Type 2 diabetes is considered as a major health burden due to its rising prevalence and disabling, life threatening complications. Dyslipidemia, often coexisting with T2DM as a feature of insulin resistance, is hypothesized to be linked with altered magnesium homeostasis. This study was designed to evaluate the serum magnesium levels and its influence on serum lipids in type 2 diabetics. Lipid profile, serum magnesium (Mg) and fasting serum glucose (FSG) were measured in 30 newly diagnosed normotensive type 2 diabetic patients chosen as cases (Group II) just before introducing any treatment, and was compared with that of 30 healthy controls (Group I). The serum magnesium was found to be significantly lower (p<0.001) and LDL-c was found to be significantly higher (p<0.01) in cases. The correlation analysis revealed a significant negative association of FSG to serum magnesium (r = -0.720), total cholesterol (r = -0.483) and a positive correlation to HDL-c (r = -0.440). However, serum magnesium showed a significant positive relation only with serum HDL-c (r = 0.372, p<0.05). Serum magnesium and lipid fractions showed wide range of variation within the normal reference ranges in the newly diagnosed T2D subjects. Further large scale studies are needed to elucidate the association of serum magnesium with lipid profile changes. Estimation of serum magnesium level may prove useful in T2DM with normal or abnormal lipid levels or in those who are prone to develop dyslipidemia or certain complications associated with dyslipidemia.

Key words: Lipid Profile, Type 2 Diabetes, Serum Magnesium, Fasting Serum Glucose
Dyslipidemia is frequently found in type T2DM as a feature of insulin resistance syndrome; one of the key elements of pathogenesis in T2DM. Moreover, this plays an important role in the development of atherosclerosis resulting in macrovascular complications (coronary heart disease) which is the leading cause of mortality and morbidity in diabetic subjects.\(^8\)\(^9\)

Different reports suggest that diabetes mellitus is also associated with disturbances in electrolyte metabolism. In patients with high fasting glucose, Na\(^+\) and Mg\(^{2+}\) tend to be lower while K\(^+\) is higher. Among the three parameters, only serum Mg\(^{2+}\) significantly correlate with the level of hemoglobin A\(_1\)c and thus may be related to long-term control of diabetes. Hypomagnesemia may worsen insulin resistance. The kidneys possibly lose their ability to retain magnesium during periods of severe hyperglycemia. The increased loss of magnesium in urine may then result in lower blood levels of magnesium.\(^10\) Thus, magnesium depletion and insulin resistance result in a vicious cycle of worsening insulin resistance and decrease in intracellular Mg\(^{2+}\) which limits the role of magnesium in vital cellular processes.\(^10\)\(^11\)

Among the clinical variables, poor glycemic control, prolonged duration, and coexisting hypertension have been proven as the potential predictors of dyslipidemia in T2DM.\(^12\) However, recent studies have shown association of low serum magnesium with dyslipidemia in T2DM.\(^13\)-\(^16\) A number of studies have also reported beneficial effects of magnesium supplementation on lowering plasma total cholesterol and LDLc and an increase of HDLc level.\(^17\)\(^18\) However, the number of such studies correlating all these parameters in DM patients in our country is limited and often underreported. Considering the above facts and the increasing prevalence of DM in Bangladesh, the present study was conducted with an objective to evaluate the serum magnesium, fasting sugar and lipid profile in T2DM cases and to compare them with those of controls and to correlate them, with other parameters.
comparisons between different groups were made using t-test, and correlation co-efficient was calculated to determine the association between said variables. All the data were compiled and analyzed with SPSS 12.0. A p value <0.05 was considered as significant.

Results

The new untreated T2DM cases had significantly higher (p<0.001) mean fasting serum glucose (14.86 ± 5.0 mmol/l) than that of the controls (4.23 ± 0.67 mmol/l). Statistical analysis showed significant difference of serum magnesium (p<0.001) and LDL-c (p<0.01) between the study groups (Table-I).

Table-I: Comparison of serum magnesium and lipid profile between the study groups.

<table>
<thead>
<tr>
<th>Group(n)</th>
<th>Mg2+ (mmol/l)</th>
<th>TG (mg/dl)</th>
<th>TC (mg/dl)</th>
<th>HDL-c (mg/dl)</th>
<th>LDL-c (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (30)</td>
<td>0.58 ±0.04</td>
<td>83 ± 22</td>
<td>141 ± 37</td>
<td>36 ± 4</td>
<td>87 ± 38</td>
</tr>
<tr>
<td>II(30)</td>
<td>0.44±0.08*</td>
<td>74 ± 26</td>
<td>150 ± 40</td>
<td>34 ± 5</td>
<td>114± 37*</td>
</tr>
<tr>
<td>p values</td>
<td>0.0001</td>
<td>0.153</td>
<td>0.369</td>
<td>0.092</td>
<td>0.007</td>
</tr>
</tbody>
</table>

* & ** superscript in each column indicate significance difference at level p value <0.001 & <0.01, respectively. Group I: controls; Group II: newly diagnosed untreated diabetic patients.

Correlation analysis registered no significant association of FSG to serum magnesium or lipid profile in control, but for the diabetic cases FSG showed significant negative correlation with serum Mg2+ and total cholesterol (-0.720, -0.483; p = 0.0001& 0.007, respectively) as well as a positive relation with HDL Cholesterol (r = 0.440,p = 0.015). Similarly serum Mg2+ depicted significant association in diabetic group where serum Mg2+ was positively related to serum HDL-c (r =0.372, p = 0.042) only (Figure-1).

Figure-1: Cross correlations of fasting serum glucose, serum Mg2+ and lipid levels (a, b, c, d) in newly diagnosed T2DM cases.
Lipid Profile, Magnesium and Fasting Glucose in T2DM

Discussion

In this study different values have been noticed in lipid parameters between the two groups, but within the normal reference ranges. The major lipid profile fractions; total cholesterol, triglyceride and LDL-c are considered desirable or normal up to 200 mg/dl, 150 mg/dl and 100 mg/dl respectively and HDL-c > 40 mg/dl for male and > 50 mg/dl for female is considered low or abnormal. The mean values of TG and total cholesterol in both study groups were close to these reference limits. However, the mean LDL-c was significantly higher in diabetic groups. The HDL-c was also found below the desired reference limit for both diabetic and healthy control groups with no statistically significant difference. These observations are consistent with a recent local study which revealed that most of the respondents had total cholesterol and triglyceride within normal limit but majority had abnormal LDL-c (about 60%) and HDL-c (82%) level. There was a fall of serum magnesium below the lower reference limit (1.7 to 2.4 mmol/l) in both diabetics and controls. However, there were no set of reference values for serum Mg2+ or lipid fractions in Bangladeshi population for valid comparison. Serum Mg2+ was also found to be significantly lower in diabetics than controls.

Fasting serum glucose (FSG) showed a significant inverse correlation to TC and a positive association with HDL-c in newly diagnosed cases of this study. But, a number of studies done to illustrate metabolic control of diabetes mellitus and serum lipid levels have shown just the opposite; positive relation with TC, LDL-c levels and negative relation with HDL-c. Indeed, studies with controversial reports are available as well showing no such correlation with cholesterol.

One of the major findings of the present study was a significant inverse correlation of serum Mg2+ with FSG and a direct association with HDL-c in diabetic subjects only, like most of the studies referred earlier. Some of these have also showed the same in terms of FSG for controls as well. Again, there is evidence of significant negative correlation with other lipid fractions in cases, but the observation differed from one another. Mishra et al. found a significant negative correlation of serum Mg2+ with TG and VLDL-c and strong positive association with HDLc. There was also a negative relation to TC and LDL-c which was statistically insignificant. On the other hand, Nasri et al. showed significant inverse correlations of serum Mg2+ with serum Total and LDL cholesterol, but non-significant correlations of serum Mg2+ with serum Lp(a), HDL-c and TG. Another recent study simply compared serum Mg2+ in T2DM with and without complications (mainly CAD) in contrast to a healthy control group revealing highly significant lower levels in complicated diabetic subjects. Hence, despite of such controversies, it could be concluded that the lower levels of serum magnesium may have a bearing on the altered lipid levels even within the normal ranges.

This small scale study was undertaken to explore the level as well as interrelation of serum magnesium and the established common biochemical parameters namely lipid profile and fasting serum glucose in T2DM subjects. Depletion of serum Mg2+ below the lower reference value was common for both healthy and the diabetic subjects with a highly significant statistical difference. Lower serum Mg2+ level showed significant correlation with FSG and HDL-c in the newly diagnosed cases with no proven complications, which could be considered as a hidden link between the pathogenesis of diabetes and its progression towards certain complications. Large scale population based studies are necessary for further clarification of the facts. Meanwhile, estimation of serum Mg2+ might be added to the routine biochemical monitoring along with lipid profile in T2DM subjects from the very first day of their diagnosis.

References


