

Suggested Insulin Regimens for Patients with Type 1 Diabetes Mellitus Who Wish to Fast During the Month of Ramadan

Abdallah Kobeissy, MD; Mira S. Zantout, BSc; and Sami T. Azar, MD

Department of Internal Medicine, Division of Endocrinology, American University of Beirut Medical Center, Beirut, Lebanon

ABSTRACT

Objectives: This paper reviews available information on insulin regimens that may enable patients with type 1 diabetes mellitus to fast during the month of Ramadan with minimal complications. It also provides guidance for health care professionals in managing patients who wish to observe the fast.

Methods: Relevant English-language articles were identified through searches of the MEDLINE, EMBASE, and Index Medicus Eastern Mediterranean Region databases (all, 1980–2008) conducted in February 2008 using the terms *Ramadan*, *fasting*, *type 1 diabetes mellitus*, *hypoglycemia*, and *hypotension*. Only original research and review articles related to adult patients with type 1 diabetes were considered for review, excluding pregnant women and patients with poorly controlled disease.

Results: The literature review identified 5 clinical trials relevant to type 1 diabetes and fasting. Two main meals are eaten during Ramadan, one before dawn (*Suhur*) and the other at sunset (*Iftar*). Suggested adjustments to the insulin regimen during fasting include using 70% of the pre-Ramadan dose, divided as follows: 60% as insulin glargine given in the evening and 40% as an ultra–short-acting insulin (insulin aspart or lispro) given in 2 doses, 1 at *Suhur* and 1 at *Iftar*. Alternatively, 85% of the pre-Ramadan dose may be divided as 70% Ultralente and 30% regular insulin, both given in 2 doses, 1 at *Suhur* and 1 at *Iftar*. Another option is to give 100% of the pre-Ramadan morning dose of 70/30 premixed insulin at *Iftar* and 50% of the usual evening dose at *Suhur*. Patients who observe the fast should be advised to monitor their blood glucose regularly, avoid skipping meals or over-eating, and maintain contact with their physician throughout the fast. The fast should be broken immediately if blood glucose drops below 60 mg/dL (3.3 mmol/L). Breaking the fast should be considered when blood glucose drops below 80 mg/dL (4.4 mmol/L),

and the fast should be interrupted if blood glucose rises above 300 mg/dL (16.7 mmol/L) to avoid diabetic ketoacidosis. Fasting is contraindicated in patients with poorly controlled type 1 diabetes, including those with a history of severe hypoglycemia and/or diabetic ketoacidosis at least 3 months before Ramadan; those with comorbid conditions (eg, unstable angina, uncontrolled hypertension, advanced macrovascular complications, infections, renal insufficiency); those who are noncompliant with diet and medication; those who engage in intense physical activity; pregnant women; and the elderly.

Conclusion: Patients with type 1 diabetes who wish to fast during Ramadan should follow specific recommendations and be closely monitored by their physician. (*Clin Ther.* 2008;30:1408–1415) © 2008 Excerpta Medica Inc.

Key words: type 1 diabetes, Ramadan, fasting, insulin therapy.

INTRODUCTION

Each year, Muslims around the world observe a period of fasting during Ramadan, the ninth lunar month of the Islamic year.¹ It is a religious obligation for all healthy adult Muslims to fast during Ramadan.² This involves refraining from eating, drinking, smoking, or taking medications (orally or parentally) from dawn to sunset each day—approximately 11 to 20 hours, depending on the geographic location and season^{1,2}—for 28 to 30 days.^{1,3} Two main meals are eaten during Ramadan, one before dawn (*Suhur*) and the other at sunset (*Iftar*).^{1,2} Between *Iftar* and *Suhur*, there is no restriction on the intake of food or fluids.⁴

Accepted for publication July 3, 2008.
doi:10.1016/j.clinthera.2008.08.007
0149-2918/\$32.00

© 2008 Excerpta Medica Inc. All rights reserved.

If an individual has a medical condition that would be adversely affected by fasting during Ramadan, the rules of Islam exempt this individual from the obligation to fast for as many days as are necessary.^{4,5} Patients with type 1 diabetes mellitus fall into this category, and their physicians generally advise them not to fast because of difficulties in maintaining glycemic control and the potentially serious complications.^{4,6,7} However, some patients may be determined to fast, even against the advice of their physicians, and some may not consult their physician at all.^{5,8} According to the Epidemiology of Diabetes and Ramadan study,⁹ a population-based retrospective survey conducted during Ramadan in 13 countries, 42.8% of patients with type 1 diabetes fasted for at least 15 days. Of these patients, 10.3% were not followed by a specialist, and 76.0% were reported to obtain advice on diabetes care from relatives.

On the other hand, physicians may allow their patients to fast, provided the patients are followed closely and perform appropriate self-monitoring.¹⁰ However, there is uncertainty about what lifestyle practices and insulin regimens to recommend for patients with type 1 diabetes who wish to fast during Ramadan. Therefore, this article reviews available information on Ramadan fasting in this patient group and identifies insulin regimens that may enable patients to fast with minimal complications. It also provides guidance for health care professionals in managing patients who wish to observe the fast.

METHODS

Relevant English-language articles were identified through searches of the MEDLINE, EMBASE, and Index Medicus Eastern Mediterranean Region databases (all, 1980–2008) conducted in February 2008 using the terms *Ramadan*, *fasting*, *type 1 diabetes mellitus*, *hypoglycemia*, and *hypotension*. Original research and review articles related to adult patients with type 1 diabetes were considered for review, excluding pregnant women and patients with poorly controlled disease.

POTENTIAL RISKS OF FASTING IN PATIENTS WITH TYPE 1 DIABETES

Because the dietary pattern during Ramadan consists of 2 meals separated by many hours without food, patients with type 1 diabetes may be more susceptible than others to serious complications. These complica-

tions include hypoglycemia, hyperglycemia, diabetic ketoacidosis, dehydration, and thrombosis.^{1,6,9,11}

Hypoglycemia

Hypoglycemia accounts for 2% to 4% of overall mortality in patients with type 1 diabetes.¹² Generally, patients with type 1 diabetes who fast during Ramadan have an increased risk of hypoglycemia.^{1,9} One study reported a 4.7-fold increase in the risk of severe hypoglycemia during Ramadan in patients with type 1 diabetes, from 3% in the month before to 14% during the month of fasting ($P = 0.017$).⁹ This increase in hypoglycemic events is believed to be mainly the result of decreased food intake during the hours of fasting. Hypoglycemia may be exacerbated by the disturbance in counterregulatory hormone secretion in patients with type 1 diabetes who take insulin regularly. In these patients, glucagon levels may not increase appropriately in response to hypoglycemia.^{1,2,13–16} An additional potential mechanism is the defect in epinephrine secretion due to autonomic neuropathy that is a common complication in many patients with diabetes.^{15,16}

Hyperglycemia and Diabetic Ketoacidosis

Hyperglycemia is a well-established cause of both direct and late complications of diabetes, and one of its serious direct complications is diabetic ketoacidosis. One study reported an ~3-fold increase in the number of episodes of severe hyperglycemia with or without ketoacidosis (from 5% to 16%) in patients with diabetes who fasted during Ramadan.⁹ This increased frequency of hyperglycemia/diabetic ketoacidosis may be attributed to 2 main causes: decreasing the insulin dose to prevent the occurrence of hypoglycemia (24% of patients reported reducing their insulin dose compared with their usual requirement⁹) and the increased caloric content of food typically consumed in the form of carbohydrates, sugary fluids, juices, and fatty meals during the month of Ramadan.^{2,8,11–13}

Dehydration and Thrombosis

Decreased food and fluid intake during the hours of fasting creates a predisposition to dehydration, which is further increased in hot climates. The reduction in fluid intake, accompanied by the osmotic diuretic effect of hyperglycemia, may further contract the intravascular volume, leading to orthostatic hypotension. In the setting of diabetic neuropathy, dysfunction of the autonomic response to hypotension

may result in syncope¹⁷ and its serious sequelae. Contraction of the intravascular volume may lead to increased viscosity of the blood, which may worsen the hypercoagulable state in patients with diabetes,¹⁸ leading to an increased risk for thrombosis.

RESULTS

There are few guidelines concerning what type of insulin to use or how and when to adjust the dosage to minimize complications in patients with type 1 diabetes who wish to fast during Ramadan. The literature review identified 5 clinical trials that were relevant to type 1 diabetes and fasting. Four trials had a prospective, open-label design,^{6,19-21} and 1 had an open-label, crossover, comparative design (Table I).² Some of these trials examined the general feasibility of fasting in patients with type 1 diabetes, whereas others specifically addressed fasting during Ramadan, suggesting possible insulin regimens for use during the fast and discussing the advantages and disadvantages of various insulin regimens and types of insulins.

A prospective, open-label study by Khairallah et al⁶ examined the use of insulin glargine (long acting) and insulin lispro or aspart (ultra-short acting) divided in a 6:4 ratio in 9 patients with type 1 diabetes (5 men, 4 women) over the month of Ramadan. Among the 5 patients who were able to fast for the entire month, there was a significant 28% decrease from baseline in the insulin requirement ($P = 0.002$). One patient discontinued the fast because of hyperglycemia that developed on the first day of the adjusted insulin regimen; 2 patients broke the fast because of episodes of daytime hypoglycemia; and 1 discontinued for personal reasons. No worsening of glycemic control was noted at the end of Ramadan (0.2% decrease in glycosylated hemoglobin [HbA_{1c}]). One subject reported several episodes of mild hypoglycemia over the course of the fast, but there were no episodes of hypoglycemia or diabetic ketoacidosis that required hospitalization. The authors suggested adjusting the insulin regimen by giving 70% of the pre-Ramadan doses.

A prospective, open-label study by Kassem et al¹⁹ evaluated the use of a combination of Ultralente and regular insulin in a 7:3 ratio of the total insulin dose in 17 patients with type 1 diabetes (9 women, 8 men; mean [SD] age, 18.8 [4.9] years) over the month of Ramadan. All subjects completed their fast successfully, with a 13% reduction in the insulin requirement ($P < 0.001$). There were no reported episodes of severe

hypoglycemia that necessitated hospitalization. As in the previous study, there was no significant change in HbA_{1c} from before to after Ramadan (9.0% and 9.2%, respectively). The authors recommended that the total insulin dose be reduced to 85% of the pre-Ramadan dose.

An open-label, comparative, crossover study by Kadiri et al² compared regular insulin with insulin lispro, both given with neutral protamine Hagedorn (NPH) insulin, over a 2-week period in 64 patients with type 1 diabetes (43 men, 21 women; mean [SD] age, 31.8 [1.8] years). All patients completed the study. Insulin lispro was significantly better than regular insulin in terms of the 2-hour glucose level after the sunset meal ($P = 0.026$) and the incidence and frequency of hypoglycemic events ($P < 0.001$). This study did not include a specific adjustment of the pre-Ramadan insulin dose; patients performed regular self-monitoring and adjusted the dose accordingly.

Reiter et al²⁰ studied the tolerability of prolonged fasting (25 hours) in 56 patients with type 1 diabetes (31 women, 25 men), of whom 39 (22 women, 17 men; mean age, 18.4 years) were administering multiple daily insulin injections and the remainder were using an insulin pump. (Data for the 2 groups were reported separately; the latter group was not discussed in this publication.) Patients were to take from one third to half of their usual insulin dose before beginning the fast and after breaking the fast, and were instructed to discontinue fasting if they developed hypoglycemic symptoms or if their glucose level decreased to <80 mg/dL. Of the 39 participants, 67% completed the fast successfully and the rest broke the fast because of hypoglycemic events. Those who completed the fast had significantly higher baseline HbA_{1c} values compared with those who were unsuccessful (mean [SD], 9.0% [1.6%] vs 8.2% [1.2%], respectively; $P = 0.034$) and had a significantly greater reduction in insulin dose (65.7% vs 50.3%; $P = 0.046$). The difference in baseline HbA_{1c} values was a limitation of the study. Subjects monitored their blood glucose every 2.5 waking hours during the 25-hour fast, and no serious complications were reported. The authors suggested giving 75% of the usual rapid-acting insulin dose and 25% of the usual long-acting insulin dose before the Iftar meal. They added that the long-acting insulin may be given at any time in the evening after Iftar.

Mucha et al²¹ evaluated insulin glargine for the maintenance of glycemic control in 15 patients with

Table I. Clinical trials of Ramadan fasting in patients with type 1 diabetes.

Authors	No. of Patients	Age, Mean (SD), y	Duration of Fasting	HbA _{1c} , Mean (SD), %		Insulin Type	Results
				Before Fasting	After Fasting		
Khairallah et al ⁶ Prospective, OL	5 M, 4 F	NA	30 d	7.7 (0.7)	7.5 (0.8)	Glargine and lispro or aspart (6:4 ratio of total dose)	Dose reduction: 28% ($P = 0.002$)
Kassem et al ¹⁹ Prospective, OL	9 F, 8 M	18.8 (4.9)	30 d	9.0 (1.7)	9.2 (2.0)	Ultralente and regular (7:3 ratio of total dose)	Dose reduction: 13% ($P < 0.001$)
Reiter et al ²⁰ Prospective, OL	22 F, 17 M	18.4 (NA)	25 h	8.7 (1.5)	NA	Any combination of long- and rapid-acting insulins	Dose reduction: 65.7%
Mucha et al ²¹ Prospective, OL	8 M, 7 F	41 (NA)	18 h	6.7	NA	Glargine and a rapid-acting insulin	NA
Kadiri et al ² OL, CO, comparative	43 M, 21 F	31.8 (1.8)	2 wk	NA	NA	NPH/lispro vs NPH/regular	Significant differences in 2-h glucose after sunset meal ($P = 0.026$, lispro vs regular) and incidence of hypoglycemia ($P < 0.001$, lispro vs regular)

HbA_{1c} = glycosylated hemoglobin; OL = open label; M = male; F = female; NA = not available; CO = crossover; NPH = neutral protamine Hagedorn.

type 1 diabetes (8 men, 7 women; mean age, 41 years) during an 18-hour fast. The study was conducted over 2 days; the first day was considered a control day and included 3 meals, whereas the second day was the fast day, with meals at Suhur and Iftar. Patients received their usual dose of insulin glargine at bedtime along with a rapid-acting insulin before each meal (dose estimated based on self-monitoring). This regimen was well tolerated and euglycemia was maintained. Two episodes of hypoglycemia were reported on the day of fasting, compared with 8 episodes on the control day. Because the study duration was short, it was not possible to extrapolate the glycemic-control or tolerability findings to a full month of fasting. Moreover, the authors did not recommend an insulin regimen or dose adjustment that could be used by fasting patients with type 1 diabetes.

A prospective study by Al Nakhi et al¹⁰ in 15 patients (9 male, 6 female), 11 of whom had type 1 diabetes, examined a 3-dose insulin regimen that consisted of 2 doses of short-acting insulin before Iftar and Suhur, and 1 dose of intermediate-acting insulin administered at bedtime. All patients completed the month of fasting with no reported episodes of hypoglycemia or diabetic ketoacidosis.

DISCUSSION AND RECOMMENDATIONS

There are no definitive recommendations for the management of patients with type 1 diabetes who wish to fast during Ramadan.⁴ The few published trials included small numbers of patients who had borderline glycemic control (HbA_{1c} 7%–8%) at baseline. Furthermore, these studies did not include adolescents, the elderly, or patients with concomitant medical conditions (eg, renal impairment). The studies did not employ control periods before and after fasting. Therefore, their recommendations cannot be generalized to all fasting patients with type 1 diabetes.

Until further evidence and evidence-based recommendations become available, physicians should follow general guidelines in counseling their patients who wish to fast, without overlooking the need for individualized care. First, we suggest screening patients according to the following criteria. Fasting is contraindicated in patients with poorly controlled type 1 diabetes, including those with a history of severe hypoglycemia and/or diabetic ketoacidosis at least 3 months before Ramadan.^{1,3} The presence of comorbid conditions such as unstable angina, uncon-

trolled hypertension, advanced macrovascular complications, infections, and renal insufficiency are further contraindications to fasting.¹¹ Finally, fasting is contraindicated in patients with type 1 diabetes who are noncompliant with diet and medication, are pregnant, engage in intense physical activity during the day,^{20,22} have a mental illness caused by disease or the effects of medications, or are elderly and dependent on others for their medical care.²³

At a consultation at least 1 month before the start of Ramadan,^{1,6} patients who do not have the aforementioned contraindications and wish to fast should undergo a full medical assessment and counseling session.^{1,3–5,20,22} The medical assessment should include a complete physical examination, an assessment of metabolic control, and laboratory testing (fasting blood glucose, lipid profile, urine acetone, HbA_{1c}, spot urine microalbumin, creatinine ratio).²¹

Patients should be counseled about the need to adjust their insulin regimen before beginning the fast.^{4,6,19} Summarizing the suggested strategies in **Table II**, 70% of the pre-Ramadan insulin dose may be divided as follows: 60% as insulin glargine given in the evening and 40% as an ultra-short-acting insulin (insulin aspart or lispro) given in 2 doses, 1 at Suhur and 1 at Iftar.⁶ If a snack is taken in the hours after the sunset meal (which is a common practice during Ramadan), regular insulin may be preferable to insulin lispro at Iftar, as regular insulin has a longer duration of action than an ultra-short-acting insulin.⁶ Alternatively, 85% of the pre-Ramadan dose may be divided as 70% Ultralente and 30% regular insulin, both given as 2 doses, 1 at Suhur and 1 at Iftar.¹⁹ Finally, 100% of the pre-Ramadan morning dose of 70/30 premixed insulin may be given at Iftar and 50% of the usual evening dose may be given at Suhur.¹ With regard to patients taking NPH insulin, it should be noted that this type of insulin may be associated with hypoglycemic events during prolonged fasting, as its peak effect usually occurs between 6 and 10 hours after the time of injection.^{2,10} Therefore, a long-acting insulin (eg, insulin glargine) that lacks the peak effect would be more appropriate.

Patients and their families should be taught to identify the signs and symptoms of hypoglycemia, hyperglycemia, and dehydration, as well as the measures to take should any of these complications occur.^{1,3,4,11,20,22} It is recommended that blood glucose be monitored every 2 to 5 hours, before bedtime, and on awakening,²⁰

Table II. Suggested changes to the insulin regimen in patients with type 1 diabetes who wish to fast during the month of Ramadan.

- 70% of the pre-Ramadan insulin dose may be divided as follows: 60% as 1 daily injection of glargine in the evening and 40% as ultra-short-acting insulin (aspart or lispro) given in 2 doses, 1 at Suhur and 1 at Iftar. Regular insulin should be used at Iftar instead of an ultra-short-acting insulin if a snack is to be taken in the hours after the sunset meal.⁶
- 75% of the usual dose of rapid-acting insulin and 25% of the usual dose of long-acting insulin may be given before the Iftar meal.²⁰
- 85% of the pre-Ramadan dose may be divided as 70% Ultralente and 30% regular insulin, both given in 2 doses, 1 at Suhur and 1 at Iftar.¹⁹
- 100% of the pre-Ramadan morning dose of 70/30 premixed insulin may be given at Iftar and 50% of the usual evening dose at Suhur.¹

and patients should be instructed to break the fast immediately if blood glucose drops below 60 mg/dL (3.3 mmol/L).¹ Breaking the fast should be considered when blood glucose drops below 80 mg/dL (4.4 mmol/L),²⁰ and the fast should be interrupted if blood glucose rises above 300 mg/dL (16.7 mmol/L)¹ to avoid diabetic ketoacidosis.

The importance of compliance with lifestyle recommendations should also be emphasized to patients wishing to fast. They should be counseled against strenuous physical activity to avoid hypoglycemia, particularly during the fasting hours, although regular physical activity can be maintained. They should be encouraged to eat a healthy, balanced diet during the nonfasting hours, rather than skipping meals or gorging on foods that are high in fat and carbohydrate content, which may lead to episodes of hyperglycemia.⁵ It has been recommended that complex carbohydrates be eaten at the Suhur meal because of their slow digestion and absorption, and that simple carbohydrates be reserved for the Iftar meal.¹

Physicians may consider seeing patients with type 1 diabetes who are observing the Ramadan fast once or twice weekly to question them about adherence with the adjusted therapeutic regimen and compliance with dietary and activity restrictions.²³ An algorithm for the approach to managing a patient with type 1 diabetes who wishes to fast during Ramadan appears in the figure.

CONCLUSIONS

Few published studies have addressed the management of patients with type 1 diabetes who wish to fast during Ramadan. Comprehensive patient education should include guidance on adjusting the insulin regimen and

should stress the importance of self-monitoring and following guidelines on diet and levels of physical activity. At present, there is a lack of data on which to base guidelines or design robust management plans for these patients. There is a need for large-scale, randomized, controlled interventional trials to broaden our understanding of the implications of fasting in individuals with type 1 diabetes. In addition, future studies should examine diet and food intake, as well as investigating fasting in different age groups and patients with concomitant medical conditions.

REFERENCES

1. Al-Arouj M, Bouguerra R, Buse J, et al. Recommendations for management of diabetes during Ramadan. *Diabetes Care*. 2005;28:2305–2311.
2. Kadiri A, Al-Nakhi A, El-Ghazali S, et al. Treatment of type 1 diabetes with insulin lispro during Ramadan. *Diabetes Metab*. 2001;27:482–486.
3. Azizi F, Siahkollah B. Ramadan fasting and diabetes mellitus. *Arch Iran Med*. 2003;6:237–242.
4. Pinar R. Management of people with diabetes during Ramadan. *Br J Nurs*. 2002;11:1300–1303.
5. Sulimani RA, Famuyiwa FO, Laajam MA. Diabetes mellitus and Ramadan fasting: The need for critical appraisal. *Diabet Med*. 1988;5:589–591.
6. Khairallah W, Merheb M, Filti F, Azar S. Ramadan fasting in type-1 diabetics. *LMJ*. 2008;56:46.
7. Mafauzy M, Mohammed WB, Anum MY, et al. A study of fasting diabetic patients during the month of Ramadan. *Med J Malaya*. 1990;45:14–17.
8. Rashed AH. The fast of Ramadan. *BMJ*. 1992;304:521–522.
9. Salti I, Bénard E, Detournay B, et al, for the EPIDIAR Study Group. A population-based study of diabetes and

<p>Patient has >1 contraindication to fasting</p>	<p>Poor glycemic control Comorbid conditions (unstable angina, uncontrolled hypertension, advanced macrovascular complications, infection, renal insufficiency) Noncompliance with diet or medication Pregnancy Intense physical activity Mental illness Advanced age</p>	<p>No, or patient insists on fasting</p>	<p>Education Signs of hypoglycemia and hyperglycemia Frequent glucose monitoring and advice on when to break the fast* Moderate physical activity</p>
<p>Yes</p>	<p>Refraining from fasting is strongly recommended</p>	<p>Baseline metabolic profile Fasting blood glucose Lipid profile Urine acetone HbA_{1c} Spot urinalysis for microalbumin and creatinine</p>	<p>Dietary control Eating a balanced, healthy diet Avoiding overeating and skipping meals Referral to a dietitian</p>
<p>Complete physical examination</p>	<p>Adjust insulin regimen</p>	<p>Education</p>	<p>Signs of hypoglycemia and hyperglycemia Frequent glucose monitoring and advice on when to break the fast* Moderate physical activity</p>

Figure. Approach to the management of patients with type 1 diabetes who wish to fast during Ramadan. *The fast should be broken immediately if blood glucose is <60 mg/dL (3.3 mmol/L) or >300 mg/dL (16.7 mmol/L),¹ and breaking the fast should be considered if blood glucose is <80 mg/dL (4.4 mmol/L).²⁰ HbA_{1c} = glycosylated hemoglobin.

- its characteristics during the fasting month of Ramadan in 13 countries: Results of the Epidemiology of Diabetes and Ramadan 1422/2001 (EPIDIAR) Study. *Diabetes Care*. 2004;27:2306–2311.
10. Al Nakhi A, Al-Arouj M, Kandari A, Morad M. Multiple insulin injection during fasting Ramadan in IDDM patients. *Diabetologia*. 1997;1297: A330. Abstract.
 11. Benaji B, Mounib N, Roky R, et al. Diabetes and Ramadan: Review of the literature. *Diabetes Res Clin Pract*. 2006;73:117–125.
 12. Laing SP, Swerdlow AJ, Slater SD, et al. The British Diabetic Association Cohort Study, II: Cause-specific mortality in patients with insulin-treated diabetes mellitus. *Diabet Med*. 1999;16:466–471.
 13. Kadiri A. Profile of the fasting diabetic patient and nutrition during Ramadan. *Pract Diabet Int*. 2005;15: S5–S6.
 14. Bolli GB, Dimitriadis GD, Pehling GB, et al. Abnormal glucose counterregulation after subcutaneous insulin in insulin-dependent diabetes mellitus. *N Engl J Med*. 1984;310: 1706–1711.
 15. Cryer PE. Mechanisms of hypoglycemia-associated autonomic failure and its component syndromes in diabetes. *Diabetes*. 2005;54:3592–3601.
 16. Boyle PJ, Zrebiec J. Physiological and behavioral aspects of glycemic control and hypoglycemia in diabetes. *South Med J*. 2007;100:175–182.
 17. Laederach-Hofmann K, Weidmann P, Ferrari P. Hypovolemia contributes to the pathogenesis of orthostatic hypotension in patients with diabetes mellitus. *Am J Med*. 1999; 106:50–58.
 18. Carr ME. Diabetes mellitus: A hypercoagulable state. *J Diabetes Complications*. 2001;15:44–54.
 19. Kassem HS, Zantout MS, Azar ST. Insulin therapy during Ramadan fast for type 1 diabetes patients. *J Endocrinol Invest*. 2005;28:802–805.
 20. Reiter J, Wexler ID, Shehadeh N, et al. Type 1 diabetes and prolonged fasting. *Diabet Med*. 2007;24:436–439.
 21. Mucha GT, Merkel S, Thomas W, Bantle JP. Fasting and insulin glargine in individuals with type 1 diabetes. *Diabetes Care*. 2004;27:1209–1210.
 22. *International Meeting on Diabetes and Ramadan Recommendations: Edition of the Hassan II Foundation for Scientific and Medical Research on Ramadan*. Casablanca, Morocco: FRSMR; 1995.
 23. Omar MA, Motala AA. Fasting in Ramadan and the diabetic patient. *Diabetes Care*. 1997;20:1925–1926.
- Address correspondence to:** Sami T. Azar, MD, Department of Internal Medicine, Division of Endocrinology, American University of Beirut Medical Center, 3 Dag Hammarskjöld Plaza, 8th Floor, New York, NY 10017. E-mail: sazar@aub.edu.lb