



CORRELATION OF SERUM MAGNESIUM LEVELS WITH SEVERITY OF ALBUMINURIA IN DIABETIC NEPHROPATHY

General Medicine

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ABSTRACT

Background and Aim of Study: Diabetic nephropathy is a syndrome characterized by the presence of pathological quantities of urine albumin excretion, diabetic glomerular lesions and loss of GFR in diabetics. It is a leading cause of ESRD worldwide. There is substantial evidence of associations between hypomagnesemia and diabetic nephropathy. Hypomagnesemia independently predicts the progression of diabetic nephropathy to ESRD. Identifying and treating hypomagnesemia in diabetic nephropathy can potentially delay ESRD. Our study was a cross sectional observational study undertaken to measure and correlate the serum magnesium levels with severity of albuminuria in diabetic nephropathy. **Materials and Methods :** In this study, data is obtained from 100 patients of diabetic nephropathy in a tertiary care hospital Mysuru between January 2019 to June 2020. Necessary investigations were done, results were recorded and data was analysed. **Results :** Among 100 patients studied, mean serum magnesium was found to be 1.19meq/L; mean serum magnesium levels among those with microalbuminuria was 1.45meq/L and 1.11meq/L among those with macroalbuminuria. Serum magnesium was found to be lower among patients with macroalbuminuria compared to those with microalbuminuria. Statistically significant ($p < 0.001$) inverse correlation was found between serum magnesium and severity of albuminuria. **Conclusion :** In this study, we observed that with different stages of diabetic nephropathy according to severity of albuminuria, serum magnesium levels were found to be decreasing with increasing severity of albuminuria. It has also been observed that poor glycemic control had similar findings. It is warranted that hypomagnesemia is a predictor of progression of diabetic nephropathy to end stage renal disease. Hence identifying hypomagnesemia and treating it in early stages can have potential in delaying the progression of diabetic nephropathy to ESRD.

KEYWORDS

Diabetic nephropathy, ESRD(end stage renal disease),UACR(urine albumin creatinine ratio), Hypomagnesemia.

INTRODUCTION

Diabetic nephropathy(DN) is a syndrome characterized by the presence of pathological quantities of urine albumin excretion, diabetic glomerular lesions and loss of GFR in diabetics. It is a chronic complication of both type 1 and type 2 DM.¹ The diabetes epidemic has resulted in diabetic nephropathy becoming the most frequent cause of ESRD in most countries. Magnesium is an abundant mineral in human body, is a cofactor in more than 300 enzymes that regulate various biochemical reactions in the body, including protein synthesis, muscle and nerve function, blood glucose control and blood pressure regulation. About one-third of patients with type 2 diabetes are found to have hypomagnesemia, mainly due to enhanced renal excretion. Magnesium depletion is found to have negative impact on glucose homeostasis and insulin sensitivity.³ Moreover, there is substantial evidence of associations between hypomagnesemia and various complications of diabetes including neuropathy, retinopathy, foot ulcers and albuminuria.⁴ In patients with diabetes mellitus who develop microalbuminuria, serum magnesium was low when compared with normoalbuminuric patients.⁵⁻¹¹ Hence this study is undertaken to study serum magnesium levels in patients with different stages of diabetic nephropathy and with different levels of albuminuria.

MATERIALS AND METHODS :

This was a hospital based cross sectional study for a period of 18 months from January 2019 to June 2020. Total of 100 patients visiting general medicine OPD, Nephrology OPD/admitted in department of General Medicine were enrolled in the study after obtaining approval from ethical committee of our institute. Clinical history and examination was done. Necessary investigations were done and data was recorded.

Inclusion Criteria : Patients with Type 2 Diabetes and Type 1 Diabetes > 5yrs with albuminuria, elevated serum creatinine and patients diagnosed with diabetic nephropathy were included.

Exclusion Criteria :

Patients with :

1. Hypertensive nephropathy
2. Congestive cardiac failure
3. Urinary tract infection
4. Severe diarrhea

5. Alcoholics
6. Ketoacidosis
7. Patients on long term diuretics and drugs causing hypomagnesemia
8. Gestational diabetes

Ethical Approval : Ethical approval was obtained from Mysore Medical College and Research Institute ethical committee and the ethical protocols of the declaration of Helsinki(1967) including the ethical principles of informed consent, voluntary participation and withdrawal, privacy and confidentiality were followed. Sample size calculation done using the formula $n = 4pq/d^2$ with 95% confidence interval and 5% level of significance of (Standard deviation) = 35.95 and absolute allowable error of 7%. The sample size is 100.

Statistical Methods : Descriptive and inferential statistical analysis has been used in present study. Descriptive analyses were reported as mean, standard deviation, frequency and percent of continuous variables. Chi square test and Fischer exact test were used to establish association and correlations. p value < 0.05 was considered to be significant.

RESULTS :

Total of 100 patients of diabetes mellitus with albuminuria were included in the study. Among 100, 50%($n=50$) were males and 50%($n=50$) were female. Mean duration of diabetes was 11.9 years. Serum magnesium was found to be lower among those with longer duration of diabetes. We found a negative correlation between HbA1c and magnesium levels. Those with poor glycemic control were found to have lower serum magnesium levels and higher levels of albuminuria. Among 100 subjects, mean UACR was found to be 729.7 $\mu\text{g}/\text{mg}$, mean serum magnesium was 1.19meq/L. Microalbuminuria was found in 25 subjects with mean UACR of 205.10 $\mu\text{g}/\text{mg}$, 75 had macroalbuminuria with mean UACR of 904.68 $\mu\text{g}/\text{mg}$. Mean magnesium among microalbuminuria group was 1.45meq/L and 1.11meq/L in macroalbuminuria group.

Table 1 : HbA1c and serum magnesium correlation

		S. Mg	HbA1c
S. Mg	Pearson Correlation	1	-.645**
	Sig. (2-tailed)		.000
	N	100	100

HbA1c	Pearson Correlation	-.645**	1
	Sig. (2-tailed)	.000	
	N	100	100

** . Correlation is significant at the 0.01 level (2-tailed).

Table 2 : Urine albumin creatinine ratio and serum magnesium correlation

S. Mg	Pearson Correlation	1	-.918**
	Sig. (2-tailed)		.000
	N	100	100
UACR	Pearson Correlation	-.918**	1
	Sig. (2-tailed)	.000	
	N	100	100

** . Correlation is significant at the 0.01 level (2-tailed).

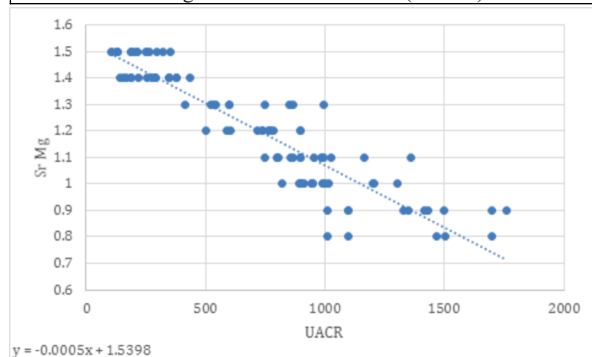


Figure 1 : UACR and serum magnesium

Table 3: Mean serum magnesium levels in albuminuria

Group Statistics					
	Stage of albuminuria	N	Mean	Std. Deviation	Std. Error Mean
UACR	Micro	25	205.1040	61.83800	12.36760
	Macro	75	904.6867	340.45714	39.31260
S. Mg	Micro	25	1.4560	.05066	.01013
	Macro	75	1.1107	.17902	.02067

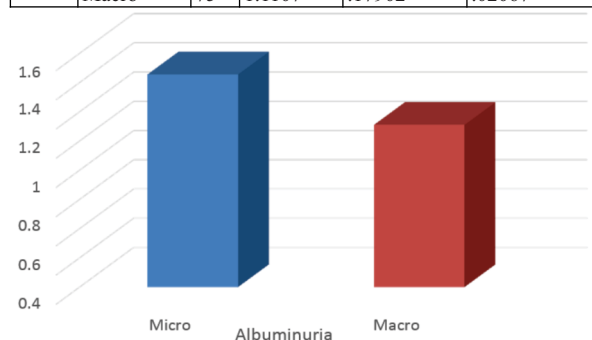


Figure 2: Stage of albuminuria and serum magnesium levels

Fig 2: Serum magnesium level is plotted in Y-axis. Lower levels of serum magnesium was found among those with macroalbuminuria compared to those with microalbuminuria

DISCUSSION :

Number of people living with diabetes has doubled in the last 20 years and microvascular ,macrovascular complications of diabetes are well established.Diabetic nephropathy is a chronic kidney disease that is attributable to diabetes. Screening for albuminuria, achieving good metabolic control,treating dyslipidemia, hypertension should be focused on in every patient to retard progression to nephropathy. Hypomagnesemia has been found to be associated with diabetes and significant reduction in serum values has been noticed among those with albuminuria. Incidence of hypomagnesemia among diabetics varies between 11-47.7% . Magnesium depletion is associated with poor glycemic control. On the other hand magnesium depletion may cause a state of an insulin insensitivity in diabetic patients. Previous studies have shown a negative correlation between serum magnesium and HbA1c levels ;similar findings are noted in the present study.In a study conducted by Corsonello et al,mean duration of diabetes was found to be 10.5 ± 7.15 years among diabetics with microalbuminuria

which was lower compared to mean duration of diabetes among those with macroalbuminuria which was 13.25 ± 8.15 years . Similar findings have been noted in our study where duration of diabetes was more among those with macroalbuminuria compared to microalbuminuria patients.In our study, lower levels of serum magnesium were found among those with macroalbuminuria compared to those with microalbuminuria which are similar to findings from study conducted by Aneesh T et al. There are certain possible mechanisms that explain relation between microalbuminuria and magnesium deficiency. One of them is insulin resistance.Magnesium deficiency in diabetes has been attributed to many factors such as reduced appetite and reduced intake,reduced absorption from intestine,increased renal loss.Magnesium acts as mild calcium antagonist . Mg deficiency causes increased intracellular calcium which interrupts the response of adipocytes and skeletal muscles to insulin, reduce postreceptorial activity and eventually lead to insulin resistance. In turn ,insulin deficiency and resistance effect tubular reabsorption of Mg. Some hypotheses also state oxidative stress as contributing to diabetic microvascular complications.Magnesium is implicated to have antioxidant properties. Hence deficiency may contribute to development of diabetic microangiopathies and also is a consequence of diabetic nephropathy.

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