Triglyceride Profile in Dyslipidaemia of Type 2 Diabetes Mellitus

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ABSTRACT

Objective: To evaluate ratios of serum triglycerides and cholesterol levels which may indicate postprandial lipid handling and to assess their role as prospective markers of dyslipidaemia in type 2 diabetes mellitus.

Study Design: Comparative, observational study.

Place and Duration of Study: Bismillah Taqee Hospital, Karachi from July 2002 till December 2003.

Patients and Methods: The study comprised 160 subjects, including 83 known type 2 diabetics (45 males, 38 females) and 77 age-matched controls (45 males, 32 females). Fasting blood samples were analysed for serum triglycerides and total cholesterol, using automated chemistry analyzer. HDL-C was determined by precipitation method and LDL-C and VLDL-C were estimated by Friedewald formula. LDL/HDL ratio and TG/HDL ratios were also calculated. The mean values for male and female diabetics were compared with that for the male and female non-diabetics respectively and tested for significance by paired t-test.

Results: Serum triglycerides and VLDL were raised in both male and female diabetics. No significant differences were observed in levels of serum total cholesterol, LDL, HDL and the LDL/HDL ratio. The mean value of the TG/HDL ratio for male diabetics was higher than that for the male non-diabetics (p=0.39). A statistically significant difference was found in the TG/HDL ratios for the female diabetics and non-diabetics (p<0.05).

Conclusion: In this study, type 2 diabetics showed marked hypertriglyceridaemia and raised TG/HDL ratio. The dyslipidaemia of diabetes predisposes to development of coronary heart disease and, therefore, evaluation of the TG:HDL ratio may provide a good tool to monitor and manage the lipid abnormalities in diabetics.

Key words: Type 2 diabetes. Serum triglycerides. High density lipoprotein cholesterol (HDL-C). Low density lipoprotein cholesterol (LDL). Atherogenic index. Triglyceride high density lipoprotein ratio (TG:HDL ratio).

INTRODUCTION

Diabetics are at an increased risk of developing Coronary Heart Disease (CHD).¹ Both the Bedford study² and the Whitehall study³ showed a strong relationship between glucose intolerance and arterial disease.

A major reason for this increased risk of atherosclerosis lies in the changes that take place in the lipid/lipoprotein metabolism in the diabetic.¹,⁴ Studies have shown that the impact of diabetes on the relative risk for developing CHD is greater for women than men, as diabetes eliminates the “female advantage”. This increased risk in diabetic women is due to lower HDL-cholesterol levels (<50 mg/dL) and raised triglycerides (TG) levels.¹,⁴

Many studies have also indicated an important predictive role of increased serum TG levels contributing to the risk for CHD, especially in type 2 diabetics.⁵,⁶ In type 2 diabetics, high TG levels and low HDL-C levels frequently co-exist, which are important factors for CHD. In this regard, TG/HDL-C ratio is one of the important predictors of heart disease. It is generally considered that number below 2.5 represents a lower risk of heart disease. This ratio is also an indicator of LDL particle size⁷ and a good predictor of LDL, phenotype B, that is associated with an increased atherogenic risk.⁸,⁹

Whereas, HDL has been assigned a protective role against the development of atherosclerosis because of its role in reverse cholesterol transport. HDL is also associated with the metabolism of the TG rich lipoproteins, since it is the reservoir of apoprotein C-2,¹⁰ which is the activator of lipoprotein lipase, the enzyme responsible for the metabolism of chylomicrons and VLDL in the peripheral tissues. During the postprandial metabolism of these lipoproteins, there is an active exchange of lipids and apolipoproteins with HDL.

Hence the TG:HDL ratio highlights the integrated role of these two parameters in the removal of a lipid load from the circulation in the postprandial state.

Many investigators have reported that while fasting levels of lipids are important in evaluating the risk of CHD, it may be more relevant to consider the postprandial metabolism of lipids,¹¹ particularly in patients with hypertriglyceridaemia.¹² It has also been shown that
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RESULTS

There were a total of 160 subjects. The diabetics (n=83) were further divided into males (n=45) and females (n=38). The clinically verified non-diabetics (n=77), were also further divided into male (n=45) and female (n=32).

The mean values for serum total cholesterol, HDL-C, LDL-C, VLDL-C and triglycerides in the male diabetics and non-diabetics are given in Table I. The mean value of serum triglycerides level was considerably higher in the diabetics as opposed to that estimated for the non-diabetics (p=0.028).

Table I: Lipids and lipoproteins in male type 2 diabetics.

<table>
<thead>
<tr>
<th></th>
<th>Non-diabetics</th>
<th>Type 2 diabetics</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum triglycerides</td>
<td>170 ± 84</td>
<td>187 ± 69</td>
<td>0.28</td>
</tr>
<tr>
<td>Serum cholesterol</td>
<td>194 ± 33</td>
<td>196 ± 37</td>
<td>0.8</td>
</tr>
<tr>
<td>HDL cholesterol</td>
<td>36 ± 5.6</td>
<td>35 ± 7.1</td>
<td>0.6</td>
</tr>
<tr>
<td>LDL cholesterol</td>
<td>126 ± 28</td>
<td>123 ± 37</td>
<td>0.7</td>
</tr>
<tr>
<td>VLDL cholesterol</td>
<td>34 ± 17</td>
<td>37 ± 14</td>
<td>0.286</td>
</tr>
<tr>
<td>TG: HDL</td>
<td>5.0 ± 3.0</td>
<td>5.5 ± 2.2</td>
<td>0.39</td>
</tr>
<tr>
<td>LDL: HDL</td>
<td>3.6 ± 1.2</td>
<td>3.7 ± 1.4</td>
<td>0.96</td>
</tr>
</tbody>
</table>

The mean values for serum levels of total cholesterol, HDL-C, LDL-C in the female diabetics were found to be non-significant when compared to those of the female non-diabetics. However, the mean value for serum triglycerides was again found to be considerably higher in female diabetics compared to that of non-diabetics (p=0.06) Table II.

Table II: Lipids and lipoproteins in female type 2 diabetics.

<table>
<thead>
<tr>
<th></th>
<th>Non-diabetics</th>
<th>Type 2 diabetics</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum triglycerides</td>
<td>184 ± 64</td>
<td>177 ± 65</td>
<td>0.06</td>
</tr>
<tr>
<td>Serum cholesterol</td>
<td>210 ± 50</td>
<td>201 ± 34</td>
<td>0.3</td>
</tr>
<tr>
<td>HDL cholesterol</td>
<td>39 ± 6.7</td>
<td>38 ± 6.6</td>
<td>0.4</td>
</tr>
<tr>
<td>LDL cholesterol</td>
<td>142 ± 46</td>
<td>129 ± 26</td>
<td>0.18</td>
</tr>
<tr>
<td>VLDL cholesterol</td>
<td>30 ± 13</td>
<td>35 ± 13</td>
<td>0.08</td>
</tr>
<tr>
<td>TG: HDL</td>
<td>3.9 ± 1.8</td>
<td>4.9 ± 2.0</td>
<td>0.04</td>
</tr>
<tr>
<td>LDL: HDL</td>
<td>3.7 ± 1.1</td>
<td>3.5 ± 0.8</td>
<td>0.4</td>
</tr>
</tbody>
</table>

The lipid ratios i.e. LDL: HDL ratio and TG: HDL ratio were not significantly different between male diabetics and non-diabetics. The difference in the LDL: HDL ratio in the females was found to be non-significant but a comparison of TG: HDL ratios estimated for the female diabetics and non-diabetics showed a significant difference (p<0.05).

PATIENTS AND METHODS

The study was carried out as a comparative, observational study on a total of 160 subjects, who were all outpatients at Bismillah Taqee Hospital, Karachi. The subject population was divided into two groups of clinically diagnosed cases of type 2 diabetes and clinically verified non-diabetics who were further subdivided gender-wise.

The inclusion criteria for the former group was clinically diagnosed type 2 non-obese diabetics above 40 years of age with no history of any other pre-existing disease e.g. known coronary heart disease, renal disease or hormonal abnormalities that could effect the lipid profile.

Fasting venous blood samples were taken from all individuals and analyzed on the same day. Serum triglyceride and cholesterol were estimated by enzymatic methods by auto-analyzer. The co-efficient of variation was cholesterol (3.5%) and triglycerides (3.2%). The automated chemistry was subjected to rigorous internal and external quality control measures. HDL-C was estimated by precipitation method and LDL-C and VLDL-C were calculated by the Friedewald formula. The ratios of TG:HDL and LDL:HDL were calculated from their respective mean values.

Data was entered and analysis was done on Microsoft Excel. The mean values for each parameter in the male and female diabetics were compared with that of the male and female non-diabetics respectively and the differences were tested for significance by paired t-test.
DISCUSSION

The study was carried out on normoglycemic type 2 diabetics and non-diabetics controls to assess the role of individual parameters of lipid profile in the dyslipidaemia of type 2 diabetes mellitus, with particular emphasis on the lipid ratios.

The lipid ratios LDL:HDL and TG:HDL may be better indicators of how the individual parameters correlate with each other, while in circulation during the postparandial state.

Diabetes mellitus type 2 is typically associated with a dyslipidaemia characterized by hypertriglyceridaemia and low HDL-C levels, while the levels of total cholesterol and LDL-cholesterol may not differ significantly from those in the non-diabetics. However, patients with diabetes often have an abnormally high number of small dense LDL particles, which has been found to be related to the TG:HDL ratio.

These have been reported to be more atherogenic than larger LDL particles. Thus, the LDL-C level in a diabetic is not the only parameter that should be observed to evaluate markedly increased cardiovascular risk in patients with type 2 diabetes.

The results show that regarding the individual values lipid profile, the main impact of type 2 diabetes appeared to be on the serum triglyceride and VLDL levels in both men and women. The mean values of both these parameters were raised in comparison to their controls, with the difference being greater and more significant in the female diabetics. No significant differences were found between the levels of serum total cholesterol, HDL-C and LDL-C in diabetic men when compared to their controls. The diabetic women, however, had lower mean values for these parameters compared to their controls. These findings coincide with that of other studies carried out in the region. There is a reported hypertriglyceridaemia as a significant finding in dyslipidaemia of type 2 diabetes. Other local studies have reported hypertriglyceridaemia as the predominant type of dyslipidaemia (60%) followed by low levels of HDL-C (52%). The findings were more common in females.

This study supports the above findings by showing that hypertriglyceridaemia predominates and is more significant in female type 2 diabetics.

However, another study done in Pakistan reported raised levels of total cholesterol and LDL as the main finding.

Hence, majority of studies reported the finding of hypertriglyceridaemia as the major indicator of dyslipidaemia predisposing to coronary risk in the type 2 diabetics of the population.

The LDL:HDL ratio did not differ significantly between the diabetic groups and their controls.

The values of the TG:HDL ratio was higher in the diabetic groups when compared to their controls, being significant in the female diabetics.

The value of TG:HDL ratio takes into account both factors, i.e. the lipid load and the ability to remove the lipid laden particle from the circulation. The association of hypertriglyceridaemia with low levels of HDL and its subfraction HDL2 is established. HDL has been shown to be protective with regard to CHD because of its role in reverse transport of cholesterol and its capacity to remove triglyceride rich lipoproteins. Many studies have shown that poor efficiency in removing the lipid stress from the circulation would increase the risk of atherogenesis. The results of this study have shown that diabetics had a higher value of the TG:HDL ratio,

CONCLUSION

Triglyceride levels and TG:HDL ratio should be given as much importance as the serum cholesterol level and LDL:HDL ratio, when assessing the risk of CHD. Triglyceride levels and TG:HDL ratio may be improved in the diabetic by good blood glucose control for which aerobic exercise (e.g. walking), a high fibre diet, decreased dietary refined carbohydrates in the diet and use of fibrates to lower serum TG level, if necessary. In addition to diabetics, it may be useful to evaluate the higher risk subjects i.e. obese and the elderly by evaluating them in terms of TG:HDL ratio.

REFERENCES


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