

The Individualization of Care for People with Diabetes during Ramadan Fasting: A Narrative Review

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Abstract

Management of Muslim people with diabetes who choose to observe the fasting during the holy month Ramadan may become a complicated situation in which neither physicians nor patients have straightforward solutions. While most patients with diabetes fast Ramadan safely, some patients do face potentially life-threatening complications, including hypoglycemia, hyperglycemia, dehydration, and ketoacidosis. Several professional recommendations categorize patients with diabetes as very high/high, moderate, or low-risk groups. This classification was based principally on the type of disease, the status of metabolic control, type of treatment, and modified by the presence of other comorbidities and circumstantial factors. Ramadan clinical recommendations for individuals with diabetes are mainly based on expert opinions with limited, yet growing, scientific evidence, and research. On occasions, they do not take account of many important variables that require a personalized approach. In this narrative perspective, we discuss the individualized management of people with diabetes during Ramadan fasting taking into consideration the hours of fasting during the day, weather, resources, personal patterns of dieting, sleeping and exercise, previous fasting experience, and, most importantly, patient preferences among many other factors. This narration is aimed to encourage physicians to think out of the box and provide an individually-tailored recommendation on whether to fast and how best to modify management plans if fast was deemed safe.

Keywords: Diabetes, ethnic, hyperglycemia, hypoglycemia, individualized care, Muslims, Ramadan

INTRODUCTION

Individualized management promotes a patient-centered care model and denotes that each individual is unique and that differences among patients should be considered in order to make sound

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medical decisions. It uses information obtained from the patient to dictate the medical plan. Individualized management is a core concept in diabetes care.^[1,2] Perhaps, it is best demonstrated when dealing with cultural and ethnic issues. Management of diabetes during Ramadan is a prime example of ethnically and culturally sensitive care. Where a decision to fast needs to be made, this should be undertaken after ample discussion between the patient and his physicians concerning the risks involved guided by the current recommendations on risk stratification.

Patients who choose to fast should undergo a pre-Ramadan assessment and receive an appropriate education. Instructions should cover physical activity, meal planning, glucose monitoring, dosage, and medication timing. Comprehensive guidance on management has been issued by several groups.^[3-5] Notwithstanding, actual management plans must be highly individualized. Close follow-up is essential to reduce potential complications. An individualized approach guarantees courteous integration between the clinician's expertise and the patient's preferences and specific factors. In this review, we address several factors that should be considered when tailoring a management plan for patients with diabetes who are intending to observe the fasting.

METHODS

This is a narrative nonsystematic review of the literature with the view to proposing a practical management plan for diabetes during Ramadan fasting. The authors are acknowledged experts in clinical practice and research regarding diabetes and Ramadan fasting. The authors identified and agreed on several themes that warrant examination. Individual authors conducted theme-based literature

searches of online PubMed online databases with a specific focus on recent publications and those considering special situations and groups. The authors drafted and shared their assigned sections and also reviewed the other parts for intellectual content. The manuscript was developed further through multilateral rounds of electronic communications and one teleconference session of all authors. All authors reviewed approved the final manuscript.

EMERGING CONCEPTS

Several factors that influence the individualization of diabetes care during Ramadan emerged from the literature review and discussions. These concepts and themes are considered under three headings, namely, Ramadan-focused factors, diabetes-related matters, patients' issues [Table 1].

Ramadan-focused factors

Fasting hours

The timing of fasting during the month of Ramadan is based on the lunar calendar.^[6,7] Hence, Ramadan moves forward by about 11 days every year and returns to the same point on the Gregorian calendar every 33 years. Consequently, the duration of fasting varies from year to another and between the various geographical locations within the same year. Fasting hours differ considerably, with some countries fasting for as long as 21 h, while some fast <11 h a day. In the last couple of years, the shortest fasting period was observed in Argentina and the longest between Russia and Iceland. Perhaps, taking account of both the longer and shorter length of the fasting period and the short duration of the feeding periods is equally important.

Table 1: Recognized factors that may influence the development of personalized care for diabetes during Ramadan fasting

Ramadan-focused factors*	Diabetes-related matters*	Patients' individual issues*
Length of fasting hours	Type of diabetes	Age (adolescents and elderly)
Season of fasting	Duration of diabetes	Sex
Weather	Diabetic complications	Occupation
Geographical location	Antidiabetic therapies	Pregnancy/lactation
Social changes	Previous control	Meal pattern
Past experiences	Proneness to hypoglycemia	Exercise nature/timing
	Hypoglycemic unawareness	Motivation
	Access to care	Personal preferences

*Considering the factors under these three items does not exclude interplay of them in a given patient or a clinical scenario

The health implication of the very long periods of fasting includes increased risk of hypoglycemia and dehydration during the fasting period, particularly in patients with various degrees of renal impairment. Furthermore, a short duration of permissive periods may be too short for refeeding can cause inappropriate overfeeding and inadequate timing for medication to be adjusted appropriately between daytime and nighttime. Short night time may reduce the time allowed for exercise without risk of hypoglycemia.^[8,9]

The duration of fasting time should be considered in all individuals with increased risk. Matching the attributes and doses of various medications should be considered on an individual basis.^[10] For instance, increasing the doses of the prandial insulin to prevent post-*Iftar* (the sunset meal) excursions and delaying *Sohour* (the predawn meal) to the latest possible time to reduce the risk of hypoglycemia and dehydration is recommended.

Weather

Climate changes are closely related to the geographical location where fasting occurs. The weather is essential in modulating the abilities of various individuals to observe the fast.^[11,12] Perhaps most disadvantageous circumstances come from long fasting periods under adverse climate circumstances, e.g., for laborers in building sites, oil industry and security, and armed forces. Increased risk of hypoglycemia and dehydration can be increased. Denatured insulin due to suboptimal storage and transport conditions can also precipitate hyperglycemia.^[13]

Lifestyle patterns

Counseling and managing individuals with diabetes in the month of Ramadan should take into account eating, sleeping, and exercise patterns that depend on social, behavioral, as well as geographical factors to enable a proper risk stratification. Muslims rise for the predawn meal (*Sohour*) and dawn (*Fajr*) prayer during Ramadan. It is not unusual to notice in some countries, a delay in the start of work, shortening of the working hours, and keeping the stores and shopping malls open until late at night. This phenomenon partially reverses the typical circadian pattern of eating and drinking and leads to a change in the usual sleeping pattern.^[14,15] These changes in

eating and sleeping patterns could have different implications on the management of diabetic patients.

Fasting from dawn to dusk can increase rates of hypoglycemia for people with diabetes. However, Ramadan is also a month of celebration in many countries where many Muslims change their eating habits, where social gatherings at mealtimes are frequent. These can also theoretically lead to the worsening of glycemic control for some people with diabetes. Recent studies reported on food intake during Ramadan.^[16,17] In all of these studies, 50%–60% of participants reported a change in food intake. The most significant change was reported in type 1 diabetes mellitus (T1DM) (95.4%) compared to 65.5% in type 2 diabetes mellitus (T2DM). An increase in protein, carbohydrate, and sugar with a decrease in fat has been described by the majority who reported changes in food intake.^[16,17] Skipping *Sohour* is not advisable during Ramadan, as this will prolong the hours of fast. However, a small minority skip suhur as they prefer to have a night of uninterrupted sleep. In a recent observational trial in 1214 persons with T2DM treated with Gliclazide MR with or without other antidiabetes medications apart from insulin, it was noted that out of the 19 persons who developed hypoglycemia during Ramadan, 18 of them reported eating two or fewer meals.^[18]

Physical activity during Ramadan in many countries tends to be less than usual days. Indeed, in many Muslim majority countries, the working hours are reduced. CREED study reported no or light physical activities by 90% of the study cohort with no significant regional differences.^[16,17] However, the study did not indicate whether the physical activity was lower during Ramadan when compared to pre-Ramadan. Conversely, DAR-MENA T2DM reported a reduction in working hours, a slight increase in sleeping hours, and a slight increase in low levels of physical activity.^[17] A similar pattern was observed in patients with DAR-MENA T1DM.^[19] Published data suggest that most people with DM are not engaged in a high level of physical activity during Ramadan fasting. Guidelines recommend avoiding high-intensity exercise during fasting hours.^[3-5] For those whose lifestyle includes

moderate to high physical activity, dose adjustment of insulin and/or sulfonylurea (SU) may be required to minimize the risk of hypoglycemia.

Access to education and support

Several groups have demonstrated that Ramadan-focused education and support are paramount for the fasting group as a whole and on an individual basis.^[20,21] However, it is noteworthy that in countries where Muslims are either migrants or a minority, a recent study showed that many General Practitioner lacked cultural competency and relevant medical knowledge. They were not capable to appropriately counsel their patients with diabetes in regard to medication management during Ramadan. This resulted in medically unjustified recommendations against fasting or inappropriate changes to make during fasting. In such instances, further education of health workers and patients was deemed necessary.^[22] Of note, pharmacists could provide an additional valuable contribution to patient diabetes support and care in the community. Community pharmacists are very easily accessible and commonly visited by many people every day.^[23]

Diabetes-related matters

Duration of diabetes

Although there are no studies or reports to assess the implications of the duration of diabetes on fasting during Ramadan, in general, a longer duration implies increasing patient age, reduced beta-cell function, increased prevalence of comorbidities, and may increase the risk of hypoglycemia and hyperglycemia. The mortality rates from causes strongly associated with diabetes increased steeply with the duration of diabetes and were higher still among people with poor glycemic control.^[24] It is noteworthy that the duration of diabetes was not considered in the previously published risk scales.^[3-5] Duration of diabetes and advancing age predict diabetes morbidity and mortality rates independently. As long-term survivorship with diabetes increases and as the population ages, more research and public health efforts to reduce hypoglycemia will be needed to complement ongoing efforts to reduce cardiovascular and microvascular complications.^[25]

Type of diabetes

Patients with poor glycemic control and high glucose variability are prone to hypo- and hyperglycemia. It was reported that patients with a history of severe hypoglycemia, DKA, or hyperosmolar hyperglycemic coma within the 3 months before Ramadan, history of recurrent hypoglycemia, history of hypoglycemia unawareness, and pregnant women with diabetes are at higher risk for complications during Ramadan fasting.^[3-5,26]

A. Type 1 diabetes

As all patients with T1DM require multiple-dose insulin therapy, they were recognized to qualify for the very high or high categories in all risk stratification scales, particularly in the adolescent age group.^[27] However, recent studies of young adults suggest that if the patient is stable, otherwise healthy, has good hypoglycemic awareness, and complies with their individualized management plan under medical supervision, many of these patients can fast safely.^[28] Another study involving 21 adolescents with T1DM found that a majority (76%) could fast for at least 25 days.^[29] Furthermore, the use of continuous glucose monitoring equipment in this study demonstrated that blood glucose levels fluctuated, and some hypoglycemia episodes were unrecognized, indicating that regular self-monitoring during fasting is vital. These findings also highlighted the importance of thorough attention to hypoglycemia unawareness under these circumstances.^[28] Overall, optimal pre-Ramadan diabetes control correlated with better Ramadan outcomes.^[29]

While the results of new studies are encouraging, they cannot be generalized to all people with T1DM. Several strategies to ensure the safety of individuals with T1DM who choose to fast are required. They include Ramadan-focused medical education and having a pre-Ramadan medical assessment, including a robust assessment of hypoglycemia awareness. They also need to adhere to a healthy diet plan and physical activity routine, with careful modification of insulin regimen and frequent self-monitoring of blood glucose or continuous glucose monitoring.^[29]

B. Type 2 diabetes

Muslims across the world observe Ramadan fasting. A recent survey in 39 countries involving over 38,000 Muslims reported that a median of 93% fasted during Ramadan with stricter adherence rates in the MENA region and Sub-Saharan Africa.^[30] While most T2DM patients attend their physicians and receive advice regarding Ramadan fasting, a large percentage might fast without assessment or medical advice from their health-care professionals.

Antidiabetic medication

Medications used for the treatment of T2DM treatment are conventionally classified into three categories by their hypoglycemia-inducing potential. The lowest risk medications include metformin, pioglitazone, acarbose, dipeptidyl peptidase-4 inhibitors (DPP4i), SGLT2 inhibitors, and GLP1 receptor agonists. The highest risks are associated with SUs and rapid-acting insulin analogs and human insulins. Perhaps, basal insulins esp. next-generation basal insulin, and Glinides carry an intermediate risk level. However, for SUs, several studies have confirmed that not all SUs are the same. Third-generation agents (gliclazide and glimepiride) have a lower risk of hypoglycemia during Ramadan fasting compared to 2nd generation (glibenclamide).^[31] Some studies did not observe any significant differences in the proportions of patients reporting hypoglycemic events when treated with DPP-4 inhibitors (vildagliptin and sitagliptin) or new-generation SUs.^[31-33] Similarly, no significant differences in hypoglycemic events occurred when glimepiride treatment was compared with either repaglinide or insulin glargine therapy.^[34,35]

SGLT2 inhibitors, dapagliflozin, canagliflozin, and empagliflozin, are the newest class of oral antidiabetic drugs (OADs). Increased risk of dehydration in vulnerable patients has been described, which may be a particularly pertinent issue during Ramadan. Three studies have been published so far, demonstrating the safety or effectiveness of SGLT2 inhibitors during Ramadan.^[36-38] The risk of severe hypoglycemia with GLP-1 RAs during Ramadan fasting is low when used as monotherapy, but that may still be an issue when given with SUs,

glinides, or insulin.^[39] Several studies on the use of GLP-1 RAs during Ramadan have been published recently.^[40-43]

Patients on insulin pump therapy deserve a special mention. A few studies demonstrated the advantages of use of pumps in children and adults.^[44-47] When augmented with real time monitoring, use of pumps seem to provide greater benefit on glucose control in fasting.^[45] Patients need to be provided with temporary Ramadan-specific settings. It remains controversial whether there is a need to lower the basal insulin infusion rates during the fasting hours to reduce the risk of daytime hypoglycemia.^[45,46] Differences may be attributed to the different groups recruited in different studies.^[45,46] The usage of low-glucose suspend has been shown to reduce hypoglycemia significantly.^[47] Studies and meta-analysis comparing the effect of CSII or MDI in patients with diabetes who fast during Ramadan are not consistent.^[48-49] Most importantly, to get the benefit of pump therapy, appropriate patients should be well trained, stable on insulin pumps, and are supported by competent health-care professions.^[45,46]

Hypoglycemia

Hypoglycemia is the most feared risk of fasting. Several Ramadan epidemiological studies indicated that hypoglycemia increases in people with T1DM and T2DM during Ramadan fasting. A recent study (DAR-MENA T2DM) conducted in 10 countries in the MENA region found that in people with T2DM, confirmed hypoglycemia increased by twofold during Ramadan fasting (4.9% pre-Ramadan to 9.8%) during Ramadan. Similarly, severe hypoglycemia rates, although rare, increased from 0.2% to 0.9%.^[31]

A. History of pre-Ramadan hypoglycemia

Several studies have demonstrated that the rate of hypoglycemia during Ramadan in patients who had pre-Ramadan hypoglycemia was higher than those who did not have such history.^[50-53] Hence, all guidelines advise against fasting in those with a history of recurrent hypoglycemia or history of recent severe hypoglycemia.^[3-5,26,27] Clearly, in all guidelines, the same advice applies to those with hypoglycemia unawareness.^[3-5,26,27]

B. Hypoglycemia and type of medication

MENA T2DM study reported rates of hypoglycemia according to whether the person is on insulin, SU, or neither. As expected, confirmed hypoglycemia rates during Ramadan were 18.2% for those on insulin, 9.3% for those on oral antidiabetic treatment including SU, and 4.3% in those on oral antidiabetic therapy without SU.^[18] Furthermore, those on intensive insulin have higher rates of hypoglycemia than those on basal, as evident from a recent study supported by flash glucose monitoring data. In this study, the mean number of hypoglycemic episodes per sensor for those on basal insulin was lower than on intensive insulin.^[50]

C. The timing of hypoglycemia

The timing of hypoglycemia in several T1DM and T2 DM studies was shown to be highest during the period of mid-day to sunset, particularly during the last 3–4 h of the fast. Hypoglycemia occurred even though all patients received Ramadan-focused education as well as adjustments of treatment.^[50]

The resistance of patients to break the fast during hypoglycemic episodes was directly related to the proximity of the hypoglycemia to the end of fast. In this study, it was found that there was a resistance to breaking the fast when hypoglycemia occurred nearer (within two hours) to the end of fast.^[50]

Individual patient-related factors

Motivation

Several motivational factors, whether spiritual, religious, or social, might be behind many controversial decisions. Fasting is believed to help promote humility and prevent sin. Fasting is also accepted to be an expression of good faith. A commonly circulated quote states: *“Make this Ramadan the turning point in your life. Break free from the deceptions of this world and indulge in the sweetness of EEMAN.”* Most relevant to health and disease, fasting is a time of social gathering for families and friends where feelings of love, respect, and happiness are expressed.

On the other hand, others could sense fasting as a mandatory act within a specific community, where not fasting could be considered sinful. It is the responsibility of physicians, when consulted

by patients planning to fast, to understand the motivations behind such a decision and to support their patients, either alone or in collaboration with others such as local Imams, to make the proper decision.^[1,3-5] In case a patient decides to fast, health-care professionals should provide the proper education, counseling in drug adjustment in the pre-Ramadan period to help decrease adverse events and thus improve the experience of fasting.^[51,52] Observing the fast against medical advice represents a special challenges that requires a lot of support to avoid it and reduce its risks.^[53,54]

Comorbidities

All guidelines advise against fasting in people with diabetes who have other serious comorbidities such as cardiovascular disease (CVD) or impaired renal function as they are considered at a higher risk category.^[3-5] This is mostly based on clinical practice rather than evidence-based medicine. However, there is some evidence to support this advice through analysis of hypoglycemia according to risk categories as comorbidities are a critical factor in risk categorization in all guidelines.^[55]

A. Advanced chronic kidney disease

HbA1c, serum creatinine, estimated glomerular filtration rate (eGFR), and blood pressure showed no clinical or statistically significant change during Ramadan fasting.^[55] Also, data from 68 patients with T2DM and chronic kidney disease (CKD) stage 3 who fasted Ramadan in (London, UK), were compared to data of 71 matching persons who did not fast. Also, pre-and post-Ramadan datasets from each group were analyzed. The median days fasted were 21 days.^[56] In both studies, there were no differences in HbA1c, creatinine, eGFR, or blood pressure. Rates of hypoglycemia were numerically higher in the fasting group (8.3% vs. 5.6%).^[55,56]

B. Cardiovascular disease

Like CKD, people with CVD and diabetes are advised against fasting.^[3-5] Regular and timely medication for people with CVD is essential. Equally, concerns are there for the burden of fasting on people with diabetes and CVD. In a study from Dubai published in 2019 regarding CVD and diabetes during Ramadan fasting, 21 patients with

T2DM and previous stable coronary artery disease who insisted on fasting Ramadan were provided with optimum care including Ramadan focused education, flash glucose monitoring and treatment dose adjustment. 82% of patients were on SU and/or insulin, including multiple daily insulin injections.^[57] Compared to pre-Ramadan, HbA1c significantly improved from 7.8% to 7.3%. Blood pressure, serum creatinine, eGFR, and lipids profile did not show significant change during Ramadan. There was also no hospitalization among the group. However, hypoglycemic events were significantly higher compared to pre-Ramadan (1.1 vs. 3.2).

Similarly, average hypoglycemia duration increased significantly from 49.1 to 117.8 min. The timing of hypoglycemia was highest during the 12.00–18.00 h as it increased from 0.3 pre-Ramadan to 2.0 episodes/sensor during Ramadan.^[57] While the total number of patients in this study is small to look into adverse CVD events, the hypoglycemia data is valuable information for risk quantification.

The older adults

Many older adults have enjoyed fasting during Ramadan for many years, and they should not be classed as high risk based on a specific age alone but instead on health status and their social circumstances. Many older adults, especially those who have had diabetes for a prolonged period, are likely to have comorbidities. These may impact on the safety of fasting independently. Thus, they may present additional challenges to the health care paraprofessionals managing them. Consequently, assessments of functional capacity and cognition are needed, and the care provision should be adapted accordingly.^[58] It is reasonable that widely used current risk categorization systems^[3-5] consider those with old age combined with ill health as very high risk. Thus, old age *per se* should not be considered as an additional risk factor for fasting. The choice of antidiabetic agents, which carry varying risks for hypoglycemia, should also be considered.

Pregnancy

Hyperglycemia and hypoglycemia during pregnancy are associated with increased risk for both mother and baby.^[59] Limited studies report that women with

GDM on a diet only, or on diet plus metformin are reported to have increased risk of asymptomatic hypoglycemia.^[60,61] For all reasons, pregnant women with preexisting diabetes or GDM are advised not to fast until further research data are available to support any change in the risk category. During pregnancy, the vast majority of women with hyperglycemia would be treated with insulin, metformin, or glibenclamide. While the last two agents are not approved by the US Food and Drug Administration, many authorities do not oppose their fair use in pregnancy. The use of glibenclamide in during Ramadan fasting should be discouraged.

Past fasting experiences

A comprehensive medical assessment in the pre-Ramadan visit must examine the past Ramadan experience^[3-5] Information about the ability to fast, number of days fasted, any adjustments of medications needed, and outcomes should guide the advice for forthcoming fasting.^[62] In addition to the usual risk stratification using any of the published scales,^[3-5,26] any unexplained visits to emergency departments or hospital admissions should trigger detailed assessments. The nature, severity, and timing of any adverse events should form the basis for medical management. A distinction between temporary and permanent conditions that prevented or interrupted fasting will be evident from the clinical assessment. For instance, breaking the fasting during pregnancy complicated by gestational diabetes or due to unexpected acute medical or surgical emergency leading to metabolic decompensation is different from the inability to fast due to recurrent hypoglycemia, being on renal dialysis or suffering from marked hypoglycemic unawareness are two different types of circumstances.^[3-5,26] Positive experiences can also be learned from the successful adoption of healthy lifestyle modifications in doses and medications' timing. All such patients' experiences should have been documented in the previous post-Ramadan visits and be readily available in future visits.^[63-65] Some circumstances may change indefinitely. These can be exemplified by a cure of end-stage renal disease by renal transplantation and remission of diabetes or marked improvement in the severity of

hyperglycemia by bariatric surgery and effective weight management. Similarly, changes in personal circumstances (physical work under hard weather circumstances, breastfeeding) may affect the risk classification.

Personal choices and preferences

To fast or not to fast remains a personal choice guided by the physician and religious scholars.^[6,7] Fasting against medical advice has been well documented.^[64] However, cultural sensitivity, cultural understanding, and personal empathy are more likely to win the patient on the side of the scholars and health-care professionals. The physician must provide advice with great appreciation to patients' passion for observing the fast as part of their religious obligation and social belonging. This is particularly true for the very devoutly practicing individuals who cannot ever see themselves unable to fast. Invoking the religious teaching that does not put themselves at risk is equally rewarded. However, circumstances, where the decisions are ambiguous, reverting to the person's preferences, can be the best to allow the individual to live in harmony with himself and society.^[6,7]

CONCLUSIONS

Over the recent couple of decades, there has been calls for progress of the management of medical problems (including diabetes) from opinion-based to more evidence-based recommendations.^[66-68] This could be possible by the increasing global literature production on the subject.^[69-72] However, fasting guidelines should not replace the practitioners' clinical judgment. Indeed, implementation of recommendations should take into account local, personal spiritual, physical, and social factors. Several clinical scenarios challenge widely accepted generic guidelines. These could stem from Ramadan, disease, or patients-related factors, though a frequent interplay between these factors will undoubtedly exist. Physicians should identify and investigate factors that may negatively impact individuals and make judgments on the safety of fasting. A personalized medical plan that addresses patients' unique characteristics is the optimal approach for diabetes in the month of fasting.

Authors contribution

This is a collective effort. The group conceived the idea of the article. All authors drafted their assigned parts and the various sections were amalgamated (BA) and edited (BA and SAB). All authors reviewed and further developed the whole manuscript for intellectual content, style, and language, and they all approved the final manuscript.

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There are no conflicts of interest.

Compliance with ethical principles:

Not required, none of the authors reported any human or animal experiments of their own.

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