

Hypomagnesaemia in adult patients of newly detected type-2 diabetes mellitus

Tania Nasreen^{1*}, Farida Parvin², Fatima-Tuz-Zohra³, Gazi Sharmin Sultana⁴

1. Assistant Professor
Laboratory Medicine
BIRDEM General Hospital,
Dhaka, Bangladesh.
2. Associate Professor
Transfusion Medicine and
Clinical Hematology
BIRDEM General Hospital,
Dhaka, Bangladesh.
3. Specialist,
Laboratory Medicine,
Asgar Ali Hospital, Dhaka,
Bangladesh.
4. Professor,
Laboratory Medicine,
BIRDEM General Hospital,
Dhaka, Bangladesh.

Address for Correspondence :

Dr. Tania Nasreen
Assistant Professor,
Laboratory Medicine Department,
BIRDEM General Hospital,
Dhaka Bangladesh.
tnshimul3@gmail.com

Submitted: 27 – Nov - 2023

Accepted: 10 – Mar - 2024

INTRODUCTION

Magnesium (Mg⁺⁺) is the fourth most abundant cation found in the human body^{1,2}. One of the potential pathophysiological mechanisms which links serum magnesium to microvascular complications is an amplification of insulin resistance^{2,3}. Magnesium is a mild, natural calcium antagonist. So, the level of intracellular calcium is increased in magnesium deficiency patients. This increased intracellular calcium may compromise the insulin responsiveness of adipocytes and skeletal muscles which leads to the development of insulin resistance^{4,5}. Another study has also found that insulin deficiency or insulin resistance can hamper the tubular absorption of magnesium that leads to hypomagnesemia in diabetic patients⁶.

ABSTRACT

Background: Magnesium (Mg⁺⁺) deficiency is related with terrible glycemic control. Supplementation of Mg⁺⁺ lowers blood sugar, improves insulin sensitivity and as a end result, diabetic complications inclusive of diabetic nephropathy, diabetic neuropathy, diabetic retinopathy are delayed.

Objective: This study was designed to know the status of serum Mg⁺⁺ in newly detected type 2 diabetic subjects.

Methodology: The study was conducted at the Department of Laboratory Medicine (Clinical Pathology) in collaboration with BIRDEM General Hospital, Dhaka. In this study, serum magnesium level of one hundred twenty newly detected type 2 diabetic patients were measured. The test was achieved by biochemical auto analyzer (Siemens Dimension RL Max).

Result: The mean magnesium level was 1.9±3.1 mg/dl with range from 1.5-2.4 mg/dl. Hypomagnesemia (Serum magnesium < 1.8 mg/dl) was documented in 36 (30%) patients with a female: male ratio of 5:7. 32(89.7%) patients had raised HbA1c in low magnesium group. 60 (71.0%) patients had raised HbA1c in normal magnesium group. The difference was statistically significant (p<0.05) between two groups.

Conclusion: Measurement of serum concentration of magnesium is easy and not expensive. Therefore, treatment with these trace elements should be started in all newly detected type 2 diabetic patients.

Keywords: Hypomagnesaemia, Type-2 Diabetes mellites, Insulin.

Magnesium (Mg⁺⁺) plays a key role in many fundamental biological processes such as metabolism and DNA synthesis⁷. Mg⁺⁺ deficiency may cause endothelial cell dysfunction, inflammation and oxidative stress^{1,8-10}. Endothelial cells could be injured through inflammatory response. It causes an increase in capillary permeability particularly in glomerular vessels^{4,11,12}.

MATERIALS AND METHODS

This cross-sectional study was conducted at the Department of Laboratory Medicine (Clinical Pathology) in collaboration with Department of Biochemistry and Molecular Biology, BSMMU and BIRDEM General Hospital, Dhaka. The duration of

study period was from March 2016 to February 2017. Total 120 subjects of newly detected type 2 diabetes mellitus were included. Serum magnesium level in all newly detected type 2 diabetic patients were measured. Type-1 diabetes, gestational diabetes, patients with UTI/pyelonephritis, patients who were on magnesium based antacid medication, on long term diuretics, with malabsorption or chronic diarrhea, on dialysis were excluded.

Measurement of Serum Magnesium

Serum magnesium (MG) was measured in biochemical auto analyzer (Siemens Dimension RL Max). Methylthymol blue (MTB) forms a blue complex with magnesium. Calcium interference is minimized by forming a complex between calcium and Ba-EGTA (chelating agent). The amount of MG-MTB complex formed is proportional to the magnesium concentration and is measured using a bichromatic (600 and 510 nm) endpoint technique.

STATISTICAL ANALYSIS

Data was analyzed using IBM SPSS 20. The independent samples t-test was applied for normally distributed variable. Results were given as mean ± standard deviation. The comparison between groups was made by unpaired t-test and P values < 0.05 were considered significant. Ethical clearance was taken prior to collection of data.

RESULT AND OBSERVATIONS

Total 120 subjects of newly detected type 2 diabetes mellitus were included.

Table 1: Distribution of the patients by age (n=120)

Age (in years)	Frequency	Percent
≤35	22	18.3
35-45	22	18.3
45-55	46	38.3
>55	30	25.0
Total	120	100.0
Mean ± SD (Min-Max)	48.28 ± 10.85 (25-67)	

Table 1 shows age distribution of the study patients, it was observed that 46 (38.3%) patients were between 45-55 years age group. The mean age was found 48.28±10.85 years and ranged from 25 to 67 years.

Table 2: Distribution of the study patients by serum magnesium (n=120)

Serum magnesium (mg/dl)	Number of patients	Percentage
<1.8 (low)	36	30.0
1.8-2.4 (normal)	84	70.0

Table 2 shows serum magnesium level of the study patients, it was observed that 36(30.0%) had low level (<1.8 mg/dl) and 84(70%) had normal level (1.8-2.4). The mean serum magnesium level was found to be 1.9±0.3 mg/dl and ranged from 1.5 to 2.4 mg/dl.

Table 3: Comparison between serum magnesium level with sex (n=120)

Sex	Serum magnesium level (mg/dl)		P value
	Low magnesium (n=36)	Normal magnesium (n=84)	
Male	16	54	
Female	20	30	
Female: Male ratio	0.53:1		0.07 ^{ns}
	1.25:1		

ns= not significant

Table 3 shows comparison between sex with serum magnesium level. It was observed that Female: Male in low magnesium was 1.25:1 and Female: Male in normal magnesium was 0.53:1 The difference was statistically not significant (p=0.07) between two group.

Table 4: Distribution of the patients HbA1c by serum magnesium level (n=120)

HbA1c (%)	Serum magnesium level (mg/dl)		p value*
	Normal magnesium 1.8-2.4 mg/dl	Low magnesium <1.8 mg/dl	
Normal (<6.5)	24 (29.0)	4 (10.3)	
Raised (>6.5)	60 (71.0)	32 (89.7)	
Total	84 (100.0)	36 (100.0)	
Mean ± SD	7.53 ± 1.72	7.90 ± 1.69	0.04 ^s

*t test was done to measure the s= significant

Table 4 shows distribution of the patients HbA1c by serum magnesium level. 32(89.7%) had raised HbA1c in low magnesium group. 60 (71.0%) had raised HbA1c in normal magnesium group. The difference was statistically significant (p<0.05) between two groups.

DISCUSSION

The cross-sectional study was aimed at determining the serum magnesium concentration in newly detected diabetic population. The findings of this study are compared with the results of some other published articles. In this study, 120 patients of newly detected type 2 diabetes mellitus were included. It was observed that 36(30.0%) had <1.8 mg/dl and 84(70%) had normal serum magnesium level (1.8-2.4 mg/dl) and the mean \pm SD for serum magnesium in study population was 1.92 ± 0.3 mg/dl. Shaikh M k et al., 2011 in their study found that the mean \pm SD for serum magnesium in overall subjects was 1.34 ± 0.53 . The hypomagnesemia was identified in 08 (14.5%) patients of type 1 diabetes and 47 (85.5%) of type 2 diabetes ($P = 0.02$). The hypomagnesemia was identified in patients with diabetes mellitus (type 1 and type 2) with statistical significant values¹³. In another study done by Ferdousi S et al.,2010 found that serum magnesium concentration in the type 2 diabetic patients was found significantly ($p < 0.001$) lower than that of control group¹⁴. The reasons of decreased magnesium in type 2 diabetes mellitus might be due to higher urinary losses or impaired absorption of magnesium as compared to healthy persons.

We found statistically poorer glycemic control in the hypomagnesemia patients as compared with the normomagnesemia patients. A recent meta-analysis found from 13 selected studies, 9 showed a statistically significant inverse relation between magnesium intake and development of diabetes¹⁵.

CONCLUSION

These results suggest that hypomagnesemia is not caused by diabetes, but insulin resistance is the main determinant in the association of Mg²⁺ and glycaemic control in individuals with type 2 diabetes. Serum Mg was found to be inversely associated with the prevalence of diabetes. Large-scale clinical trials are needed in order to determine whether the correction of Mg deficiency could be effective to reduce the incidence of diabetes.

REFERENCES

1. Sakaguchi, Y., Shoji, T., Hayashi, T., Suzuki, A., Kawabata, H., Niihata, k., Okada, N., Isaka, Y., Rakugi, H., Tsubakihara, Y., 2012. 'Hypomagnesemia in type 2 diabetic nephropathy: a novel predictor of endstagerenal disease'. *Diabetes Care*, vol. 35;pp. 1591-1597.
2. Hans,C. P., Sialy, R., Bansal, D. D. , 2002. Magnesium deficiency and diabetes mellitus *Current Science*, vol. 83(12);pp.1456-1462
3. Rao, P. P., Shariff, M. G.,2015. Serum magnesium levels in type 2 diabetic patients with microalbuminuria and normoalbuminuria. *International Journal of Scientific Study*,vol.3(4);pp.11-15.
4. Gosling, P., Czyz, J., Nightingale, P., Manji, M., s2006. Microalbuminuria in the intensive care unit: Clinical correlates and association with outcomes in 431 patients. *Crit Care Med* ,vol. 34; pp.2158–2166
5. Barbagallo, M., Dominguez, L. J., 2015. Magnesium and Type 2 Diabetes: An Update. *Int J Diabetes Clin Res*, vol 2(19); pp. 2377-3634
6. Aneesh, T., Rao, M. Y., 2016. Serum magnesium in type 2 diabetic patients with microalbuminuria and overt proteinuria *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*,vol.15(1);pp.30-35
7. Shao, N., Kuang, H.Y., Wang, N., Gao, X.Y., Hao, M., Zou, W., Yin, H. Q., 2013. Relationship between oxidant/antioxi *Diabetes Care* 35: dant markers and severity of microalbuminuria in the early stage of nephropathy in type 2 diabetic patients. *J Diabetes Res*, Article ID 232404.
8. Xu, B., Sun, J., Deng, X., Huang, X., Sun, W., Xu, Y., Xu, M., Lu, J., Bil, Y., 2013. Low Serum Magnesium Level Is Associated with Microalbuminuria in Chinese Diabetic Patients. *International Journal of Endocrinology*, Article ID 580685; pp. 1-6.
9. Kundu, D, Roy, A., Mandal, T., Bandyopadhyay, U., Ghosh, E.,2013. Relation of microalbuminuria to glycosylated hemoglobin and duration of type 2 diabetes *Nigerian Journal of Clinical Practice*, vol 16(2); pp. 216-220.
10. Gross, J. L., Deazevedo, M. J., Silveiro, S., Henriqucanani, L.,2005. Diabetic Nephropathy: Diagnosis, Prevention, and Treatment. *Diabetes Care*, vol.28; pp.178-188
11. Hamed, S. R., Pavkovic, P., Metelko, Z.,2002, Microalbuminuria and Diabetes Mellitus *Diabetologia Croatica*, vol. 31(4); pp. 209-221.

12. Rahman, M. M., Rahim, A., Nahar, Q.,2007. Prevalence and risk factors of Type 2 diabetes in an urbanizing rural community of Bangladesh Bangladesh Med Res Counc Bull , vol.33;pp. 48-54.
13. Shaikh, M. K., Devrajani ,B. .R, Soomro, A. A., 2011. Hypomagnesemia in Patients with Diabetes mellitus. World Appl. Sci. J., vol.12 (10);pp.1803-1806.
14. Ferdousi, S., Mollah, F.H., Mia, M.,2010. Serum Levels of Zinc and Magnesium in Newly Diagnosed Type-2 Diabetic Subjects Bangladesh J Med Biochem.,vol. 3(2);pp. 46-49
15. Dong JY, Xun P, He K, Qin LQ.2011, Magnesium intake and risk of type 2 diabetes meta-analysis of prospective cohort studies. Diabetes Care ; 34:2116-22.