A STUDY OF MAGNESIUM CONCENTRATION AS A NOVEL PREDICTOR IN PATIENTS WITH NON INSULIN DEPENDENT DIABETIC NEPHROPATHY

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ABSTRACT
Diabetic Nephropathy is one of the well known complication of diabetes mellitus [DM]. It has been reported in several studies that the metabolism of trace elements like cupper magnesium has altered in diabetes. Aim of the present study was to investigate serum magnesium, creatinine, blood urea and other baseline parameters in diabetic nephropathy patients. The study includes total 65 diabetic nephropathy patients and 65 controls with the age group of 40-65 years. Fasting Blood Sugar, Post Prandial Blood Sugars were determined by using the Glucose Oxidase/ Peroxidase method, estimation of blood urea by Berthelot method, serum creatinine by modified Jaffe’s reaction commercial kit by using semiautoanalyser, serum magnesium by colorimetric xylidylic blue method using commercial kit by using semiautoanalyser. The Mean ± SD values of Fasting Blood Sugar, Post Prandial Blood Sugars, serum creatinine & blood urea (mg/dl) were increased significantly [p<0.001] and diminished serum magnesium (mg/dl) [p<0.001] in diabetic nephropathy when compared with the controls. Renal function is the major regulator of the serum magnesium level. Continues high levels of blood glucose and low magnesium leads to more distressing clinical complications in diabetic nephropathy. To
check the serum magnesium and renal functions are one of the early detectors of diabetic nephropathy.

**KEYWORDS**: hypomagnesaemia, Diabetic Nephropathy, Renal failure.

**INTRODUCTION**

The International Diabetes Federation’s (IDF) fifth diabetes atlas has liberated the staggering figures. According to IDF data India’s prevalence of diabetes among 30-79 year old is 9.2%. in India over 61 million of diabetic population by the year 2011 & by the 2030 India’s diabetic burden is expected to cross 100 million mark.[1] Diabetes Mellitus (DM) is characterized by the metabolic disorders related to high blood glucose levels. This hyperglycemia leads to various vascular complications like coronary artery diseases, neuropathy, nephropathy, and retinopathy.[2]

Diabetic nephropathy is one of the major cause of chronic renal failure and important cause of death in type 2 DM. [2,3] The strong relationship between hyperglycemia and other complications of DM studied with blood urea, serum creatinine and magnesium (Mg++) concentrations. Mg++ is essential for the insulin secretion, insulin receptor interaction, post receptor events and normal carbohydrates utilization by Mg++ dependant enzymes. [4] Hyperglycemia leads to decreased serum Mg++ levels. Hypoglycemia leads to collagen & ADP – induced platelet aggregation along with diminished functions of Mg++ dependant enzymes and oxidative stress. [5,6]

Renal function is the major regulator of the serum Mg++ level. There is significant association between hypomagnesaemia and poor renal function in type 2 diabetic nephropathy and independent hypertension are essential risk factor for the progression of type 2 diabetic nephropathy.[5,6,7]

Early diagnosis of diabetic nephropathy is very much important to achieve the effectiveness of treatment, to revert complications by adequate interventions and to predict prognosis. The present study was aimed to study the fasting, post prandial blood sugar levels, blood urea along with magnesium concentrations in type 2 diabetic nephropathy.

**MATERIALS AND METHODS**

This research was conducted in the Department of Biochemistry, Mahatma Gandhi Memorial Hospital, Warangal and Department of Biochemistry PDVVPF, s Medical College,
Ahmednagar, Maharashtra. Prior to start the study, local institutional ethical clearance was obtained and utmost care was taken during experimental procedure according to the Declaration of Helsinki 1964.

**Study type:** Hospital based case-control study.

This study has been performed on total 130 subjects which includes 65 diabetic nephropathy patients (45 males & 15 females) & 65 age & sex matched healthy controls (43 males and 17 females) from the age group 35-60 years. All patients were under the strict supervision of medical professionals during this period. Patient’s category includes type 2 diabetes mellitus with more than 10 years of duration.

Patients with chronic renal failure, glomerular nephritis due to other systemic and hypertension were excluded from the study.

After obtaining a written consent form from all the subjects who were included in the study and by giving detail information of study, blood samples were collected from controls and patients. Total 5ml blood was withdrawn aseptically from the antecubital vein from each subject in a EDTA bulb & plain container. The samples were centrifuged at 3000 rpm for 10 min to separate serum / plasma. Lipaemic and icteric samples were discarded.

The FBS & PPBS were measured by Glucose oxidase/Peroxidase method using semiautoanalyser.[8,9] Estimation of blood urea by Berthelot method[10], serum creatinine by modified Jaffe’s reaction commercial kit by using semiautoanalyser[11], serum magnesium by colorimetric xylidy blue method using commercial kit using semiautoanalyser.[12]

**Statistical Analysis**

The statistical analysis was carried out by using the SPSS (Statistical Package for Social Sciences) statistical software, version 17.0 for Windows. The Student’s ‘z’ test were applied for the significance and the results were expressed in mean ± SD. p values (p <0.001) were considered as significant.

**RESULTS**

Table No 1 reveals Mean ± SD levels of FBS, PPBS, blood urea, sr. creatinine serum Mg++ levels (mg/dl) in both patients and controls. Concentration of FBS level (147.06 ± 8.4), PPBS (240.6 ±8.4), blood urea (75.5 ±8.06) serum creatinine (4.35±6.85) were significantly
increased in diabetic nephropathy patients when compared with healthy controls. Highly significant decrease was found in Mg$^{++}$ concentration (1.06 ±0.26) in patients when compared with controls (2.05±0.3).

**Table No-1 Shows the baseline characteristics of all the controls and subjects.**

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Parameters</th>
<th>Controls (n=65)</th>
<th>Diabetic nephropathy (n=65)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age</td>
<td>50 ±9.8</td>
<td>48.5 ±9.7</td>
<td>p&gt;0.01</td>
</tr>
<tr>
<td>2</td>
<td>FBS [mg/dl]</td>
<td>85.1±4.6</td>
<td>147.06 ±8.4</td>
<td>p&gt;0.001**</td>
</tr>
<tr>
<td>3</td>
<td>PPBS [mg/dl]</td>
<td>124.9±8.9</td>
<td>240.6 ±8.4</td>
<td>P&lt;0.001**</td>
</tr>
<tr>
<td>4</td>
<td>Blood urea [mg/dl]</td>
<td>22.93±4.3</td>
<td>75.5 ±8.06</td>
<td>P&lt;0.001**</td>
</tr>
<tr>
<td>5</td>
<td>Serum Creatinine [mg/dl]</td>
<td>0.8.14±1.2</td>
<td>4.35±6.85</td>
<td>P&lt;0.001**</td>
</tr>
<tr>
<td>6</td>
<td>Serum Mg$^{++}$ [mg/dl]</td>
<td>2.05±0.3</td>
<td>1.06 ±0.26</td>
<td>P&lt;0.001**</td>
</tr>
</tbody>
</table>

Values were expressed in mean with standard deviation (Mean±SD).

**indicates statistically significant (p<0.001)
n=number of patients.

**Table No- 2: Shows the negative correlation of Mg$^{++}$ with FBS, PPBS and blood urea in diabetic nephropathy patients.**

<table>
<thead>
<tr>
<th>Sr No</th>
<th>FBS</th>
<th>PPBS</th>
<th>Urea</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Correlation coefficient</td>
<td>-0.05</td>
<td>-0.17</td>
</tr>
<tr>
<td>2</td>
<td>‘t’ value</td>
<td>-0.36</td>
<td>-1.03</td>
</tr>
<tr>
<td>3</td>
<td>Interpretation</td>
<td>[-] correlation</td>
<td>[-] correlation</td>
</tr>
</tbody>
</table>

DISCUSSION

It is observed that hypomagnesaemia were prone for complications in type 2 DM.\cite{13} The exact cause of hypomagnesaemia is unknown, but an increased urinary loss of Mg may contribute to it. Some studies revealed that hyperglycemia contribute to hypomagnesaemia by causing depression in the net tubular reabsorption of Mg$^{++}$.\cite{14}

One of the potential pathophysiological mechanisms is that low serum Mg$^{++}$ play an important role in pathogenesis of insulin resistance. Another study has also found that insulin resistance can affect the tubular absorption of Mg$^{++}$which leads to hypomagnesaemia in type 2 DM patients. This leads to increased risks of microalbuminuria.\cite{15,16} Our findings are supported by the various researchers.

Insulin resistance impairs the glucose utilization by insulin sensitive tissue and increased hepatic glucose uptake. Both defects contribute hyperglycemia. In our present study the mean values of FBS and PPBS were increased significantly (p<0.001) when compared with control.
Role of enhanced blood glucose levels in pathogenesis of diabetic nephropathy is supported the fact that diabetic nephropathy is more likely to developed patients with less glycemic control.\[^{13,17,18}\]

We have found highly significant level of blood urea and serum creatinine (p<0.001) in patients compared to controls. Serum creatinine and blood urea are well established markers of glomerular filtration rate GFR. Serum creatinine is more sensitive marker of kidney functions. Since functioning nephrons are decreased in diabetic nephropathy, kidney functioning is decreased hence serum creatinine is increased.\[^{19,20}\]

**CONCLUSION**

From our study it an evident that, increased glycemic index leads to diabetic nephropathy. Hypomagnesaemia is the good sensitive indicator for the early diagnosis of diabetic nephropathy. So that early diagnosis will be helpful for effectiveness of treatment and predicts progress.

**ACKNOWLEDGMENTS**

The author deeply acknowledges Dr. Abhijeet Shinde MD Medicine (diabetologist), MGM Hospital Warangal (A.P.) India for co-operating and allowing me to collect the sample.

**REFERENCES**

12. Farrell EC. ‘Magnesium’ in Clinical Chemistry. Theory, analysis and Correlation. The 
13. Pramod P Rao, Mohamed Ghouse Shariff. Serum Magnesium Levels in Type 2 Diabetic 
   Patients with Microalbuminuria and Normoalbuminuria. International Journal of 
14. McCarty MF. Magnesium may mediate the favorable impact of whole grains on insulin 
15. Mandon B, Siga E, Chabardes D, Firsov Det al. Insulin stimulates Na+, Cl-, Ca2+, and 
   Mg2+ transports in TAL of mouse nephron: Cross-potentiation with AVP. Am J Physiol 
   Diabetes Care 2011; 34: 982-987.
17. Baihui Xu, Jichao Sun, Xinru Deng, Xiaolin Huang et al. Low Serum Magnesium Level 
   Is Associated with Microalbuminuria in Chinese Diabetic Patients. International Journal 
18. Endres DB, Rude RK. Mineral and Bone Metabolism in: Burtis CA, Ashwood ER. TB of 
19. Adlelr AI, Stevens RJ, Manley SE, Bilous WR et al. development and progression of 
   nephropathy in type 2 diabetes: the United Kingdom Prospective Diabetes Study 
   2191-2192.