



Original research

Attitudes and habits of patients with type 1 diabetes during fasting Ramadan[☆]

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A B S T R A C T

Objective: Fasting Ramadan is associated with changes in lifestyle patterns of patients with diabetes who choose to perform fasting. We aimed to determine the attitude and habits of patients with type 1 diabetes during fasting Ramadan.

Methods: The study comprised a prospective cohort of patients with type 1 diabetes who were on insulin pump or multiple daily insulin injections (MDI) regimen. Patient questionnaires included the frequency of self-monitoring of blood glucose (SMBG), the need to make changes in insulin regimen by patients, timings of insulin administration, performing carbohydrate counting and levels of physical activity.

Results: A total of 156 patients were studied (61 patients on insulin pump and 95 patients on MDI). Patients on pump therapy performed SMBG more frequently than those on MDI regimen (4.8 ± 1.4 and 3.7 ± 1.7 times per day, respectively, $P = 0.001$) and were more likely to perform carbohydrate counting (32.7% and 8.4% of pump and MDI patients, respectively, $P < 0.001$). There was no difference in the percentage of patients who made changes in insulin doses (74.5% of the pump group and 77.3% of MDI patients) or those who had any level of physical activity (12.5% of the pump group and 21.1% of the MDI group). The timing of administering meal insulin in relation to sunset meal was variable with a preference to taking the injection immediately at sunset. There was no difference in glucose control between both groups as measured by fructosamine levels or the number of days that patients have to stop fasting.

Conclusion: Fasting Ramadan is associated with significant and variable changes in the attitude and behaviors of patients with type 1 diabetes with no difference in glucose control between patients on insulin pump or MDI regimen. Further studies are needed to define the role of education and its effect on these attitudes and patient care in this population.

[ClinicalTrials.gov](https://clinicaltrials.gov) Identifier: NCT01941238.

Fasting the month of Ramadan is a fundamental religious practice performed by millions of Muslims every year. Fasting Ramadan has been shown to be associated with an increased risk of hypoglycemia and glycemic deterioration in some patients with diabetes, particularly type 1 diabetes [1,2]. During this month and depending on culture patients adapt many changes that affect eating habits, physical activity and sleep patterns. Food intake becomes exclusively nocturnal and is characterized by a large fast-breaking meal at sunset commonly with large portions of carbohydrate-rich food. In the majority of Muslim countries, the working hours are reduced and patients' daily activity pattern changes where the main activity occurs at night and much less activity prevails during daytime. Patients with type 1 diabetes are considered high risk for acute complications during Ramadan and expert professional guidelines advice that these patients should not fast [2,3]. Despite that it was reported that about 43% of those patients fast

during Ramadan [4]. Often these patients would fast without medical guidance which may lead to the development of acute complications [1]. Therefore, managing patients with type 1 diabetes during fasting Ramadan can be challenging. Assessment of lifestyle aspects of those patients is important in order to address required changes in insulin doses and timing of insulin administration to assure safe fasting. Clinical studies addressing fasting in patients with type 1 diabetes are limited. We aimed to examine the attitude and daily habits of patients with type 1 diabetes who fast Ramadan, comparing patients on insulin pump with those on multiple daily insulin injections (MDI).

Methods

The study comprised of a prospective cohort of patients with type 1 diabetes who were either on insulin pump or MDI regimen attending

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diabetes clinics in Ministry of National Guard hospitals in three cities in Saudi Arabia. All patients planning fasting Ramadan were offered to participate. Patients were included if they were ≥ 14 years of age and were diagnosed with type 1 diabetes for at least 6 months and on either insulin pump (for at least 3 months) or MDI regimen which included a basal insulin (Glargine or Detemir) with a rapid-acting insulin (Aspart, Glulisine or Lispro). Patients were required to have two study visits, one at 1–2 months before the start of Ramadan and the other visit after the end of the month. Demographic data and data on the frequency of performing self-monitoring of blood glucose (SMBG), eating habits, performing carbohydrate counting, presence of physical activity, self-management of insulin doses, timing of meal (or bolus) insulin in relation to meals were collected using self-administrable questionnaires. The questionnaire was validated on a pilot of patients before starting the study. Eating habits at the time of breaking of fasting at sunset “Iftar” was assessed as there are different practices including taking the main meal immediately at sunset, after sunset prayer or late evening. Timing of taking meal insulin in relation to iftar meal, using insulin at pre-dawn meal “Suhur” and taking an extra meal at midnight with or without insulin were assessed. Levels of physical activities were categorized into active, not active enough and inactive. Active was defined as more than 15 minutes of medium exercise or 60 minutes of heavy exercise per week. Not active enough was defined as 30 to less than 150 minutes of medium exercise per week. Inactive was defined as less than 30 minutes of medium exercise per week. The intensity of physical activity was defined as medium exercise which included only walking and heavy exercise which included jogging or running. All patients received standardized diabetes education according to the curriculum of the international diabetes federation. The aspects of diabetes care including adjustment of insulin doses were left to be managed at the discretion of the treating physician. Patients accustomed to making adjustments to their insulin doses based on results of SMBG and carbohydrate counting were allowed to continue to do so. The number of days that patients had to break their fast along with accompanied reasons – usually hypoglycemia or significant hyperglycemia- was assessed. Due to the risk of fasting in patients with type 1 diabetes and following professional guidelines of target fasting and premeal glucose levels of 4.4–7.2 mmol/L [5], a capillary glucose value of < 4.4 mmol/L was defined as hypoglycemia. Patients were advised to stop their fast if they had hypoglycemia or significant hyperglycemia-defined as a glucose value of > 16.6 mmol at any time of the day [3]. Glucose control was assessed by measuring serum fructosamine levels before and after the month of Ramadan. This study reports data focused on attitudes and behaviours, data on hypoglycemia using CGM and SMBG have been reported in a separate publication [20].

Statistical analysis

Data was entered and analysed using the Statistical Package of Social Sciences (SPSS). Continuous results were expressed as means and SDs or medians and interquartile ranges according to the data distribution, and categorical data was presented as proportions with 95% confidence intervals. Between-group comparison was done using a student-*t*-test or Mann-Whitney *U* test where the data are not normally distributed. For categorical data, chi square test (with Yates’ correction or Fisher’s exact test where appropriate) were used. The level of statistical significance was chosen as $P \leq 0.05$ (two-sided).

Results

A total of 156 patients with type 1 diabetes were studied, 61 patients on insulin pump and 95 patients on MDI regimen. The baseline characteristics of patients are shown in Table 1. The mean age, mean duration of diabetes, body mass index and level of education were not

Table 1
Baseline characteristics of study groups.

	Insulin pump (n = 61)	MDI (n = 95)	P value
Gender			
Male	18 (29.5%)	41 (43.2%)	0.09
Female	43 (70.5%)	54 (56.8%)	
Age (years)	23.4 \pm 06.1	21.3 \pm 06.3	0.04
Educational level			
Elementary/Intermediate	3 (5%)	13 (13.8%)	0.23
High school	25 (41.7%)	42 (44.7%)	
University	31 (51.7%)	37 (39.4%)	
Duration of diabetes (years)	10.8 \pm 05.4	9.3 \pm 06.6	0.19
BMI	26.4	25.8	0.51
HbA1c % (mmol/mol)	8.5 \pm 1.6 (69.4 \pm 9.6)	9.3 \pm 2.3 (78.1 \pm 17.3)	0.04
Fructosamine (μ mol/L)	385.6 \pm 76.1	409.2 \pm 95.5	0.12
Perform carbohydrate counting	20 (32.7%)	8 (8.4%)	< 0.001
Performed SMBG ≥ 4 times/day	35 (57.4%)	23 (24.5%)	0.001
Physical Activity*			
Active	15 (25.0%)	18 (20.2%)	0.76
Not active enough	25 (41.7%)	41 (46.1%)	
Inactive	20 (33.3%)	30 (33.7%)	

BMI, Body Mass Index; HbA1c, glycated hemoglobin. *Active:(> 150 mins of medium exercise or 60 mins of heavy exercise per week); Not active enough: (30 to < 150 mins of medium exercise per week/week); Inactive: (< 30 mins of medium exercise per week), *SMBG: self-monitoring of blood glucose.

different in the insulin pump patients and MDI group while HbA1c levels were significantly lower in the insulin pump group compared to the MDI group [8.5 \pm 1.6% (69.4 \pm 9.6 mmol/mol) versus 9.3 \pm 2.3% (78.1 \pm 17.3 mmol/mol, $P = 0.045$]. Levels of serum fructosamine were not different between both groups before Ramadan (385.6 \pm 76.1 μ mol/L in the insulin pump group and 409.2 \pm 95.5 μ mol/L in the MDI group, $P = 0.12$).

Table 2 shows the behaviors and attitudes of studied patients during Ramadan. Carbohydrate counting was performed by more patients in the insulin pump group compared to the MDI group, 36.1% and 26.1%, respectively, $P < 0.001$. SMBG was performed 4 times or more daily by 57.4% of the pump group compared to 24.5% of the MDI group, $P < 0.001$. A higher number of patients in both groups performed SMBG 2 times or more daily, with more patients doing so in the insulin pump group (95% of the pump group and 77.6% of the MDI group, $p < 0.01$). Fig. 1 shows the difference between the two groups in favored time of day performing SMBG. There was a significant difference in patients who reported omitting at least one daily insulin dose between both groups: 27.6% of the pump group (not taking bolus insulin doses) compared to 57.6% of the MDI group, $p = 0.005$. Planning to change insulin doses in Ramadan was reported by 54.1% of the pump group versus 36.8% of the MDI group, $P = 0.037$. However, during Ramadan more patients in both groups made adjustments to their insulin doses with an end result of no difference between both groups (74.5% of the pump group and 77.3% of the MDI group, $P = 0.751$). The timing of taking the main meal in relation to sunset (Iftar) along with timing of taking meal insulin varied significantly among patients, but did not vary between the insulin pump and MDI groups. The favored time for taking the main meal was at sunset call for prayer (54.3% of patients) followed by taking a small meal at sunset then consuming the main meal immediately after sunset prayer (34.5% of patients). Meal insulin at Iftar was administered in the majority of patients at sunset call (60.6% of patients).

There was no difference in the percentage of patients who performed any type of physical activity during Ramadan (81.3% of the pump group and 77.5% of the MDI group). Most patients (78.7% of the

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