2D Echocardiogram (2D ECHO), Fundoscopic examination and nerve conduction velocity (NCV) studies.

OBSERVATION AND RESULTS

Table 1. Serum magnesium levels among male and female patients

Patient profile	Total patients (mean magnesium levels mg/dl)	Male (mean magnesium levels in mg/dl)	Female (mean magnesium level in mg/dl)	P value
Total patients	1.95 ±1.32	1.94 ±0.55	1.96 ±0.45	0.863
Diabetes without complications	2.16 ±0.42	2.16 ±0.41	2.16 ±0.44	1.000
Diabetic retinopathy	1.19 ±0.17	1.19 ±0.19	1.19 ±0.13	1.000
Diabetes with cardiac complications	2.16 ±0.37	2.16 ±0.38	2.11	0.436
Diabetic neuropathy	2.08 ±0.37	1.94 ±0.32	2.29 ±0.36	<0.001*
Diabetic nephropathy	2.00 ±0.43	2.01 ±0.49	1.96 ±0.25	0.578

Table 2 : Serum magnesium levels among study groups

Patient profile	Number of Patients	Mean serum magnesium levels (mg/dl)	Range (mg/dl)
Total patients	75	1.95± 0.50	1.03-2.88

Diabetes without complication	17	2.17 ±0.42	1.45-2.88
Diabetic Retinopathy	13	1.2 ± 0.16	1.01-1.63
Diabetes with Cardiac complications	15	2.16 ± 0.36	1.99-2.74
Diabetic Neuropathy	15	2.08± 0.36	1.38-2.67
Diabetic Nephropathy	15	2.01 ± 0.42	1.03-2.62

Table 3 : Analysis of diabetic patients with and without complications.

Patient profile	Total patients (75)	Mean values in diabetic patients without complications (17)	Mean values in patients of diabetic retinopathy (13)	Mean values in diabetic patients with cardiac complications (15)	Mean values in patients of diabetic neuropathy (15)	Mean values in patients of diabetic nephropathy (15)
Age (years)	57.34±11.55	50.82±7.15	61.71 ± 9.48	50.22±12.34	69.13 ± 7.87	56.13 ± 8.65
Duration of disease (years)	11.06±6.04	7.41±2.87	14 ± 4.22	6.31±3.06	18.6 ± 5.7	10.26 ± 3.89
FBS (mg/dl)	232.24±39.8	228±36.4	249 ± 37.80	242.8±37.45	209 ± 25.41	249 ± 37.80
PP2BS (mg/dl)	291.14±45.7	284.35±37.12	314 ± 51.40	301.8±44.88	270 ± 29	289 ± 55.02
HBA1C (%)	9.79 ±1.32	9.67±1.21	10.43 ± 1.09	10.02±1.35	9 ± 0.8	9.72 ± 1.64
Serum magnesium (mg/dl)	1.95 ±0.50	2.16±0.42	1.19 ± 0.17	2.16±0.37	2.08 ± 0.37	2.00 ± 0.43

DISCUSSION

The present study included 75 patients comprising of 37 (49.33%) male and 38 (50.66%) female with type 2 Diabetes mellitus, among these 17 (22.6%) were having diabetes without any complications, 13 (17.3%) had diabetic retinopathy, 15 (20%) had diabetes with cardiac complications such as coronary artery disease, myocardial infarction and cardiomyopathy, 15 (20%) had diabetic neuropathy and 15 (20%) had diabetic nephropathy.

In our study mean age of patients was 57.34± 11.55 years ranging from 38 to 85 years, mean age of all male patients was 58 ±11.64 years ranging from 38 to 83 years, mean age of all female patients was 56.71 ± 11.57 years ranging from 39 to 85 years, mean duration of disease was 11.06 ±6.04 years ranging from 3 to 30 years, mean FBS was 232±39.81 mg/dl ranging from 180 mg/dl to 323mg/dl, mean PP2BS was 291±45.77 mg/dl ranging from 221mg/dl to 410mg/dl, mean glycated heamoglobin was 9.79 ±1.32% ranging from 8 to12.5% and mean serum magnesium level was 1.95±0.50 mg /dl ranging from 1.01 to 2.88 mg/dl.

Diabetic patients without complications

17 Patients without diabetic complications included 12 female and 5 male, whose mean age was 50.82 ± 7.15 years ranging from 39 to 63 years, mean duration of disease was 7.4± 2.8 years ranging from 4 to13 years, mean FBS was 228±36.4 mg/dl ranging from 180 to 290mg/dl, mean PP2BS was 284±37.12 mg/dl ranging from 221 to 380mg/dl, mean HbA1C was 9.67±1.21% ranging from 8 to 12% and mean serum magnesium level was 2.16±0.42 mg/dl ranging from 1.45 to 2.88mg/dl.

Diabetic females patients of little younger age and lesser duration of disease with near normal serum magnesium level did not have any complications at the time of presentation. No such study is available where diabetic patients without complications were evaluated.

Diabetic patients with Retinopathy

13 patients with only diabetic retinopathy were selected which included 5 males and 8 females, mean age in this group was 61.71 ± 9.48 years ranging from 42 to 72 years, mean duration of disease was 14±4.2 years ranging from 8 to 19 years, mean FBS was 249±37.8mg/dl ranging from 203 to 320 mg/dl, mean PP2BS was 314±51.4mg/dl ranging from 250 to 410mg/dl, mean HbA1C was 10.4±1.09% ranging from 9 to 12.3% and mean serum magnesium was 1.19±0.17mg/dl ranging from 1.01 to 1.32mg/dl. Diabetic patients with older age, longer duration of disease, high HbA1c level and low serum magnesium level had retinopathy.

In a study by Kundu et al (82) in diabetic patients found mean FBS of 231±21.3mg/dl, mean PP2BS of 265±26.5 mg/dl, while HBA1c of 10.54±1.02%. and mean serum magnesium level of 1.38±0.30 mg/dl. Similar to our study Kundu et al(4)

found statistically significant hypomagnesemia in diabetic retinopathy patients (p<0.001), and N Saproo et al (83) also reported statistically significant association between hypomagnesemia and diabetic retinopathy (p=0.002).

Diabetes with Cardiac complications

Total patients in diabetes with cardiac complications group were 15 out of which 14 were males and 1 was female, mean age was 50.2± 12.34 years ranging from 38 to 85 years, mean duration of disease was 6.13±3.06 years ranging from 3 to16 years, mean FBS was 242.8±37.45mg/dl ranging from 195 to 291mg/dl, mean PP2BS was 301.8±44.88 mg/dl ranging from 230 to 390 mg/dl, mean HB1Ac was 10.0±1.35% ranging from 8.4 to 11.9% and mean serum magnesium level was 2.16±0.37 mg/dl ranging from 1.32 to 2.63 mg/dl. Male diabetic patients with younger age, shorter duration of disease, high HbA1c level and normal magnesium level had cardiac complications.

Mostly the male patients had cardiac complications in present study and no observation was found statistically significant with cardiac complications in diabetic patients. Sharma A et al (84) also found that age (mean 59.2±10.2 years), duration of disease (mean 8.6±4.6 years), FBS (mean 158.4±40.6 mg/dl), PP2BS (mean 260.4±80.8 mg/dl) and HbA1c (mean 8.2%) were not statistically significant (p=0.380) with cardiac complications in diabetic patients. Wahid et al (2) have also reported no statistically significant association between cardiac complications and hypomagnesemia (p=0.628).

Diabetes with neuropathy

Total patients in diabetes with neuropathy group was 15 out of which 9 were males and 6 were females, mean age was 69.13 ± 7.87 years ranging from 60 to 85 years, mean duration of disease was 18.6±5.7 years ranging from 8 to 30 years, mean FBS was 209±25.4 mg/dl ranging from 180 to 280mg/dl, mean PP2BS was 270±29mg/dl ranging from 208 to 320mg/dl, mean glycated Hb was 9±0.8% ranging from 8 to 11% and mean serum magnesium level was 2.08±0.37 mg/dl ranging from 1.38 to 2.67mg/dl. In present study older age and longer duration of disease had statistically significant association with neuropathy. Male patients with diabetic neuropathy had significantly low serum magnesium level as compared to female patients (P <0.001). In a recent study by Chen Chu et al(85) , mean age of patients was 60.18±11.65 years, mean duration of disease was 10 years, mean HbA1c was 8.75% and mean serum magnesium was 0.87mg/dl. Similar to our study they found older age and longer duration of disease statistically significantly (p<0.001) with neuropathy, but they also found statistically significant high HbA1c level (p<0.001) with neuropathy which was not observed in our study. Similar to our observations low serum magnesium levels was found insignificant by Chen Chu et al(85) in diabetic neuropathy patients.

Diabetes with nephropathy

Total patients in diabetes with nephropathy group was 15 out of which 4 were male and 11 were female, mean age of patients was 56.13± 8.65 years ranging from 40 to 65 years, mean duration of disease was 10.26± 3.89 years ranging from 5 to 16 years, mean

FBS was 234 ±49.75 mg/dl ranging from 180 to 323 mg/dl, mean PP2BS was 289 ±55.02mg/dl ranging from 217 to 380mg/dl, mean HbA1C was 9.72± 1.64 ranging from 8 to 12.8% and mean serum magnesium levels was 2.00±0.43 mg/dl ranging from 1.03 to 2.81mg/dl. Mostly the females had nephropathy. A similar study by Kumar C. et al (82), found mean age of patients was 62 years and mean serum magnesium was 1.52 mg/dl (P = 0.004) Hypomagnesemia was significantly associated with nephropathy. While in our study longer duration of disease was associated with nephropathy (p=0.02) and serum magnesium levels were statistically insignificant (P = 0.285). Similarly Arpaci et al(81), also found significant association of hypomagnesemia with diabetic nephropathy regardless of age and duration of disease.

SUMMARY AND CONCLUSION

This study was conducted on 75 normotensive known diabetic and newly diagnosed diabetes mellitus type 2 patients of which 37 were males and 38 were females above the age of 18 years, to know any co-relation of serum magnesium on development of diabetic complications, along with duration of diabetes, blood sugar and HbA1c level and following conclusions were drawn.

1. Type 2 diabetes mellitus is a disease of middle to elderly people affecting both sexes equally.
2. Diabetes without any complication at the time of study was about 23% (17 cases) whereas retinopathy, cardiac complications, neuropathy and nephropathy was approximately 20% (13, 15, 15 and 15 cases respectively).
3. Diabetic neuropathy was more in elderly (69.13 years) followed by retinopathy (61.71 years), nephropathy (56.13 years) and cardiac complications (50.27 years) while 50.82 years of age cases did not have any diabetic complications.
4. Female patients had less diabetic associated complications as compared to males at the time of presentation, while cardiac complications were more in males and nephropathy was more in females.
5. Serum magnesium level was lowest in diabetic retinopathy group.
6. Serum magnesium level in diabetic neuropathy was statistically significantly lower (P <0.001) in males as compared to females.
7. Serum magnesium level in diabetic retinopathy was significantly lower (p < 0.001) as compared to diabetes mellitus without complications, while no significant difference was observed when compared with other complications.
8. Diabetic neuropathy was detected in patients having longer duration of disease (18.67 ± 5.7 years) followed by retinopathy (14 ± 4.2 years), nephropathy (10.27 ±3.89 years), Cardiac complication (6.13 ± 3.06 years) while short duration of disease (7.41 ± 2.87 years) cases had no diabetic complications.
9. Older age and longer duration of disease was also significantly (P <0.001) associated with diabetic retinopathy as well as neuropathy.
10. FBS, PP2BS and HbA1c level were not significantly different in patients with or without diabetic complications.
11. No significant relation was found in diabetes mellitus with complication when compared with diabetes mellitus without complication for age, duration of disease, blood glucose levels, HbA1c and magnesium level.
12. Longer duration of disease was associated with nephropathy significantly as compared to diabetes without complications.
13. Elder age, longer duration of disease and low serum magnesium level was associated with more diabetic complications.

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