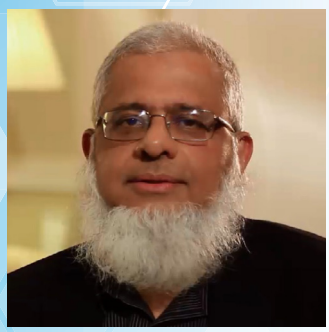
Diabetes and Ramadan

A case for safer fasting using oral antidiabetic drugs



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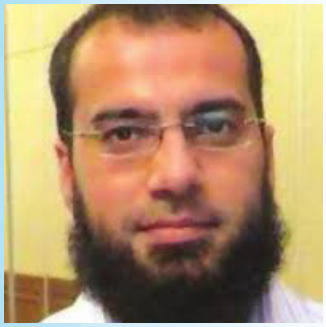

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"Whoever witnesses the month (of Ramadan) then he/she should fast. But, if any of you is ill or travelling – then he or she is exempted from fasting" Quran 2:184

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Learning objectives

You will learn:

- Individualisation of a Ramadan treatment plan is key to achieving a safer fast for those with diabetes
- Factors that affect the risk for diabetics who choose to fast during Ramadan
- How to conduct a pre-Ramadan risk assessment and make recommendations regarding the safety of choosing to fast
- The importance of an individualised Ramadan nutrition plan
- The importance of self-monitoring of blood glucose (SMBG)
- Diabetic treatment adjustments that may be necessary.

Introduction

Fasting is an integral component of Ramadan and allows Muslims to devote themselves to their faith. Followers must refrain from eating and drinking between pre-dawn and sunset, and must also abstain from using oral medications, sexual activity and smoking. Despite the increased risk of diabetic complications and a concession to be exempt from fasting, many people with diabetes will fast during Ramadan. Most patients with type 2 diabetes mellitus (T2DM) can do so safely as long as medical advice is sought and followed during fasting.

Drs Randeree and Bayat share their expertise on how best to achieve the clinical goals of an ideal Ramadan for the fasting diabetic: no hypoglycaemia (<3.9mmol/l), hyperglycaemia (>16.7mmol/l), ketoacidosis, hyperosmolar coma, weight gain, dehydration, thrombosis or deterioration in HbA_{1c}. Individualisation of a Ramadan treatment plan is key to achieving a safer fast for those with diabetes.

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Education

What is the importance of SMBG during Ramadan?

When fasting, insulin resistance/deficiency can lead to excessive glycogen breakdown and increased gluconeogenesis in people with diabetes. The EPIDIAR study[1] found that during Ramadan there was a 4.7-fold and 7.5-fold increase in the incidence of severe hypoglycaemia in people with type 1 diabetes (T1DM) and T2DM, respectively, compared to non-Ramadan periods. The incidence of severe hyperglycaemia was also found to be increased during Ramadan (three-fold and five-fold in people with T1DM and T2DM, respectively). Of interest, the recent Diabetes and Ramadan (DAR) 2020 Global Survey[2] indicated that hypoglycaemia occurred most frequently between 3pm and Iftar, followed by the time range between midday and 3pm. The least frequent timing of symptomatic hypoglycaemia was between Suhoor and 9am.

It is important to reassure patients that glucose monitoring does not break the fast and can indicate when the need to break the fast is medically necessary. All fasting diabetic patients should check their blood glucose two hours after Iftar. Those who are at low or moderate risk should check their blood glucose at least daily or twice a day, whereas for patients at high or very high risk and those using insulin and/or SUs, it is necessary to check more frequently throughout the day, ideally using the seven-point blood glucose monitoring method.

It is important for patients to check their blood glucose levels whenever they experience symptoms of hypoglycaemia, hyperglycaemia or feel unwell. Patients need to understand when it is necessary to immediately break the fast.

1. **Compared to non-Ramadan periods, T2DM patients experience a ___ increase in severe hypoglycaemic during Ramadan fasting:**
   - A. 3.0-fold
   - B. 4.7-fold
   - C. 7.5-fold

2. **For diabetics who choose to fast during Ramadan, hypoglycaemia occurs most frequently:**
   - A. Between Suhoor and 9am
   - B. Between 3pm and Iftar
   - C. Between midday and 3pm

3. **In terms of SMBG, which recommendation is true for Mrs DB during Ramadan fasting?**
   - A. At least daily after Iftar, preferably twice a day
   - B. According to the seven-point blood glucose monitoring method
   - C. Whenever experiencing symptoms of either hypoglycaemia or hyperglycaemia, or when feeling otherwise unwell
   - D. A and C
   - E. B and C

Which additional recommendations can ensure a safer Ramadan fast?

The goals of Ramadan-focused education are not only to ensure that the diabetic patient understands the necessity of changes to their medication regimen, the importance of SMBG and an awareness of the signs of when to break the fast, but also to provide guidance on meal planning and exercise.

The Ramadan Nutrition Plan (RNP)

A nutrition plan is vital to achieve optimal diabetes control and should be individualised for each patient intending to fast during Ramadan. Furthermore, this is an opportunity to help diabetic patients who are obese or overweight to improve their lifestyle and lose weight. Examples of meal plans for different countries, including South Africa, are available on the DAR website www.daralliance.org, and are designed to ensure that patients consume adequate calories and balanced meals to prevent fasting hypoglycaemia and postprandial hyperglycaemia.[3]

The ten principles of the RNP are:

1. Divide an adequate amount of calories between Suhoor, Iftar and, if necessary, 1-2 snacks
2. Meals should be balanced, with 45-50% carbohydrate, 20-30% protein and <35% fat
3. Design meals using the 'Ramadan plate method'
4. Avoid sugar-heavy desserts
5. Low-GI, high-fibre carbohydrates are preferable
6. Hydration should be maintained between meals by drinking water and non-sweetened beverages
7. Take Suhoor as late as possible
8. Adequate protein and fat should be consumed at Suhoor to induce satiety
9. Iftar should begin with water to rehydrate, and 1-2 dates to raise blood glucose
10. Low-calorie snacks such as fruit, nuts and vegetables may be consumed between meals.

4. **Ramadan meals should divide an adequate amount of calories between Suhoor, Iftar and snacks if necessary; meals should be balanced, with 20-30% carbohydrate, 40-50% protein and <35% fat:**
   - A. True
   - B. False

Case study – Routine pre-Ramadan follow-up visit

Patient information:

Mrs DB, 65-year-old Asian woman, finance clerk

- T2DM: 15 years
- Hypertension: 10 years
- Hyperlipidaemia: 10 years

A routine pre-Ramadan follow-up visit finds Mrs DB to be asymptomatic, clinically stable and with no recent hypoglycaemic events. Her blood pressure is 138/86mmHg with good pulses and no signs of diabetic retinopathy or peripheral neuropathy. She monitors her blood glucose very infrequently ("I am fine"). She experienced no problems when she participated in last year's Ramadan fast.

Laboratory

- HbA_{1c}: 7.5%
- Electrolytes normal
- eGFR: 85ml/min/1.73m^2
- Moderately increased albuminuria (alb/creat: 3.49)
- LDL cholesterol: 1.8mmol/l
- Thyroid function normal.

Current therapy

- Gliclazide MR 60mg bd
- Metformin 1000mg bd
- Dapagliflozin 10mg daily
- Perindopril 8mg daily
- Indapamide SR 1.5mg daily
- Rosuvastatin 10mg *nocte*
- Aspirin 100mg daily.

Mrs DB is very dedicated in her intention to fast during the upcoming Ramadan, having found her previous Ramadan fasting experiences to be both spiritually rewarding and free of diabetic complications; however, it is important to balance religious obligation against medical health. Ramadan can affect sleep patterns, meal schedules and circadian rhythms, and gives rise to glycaemic and metabolic changes (Figure 1).

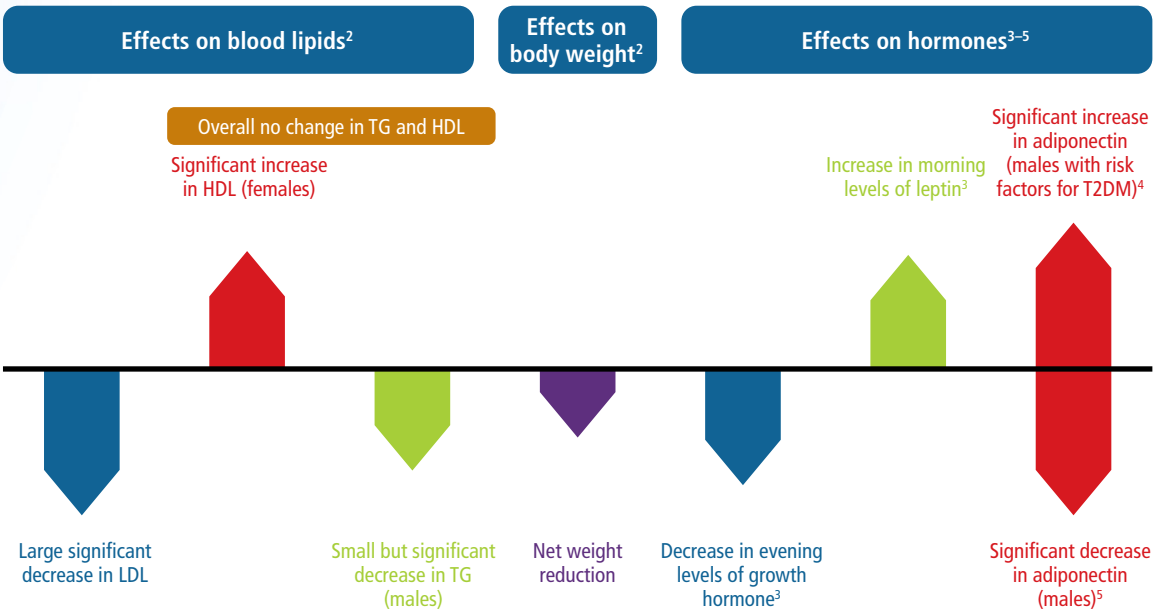

Figure 1. Metabolic changes associated with Ramadan[4-7]

It is important to reassure those who do not fast due to their medical condition that they are indeed rewarded like those who do fast, and that they should not feel guilty

Many factors affect the risk for diabetics who choose to fast during Ramadan. Type and duration of diabetes are important factors, as are the presence of diabetic complications, the type of antidiabetic medication(s), previous control, and awareness of and proneness to hypoglycaemia. Age and pregnancy/lactation are among individual influencing factors, and physical activity (occupation, exercise) also plays a role. In terms of Ramadan-related factors, length of daylight fasting hours, season, weather and geographical location may influence the risk of the diabetic individual who chooses to fast.[3]

How can Mrs DB's risk for fasting during Ramadan be determined, and what are the considerations when creating an individualised plan to ensure a safe and rewarding Ramadan for her?

Pre-Ramadan assessment

Ideally, a pre-Ramadan assessment needs to take place 6-8 weeks before the start of Ramadan (Figure 2). A detailed medical history and a risk assessment (Tables 1 and 2) will form the basis of all recommendations thereafter.[3] It is important to reassure those who do not fast due to their medical condition that they are indeed rewarded like those who do fast, and that they should not feel guilty.

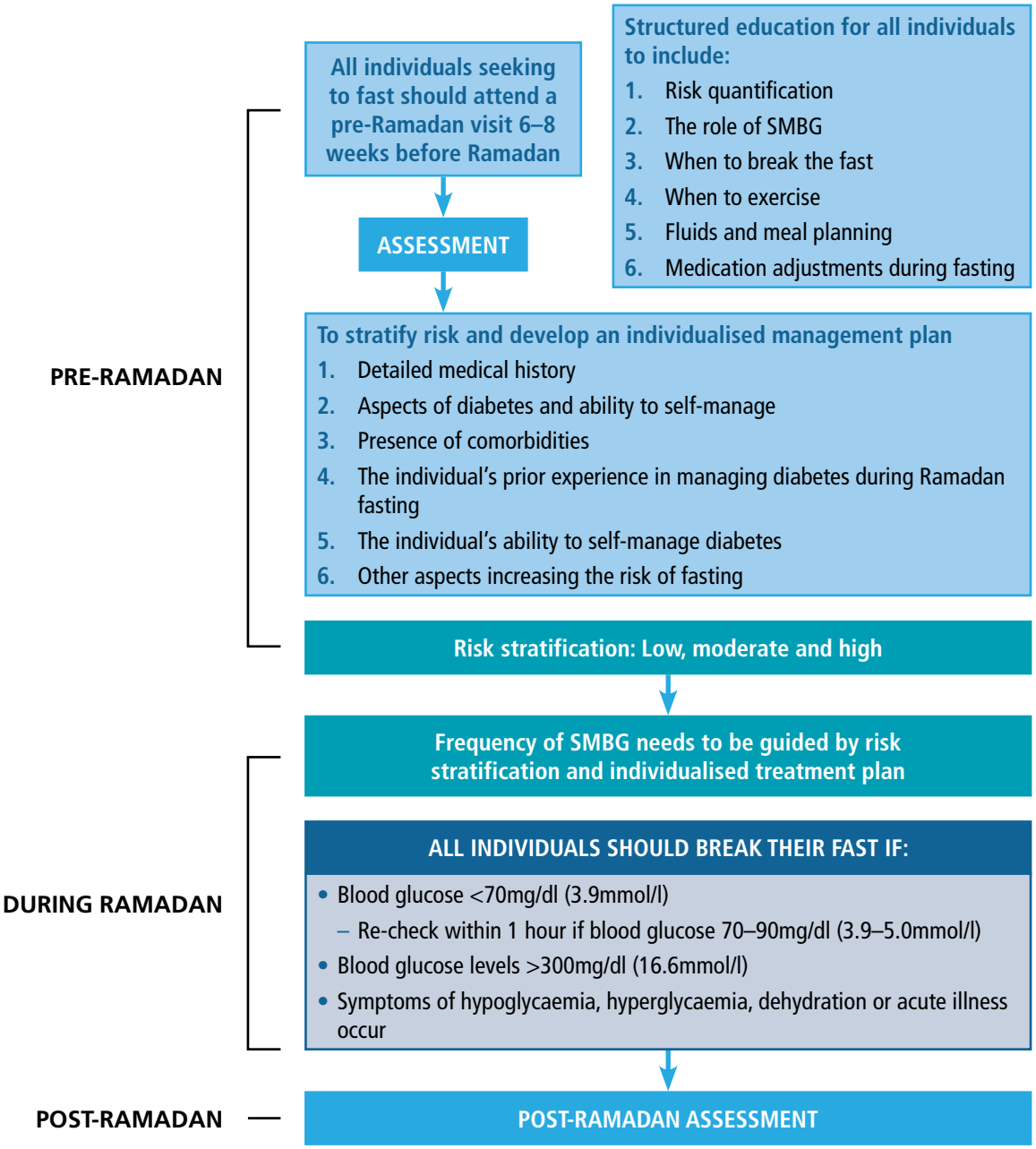

Figure 2. Assessment of diabetes patients wanting to fast during Ramadan[3]

Table 1. Elements for risk calculation and suggested risk scores for people with diabetes seeking to fast during Ramadan[3]
A risk score of 0-3 indicates low risk, 3.5-6 indicates moderate risk, and >6 indicates high risk

Risk element		Risk score
Diabetes type and duration	Type 1 diabetes	1
	Type 2 diabetes	0
	Duration ≥10 years	1
	Duration ≤10 years	0

Presence of hypoglycaemia	Hypoglycaemia unawareness	5
	Recurrent/severe hypoglycaemia	4
	Daily mild hypoglycaemia	3
	Hypoglycaemia 1-6 times per week	2
	Hypoglycaemia <1 per week	1
	No hypoglycaemia	0
Characteristics of glycaemic control	HbA_{1c} >9% (11.7mmol/l)	2
	HbA_{1c} 7.5-9% (9.4-11.7mmol/l)	1
	HbA_{1c} <7.5% (9.4mmol/l)	0
SMBG	Indicated but not conducted	2
	Indicated but conducted suboptimally	1
	Conducted as indicated	0
Acute complications ***DKA: diabetic ketoacidosis*** ***HONC: hyperglycaemic hyperosmolar nonketotic coma***	DKA/HONC in last three months	3
	DKA/HONC in last six months	2
	DKA/HONC in last 12 months	1
	No DKA or HONC	0
Chronic complications/ comorbidities	Unstable angina/heart failure/eGFR <30ml/min/1.73m^2	6
	eGFR 30-45ml/min/1.73m^2	4
	Stable CVD/eGFR 45-60ml/min/1.73m^2	2
	No CVD and normal eGFR	0
Pregnancy	Pregnant not within targets	4
	Pregnant within targets	2
	Not pregnant	0
Frailty and cognitive function	Impaired cognitive function	4
	Frail	3
	>70 years old with no home support	1
	No frailty or loss in cognitive function	0
Physical labour	Intense physical labour	1
	No physical labour	0

Previous Ramadan experience	Overall negative experience	1
	No negative or positive experience	0
Fasting hours (location)	≥16 hours	1
	<16 hours	0
Diabetes treatment	Multiple daily mixed insulin injections	3
	Basal-bolus/Insulin pump	2.5
	Once-daily mixed insulin	2
	Basal insulin	1.5
	Glibenclamide	1
	Gliclazide/MR or glimepiride or repaglinide	0.5
	Other therapy not including SU or insulin	0

Table 2. Medical and religious risk score recommendations for fasting during Ramadan[3]

Risk score/ level	Medical recommendations	Religious recommendations
Low risk 0-3 points	Fasting is safe	1. Fasting is obligatory 2. Advice not to fast is not allowed unless patient is unable to fast due the physical burden of fasting or needing to take medication or food or drink during the fasting hours
Moderate risk 3.5-6 points	1. Medical evaluation 2. Medication adjustment 3. Strict monitoring	1. Fasting is preferred but patients may choose not to fast if concerned about their health after consulting their doctor and taking into account the full medical circumstances and the patient's own previous experience 2. If patients fast, they must follow medical recommendations including regular blood glucose monitoring
High risk >6 points	Advise against fasting	Advise against fasting

5. **What is Mrs DB's risk score for Ramadan fasting this year?**

A. 2.5 B. 3.5 C. 6.5

Expert comment

It is difficult to know if Mrs DB is experiencing hypoglycaemia as she is not measuring her blood glucose regularly, but she is not symptomatic and so she scores 0 for the presence of hypoglycaemia.

Mrs DB is still alert and independent, with no frailty or loss in cognitive function, and so she scores 0 for that risk element measure. The elderly should not automatically be classified as high risk based solely on their age; general health status and social circumstances should be considered when assessing risk. Comorbidities that impact on the safety of fasting are generally more common in the elderly patient with diabetes. Functional capacity and cognition should be assessed, and the treatment plan should be adapted accordingly.

6. **What is Mrs DB's estimated risk level for Ramadan fasting this year?**
   - A. Low
   - B. Moderate
   - C. High

7. **Which recommendations regarding Ramadan fasting are appropriate for Mrs DB?**
   - A. Fasting is both safe and obligatory
   - B. Advise against fasting altogether
   - C. She can fast if she prefers, but must follow medical advice and regularly monitor her blood glucose levels

The elderly should not automatically be classified as high risk based solely on their age; general health status and social circumstances should be considered when assessing risk

Are changes to oral antidiabetic drug (OAD) regimens necessary during Ramadan fasting?

The type of antidiabetic medication used by the patient influences the potential risks of fasting during Ramadan, and therefore needs careful attention when formulating the treatment plan. A summary of considerations with regard to the use of OADs during Ramadan follows; adjustments to the use of injectable therapies are beyond the scope of this review.

Metformin

The risk of hypoglycaemia is low in T2DM patients treated with metformin monotherapy and although no randomised controlled trials (RCTs) have been conducted on patients fasting during Ramadan, metformin is considered safe for use. However, patients may need to adjust their metformin regimen during Ramadan (Figure 3).

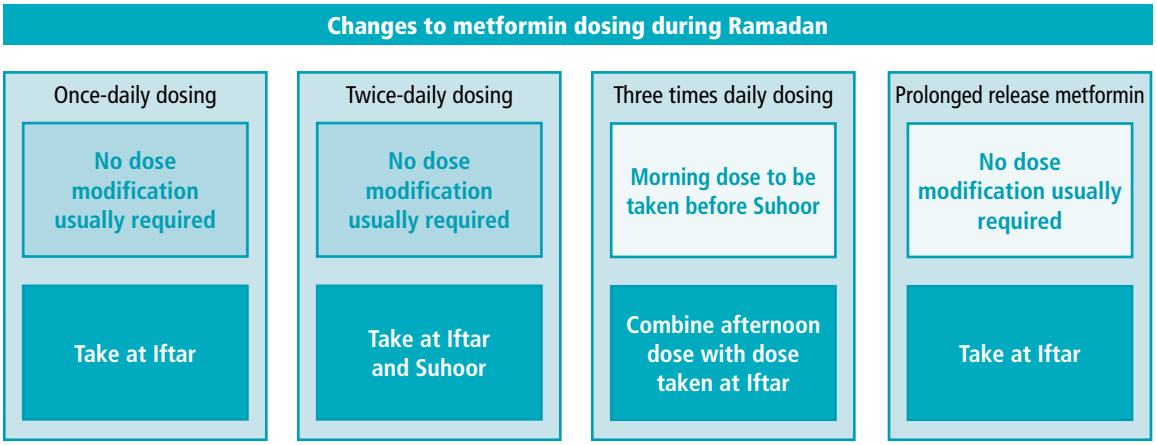

Figure 3. Dose adjustment for metformin during Ramadan[3]

Acarbose

Because the risk of hypoglycaemia is low for acarbose, it is considered safe for use during Ramadan fasting with no dose adjustment required; no RCTs have been conducted on fasting patients with diabetes.

Thiazolidinediones

Pioglitazone is associated with a low risk of hypoglycaemia; no dose modification is required during Ramadan and it can be taken at Iftar, the pre-dawn meal, or Suhoor, when breaking the fast in the evening.

Short-acting insulin secretagogues

The short-acting insulin secretagogues are appealing during Ramadan because they are taken before meals, have a short duration of action and carry a low risk of hypoglycaemia. The daily dose of short-acting insulin secretagogues, usually based on a three-meal dosing schedule, may be reduced or redistributed to two doses during Ramadan according to the meal size and composition.

Three observational studies[8-10] and two RCTs[11,12] have evaluated the use of repaglinide during Ramadan. Two of the observational studies reported no hypoglycaemic events and the third study showed no significant difference in hypoglycaemic events on repaglinide treatment compared with insulin glargine or sulphonylurea (SU) therapy. A low incidence of hypoglycaemic events was associated with repaglinide in both RCTs, with hypoglycaemic events occurring in similar proportions of patients treated with repaglinide and SU therapy.

Sulphonylureas

SUs need dose adjustment if they are used by fasting patients with diabetes (Figure 4) and therapy should be individualised following clinician guidance. Studies have shown that the proportion of patients experiencing a hypoglycaemic event while fasting is consistently lower for second-generation SUs.[13-15]

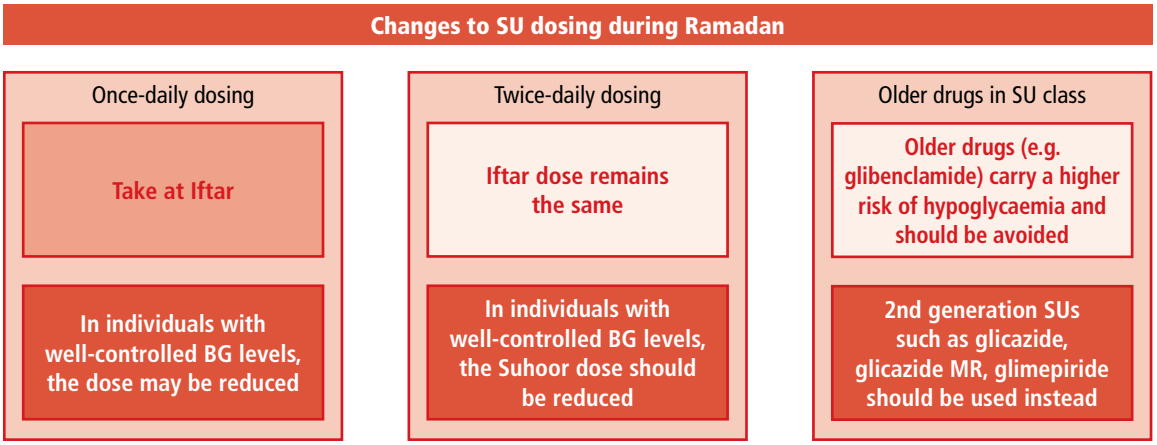

Figure 4. Dose adjustments for SUs during Ramadan fasting[3]

Dipeptidyl peptidase-4 (DPP-4) inhibitors

DPP-4 inhibitors do not require treatment modifications during Ramadan. Numerous RCTs have assessed the safety and efficacy of DPP-4 inhibitors during Ramadan; the incidence of hypoglycaemia is consistently lower with vildagliptin compared with SUs,[14,16-20] and the relative risk of hypoglycaemia is reduced with sitagliptin therapy compared with SU treatment.[13,21]

The advantages of vildagliptin and sitagliptin therapy during Ramadan include:

- A low risk of hypoglycaemia
- They maintain good glycaemic control (no Ramadan data for sitagliptin)
- They do not require dose titration prior to Ramadan
- They are taken independently of meals
- They are not associated with weight gain.

Sodium-glucose co-transporter-2 (SGLT-2) inhibitors

SGLT-2 inhibitors are considered suitable and safe for some patients during Ramadan fasting; no dose adjustments are required, and it is recommended that the dose be taken with Iftar. It is important that the patient understands the necessity of adequate hydration after breaking the fast.

Recent studies have provided reassurance about the efficacy and safety of SGLT-2 inhibitor use during Ramadan fasting after initial safety concerns with regard to an increase in urinary tract infections and mycotic infections, as well as an increased risk of ketoacidosis and dehydration.[22-25] Due to safety concerns, SGLT-2 inhibitors are not recommended for use during Ramadan in the elderly, patients with renal impairment, hypotensive individuals, those at risk of dehydration and those taking diuretics.

8. Which of the listed OADs is considered safe for use during Ramadan, with a low risk of hypoglycaemia, and requires no medication adjustment?

- **A.** Acarbose
- **B.** Pioglitazone
- **C.** SUs
- **D.** All of the above
- **E.** A and B only

9. Mrs DB is using metformin twice daily. Does her usual metformin regimen require adjustment during Ramadan fasting?

- **A.** No dose modification is necessary
- **B.** Reduce dose, take only at Iftar
- **C.** Increase dose, take only at Suhoor

10. Which of the listed features of short-acting insulin secretagogues are advantageous with regard to their use during Ramadan fasting?

- **A.** They are taken before a meal
- **B.** Their short duration of action and therefore carries a low risk of hypoglycaemia
- **C.** Usual three-meal dosing can be reduced or redistributed to two doses
- **D.** All of the above
- **E.** B and C only

11. Mrs DB is using gliclazide MR 60mg bd. What is the appropriate advice with regard to changes to her SU dosing?

- **A.** Iftar dose remains the same; reduce Suhoor dose
- **B.** Reduce Iftar dose; Suhoor dose remains the same
- **C.** There is no need to change her SU dosing

12. Studies have shown that the proportion of patients experiencing a hypoglycaemic event while fasting is consistently lower for second-generation SUs compared to the older SUs:

- **A.** True
- **B.** False

13. Which statement about the use of DPP-4 inhibitors during Ramadan is incorrect?

- **A.** There is a low risk of hypoglycaemia
- **B.** They maintain good glycaemic control
- **C.** They require prior dose titration
- **D.** They are taken independently of meals
- **E.** They are not associated with weight gain

14. **Mrs DB is using dapagliflozin. Which recommendations are appropriate with regard to SGLT-2 inhibitor use during Ramadan fasting?**
    - A. Ensure adequate hydration
    - B. Lower dose taken with Suhoor
    - C. Usual dose taken with Iftar
    - D. A and C

15. **Due to safety concerns, SGLT-2 inhibitors are not recommended for use during Ramadan in the elderly, patients with renal impairment, hypotensive individuals, those at risk of dehydration and those taking diuretics:**
    - A. True
    - B. False

Special populations need specific advice and close monitoring

T1DM

People with T1DM are advised not to fast as they risk severe complications. If the patient with T1DM insists on fasting, they should:

- Frequently check blood glucose levels
- Be otherwise healthy
- Have good hypoglycaemic awareness
- Comply with their individualised management plan under medical supervision.

Pregnant women

Pregnant women with pre-existing diabetes or gestational diabetes are advised not to fast until further research data are available to support any change in risk category.

Many pregnant women will choose to fast. Hyperglycaemia is hazardous to both mother and baby.

Key learnings

- Ramadan can affect sleep patterns, meal schedules and circadian rhythms, and gives rise to glycaemic and metabolic changes
- A nutrition plan is vital to achieve optimal diabetes control and should be individualised for each patient intending to fast during Ramadan
- SMBG does not break the fast and can indicate when there is a medical need to break the fast
- Patients at moderate risk for fasting during Ramadan can do so if they follow medical recommendations and regularly monitor their blood glucose
- The type of antidiabetic medication used may influence potential risks associated with fasting and may require adjustments to the regimen.

References

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1. Salti I, Benard E, Detournay B, *et al*. A population-based study of diabetes and 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**(10): 2306-2311.
2. Hassanein M, Hussein Z, Shaltout I, *et al*. The DAR 2020 Global survey: Ramadan fasting during COVID 19 pandemic and the impact of older age on fasting among adults with type 2 diabetes. *Diab Res Clin Pract* 2021 (in press).
3. International Diabetes Federation, in collaboration with the Diabetes and Ramadan International Alliance. Diabetes and Ramadan Practical Guidelines 2021.
4. Kul S, Savas E, Ozturk ZA, *et al*. Does Ramadan fasting alter body weight and blood lipids and fasting blood glucose in a healthy population? A meta-analysis. *J Relig Health* 2014; **53**(3): 929-942.
5. Ajabnoor GM, Bahijri S, Borai A, *et al*. Health impact of fasting in Saudi Arabia during Ramadan: association with disturbed circadian rhythm and metabolic and sleeping patterns. *PLoS One* 2014; **9**(5): e96500.
6. Feizollahzadeh S, Rasuli J, Kheirouri S, *et al*. Augmented plasma adiponectin after prolonged fasting during Ramadan in men. *Health Promot Perspect* 2014; **4**(1): 77-81.
7. Gnanou JV, Caszo BA, Khalil KM, *et al*. Effects of Ramadan fasting on glucose homeostasis and adiponectin levels in healthy adult males. *J Diabetes Metab Disord* 2015; **14**: 55.
8. Bakiner O, Ertorer ME, Bozkirli E, *et al*. Repaglinide plus single-dose insulin glargine: a safe regimen for low-risk type 2 diabetic patients who insist on fasting in Ramadan. *Acta Diabetol* 2009; **46**(1): 63-65.
9. Sari R, Balci MK, Akbas SH, *et al*. The effects of diet, sulfonylurea, and Repaglinide therapy on clinical and metabolic parameters in type 2 diabetic patients during Ramadan. *Endocr Res* 2004; **30**(2): 169-177.
10. Cesur M, Corapcioglu D, Gursoy A, *et al*. A comparison of glycemic effects of glimepiride, repaglinide, and insulin glargine in type 2 diabetes mellitus during Ramadan fasting. *Diabetes Res Clin Pract* 2007; **75**(2): 141-147.
11. Anwar A, Azmi KN, Hamidon BB, *et al*. An open label comparative study of glimepiride versus repaglinide in type 2 diabetes mellitus Muslim subjects during the month of Ramadan. *Med J Malaysia* 2006; **61**(1): 28-35.
12. Mafauzy M. Repaglinide versus glibenclamide treatment of Type 2 diabetes during Ramadan fasting. *Diabetes Res Clin Pract* 2002; **58**(1): 45-53.
13. Al Sifri S, Basiounny A, Echtay A, *et al*. The incidence of hypoglycaemia in Muslim patients with type 2 diabetes treated with sitagliptin or a sulphonylurea during Ramadan: a randomised trial. *Int J Clin Pract* 2011; **65**(11): 1132-1140.
14. Al-Arouj M, Hassoun AAK, Medlej R, *et al*. The effect of vildagliptin relative to sulphonylureas in Muslim patients with type 2 diabetes fasting during Ramadan: the VIRTUE study. *Int J Clin Pract* 2013; **67**(10): 957-963.
15. Aravind SR, Al Tayeb K, Ismail SB, *et al*. Hypoglycaemia in sulphonylurea-treated subjects with type 2 diabetes undergoing Ramadan fasting: a five-country observational study. *Curr Med Res Opin* 2011; **27**(6): 1237-1242.
16. Devendra D, Gohel B, Bravis V, *et al*. Vildagliptin therapy and hypoglycaemia in Muslim type 2 diabetes patients during Ramadan. *Int J Clin Pract* 2009; **63**(10): 1446-1450.
17. Halimi S, Levy M, Huet D, *et al*. Experience with vildagliptin in type 2 diabetic patients fasting during Ramadan in France: Insights from the VERDI Study. *Diabetes Ther* 2013; **4**(2): 385-398.
18. Hassanein M, Abdallah K, Schwizer A. A double-blind, randomized trial, including frequent patient-physician contacts and Ramadan-focused advice, assessing vildagliptin and gliclazide in patients with type 2 diabetes fasting during Ramadan: the STEADFAST study. *Vasc Health Risk Manag* 2014; **10**: 319-326.
19. Hassanein M, Hanif W, Malik W, *et al*. Comparison of the dipeptidyl peptidase-4 inhibitor vildagliptin and the sulphonylurea gliclazide in combination with metformin, in Muslim patients with type 2 diabetes mellitus fasting during Ramadan: results of the VECTOR study. *Curr Med Res Opin* 2011; **27**(7): 1367-1374.
20. Shete A, Shaikh A, Nayeem KJ, *et al*. Vildagliptin vs sulfonylurea in Indian Muslim diabetes patients fasting during Ramadan. *World J Diabetes* 2013; **4**(6): 358-364.
21. Aravind SR, Ismail SB, Balamurugan R, *et al*. Hypoglycemia in patients with type 2 diabetes from India and Malaysia treated with sitagliptin or a sulfonylurea during Ramadan: a randomized, pragmatic study. *Curr Med Res Opin* 2012; **28**(8): 1289-1296.
22. Hassanein M, Echtay A, Hassoun A, *et al*. Tolerability of canagliflozin in patients with type 2 diabetes mellitus fasting during Ramadan: Results of the Canagliflozin in Ramadan Tolerance Observational Study (CRATOS). *Int J Clin Pract* 2017; **71**(10): e12991.
23. Bashier A, Khalifa AA, Abdelgadir EI, *et al*. Safety of sodium-glucose cotransporter 2 inhibitors (SGLT2-I) during the month of Ramadan in Muslim patients with type 2 diabetes. *Oman Med J* 2018; **33**(2): 104-110.
24. Shao Y, Lim GJ, Chua CL, *et al*. The effect of Ramadan fasting and continuing sodium-glucose co-transporter-2 (SGLT2) inhibitor use on ketonemia, blood pressure and renal function in Muslim patients with type 2 diabetes. *Diabetes Res Clin Pract* 2018; **142**: 85-91.
25. Abdelgadir E, Rashid F, Bashier A, *et al*. Use of flash glucose monitoring system in assessing safety of the SGLT2 inhibitors during Ramadan fasting in high risk insulin treated patients with type 2 diabetes. *Diabetes Metab Syndr* 2019; **13**(5): 2927-2932.

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