The objective of this article is to review important changes which may occur during Islamic fasting in diabetic patients and the safety of fasting during the Islamic month of Ramadan for diabetics. Despite diverse findings regarding the physiological impact of Ramadan on diabetics, researchers have not yet found, in the diabetics who fast, any pathological changes in body weight, blood glucose, HbA1c, C-peptide, insulin, fructosamine, cholesterol, or triglycerides. In the guidelines section of the article, we recommend that diabetic patients continue their regular daily activity and diet regimen. It is also critical that diabetics adjust their drug regimen, particularly those diagnosed as type 1 diabetes mellitus. These three important factors, i.e. drug regimen adjustment, diet control, and daily activity constitute the “Ramadan 3D Triangle”. With 3D attention, proper education, and diabetes management, we conclude that most type 2 and some type 1 diabetic patients who insist on fasting can carefully observe Ramadan.

Keywords • diabetes mellitus • Ramadan fasting

Introduction

Most of the world’s great, recognized, and accepted religions recommend a period of fasting or abstinence from certain foods. Of these, the Islamic fast during the Muslim month of Ramadan is strictly observed every year. Islam specifically outlines one full month of fasting from sunrise to sunset. The experience of fasting is intended to teach Muslims self-discipline and self-restraint, and reminds them of the plight of the impoverished. Muslims observing the fast are required to abstain not only from eating and drinking, but also from consuming oral medications or use of intravenous nutritional fluids.¹

The month of Ramadan covers a period of 28 to 30 days. The dates of observance differ each year because Ramadan is set to a lunar calendar. Fasting extends each day from dawn until sunset, a period that varies by geographical location and season. In summer months and northern latitudes, the fast can last up to 18 hours or more. Islam recommends that fasting Muslims eat a meal, called “Sahar”, before dawn.

Individuals are exempt from Ramadan fasting if they are suffering from an illness that could be adversely affected by fasting. They are allowed to abstain from fasting for one day to all 30 days, depending on the condition of their illness. People diagnosed as diabetes fall into this category and, although they are exempted from fasting, they prefer to fast and often loathe not being able to observe Ramadan. Physicians working in Muslim countries and communities commonly face the difficult task of advising diabetic patients on the safety of fasting as well as recommending the dietary and drug regimens diabetics should follow if they decide to fast. The lack of adequate literature on this subject makes it difficult to answer these questions. To judge correctly whether to medically permit a diabetic to fast, it is essential for physicians to have an in-depth understanding of the effect of Ramadan fasting on the pathophysiology of diabetes mellitus.² In this article, we first review the principles of carbohydrate metabolism and alterations of certain biochemical variables in diabetics observing Ramadan fasting. We then review the current medical recommendations that allow certain
Ramadan Fasting and Diabetes Mellitus

The physiological state of diabetics during Ramadan

Carbohydrate metabolism during Ramadan fasting in healthy persons

The effect of experimental short-term fasting on carbohydrate metabolism has been extensively studied. It has been uniformly found that a slight decrease in serum glucose to 3.3 – 3.9 mmol/L (60 to 70 mg/dL) occurs in normal adults a few hours after fasting has begun. However, the reduction in serum glucose ceases due to increased gluconeogenesis in the liver. That occurs because of a decrease in insulin concentration, a rise in glucagon, and sympathetic activity. In children aged one to nine years, fasting for a 24-hour period has caused a decrease in the blood glucose to half of the baseline figure for normal children of that age group. In 22% of these children, blood glucose fell below 40 mg/dL. Few studies have shown the effect of Ramadan fasting on serum glucose. One study showed a slight decrease in serum glucose during the first days of Ramadan, followed by normalization by the 20th day and a slight rise by the 29th day of Ramadan. The lowest serum glucose level in this study was 63 mg/dL. Others have shown a mild increase or variation in serum glucose concentration, but all of them fell within physiological limits. From the foregoing studies, one may assume that the stores of glycogen along with some degree of gluconeogenesis maintain normal limits of serum glucose when a fast follows a large predawn meal. However, slight changes in serum glucose may occur in individuals depending upon food habits and individual differences in metabolism and energy regulation.

Body weight during Ramadan fasting

(a) In normal subjects:
Weight losses of 1.7 kg, 1.8 kg, 2.0 kg, and 3.8 kg have been reported in normal weight individuals after they have fasted for the month of Ramadan. In one study that was overrepresented by females, no change in body weight was seen. It has also been reported that overweight persons lose more weight than normal or underweight subjects.

(b) In diabetics:
A review of literature shows controversy about weight changes in diabetics during Ramadan. In one group of studies, patients had an increase in their weight. In another group, there was no change or a decrease in body weight. While no food or drink is consumed between dawn and sunset during the month of Ramadan, there is no restriction on the amount or type of food consumed at night. Furthermore, most diabetics reduce their daily activities during this period in fear of hypoglycemia. These factors may result in not only a lack of weight loss, but also a weight gain in such patients (see later discussion about nutrition and physical activity).

Blood glucose variations during Ramadan fasting in diabetics

Most patients show no significant change in their glucose control. In some patients, serum glucose concentration may fall or rise. This variation may be due to the amount or type of food consumption, regularity of taking medications, engorging after the fast is broken, or decreased physical activity. In most cases, no episode of acute complications (hypoglycemic or hyperglycemic types) occurs in patients under medical management, only a few cases of biochemical hypoglycemia without clinical hazards have been reported.

Other parameters of diabetes control during Ramadan fasting

In general, HbA1c values show no change or even improvement during Ramadan. Only three studies have reported slight increases in glycated hemoglobin levels while another has shown a return to initial levels immediately after the month of Ramadan. The amount of fructosamine, insulin, and C-peptide have also been reported to show no significant change before and during Ramadan fasting.

Energy intake and serum lipid variables during Ramadan fasting in diabetics

The amounts of energy (calorie) intake reported in some studies indicated a decrease in energy intake. Most patients with diabetes type 2 and type 1 show no change or a slight decrease in serum concentrations of total cholesterol and triglyceride.
cholesterol levels during Ramadan seldom occurs.23 As in healthy persons, 34 – 37 few studies have reported increases in high-density-lipoprotein (HDL) cholesterol in diabetics during Ramadan.18,19,27,31 One report indicates an increase in low-density-lipoprotein (LDL) cholesterol and a decrease in HDL cholesterol.28 Another article reports increases not only in APO A-1 and APO A-1/APO B and APO A-1/HDL ratios but also in serum concentrations of triglycerides and APO B.38 Until there is a standardization of the research on the three fundamental factors affecting diabetes in Ramadan (the Ramadan 3D Triangle of drug regimens, diet control, and daily activity), the beneficial or hazardous effects of Ramadan fasting on the serum lipids of diabetics will remain unclear.

Other biological parameters during Ramadan fasting in diabetics

Serum creatinine, uric acid, blood urea nitrogen, total protein, albumin, alanine aminotransferase, and aspartate aminotransferase values do not show significant changes during fasting periods. 15, 17, 32 The slight nonsignificant increases in some biological parameters may be due to dehydration and metabolic adaptation and have no clinical importance.

Fasting guidelines for diabetics

During the past two decades, a better understanding of pathophysiological changes during Ramadan fasting in diabetic patients has provided a few guidelines on how to advise the diabetics who wish to fast. Physicians working with Muslim diabetics should employ certain criteria to advise their patients regarding the safety of Ramadan fasting.

The following criteria should be helpful in making such a decision:20, 39

Forbid fasting in:

- all brittle type 1 diabetic patients;
- poorly-controlled type 1 or type 2 diabetic patients;
- diabetic patients who do not usually comply with diabetic regimens for diet, drug, and daily activity;
- diabetics with serious complications such as unstable angina or uncontrolled hypertension;
- patients with a history of diabetic ketoacidosis;
- pregnant diabetics;
- diabetic patients with intercurrent infections;
- elderly patients with any degree of alertness problems; and
- patients with a history of two or more episodes of hypoglycemia and/or hyperglycemia during Ramadan.

Allow fasting in:

- patients who do not have the aforementioned criteria and comply well with medical advice.

Encourage fasting in:

- all overweight type 2 patients (except for pregnant or nursing mothers) whose diabetes is stable with weight levels 20% above the ideal weight or body mass index above 28 kg/m².

Education of diabetics before Ramadan

NIDDM patients and type 1 patients who insist on fasting should be given a few recommendations about fasting.16 They should be forbidden from skipping meals, taking medications irregularly, or gorging after the fast is broken.26 The principles of pre-Ramadan considerations are:

a) assessment of physical well being;
b) assessment of metabolic control;
c) adjustment of the diet protocol for Ramadan fasting;
d) adjustment of drug regimen (e.g. change long-acting hypoglycemic drugs to short-acting ones to prevent hypoglycemia);
e) encouragement of continued proper physical activity; and
f) recognition of warning symptoms of dehydration, hypoglycemia, and other possible complications.

Recommendations during Ramadan fasting

I. Nutrition and Ramadan fasting:

Dietary indiscretion during the nonfasting period with excessive gorging or compensatory eating of carbohydrate and fatty foods may contribute to hyperglycemia and weight gain.21, 23 It has been emphasized that the benefits of Ramadan fasting appear only in patients who maintain their appropriate diets.24, 40, 41 Thus, in order to optimize control, diabetics must be reminded to abstain from high-calorie and highly-refined foods prepared during this month.40

II. Physical activity and Ramadan fasting:
Several studies indicate that light to moderate regular exercise during Ramadan fasting is harmless for NIDDM patients. It has been shown that fasting does not interfere with tolerance to exercise. It should be impressed upon diabetic patients that it is necessary to continue their usual physical activity especially during nonfasting periods.

III. Drug regimens for IDDM patients:
Some experienced physicians conclude that Ramadan fasting is safe for IDDM patients with proper self-monitoring and close professional supervision. It is fundamental to adjust the insulin regimen for good IDDM control during Ramadan fasting. Three insulin therapy methods have been studied successfully:

1. Three-dose insulin regimen: Two doses before meals (sunset and dawn) of short-acting insulin and one dose in the late evening of intermediate-acting insulin.

2. Two-dose insulin regimen: Evening insulin combined with short-acting and medium-acting insulin equivalent to the previous morning dosage, and a predawn insulin consisting only of a regular dosage of 0.1 – 0.2 unit/kg.

3. Replacing regular insulin by insulin lispro: It has been shown that postprandial glycemic excursions improve and the rate of hypoglycemia is reduced by lispro, both in type 1 and type 2 diabetic patients.

Home blood glucose monitoring should be performed just before the sunset meal and three hours afterwards. It should also be performed before the predawn meal to adjust the insulin dose and prevent any hypoglycemia and postprandial hyperglycemia following overeating.

IV. Drug regimens for type 2 diabetic patients:
Available reports indicate that the overweight NIDDM patients who observe fasting in Ramadan encounter no major problems. With proper changes in the dosage of hypoglycemic agents, the risk of hypoglycemia and hyperglycemia is greatly reduced.

Investigators of the largest series of patients treated with glibenclamide during Ramadan recommended that diabetics swap the morning dose (together with any mid-day dose) of this drug with the dosage taken at sunset. A better glycemic control has also been reported using repaglinide.

V. Other health tips for reduction of complications:
1. Implementation of the Ramadan 3D Triangle of drug regimens, diet control, and daily activity as the three pillars for more successful fasting during Ramadan.

2. Diabetic home management that consists of:
   - home blood glucose monitoring especially for type 1 patients, as described above;
   - checking urine for acetone (type 1 patients);
   - measuring daily weights and informing physicians of weight reduction (dehydration, low food intake, and polyuria) or weight increase (excessive calorie intake) above two kilograms; and
   - recording daily diet intake (prevention of excessive or insufficient energy consumption).

3. Education about the warning symptoms of dehydration, hypoglycemia, and hyperglycemia.

4. Education about breaking or discontinuing the fast as soon as any complication or new harmful condition occurs.

5. Immediate medical care for diabetics who need emergency care, rather than waiting for medical assistance when available.

6. Further attention on fasting during the summer season and geographical areas with longer fasting hours.

VI. Children with type 1 diabetes and Ramadan fasting:
We do not encourage fasting for these children. However, a few studies have demonstrated that fasting is safe among diabetic adolescents. Of these studies, one concludes that Ramadan fasting is feasible in older children and those who have had diabetes for a long time; it indicates that fasting does not alter short-term metabolic control. Nevertheless, fasting should only be encouraged in children with good glycemic control and regular blood glucose monitoring at home.

Post-Ramadan supervision of fasting diabetics
After the month of Ramadan ends, the patients’ therapeutic regimen should be changed back to its previous schedule. Patients should also be required to receive education about the general impacts of fasting on their physiology.

The research methodology on diabetics during Ramadan
From a methodological point of view, few research papers on Ramadan fasting are relevant because of the absence of control periods before Ramadan and afterwards; the absence of measurements during each week of Ramadan; a
lack of attention to dietary habits, food composition, food value, caloric control, and weight changes; and the importance of the schedule during circadian periods.

It is recommended that all these factors be taken into consideration and that all intervening and confounding variables be kept under control. It is clear that more work should be done on Ramadan fasting to evaluate the relevant physiological and pathological changes with proper research methods.

Fasting during the entire month of Ramadan is usually obligatory for healthy Muslims. However, many diabetic patients are allowed to fast periodically during Ramadan. The magnitude of periodic total fasting effect on blood glucose and hepatic glucagon depends on the number of fasting days, and this should be considered in all Ramadan fasting research activities.

Conclusion

The bulk of literature indicates that fasting in Ramadan is safe for the majority of diabetic patients with proper education and diabetic management. Most NIDDM patients can fast safely during Ramadan. Occasional IDDM patients who insist on fasting during Ramadan can also fast if they are carefully managed. Strict attention to diet control, daily activity, and drug regimen adjustment is essential for successful Ramadan fasting.

To shed more light on pathophysiological changes in Ramadan fasting, particularly in Muslim diabetics, it is recommended that a multicentric international controlled clinical trial be employed to assess the effect of differences in gender, race, physical activity, food habits, sleep patterns, and other important variables on the physiological and pathological conditions during Ramadan fasting.

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