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Original Research Article

Correlation of Serum Magnesium Level in Type 2 Diabetes Mellitus Patient with Microalbuminuria

Sheuly Ferdoushi[1], Amit Kumar Pramanik[2*], Sabrina Shafiq[3], Rubaiyat-E-Mortaz[4], Khan Md. Shahariar Zaman[3], Tania Nasreen[5], Mohammad Nuruzzaman Khan[6], Fatima Zohra[7], Rokshana Begum[8], Farhana Afroz[9], Chitra Das[10]

[1]Associate Professor, Department of Laboratory Medicine, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[2]Medical Officer, Department of Transfusion Medicine, Rajshahi Medical College Hospital, Rajshahi, Bangladesh
[3]Medical Officer, Department of Laboratory Medicine, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[4]Research Assistant, Department of Laboratory Medicine, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[5]Assistant Professor, Department of Laboratory Medicine, BIRDEM General Hospital, Dhaka, Bangladesh
[6]Associate Professor, Department of Neurosurgery, Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh
[7]Assistant Professor, Department of Psychiatry, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[8]Consultant, Department of Laboratory Medicine, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[9]Associate Professor, Department of Pathology, Green Life Medical College and Hospital, Dhaka, Bangladesh
[10]Medical Officer (OSD), Directorate General of Health Services, Dhaka, Bangladesh

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***Corresponding Author:** Amit Kumar Pramanik
Medical Officer, Department of Transfusion Medicine, Rajshahi Medical College Hospital, Rajshahi, Bangladesh

Abstract

Diabetic nephropathy is the leading cause of end stage renal disease world wide. Approximately one third of patients with type 2 diabetes have hypomagnesemia, mainly caused by enhanced renal excretion. Magnesium deficit in the diet would induce insulin resistance in humans. If it is chronic, this may lead to macro-vascular and micro-vascular complications of diabetes. This study was designed to know the relationship of serum magnesium level in type 2 diabetic patients with microalbuminuria. This study was conducted at the Department of Laboratory Medicine in Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. In this study, serum magnesium level and urine microalbumin level of 60 type 2 diabetic patients were measured. Both serum magnesium and urine microalbumin levels were measured by biochemical auto analyzer (Siemens Dimension RL Max). The mean serum magnesium level is lower in type 2 diabetes mellitus patient. There was a negative correlation between serum magnesium level and urinary microalbumin in hypomagnesemia diabetic patients. Identifying and treating hypomagnesemia can delay end stage renal disease in diabetic patient and reduce the clinical and economic burden of diabetic complications in future. The potential benefits of supplementing magnesium in type 2 diabetic patients with hypomagnesemia need to be evaluated further.

Keywords: Microalbuminuria, Type 2 Diabetes mellitus, Hypomagnesemia.

1. INTRODUCTION

Diabetes mellitus is a clinical condition characterized by increased blood glucose level (hyperglycemia) due to insufficient or inefficient (incompetent) insulin [1]. According to estimates of the World Health Organization, in 2011, there were 346 million people suffering from diabetes worldwide [2]. Magnesium (Mg), which is the fourth most abundant cation in the human. It plays a key role in many fundamental biological processes including metabolism and DNA synthesis. Mg deficiency may cause endothelial cell dysfunction, inflammation and oxidative stress [3]. Endothelial cells could be injured through inflammatory response and induces kidneys to undergo transient proteinuria. The changes can be measured by increased levels of microalbuminuria [4]. Insulin and glucose are important regulators of magnesium metabolism. Magnesium deficit in the diet would induce insulin resistance in humans and chronic dietary deficiency may lead to macrovascular and micro-vascular complications of diabetes. Hypomagnesemia

independently predicts the progression to end stage renal disease in patients with advanced type 2 diabetic nephropathy [5].

2. MATERIALS AND METHODS

This cross-sectional study was conducted at the Department of Laboratory Medicine in Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. Total 60 subjects of type 2 diabetes mellitus were included. Urinary microalbumin level and serum magnesium level were measured. Urinary microalbumin was measured by microalbumin (MALB) method which had been based on a particle-enhanced turbidimetric inhibition immunoassay (PETINIA) in biochemical auto analyzer (Siemens Dimension RL Max). Serum magnesium level was measured in biochemical auto analyzer (Siemens Dimension RL Max). Other types of diabetes, patients with UTI/ Pyelonephritis, patients who were on long term diuretics, with malabsorption or chronic diarrhea, on dialysis were excluded.

3. RESULTS

Table I: Distribution of Serum magnesium level

Serum magnesium level	Frequency	Percent
Low (<1.8)	13	21.7(%)
Normal (1.8-2.4)	47	78.3(%)
Total	**60**	**100.0**(%)
Mean ± SD (Min-Max)	2.04 ± 0.26 (1.50-2.4)	

Data were expressed as frequency and percentage and mean±SD

Table I shows serum magnesium level of the study patients. It was observed that 13(21.7%) had low level <1.8 mg/dl and 47(78.3%) had normal level (1.8-2.4) of magnesium. The mean serum magnesium was found 2.04 ± 0.26 mg/dl and ranged from 1.5 to 2.4 mg/dl.

Table II: Distribution of the patients by urine micro albumin

Urine microalbumin (mcg/min)	Frequency	Percent
Normoalbuminuria (<20)	31	51.7(%)
Microalbuminuria (≥20)	29	48.3(%)
Total	**60**	**100.0**(%)
Mean ± SD (Min-Max)	36.69 ± 44.21 (2-145)	

Data were expressed as frequency and percentage and mean±SD

Table II shows urine microalbumin of the study patients, it was observed that 29(48.3%) patients had microalbuminuria and 31(51.7%) normoalbuminuria. The mean fasting glucose profile was found 36.69 ± 44.21 mg/dl with range from 2-145 mg/dl.

Table III: Distribution of the patients serum magnesium level by urine microalbumin

Serum magnesium level (mg/dl)	Urine micro albumin (mcg/min)		p value*
	Normoalbuminuria (<20)	Microalbuminuria (≥20)	
Low (<1.8)	0 (0)	13 (44.8)	
Normal (1.8-2.4)	31 (100.0)	16 (55.2)	
Total	**31 (100.0)**	**29 (100.0)**	
Mean ± SD	2.13 ± 0.152	1.94 ± 0.31	0.005

Data were expressed as mean±SD, t test was done to measure the level of significance, *= significant.

Table III shows comparison between serum magnesium with urine microalbuminuria. It was observed that 0% low serum magnesium in normoalbuminuria group and 13 (44.8%) patients had low serum magnesium in microalbuminuria group. The mean serum magnesium was found 1.9±0.31 mg/dl in microalbuminuria group and 2.13 ± 0.152 mg/dl in normoalbuminuria. The difference was statistically significant (p<0.05) between two groups.

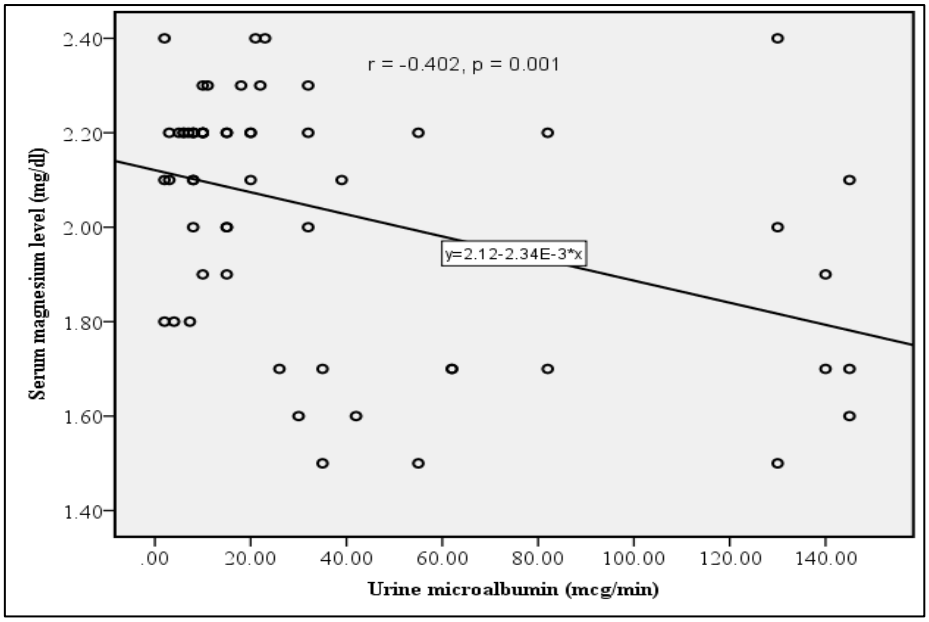

Figure 1: Scatter diagram showing significant negative correlation (r= -0.402, p=0.001) between urinary microalbumin and serum magnesium

4. DISCUSSION

The human body magnesium content in an adult is approximately 1000 mmol or 22.66 gm. Serum total magnesium in normal adults is 0.75 and 0.95 mmol/L (1.7–2.2 mg/dL or 1.5–1.9 mEq/L). There appear to be no significant sex or age differences. Microalbuminuria includes a range of urinary excretion of albumin of 20 to 200 microgram/minute or 30 to 300 mg/24 hrs. Causes of microalbuminuria includes short term hyperglycemia, exercise, urinary tract infections, marked hypertension, heart failure, acute febrile illness, dehydration. These conditions damage glomerulous of kidney and then progress toward microalbuminuria to proteinuria. Intracellular magnesium plays a key role in regulating insulin action, insulin-mediated-glucose-uptake and vascular tone [6]. Reduced intracellular magnesium concentrations result in a defective tyrosine-kinase activity postreceptorial impairment in insulin action and worsening of insulin resistance in diabetic patients [7]. Oxidative stress is an important causative factor for microalbuminuria [8]. Magnesium has antioxidant property. Therefore, oxidative stress has association between low serum magnesium and microalbuminuria [9]. The findings of this study are compared with the results of some other published articles elsewhere in the world to verify the results. In this study, serum magnesium levels were studied in all the type 2 diabetic patients. It was observed that 13(21.7%) had <1.8 mg/dl and 47(78.3%) had normal serum magnesium level (1.8-2.4 mg/dl) and the mean ± SD for serum magnesium in study population was 2.04 ± 0.26 mg/dl. Shaikh M K *et al.*, [10] in a study found that the mean ± 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 values. In another study done by Ferdousi S *et al.*, [11] found that serum magnesium concentration in the type 2 diabetic patients was found significantly (p<0.001) lower than that of control group. The reasons of lowered magnesium in type 2 diabetes mellitus might be due to higher urinary loss or impaired absorption of magnesium as compared to healthy persons. The findings of this study are in accordance with above published studies. In this study, urinary microalbumin level was measured in 60 subjects of type 2 diabetes mellitus and observed that 29(48.3%) patients had microalbuminuria and 31(51.7%) normoalbuminuria. The mean microalbumin level was found 36.69±44.21 mg/L with range from 2-145 mg/L. Xu B *et al.*, [12] had shown that 11.37% of the study population had microalbuminuria, in another study done by Varghese *et al.*, [13] found that overall prevalence of microalbuminuria was 36.3%. So, the findings of present study are within the range of previously published studies, but more than the study done by Xu B *et al.*, This difference in result could be due to demographical variation. It was observed that 0(2.98%) patients had low serum magnesium in normoalbuminuria group and 13(44.8%) in microalbuminuria group. The mean serum magnesium was found 2.13±0.15 mg/dl in normoalbuminuria and 1.94±0.31 mg/dl in microalbuminuria group. The difference was statistically significant (p<0.05) between two groups. In the present study, the mean serum. Rao P P *et al.*, [10] shown that of 50 diabetic patients with microalbuminuria, 3 participants had hypomagnesemia (mean 2.09 ± 0.28 mg/dl) and 1 had hypermagnesemia (2.6 mg/dl). Mg++ levels were normal in normoalbuminuria group. In another study, Aneesh T *et al.*, [5] shown that the mean magnesium level in the study population (n=60) was 1.85±0.34 mg/dl. The mean magnesium levels in the overt proteinuria group (n=20) was found to be lower (1.57±0.17 mg/dl) compared to

the microalbuminuria group (n=20) (1.90±0.21 mg/dl) and more so in the normoalbuminuria group (n=20) (2.10±0.37 mg/dl). The correlation was statistically significant (P<0.001). To observe the correlation between serum magnesium level and urinary microalbumin Pearson's correlation test was done. In present study, there was a negative correlation between serum magnesium level and urinary microalbumin level in type 2 diabetes mellitus patients respectively (r= -0.402). The correlation was statistically significant (P<0.05). In a study conducted by Aneesh T *et al.*, [5] found statistically significant correlation (P<0.001) between serum magnesium and urine microalbumin. Sakaguchi Y *et al.*, [3] also found statistically significant correlation (P = 0.004) between these two parameters in diabetic patients. So the findings of present study are consistent with the previously discussed studies. Serum Mg was inversely associated with the prevalence of microalbuminuria. Further large-scale clinical trials are needed to determine whether correction of Mg deficiency, through medications or dietary intake, could be effective to reduce the incidence of microalbuminuria. Screening for serum Mg levels in Type 2 diabetes and its deficiency correction may help in achieving better glycemic control and reduce further diabetic complications.

5. CONCLUSION

There was a negative correlation between serum magnesium level and urinary microalbumin in hypomagnesemia diabetic patients. In this regard, hypomagnesemia may predict the progression to ESRD in patients with type 2 diabetic nephropathy. Therefore, treatment with this trace element may improve disease outcome and delays diabetic complications.

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Conflicts of Interest: There are no conflicts of interest.

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