Changes in Serum Lipids and Electrolytes in Type II Diabetes Mellitus During Ramadan


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Our objectives were to study the effect of 1 month of religious fasting (Ramadan) on serum lipids and electrolyte profiles in patients with non-insulin dependent diabetes mellitus (NIDDM) in the outpatient department in a teaching district general hospital in North Jordan. We found that blood glucose and total cholesterol levels did not change significantly during Ramadan compared with the pre-fasting period (mean decrease of 0.33 mmol/l and 0.23 mmol/l respectively). However, a statistically significant decrease in serum triglycerides and increase in serum high density lipoprotein cholesterol (HDL cholesterol) occurred during the same period (mean of 0.49 mmol/l and 0.13 mmol/l respectively). Serum low density lipoprotein cholesterol (LDL cholesterol) decreased in the same period (mean of 0.16 mmol/l). Serum sodium and potassium showed insignificant changes during the fasting month (mean of 1.6 mmol/l and 0.1 mmol/l respectively). Thus fasting for 1 month (Ramadan) affects NIDDM patients, serum HDL and LDL cholesterol and serum triglycerides favourably. The favourable changes in serum HDL and LDL cholesterol were observed up to 4 weeks after fasting. No significant changes in serum glucose total cholesterol sodium and potassium occurred during the same period.

The most common and serious complications of diabetes mellitus (DM) are accelerated coronary and peripheral vascular atherosclerosis.1-3 Lipid abnormalities in DM play a key role in the propensity to atherosclerosis and have been studied extensively.4,5 In non-insulin-dependent diabetes mellitus (NIDDM), hypertriglyceridaemia and low HDL levels are commonly seen.6 These abnormalities are reversed by long-term good diabetic control.7-9

In Jordan religious fasting during the month of Ramadan is widely practised even by diabetics. We undertook the study to look at the changes in the lipid profile of NIDDM during and after fasting. We studied changes in sodium and potassium levels for the same period to assess the impact of fasting and the unfavourable weather conditions on them.

Methods

Patients with NIDDM attending the medical clinics at PBTH (Princess Basma Teaching Hospital, Irbid,
Diabetes Mellitus during Ramadan

and who wished to fast, were invited to participate in the study. The study's aims were explained in detail to the patients and all of them gave their consent to the study. The study was carried out between 4 March 1990 and 19 May 1990. Fifty-six patients participated in the study, of whom 43 completed the full protocol. The results refer to these 43 patients unless otherwise specified.

The inclusion criteria to the study were:
1. patients of any age and either sex;
2. patients should have NIDDM and should have been receiving treatment with oral hypoglycaemic drugs or insulin for at least 5 months;
3. patients should wish to fast and be able to attend for blood sampling;
4. patients were not taking primary lipid modulating drugs, and should have had no change in their current medication of whatever type for at least 3 months prior to participating.

Blood samples were taken 2 weeks prior to the start of the fasting month. During Ramadan, blood samples were taken at the end of the second and fourth weeks. A fourth sample was taken 4 weeks after the end of the fasting month.

All blood samples were taken after at least 12 hours fasting and as far as possible at the same time of the day for all volunteers during the study period. During each visit the patient's weight was checked and dietary questionnaires were completed; however, due to logistical problems not all patients were assessed in this manner.

Triglycerides, total cholesterol, HDL and LDL cholesterol were assayed by standard enzymatic technique with spectrophotometric detection (Biomerieux Kits, France). Blood glucose was estimated using a glucose oxidase method (Diamond IMT kits, Jordan). Both techniques have been validated using standard external controls. Serum sodium and potassium were measured by flame photometry (Corning 405-England).

Data were analysed with the Minitab package for PC computers. All data were normally distributed. Repeated-measure analysis of variance (AOV) was done using multiple regression. We compared pre-fasting, fasting during the fourth week and post-fasting values. We also applied Scheffe’s multi-comparison procedure to assess the significance of changes in fasting values vs pre-fasting values and changes in fasting vs post-fasting values.

Results

Table 1 summarizes the characteristics of patients on entry into the study: 44% were male with an age range of 26–60 years and a median age of 50 years. One patient was on a diet. Forty patients were taking oral hypoglycaemic drugs, and two were taking insulin; 13 were taking other medications (other than for DM). Twelve patients had cardiovascular diseases namely hypertension and IHD.

Tables 2 and 3 show changes in lipids, glucose, electrolytes and weight during the study period. During that period, mean glucose levels were above the range indicative of acceptable control of DM. Glucose level showed a slight mean decrease of 0.33 mmol/l during the fourth week of Ramadan but this returned to pre-fasting values within 1 month of fasting. None of these changes were statistically significant.

Serum triglycerides showed a similar trend of a decrease in the fourth week of fasting (a mean decrease of 0.49 mmol/l); but it increased again in the post-fasting period (mean increase of 0.69 mmol/l). As shown in Table 3, these changes were barely statistically significant. Each period effect was significant (Scheffe’s test) but in opposite directions. The overall effect seems to be toward a borderline significance level.

Total serum cholesterol showed a mean decrease of 0.23 mmol/l during the fasting period. However, HDL cholesterol showed a highly significant increase. There was a mean increase of 0.13 mmol/l during the fourth week of Ramadan. That increase was maintained but of much smaller magnitude (mean of 0.03 mmol/l) for 4 weeks after fasting.

Changes in LDL cholesterol were the opposite of HDL but were not statistically significant. There was a mean decrease of 0.16 mmol/l during the 4th week of Ramadan. The decrease in LDL cholesterol was more impressive 4 weeks after Ramadan (mean of 0.53 mmol/l).

Serum sodium increased during the second half of Ramadan (mean 1.6 mmol/l). Potassium values hardly showed any change (mean 0.1 mmol/l) during the same

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<tr>
<th>Table 1</th>
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<tbody>
<tr>
<td>No.</td>
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<tr>
<td>Sex (m/f)</td>
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<tr>
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<td>2 glipizide)</td>
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<td>insulin</td>
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</tr>
<tr>
<td>others</td>
</tr>
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<td>Positive family history of DM</td>
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</tbody>
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period. None of these changes were statistically significant.

It is of interest to note (Table 4) that the lipid profiles of our patients were comparable with similar NIDDM populations. In fact, the levels were within or just above the normal ranges quoted in the literature.

**Discussion**

We were prompted to undertake this study by several observations. First, there is a high prevalence of DM in North Jordan. This is reflected in the large number of patients with DM attending the medical outpatient clinics in our hospital. Unfortunately there are no reliable epidemiological data about the true prevalence and incidence. The majority of patients have NIDDM and the incidence in children is very low. Second, there is a high incidence of all kinds of diabetic complications. The most distressing is the high incidence of foot amputations. Other risk factors for atherosclerosis are very common in our society. Smoking, hypertension, obesity and unhealthy diets are very prevalent.

Many factors appear to contribute to the enhanced atherosclerosis potential in diabetics. These include alterations in clotting factors, platelet dysfunction, altered arterial smooth muscle cell metabolism, abnormal plasma lipid and lipoprotein metabolism and altered blood pressure regulation.

Given the above, we took the opportunity to study the lipid profile in DM. The religious fasting month of Ramadan provided an opportunity to assess the effects of fasting on these profiles. During Ramadan, fasting from the ingestion of water and food is observed between sunrise and sunset, a period of 15 hours or more (depending on the season and location). Our study has shown that lipids undergo a favourable change during fasting. HDL has increased significantly. LDL, on the other hand has decreased. These changes persisted for a period of 4 weeks after fasting.
Such changes, if maintained for long periods, would have a favourable effect on atherosclerosis and its various manifestations. Total serum cholesterol did not show a significant change, but the trend was for a decrease during the fasting period. Triglycerides decreased significantly only during fasting.

It is interesting to note that these effects were seen during a relatively short period of fasting (1 month) and some of these favourable changes lasted for at least 4 weeks after that. However, more worrying is the fact that blood glucose levels did not change significantly during the same period, in spite of the intensive follow-up during the study period. This is likely to be a reflection of the poor diabetic control in general. The reasons for this are legion. Poor understanding of the disease, poor medical care, adverse socioeconomic factors and deep-rooted cultural attitudes all contribute.

We recognize some limitations in our study. The diet consumed by patients varied. We attempted to assess this variability by dietary questionnaire. Our own observations and an assessment of the dietary questionnaire suggest that diet, although different in Ramadan, did not change in its total caloric value nor in its major components. This is reflected in the fact that our patients' weight did not change significantly during the study period.

Nevertheless, the favourable changes in lipid profiles without similar changes in glucose levels suggest that dietary changes played a significant role. Yet fasting on its own may also be a major factor for the favourable changes.

Serum sodium and potassium changes were not clinically significant. It seems that the effect of fasting is minimal.

Despite all the limitations of our study, we think that some important conclusions can be drawn. Hypertriglyceridaemia was common in our diabetic patients. This is likely to be due to hyperglycaemia. HDL levels were below the normal range before fasting but increased during fasting. On the other hand LDL levels were within the normal range before fasting and tended to decrease with fasting. It is of note that the total serum cholesterol level in our patients was within the normal range during the various periods.

Such short-term studies should lead to long-term ones looking at the various aspects of DM in our community: its epidemiology, genetics, management and the various factors contributing to its complications. This could be facilitated by a diabetic register and specialized clinics. Our short study demonstrated that given the will and motivation, dietary changes (in content and timing) may contribute to a better control of diabetes and its complications, especially if maintained for long periods. It also showed that this is likely to be realistic and achievable. This message must be conveyed and stressed to all diabetics. A final comforting observation is that nearly all patients felt better during fasting.

Acknowledgements

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References