



Burden and Patterns of Medical Emergencies during Ramadan Fasting: A Narrative Review

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Abstract

Introduction Acute medical problems may occur more frequently during Ramadan fasting (RF). We aimed to provide a narrative overview of the global literature on medical emergencies during RF.

Methods This is a nonsystematic review of the international literature from one major medical online database (PubMed, National Institutes of Health, United States). The relevant literature was narrated in a concise thematic account.

Results There is a variable impact in the burden and time distribution of emergency services and hospitalization during RF that may require readjustment of resource allocation. Studies of the risk of accidents and injuries may be increased overall or at specified times, around Iftar time. A classical impact of emergencies has been the risk of worsening peptic ulcer disease. RF impacts diabetic emergencies such as severe hypoglycemia, hyperglycemia, and diabetic ketoacidosis, particularly in type 1 diabetes and poorly controlled patients. Glucocorticoid replacement therapy may represent a challenge to patients and physicians that require education and dose adjustment. Acute neurological conditions of interest include the “first day of Ramadan headache,” epilepsy, and strokes. Several studies evaluated the risk of the acute coronary syndrome and heart failure with inconsistent findings. RF may impact the renal and urological systems through stone disease, renal colic, and acute kidney. The impact on hematological conditions was mostly focused on the safety of anticoagulant therapy during Ramadan.

Keywords

- ▶ Ramadan fasting
- ▶ emergency services
- ▶ accidents and injuries
- ▶ peptic ulcer disease
- ▶ diabetic emergencies
- ▶ glucocorticoid replacement
- ▶ acute neurological conditions

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Conclusion The review addresses the emergency medical encounters of the fasting patient during Ramadan to allow a holistic and ethnically sensitive approach to medical care under circumstances where decisions have to be taken with no delay.

Introduction

Ramadan fasting (RF) practiced by adult Muslims entails abstinence from food, water, all oral substances, intravenous fluid therapy, and smoking between dawn and sunset during the ninth month of the Muslims' lunar calendar. The last three decades witnessed a rising interest in the research on Ramadan's fasting in health and disease, with a disproportionate focus on diabetes.¹ Ramadan's impact on health and disease stems from the biological effects of prolonged fasting during the daytime, possible overfeeding at night, and various social changes.² Acute medical emergencies may happen at any time under various circumstances. The impact of RF on medical emergencies and circumstances that make them worse or not heal readily has yet to be comprehensively reviewed.³ Therefore, we have reviewed the literature on the subject to provide a concise thematic account to enhance the knowledge that enhances safety during Ramadan.

Materials and Methods

This is a narrative, nonsystematic review of the literature retrieved from a major online database. The PubMed database was searched from its inception to the day of the search. The combined search term (Ramadan AND Medical emergency) was used in different formats to identify the relevant records up to December 15, 2022. Retrieved articles were examined to confirm relevance, reviewed, and narrated thematically. This review aims to provide a reasonably concise but adequately representative narration of the literature on medical emergencies during Ramadan. Only full-text research articles in English were included. No statistical analysis was conducted on the data included in the original articles, and detailed numerical presentations were avoided. All types of articles were included except single case reports, letters, and editorials. The final product was refined through several multilateral rounds of discussion. The emerging themes from this literature review are highlighted in ►Table 1.

Results

Historical Note

Gastrointestinal-related emergencies are among the earliest reports in the medical literature on the health aspects of RF that can be traced in PubMed.⁴⁻⁶ Greater incidence of perforated peptic ulcers in Ramadan was reported by Leca and Fortesa from Algeria in 1954.⁴ Furthermore, the significance of the frequency of perforated ulcers during Ramadan from Morocco by Lahbabi in 1957.⁵ Also, experience with the effect of RF on the frequency of perforation of gastroduode-

nal ulcers among the population of Tunisia was reported by Vach in 1966.⁶ Indeed, the symptomatic worsening of peptic disease during Ramadan is well imprinted in the folk culture in the era preceding the discovery of histamine H2 antagonists. Diabetic complications came to the scene later.¹

The burden of EMS during Ramadan

Burden, Distribution, Nature in Order

An important goal for the emergency department (ED) operational management is planning for changes in patient volume and assuring staffing accordingly. EDs worldwide experience substantial variability in hourly patient arrivals and change considerably during holidays, posing challenges to resource allocation. Ramadan is associated with social and biological changes in a repetitive annual occurrence, which may impact the burden on emergency services. ►Table 2 lists several main studies addressing the impact on burden and pattern of attendance to EDs, hospitalizations, and admissions to intensive care.⁷⁻¹³ The salient findings of these and other studies are discussed below.⁷⁻²⁰

One study from Qatar found that Ramadan was not associated with the change in patient age or the proportion of high-acuity cases. However, it was associated with an increase in the proportion of male, pediatric, and Qatari national patient visits.¹⁴ These results are similar to those of others who found a significant diurnal variation in the hourly number of cases. He noted a marked increase in patients in the early evening, late evening, and early morning hours.¹⁵ However, other groups found a slight reduction in the number of cases presented during Ramadan. The numbers for patients presented during Ramadan are slightly higher during fasting hours (53% vs. 47%).¹⁶ Others noted that 60% of patients who presented during Ramadan attended during the night shift.¹⁷

Topacoglu et al found that the frequency of visits has stayed the same. However, certain conditions like diabetes-related complications have more tendency to present during Ramadan.⁹ In a multiethnic community, the proportion of Muslim patients presented to the ED department was found to be increased during the month of Ramadan.⁷ During one study, the increased frequency of Muslim patients was specifically due to abdominal pain. Observed a small but not significant increase in accident-related attendance.⁸ EDs might experience a decrease in volumes, a longer stay, and potentially worse outcomes during Ramadan, with no changes to the frequencies of visits related to common medical conditions.¹²

Whereas the previous results concentrated on ED attendance, others studied patients admitted to the intensive care unit (ICU) in Tunisia in Shaban, Ramadan, and Shawal. The percentages of admitted patients with chronic kidney

Table 1 The themes that emerged from the review of the literature

The overall burden of attendance at emergency medical services (EMS) resources, hospitalization
Time and disease pattern of EMS seeking and outcomes
Metabolic disturbances (diabetes, adrenals)
Disorders of the gut and liver diseases
Acute cardiac conditions (acute coronary syndromes and heart failure)
Acute renal disorders (stones, colic and acute kidney injury)
Acute neurological disorders (headache, stroke, epilepsy)
Impact on anticoagulant therapy
Rates and nature of accidents and Injuries.
Bioethical considerations

disease (CKD) (2.3, 3.5, and 7.3%, respectively) and for hypovolemic shock (1.6, 6.1, and 5.0%, respectively) were significantly higher. While there were no differences in any studied outcomes in patients admitted to ICU before, during, or after Ramadan, there was a significant increase in patients presenting with a history of CKD, hypovolemic shock, and inverted urinary sodium to potassium ratio.¹⁸

The characteristics of visits to the adult ED between those in 2016, which included the longest fasting time, and those in the year 2000, which included the shortest fasting time, were studied in Ankara, Turkey.¹⁹ Patient visits made during Ramadan in the years 2000 and 2016 were included in the study. There was a statistically significant difference

between the total number of visits to the ED in the Ramadan months of 2000 and 2016 ($p < 0.001$). Moreover, there was a statistically significant difference in the number of complaints between Ramadan of 2000 and 2016 ($p < 0.001$). Also, Halasa found more patients presenting during the night hours than during daytime hours, echoing previous results; however, he found a larger proportion of younger patients presented with respiratory tract infections during Ramadan.¹¹ Finally, Balhara et al¹³ examined patients in the United Arab Emirates (UAE) and Sawaya et al²⁰ examined patients in Lebanon, they both observed a reduction in pediatric patient group attendance, with Balhara et al noting a decrease in the length of stay in this group of patients.

Accidents and Injuries

► **Table 3** summarizes the different studies in this context that came up with contrasting findings and conclusions.^{21–26} The number of persons injured by traffic accidents was slightly higher during Ramadan than in other months in Al Ain, UAE. Most of the accidents and injuries occurred from 8.00 a.m. to 2.00 p.m.²¹ However, Mehmood et al found that the frequency of road traffic crashes did not change significantly during Ramadan when studying road traffic data in Karachi in Pakistan for 2006 and 2011.²² Furthermore, Akman and Kuru analyzed the causes and outcomes of presentations to EDs due to injuries from motor vehicle crashes and pedestrian strikes. They found that motor vehicle crashes did not increase during Ramadan.²⁴ Also, Khammash and Al-Shouha enrolled all patients with an road traffic accident-related diagnosis in the ED of Princess Basma Teaching Hospital, Irbid, Jordan, during and around Ramadan. They found no significant differences

Table 2 The burden and pattern of emergency attendance, acute admissions, and seeking of emergency services during RF

Author, year (Ref)	Settings, region	Results and conclusions
Langford et al, 1994 ⁷	A &E, London, UK, 1993	There is a significant rise in the number of attendances in total and non-accident-related attendance but not in accident-related attendance
Parrilla Ruiz et al, 2003 ⁸	ED, Madrid, Spain, 2001.	There is Increase abdominal pain consultation related to fasting followed by large meals during Ramadan
Topacoglu et al, 2005 ⁹	ED, Izmir, Turkey (2000–2004)	ER visits were significantly higher in Ramadan for hypertension and uncomplicated headache diabetes-related conditions in Ramadan were significantly younger patients
Pekdemir et al, 2010 ¹⁰	ED, Kocaeli, Turkey, 2009	The clinical features of patients admitted to the ED and the number of ED admissions for specific ailments did not change significantly
Halasa, 2014 ¹¹	ED, Private Hospital, Jordan, 2010	Significant increase in late night and early morning ED visits in Ramadan compared with other months
Al Assaad et al, 2018 ¹²	ED Tertiary Care Center, Beirut, Lebanon, 3 years	Decrease ED volume with longer ED stay and worse outcome during Ramadan
Balhara et al, 2018 ¹³	ED, Tertiary Hospital, Abu Dhabi, UAE (2010–2013)	Decrease ED visits and later peak time after breaking the fast. More GI and trauma cases.

Abbreviations: ED, emergency department; GI, gastrointestinal; RF, Ramadan fasting; UAE, United Arab Emirates.

Table 3 Patterns and types of accident and injuries during Ramadan fasting

Authors (Year)	Variables and sample size	Settings	Findings/Conclusion
Bener et al, 1992 ²¹	Retrospective study of all 1197 people injured during Ramadan	Al Ain Hospital, UAE (1990)	Slight increase in RTA injuries during Ramadan
Mehmood et al, 2015 ²²	Retrospective analysis of the Road Traffic Injury Surveillance Project (N = 163,022)	Karachi, Pakistan (2006–2011)	No significant change in RTA during Ramadan. Cluster around breaking the fast and the Tarawih prayers
Tahir et al, 2014 ²³	12,969 RTAs occurred in Ramadan versus a monthly average of 11 573 RTAs	Punjab, Pakistan (August, 2011 versus rest of 2011)	Significant increase in RTA emergencies during Ramadan compared with other months
Akman and Kuru, 2020 ²⁴	Causes and outcomes of presentations to EDs due to RTA injuries (N = 798)	Canakkale Province, Turkiye (2019–2020)	RTA did not increase during religious seasons including Ramadan
Ghumman and Horney, 2016 ²⁵	Manual review of death certificates during the heat wave	Hospitals and clinics, Karachi, Pakistan (2015)	No significant increase in heat-related mortality in a heat wave coinciding with Ramadan
Khammash and Al-Shouha, 2006 ²⁶	228 RTA-related injuries: 96 during RF and 132 during the control period	Princess Basma Hospital, Irbid, Jordan (2004)	No significant change in the number and type of injury in time of day or weekdays

Abbreviations: ED, emergency department; RF, Ramadan fasting; RTA, road traffic accident; UAE, United Arab Emirates.

between the numbers and severity of injuries among the subgroups of patients concerning the time of the day or the weekdays.²⁶

Surgical Emergencies

The changing pattern of surgical emergencies during Ramadan was investigated in two large retrospective cohort studies with contracting conclusions from Turkiye and Kuwait.^{27,28} The changes in patients' profiles were investigated in the surgical emergency unit in Ankara Numune Hospital using the intraoperative diagnosis of 1,408 patients who underwent surgery in the emergency unit between 1999 and 2003, during and after Ramadan.²⁷ Peptic ulcer perforation and acute mesenteric ischemia significantly increased during Ramadan compared with the months before and after Ramadan. On the other hand, violence-induced penetrating injuries like stab wounds and gunshot wounds decreased significantly during Ramadan. Other surgical interventions did not change.²⁷ On the contrary, examination of the surgical department of Al-Sabah Hospital, Kuwait, examined all patients ($n = 61,832$) who attended the surgical department during three consecutive lunar months each year (the fasting month - Ramadan, the month before [Shaban], and the month after [Shawal]), for the five consecutive years.²⁸ The majority (85%) were Muslims (mixed group). The study was further refined to analyze Kuwaiti patients who were all Muslims (Muslim group). *Primary outcome measure:* Attendance at the surgical department attendance in the mixed group was less during Ramadan and Shawal than during Shaban ($p = 0.06$). In the mixed group, attendance during Shawal was much less than in Shaban ($p = 0.0007$). Patients in the Muslim group attending the

surgical department (2000–2004) showed decreased attendance during Ramadan and Shawal compared with Shaban ($p = 0.015$). The total number of cases admitted to the hospital through the surgical department was less in Ramadan and Shawal than in Shaban ($p = 0.6$). These studies suggest that (1) physiologic and behavioral changes during Ramadan may alter patient profiles in a surgical emergency unit, and (2) there is a decrease in the number of Muslim patients attending the surgical department during the fasting month of Ramadan and Shawal compared with Shaban, possibly indicating that Muslim fasting may positively decrease the number of patients attending the surgical department.

Acute Diabetic Emergencies

Attendance to Emergency Services and Hospitalizations
Diabetes-related emergencies are the most common endocrine emergencies encountered during Ramadan, leading to a surge in diabetes studies during Ramadan. A retrospective study examined the variation in visits to the ED during Ramadan compared with other lunar months at a tertiary care hospital in Jeddah city in adults (> 18 years) using an electronic medical record review of patients with diabetes emergencies who visited the emergency room (ER) of a military hospital from the 9th to 11th lunar months during 2017 to 2018.²⁹ The frequency of ER visits, sociodemographic characteristics, and clinical features were determined. A total of 24,498 admissions were recorded. The prevalence of diabetes emergency visits was only 0.84%. Based on inclusion criteria, a total of 133 subjects were included in the study (54.1% men and 45.9% women). Most (73.7%) were on insulin

therapy, and more than half (51.9%) had type 2 diabetes mellitus (T2DM). There was a significant difference ($p = 0.001$) in the prevalence of diabetes emergency visits between the three lunar months, Shaban, Ramadan, and Shawal, 7, 5, and 4%, respectively. However, the highest prevalence was not during Ramadan. Although some correlations were identified, the study found no significant differences between the frequency of ER visits and various demographic, clinical factors, and diabetes profiles between Ramadan and other preceding and succeeding lunar months. These authors suggested a downward prevalence trend from Shaban to Ramadan and Shawal. The results suggest that fasting during the month of Ramadan does not negatively impact diabetes emergencies in comparison with other months. Hyperglycemia among T2DM and insulin-treated patients were recorded as the highest feature of diabetes emergency visits during the 3 months studied, with no significant differences between the months. These findings highlight the need for type 2 and insulin-treated patients to be thoroughly assessed by primary care physicians, and in-depth health education and guidance should be given to them.

Additionally, the admissions for diabetes emergencies among 295 patients who fasted or planned to fast 1 month before ($N = 119$), during ($N = 106$), and 1 month after ($N = 70$) Ramadan of 2019 in public hospitals in Malaysia were investigated.³⁰ Admissions for hyperglycemic emergencies accounted for two-thirds of admissions. Thirty-seven percent of admissions for hypoglycemia occurred before Ramadan and 32.1% during Ramadan. Contributing factors to hypoglycemia included the use of sulphonylurea (59.6%), the presence of nephropathy (54.5%), and a history of hypoglycemia (45.5%). Diabetic ketoacidosis (DKA) accounted for more admissions than hyperosmolar hyperglycemic state (HHS) (119 vs. 77), and the highest proportion occurred during Ramadan (36.1%). Most of the admissions for hyperglycemic emergencies were among those with T2DM (75.9% for DKA and 97.4% for HHS). Only 31.5% of patients admitted for diabetes emergencies recalled having received Ramadan advice in the past. Also, a review of the records of 402 patients with diabetes admitted to the medical department at Benghazi Medical Center, Libya, during Ramadan and Dhu al-Qidah of 2016 was conducted.³¹ The differences in reasons for admission, length of stay, and in-hospital mortality were compared between patients admitted during Ramadan and Dhu al-Qidah and between patients who were fasting at the time of admission during Ramadan and those who were not. During Ramadan, 186 patients were admitted compared with 216 during Dhu al-Qidah. There was no significant difference in reasons for admission, length of hospital stay, or in-hospital mortality (borderline for mortality, $p = 0.078$) between patients with diabetes admitted during Ramadan and Dhu al-Qidah. Similar to the previous study from Saudi Arabia,²⁹ Of those admitted in Ramadan, 59.1% were fasting on admission. Fasting patients admitted during Ramadan had a significantly higher proportion of diseases of the circulatory system when compared with nonfasting patients (39.4% vs. 23.6%, $p = 0.028$). In comparison, in-hospital mor-

tality was higher in nonfasting patients (29.2% vs. 8.7%, $p < 0.001$). There was no significant difference in length of stay between fasting and nonfasting patients.

Severe Hypoglycemia

The risk of hypoglycemia in patients with diabetes fasting during Ramadan has improved over the years. The first study to highlight the incidence of hypoglycemia in fasting patients with diabetes was the landmark EPIDIAR study.³² It was a population-based, retrospective transversal survey conducted in 13 countries. A total of 12,914 patients with diabetes were recruited using a stratified sampling method, and 12,243 were considered for the analysis. During Ramadan, 42.8% of patients with T1DM and 78.7% with T2DM fasted for at least 15 days. Severe hypoglycemic episodes were significantly more frequent during Ramadan than in other months (T1DM, 0.14 vs. 0.03 episode/month, $p = 0.0174$; T2DM, 0.03 vs. 0.004 episode/month, $p < 0.0001$). More recently, a real-world survey studied the risk of hypoglycemia during Ramadan, its risk factors, and the impact of hypoglycemia on patients' behavior in a cross-sectional multicountry observational study, with data captured within 6 weeks after Ramadan 2015. In a cohort of 1,759 patients, hypoglycemia was reported by 290 patients (16.8%), mainly affecting insulin-treated patients in general.³³ Fasting was interrupted by 67% of those who experienced hypoglycemia, and recourse to emergency services was pursued by less than a quarter of patients with hypoglycemia. Another comparison of the incidence of symptomatic hypoglycemia in fasting Muslim patients with T2DM treated with sitagliptin ($n = 507$) or a sulphonylurea ($n = 514$) during Ramadan.³⁴ However, there were no reported events that required medical assistance or were considered severe (i.e., events that caused loss of consciousness, seizure, coma, or physical injury) during Ramadan. Similar findings of low hypoglycemia risk are seen within the pediatric population; the safety of Ramadan was evaluated among 50 children and adolescents with T1DM, age 12.7 years. Twenty-seven patients (54%) were on multiple daily injections (MDIs) insulin regimens, and 23 (46%) were on insulin pump therapy.³⁵ Participants were compared according to the insulin treatment regimen and their glycemic control level before Ramadan. The children could fast for 20 days of Ramadan, and the most common cause for breaking the fast was mild hypoglycemia (7.8% among all cases). There was no significant difference between the two insulin regimen groups in breaking fast days, frequency of hypo- or hyperglycemia, weight, and hemoglobin A1c (HbA1c) changes post-Ramadan. Patients with HbA1c $\leq 8.5\%$ were able to fast more during Ramadan with significantly less-frequent hypoglycemic attacks than patients with HbA1c > 8.5 (1.2 vs. 3.3 days of hypoglycemia, $p = 0.01$, respectively).

Severe Hyperglycemia

To determine the burden of severe hyperglycemia-related admissions in diabetes patients fasting during Ramadan, a retrospective chart review was conducted that included all Muslims admitted with DKA in Abu Dhabi, UAE, over 10 years

(2005–2014).³⁶ There were 432 episodes of DKA involving 283 patients. Of these, 370 episodes (85.6%) involved 231 patients (81.6%) with type 1 diabetes. The number of admission episodes was not different during Ramadan from the average calendar month (3.6 episodes/month vs. 3.3 episodes/month, respectively, $p = 0.77$). No recurrences of admissions were observed during Ramadan. Some other observed seasonality trends were not related to Ramadan. On the contrary, a retrospective study of all adults admitted with DKA explored the relationship of admissions to Ramadan by comparing it to the month before (Shaban) and the month after (Shawal) and found different results.³⁷ Fifty-one patients with DKA were admitted; 19 in Ramadan (37.3%), 8 in Shaban (15.7%), and 24 in Shawal (47%), showing a significant increment in Ramadan compared with Shaban and a higher increment in Shawal ($p = 0.019$). The most common precipitating factor for DKA during Ramadan and Shaban is missing insulin doses, while infections are considered the main stimulating agent in Shawal. However, a critical reappraisal of the literature up to 2019 concluded that the state of knowledge and evidence suggests that the risk of DKA is not increased during RF.³⁸ It was supported by findings from a prospective evaluation of patients with diabetes wishing to fast during Ramadan, excluding patients considered at very high risk. In this cohort, no patient reported significant hyperglycemia, ketosis, or severe hypoglycemia.³⁹

Over the last few years, technology has reshaped the outcomes of patients with diabetes. This is also evident in the context of Ramadan. A systematic review and meta-analysis addressed the role of technology in the safety of RF in young patients with T1DM.⁴⁰ Pooled data from 17 observational studies involving 1,699 patients treated with either continuous subcutaneous insulin infusion (CSII) or non-CSII (including premixed and MDI) regimens. The CSII-treated group ($n = 203$) was older (22.9 vs. 17.8 years) and had longer diabetes duration (116.7 vs. 74.8 months) and lower glycated hemoglobin (7.8% vs. 9.1%) at baseline than the non-CSII-treated group ($n = 1,496$). The non-CSII-treated group had less nonsevere hypoglycemia than the CSII-treated group (22% vs. 35%). The CSII regimen had lower rates of severe hypoglycemia and hyperglycemia/ketosis. However, a higher rate of nonsevere hyperglycemia than premixed/MDI regimens suggesting appropriate patient selection with regular supervised fine-tuning of the basal insulin rate with intensive glucose monitoring might mitigate the residual hypoglycemia risk during Ramadan.

Adrenal Crisis

Adrenal replacement therapy is conventionally given at set times of the day. Therefore, although the conventional drug is hydrocortisone, its biological half-life is too short to cover the long fasting hours. RF may disturb the replacement routine. Some earlier authors categorized adrenal crisis as high risk and naturally advised to avoid fasting.⁴¹ To avoid this, they recommended longer-acting glucocorticoids, such as prednisolone at Suhoor time and hydrocortisone in the evening, taken at Iftar time. The dose of prednisolone is

based on the usual morning hydrocortisone dose. The mineralocorticoid dose should be taken in primary adrenal insufficiency (AI) at Suhoor time. Patients should be educated regarding the acute illness rules and should have contact details and access to return to the clinic if needed. Maintaining hydration and mineral balance and avoiding exhausting exercise, particularly in hot weather, are obvious precautions for patients on adrenal replacement therapy.⁴¹ However, a cross-sectional study of approximately 180 patients with known and treated adrenal insufficiency was undertaken to create a more evidence base.⁴² A 14-item questionnaire concerning patients' knowledge about the disease and fasting during Ramadan was used. One hundred thirty-eight patients (76.7%) received advice from their physician not to fast, and 91 patients (50.5%) tried to fast. Complications occurred in 67.0%, including asthenia in 88.5% of cases, intense thirst in 32.8%, symptoms of dehydration in 49.2%, and symptoms of hypoglycemia in 18%. More recently, a U.K.-based group proposed detailed risk stratification for patients with AI and optimal management strategies.⁴³ They suggested that patients with AI wishing to fast should undergo a thorough risk assessment, ideally several months before Ramadan. "High-risk" and "very high-risk" patients should be encouraged to explore alternative options to fasting. Before the commencement of Ramadan, all patients must receive up-to-date education on sick day rules, instructions on when to terminate their fast or abstain from fasting, carry steroid warning information and have a valid intramuscular hydrocortisone pack, and know how to administer this. Switching patients with AI desiring to fast from multiple daily hydrocortisone replacements to prednisolone 5 mg once daily at dawn (during Suhoor) was recommended and discussed. They also agreed that patients on fludrocortisone for AI should be advised to take their total dose at dawn. At the same time, another group from Tunisia underscored the risks of fasting in patients with adrenal insufficiency, defined the subjects at risk of complications, and proposed the measures that can be undertaken for safe fasting.⁴⁴ They questioned if the optimal glucocorticoid replacement therapy for safe fasting had yet been determined. They also highlighted the risk stratification and the importance of the pre-Ramadan visit for adrenal insufficiency. Failing this, the management of the adrenal crisis during Ramadan is similar to the standards of care.⁴⁴

Cardiovascular Emergencies

Patients with acute coronary syndrome (ACS) may face health issues during Ramadan due to lifestyle changes. Five studies explored the relationship between RF and ACS, and three examined the relationship to heart failure.^{45–52} **Table 4** summarizes the ACS studies.^{45–49} All cardiology studies' salient features and conclusions are reviewed below.

The association between acute myocardial infarction (AMI) outcome and RF by comparing the month preceding Ramadan, Ramadan, and 1 month after Ramadan.⁴⁵ Incidents of AMI between Ramadan and 1 month before were the same, while 1-month post-Ramadan showed an increase in AMI incidence and mortality. Similar findings were observed by

Table 4 Summary of the studies on the acute coronary events during RF

Author (ref)	Condition, settings	Results and conclusions
Betesh-Abay et al, 2022 ⁴⁵	877 Muslims out of 5,848 had AMI admissions (2002–2017)	No difference in AMI incidence in Ramadan vs. before Ramadan was found ($p = 0.893$). However, post-Ramadan AMI incidence increased (AdjIRR = 3.068, $p = 0.018$) than before Ramadan. The highest mortality risk was also post-Ramadan
Sriha Belguith et al, 2016 ⁴⁶	Non-traumatic chest pain at ED (765); Tunisia	The ACS (172) was 17% per month before, 22% during, and 28% after RF ($p = 0.007$). RF was not associated with an increased risk of ACS
Temizhan et al, 1999 ⁴⁷	Emergency ACS admissions Ankara, Turkiye (1991–1997)	RF does not increase acute coronary heart disease events
Raffee et al, 2020 ⁴⁸	ACS ($N = 226$); Jordan (2016–2017)	There is no significant association between RF in cardiac patients and the occurrence of ACS
Al Suwaidi et al, 2006 ⁴⁹	ACS: fasting 162/total 1,019 Qatar (2002–2003)	RF does not increase acute coronary heart disease events

Abbreviation: ACS, acute coronary syndrome; AdjIRR, Adjusted incidence rate ratio; AMI, acute myocardial infarction; ED, emergency department; RF, Ramadan fasting.

Author (ref) Condition, Settings Results and conclusions.

others who studied the 3 months per year before, during, and after RF, between the years 2012 and 2014.⁴⁶ ACS prevalence here was 17% a month before, 22% during, and 28% 1 month after Ramadan, the prevalence of ACS in patients presenting with chest pain during the RF showed no increased risk of ACS during Ramadan, but the risk doubled after Ramadan. However, in a retrospective study of patients hospitalized at ED (1991–1997), ACS events were significantly lower in Ramadan than before or after Ramadan.⁴⁷ Also, another study studied the relation between RF and the occurrence of ACS in 226 patients with main diagnoses of ACS.⁴⁸ The authors found no significant association between RF and ACS occurrence. However, another group investigated the impact of food and sleep lifestyle changes during Ramadan on the time of presentation of fasting hospitalized patients (162 fasting out of a total of 1,019). Changes in the timing of food intake and circadian rhythm during RF might affect the timing of ACS presentation.⁴⁹

Three studies investigated heart failure occurrence during RF with nonconcordant results. A retrospective review of clinical data was conducted on all Qatari patients hospitalized for 10 years (January 1991 through December 2001) with heart failure.⁵⁰ Patients were divided according to the time of presentation in relation to the month of Ramadan, 1 month before, during, and 1 month after Ramadan. The number of hospitalizations for congestive heart failure (CHF) in various periods was analyzed. Of the 20,856 patients treated during the 10 years, 8,446 were Qataris, with 5,095 males and 3,351 females. No significant difference was found in the number of hospitalizations for CHF while fasting in Ramadan compared with the nonfasting months. Also, data were derived from Gulf CARE (Gulf aCute heArt failuRe rEgistry), a prospective multi-center study of consecutive patients hospitalized with acute heart failure (AHF) (2012). The study included 4,157 patients, of which 306 (7.4%) were hospitalized with AHF in the fasting month of Ramadan, while 3,851 patients (92.6%) were hospitalized on other days.⁵¹ The study demonstrated improved

volume status in fasting patients. There were also favorable effects on atrial arrhythmia and total cholesterol and no effects on immediate or long-term outcomes. On the contrary, in a smaller study of 249 heart failure patients with reduced ejection fraction (HFrEF) who observed RF, 92% remained hemodynamically stable, and 8% developed instability.⁵² Significantly unstable patients are less adherent to diet and medication and less likely to cause ischemic cardiomyopathy to be the underlying cause. In most patients with chronic HFrEF, who are adherent to their medication, RF is safe. However, nonadherence to diet and medication during Ramadan is associated with increased decompensated heart failure.

Acute Renal Problems

In nephrology and urology, three groups of acute medical conditions were studied during Ramadan.⁵³ These included renal stone disease, colic, and acute kidney injury (AKI) (–Table 5). These will be discussed briefly below.

There are concerns about whether the occurrence of renal colic (RC) increases during Ramadan. A prospective observational study investigated patients with symptoms of RC who were referred to the emergency wards in two major hospitals in Iran.⁵³ The study period was divided into 2 weeks before the commencement of Ramadan (stage 1), during the first 2 weeks (stage 2), the last 2 weeks (stage 3), and 2 weeks after Ramadan (stage 4). During the study period, 610 subjects were admitted with RC; there were 441 males (72.3%) and 169 females (27.7%). The number of patients with RC was highest during the first 2 weeks of Ramadan compared with the other periods (stage 1: 157, stage 2: 195, stage 3: 139, stage 4: 119, $p < 0.05$). This study shows that the number of admissions due to RC was high during the first 2 weeks of Ramadan. However, admissions decreased during the last 2 weeks of Ramadan, and this trend continued after Ramadan. Also, a retrospective study examined ER records in Jeddah, an area with a high prevalence of urolithiasis, for three consecutive years to determine the effect of climatic

Table 5 Summary of studies on the acute events during Ramadan fasting in nephrology and urology

Author (ref)	Condition, settings	Results and conclusions
Abdolreza et al, 2011 ⁵³	Prospective study. 610 patients with RC	A significant increase in the incidence of RC during RF. However, other factors may have an important role
al-Hadramy, 1997 ⁵⁴	Retrospective study of all males with acute RC attending ED (KSA, 1992–1994)	No significant increase in RC in relationship to RF
Cevik et al, 2016 ⁵⁸	Prospective study, 176 patients with RC before and during Ramadan (Turkey, 2014)	RF does not change the number of RC visits
Al Mahayni et al, 2018 ⁵⁷	Retrospective study, 237 patients with RC over 10 years (KSA)	RF does not increase the risk for developing urinary stones compared with nonfasting months. However, RF during the summer may increase the risk of developing ureter stones
Al Wakeel, 2014 ⁵⁹	39 CKD and 32 HD patients pre-, during, and post-RF (KSA)	CKD and HD patients tolerated 4-hour fasting for 1 month, although there were considerable changes in some blood chemistry variables. No serious adverse events
AlAbdan et al, 2022 ⁶⁰	Assessed RF-AKI risk link in 1,199 patients	Most patients with comorbid conditions are not harmed by RF. Risk of developing AKI were significantly lower (adjusted odds ratio 0.65)
Wan Md Adnan et al, 2014 ⁶¹	HD in tropical climates – Malaysia	RF is associated with reduced weight and improved serum albumin and phosphate level in HD patients
Adanan et al, 2021 ⁶²	HD patients cohort – Malaysia	HD patients' experiences and perceptions regarding RF warrants the need for effective communication with patients

Abbreviations: AKI, acute kidney injury; CKD, chronic kidney disease; HD, hemodialysis; KSA, Kingdom of Saudi Arabia; RC, renal colic; RF, Ramadan fasting.

changes on the occurrence of urinary stone colic.⁵⁴ Males diagnosed with urinary colic during this period were recorded monthly. Data were recorded before, during, and after Ramadan. The results showed a steady increase in urinary stone colic in the hot season, with a maximum rate in June, July, and August. The mean number of males with stone colic in these months was 45.33, 44.19, and 45.16, respectively. The lowest number was in March (28.06), with a rate of 4.11 per 1,000 patients. A strong correlation was found between urinary stone colic and temperature and atmospheric pressure with a *p*-value of < 0.0001. No significant correlation was observed with relative humidity. Similarly, RF and the pilgrimage festival remained the same. These results suggest a clear seasonal corresponding of stone to the hot summer months in this area. No significant increase in urinary stone colic was observed concerning the fasting month of Ramadan or the pilgrimage festival. Although RC is associated with high ambient temperature and physiological changes during fast, the literature on Ramadan and RC incidence is scarce. Furthermore, visits during RF to a large tertiary center from 2004 to 2015 with a primary diagnosis of RC were analyzed. The two ethnic groups residing in the locality (Palestinian Muslims and Jews) were compared.⁵⁵ They identified 10,435 unique patients with 18,163 ED visits with a primary diagnosis of RC. However, the Palestinians, who represent 18.5% of the population in the region, contributed approximately 25% of the ED visits with RC. After adjusting for seasons, there was a

positive and significant association between temperature and ED visits within all subgroups. Positive association with Ramadan was observed during the first 2 weeks of fasting among Muslims (relative risk [RR] 1.27) but not among Jews (RR 1.061). However, commenting on these data, it was argued that ethnicity could be a confounding factor since the control nonfasting group was from a completely different ethnic group. The genetic factors and diet may make the comparison between the two groups misleading.⁵⁶

Regarding RC, the RC frequency secondary to urinary stones in Ramadan was compared with other months and seasons in a retrospective cross-sectional study.⁵⁷ They used the medical records of 237 patients admitted through the ER with a diagnosis of RC secondary to urinary stones over 10 years at King Abdulaziz Medical City, Riyadh, Saudi Arabia. Patients fasting during Ramadan are two times more likely to present with calculus of the ureter than calculus in another location in the urinary tract, mainly when the holy month of Ramadan falls in the summer season. There was no significant difference in the frequency of urinary stones between Ramadan and non-Ramadan months. Therefore, they concluded that RF does not increase the risk of developing urinary stones compared with nonfasting months. However, another study evaluated the effects of RF on the number of RC-related ED visits and laboratory results of patients with RC in a prospective observational study.⁵⁸ The study period was divided into two parts: before and during Ramadan. All laboratory results of patients and daily air temperature

values were recorded. A total of 176 patients (n : 89 before Ramadan, n : 87 in Ramadan) with RC were enrolled in the study. During Ramadan, 73.1% of patients were admitted in the first half of the month, and 26.9% were admitted in the second half. Only urine density and white blood cell values in Ramadan and non-Ramadan periods differed significantly ($p = 0.004$ and $p = 0.001$). Hemoglobin, available crystal, and triple phosphate crystal values in the first and the second half of Ramadan were significantly different ($p = 0.04$, $p = 0.03$, and $p = 0.03$). This study highlighted that fasting during Ramadan does not change the number of RC visits. In addition, although fasting causes some changes in urinary metabolites, there is not enough evidence that these changes increase urinary calculus formation.

Lastly, the effects of RF were assessed among CKD and hemodialysis (HD) patients in a prospective study seen in 2010 at two university hospitals (Saudi Arabia).⁵⁹ Volunteers among CKD and HD patients were evaluated for kidney function and complications before, during, and after RF (14 hours). A modified schedule for medication and dialysis regimen was provided to the participants. Thirty-nine CKD patients (41.0% in stage 3 and 43.6% in stage 4) were included. There were no differences in the laboratory and clinical variables before, during, and after the fasting month. Thirty-two HD patients with a mean duration of dialysis of 4.4 years were also included in the study. During the fasting period, there was a significant increase in erythrocyte count, serum creatinine, blood urea, serum phosphorus, serum albumin, and serum uric acid levels. Hyperkalemia developed in 25.0 and 15.6% of the HD patients during and after the fasting period, and hyponatremia in 15.6 and 28.0%, respectively. Forty-six percent of the patients developed hypertension and 36.7% fluid overload. No adverse events requiring hospital admission were observed. Thus, CKD and HD patients tolerated 4-hour fasting for 1 month, although there were considerable changes in some blood chemistry variables. No serious adverse events occurred.

Also, the relationship between fasting and the risk of AKI and identified patients at high risk was assessed in a single-center, retrospective, propensity-score-matched cohort study using data collected from adult patients admitted to the ED during Ramadan the following month over two consecutive years (2016 and 2017).⁶⁰ A total of 1,199 patients were included; each cohort had 499 patients after matching. In the fasting cohort, the incidence of AKI and the risk of developing AKI were significantly lower (adjusted odds ratio [AOR] 0.65). The most indicative risk factors for AKI were hypertension (AOR 2.17), history of AKI (AOR 5.05), and liver cirrhosis (AOR 3.01). Patients with these factors or most other comorbidities in the fasting cohort had a lower risk of AKI than their nonfasting counterparts. Furthermore, the effect of RF on HD patients in tropical climates was examined in a prospective cross-sectional study that recruited Muslim patients on regular HD from three HD centers in Kuala Lumpur.⁶¹ Patients who fasted for any number of days were included ($n = 35$, 54% female, age 54 years). Eighty-nine percent of patients fasted for more than 15 days, and 49% had diabetes. Both pre- and postdialysis

weights were significantly decreased during RF compared with the month prior ($p \leq 0.001$). There was a significant decrease in ultrafiltration ($p = 0.002$). There were no significant differences in dry weight, interdialytic weight gain, mean urea reduction ratio, or blood pressure measurements comparing pre- and end-of-RF. There was a significant increase in serum albumin level ($p = 0.006$) and a decrease in serum phosphate level ($p = 0.02$) at the end of Ramadan. Finally, in an experimental phenomenology qualitative study studied the experiences and perceptions of Muslim HD patients observing RF from three HD centers (Malaysia).⁶² Four major themes emerged from the data, namely: (1) "fasting experiences," (2) "perceived side effects of fasting," (3) "health-seeking behavior," and (4) "education and awareness needs." Patients expressed the significance of RF and the perceived impact of fasting on their health. Additionally, there is a lack of health-seeking behavior observed among patients, thus, raising the need for awareness and education related to RF.

Acute Gastrointestinal Problems

The main medical conditions that had acute complications were related to peptic ulcer disease (PUD), as shown in **Table 6**.⁶³⁻⁶⁷ These will be discussed briefly below. A prospective observation of a cohort of 516 patients with PUD before, during, and after RF was performed. They found no differences in the worsening of peptic acid disease during Ramadan compared with the durations before and after Ramadan.⁶³ Also, the relationship between RF and duodenal ulcer perforation was evaluated, and the risk factors for peptic disease in RF were assessed.⁶⁴ A retrospective analysis was conducted for all patients who underwent surgery for duodenal ulcer perforation in the emergency service between 1998 and 2003. Comparisons were made between patients who were operated on in Ramadan within 5 years (5 months during the study period) (group 1) and during the remaining periods (55 months during the study period) (group 2). Two hundred and sixty patients were included (50 in group 1 and 210 in group 2) in the study. The number of surgeries per month was statistically high in group 1 than in group 2 (10 patients per month vs. 3.8 patients per month, $p < 0.018$). Predisposing factors play a significant role and may be the reason for the difference. This study suggests that duodenal ulcer perforation is relatively high in Ramadan among the fasting and has predisposing factors (especially a history of dyspepsia). Therefore, they believe that people with predisposing factors and dyspeptic symptoms must be well-informed and need special care. Also, the study of the effect of RF on PUD and its complications in patients presenting to the ED at Al-Ain Hospital, UAE, was conducted.⁶⁵ The authors retrospectively reviewed patient records over the 10 years, 1992 to 2002. Of the patients treated for PUD, 215 were seen during Ramadan and 255 in the month after Ramadan. The frequency of PUD was higher after Ramadan than during Ramadan, but this was not statistically significant. PUD occurred more frequently in the age group of 30 to 49 years. In addition, the effects of RF on peptic ulcers and acute upper gastrointestinal bleeding were investigated.⁶⁶

Table 6 Summary of the risk of peptic acid disease and complications of gastrointestinal conditions during RF

Authors (year)	Study variables	Settings	Findings/Conclusion
Al-Kaabi et al, 2004 ⁶³	516 patients with PUD	ED patients, Al Ain, UAE	No change in PUD during Ramadan
Kucuk et al, 2005 ⁶⁴	Patients operated on in Ramadan (N = 50); patients operated on in remaining periods (N = 210)	Retrospective hospital study (1998–2003)	Surgeries per month were higher in the RF than non-RF group (10 vs. 3.8 per month, $p < 0.018$)
Bener et al, 2006 ⁶⁵	PUD (215 fasting, 265 not fasting)	ED, Al Ain, UAE, 1992–2002	PUD perforation tended to occur more frequently insignificantly after RF
Emami and Rahimi, 2006 ⁶⁶	Peptic ulcer and acute upper gastrointestinal bleeding	Hospital admissions, 2002–2004, Isfahan, Iran	RF can increase acute upper GI bleeding due to DU, but it does not worsen the prognosis
Ozkan et al, 2009 ⁶⁷	AUGIH (43 during RF vs. 28 non-RF)	ED, Erciyes University Hospital, Kayseri, Turkey	Patients presenting with AUGIH during Ramadan is significantly higher than that in an ordinary month

Abbreviations: AUGIH, acute upper gastrointestinal hemorrhage; DU, duodenal ulcer; ED, emergency department; GI, gastrointestinal; PUD, peptic ulcer disease; RF, Ramadan fasting; UAE, United Arab Emirates.

They studied all patients admitted to the hospital with acute upper gastrointestinal bleeding from the 10th day of Ramadan till 1 month later, from 2002 to 2004. Patients were divided into two groups: the fasting group fasting at least 10 days before admission, and the nonfasting group. The study included 236 patients (108 fasting and 128 nonfasting groups). The fasting group showed more frequent duodenal ulcers (38%) compared with the nonfasting group (19.5%) ($p = 0.002$). The frequency of esophageal varices was significantly higher in the nonfasting group. There was no correlation between fasting and other causes of gastrointestinal bleeding. In the fasting group, 38%, and in the nonfasting group, 18.9% had previous dyspeptic symptoms ($p = 0.001$). The two groups were similar regarding prognostic factors. Also, the epidemiological characteristics and clinical results of patients who presented with acute upper gastrointestinal hemorrhage (AUGIH) during the month of Ramadan (October 2007) were compared with those who presented with AUGIH during another non-Ramadan month (December 2007) in a study that evaluated multiple parameters, including age, sex, symptoms, gastrointestinal disease history, risk factors, coexisting diseases, results of rectal, nasogastric, and endoscopic examinations, treatment modalities, and clinical outcomes.⁶⁷ Significantly more patients were diagnosed with AUGIH during Ramadan than in a non-Ramadan month (43 vs. 28, respectively). Significantly more patients diagnosed during Ramadan had a previous hemorrhage history than the non-Ramadan month (72.1% vs. 42.9%, respectively). The most common event in both groups was a peptic ulcer; overall endoscopy findings differed. No other significant differences were found.

Whether acute pancreatitis (AP) is more common in individuals who celebrate it during RF was addressed.⁶⁸ The occurrence of AP in a fasting population and a nonfasting population during Ramadan versus the rest of the year was undertaken. Over the 10-year study period, 1,167 patients

were admitted to the ED with AP. Of these, 91.6% were nonfasting, and 98 (8.4%) were fasting. Of these, 17.3% of fasting and 8.8% of nonfasting patients were admitted with AP during Ramadan (RR: 1.12; OR: 2.15; $p = 0.01$). During Ramadan, the rate of AP out of referrals was 0.1% in fasting patients versus 0.004% in nonfasting individuals (OR: 2.54). During the other months of the year, the rate of AP out of referrals was 0.009% in fasting patients versus 0.008% in nonfasting individuals ($p < 0.001$). Given a high rate of AP in the fasting population during Ramadan in the studied cohort, they urged physicians to be aware of the link and suspect it for fasting patients presenting with epigastric pain during the Ramadan fast.

Acute Neurological Problems

The most common diseases in Ramadan and Shawal were ischemic stroke (36.7 and 40%), seizure (27.1 and 23.3%), and headache (12 and 14.7%), respectively. They did not find significant differences in sex, age, marital state, incidence and admission time, and risk factors for neurologic diseases between Ramadan and Shawal ($p > 0.05$). In this study, the admission rate for most neurological diseases was not significantly different in Ramadan and Shawal. Providing appropriate medical advice could considerably prevent neurological disorders during Ramadan.⁶⁹ However, in more focused studies, other workers associated three classes of acute neurological problems of varying severity with RF (–Table 7). Patients may present to emergency or urgent care services. They include headache disorders, uncontrolled epilepsy, and stroke.^{70–77} The various studies are discussed briefly below.

In a double-blind, randomized prospective crossover trial of etoricoxib 90 mg versus placebo by Drescher et al, taken just before the onset of fasting during the first 2 weeks of Ramadan 2010 in healthy adults, 189 completed the postfast questionnaire.⁷⁰ Etoricoxib reduced the incidence of “first of Ramadan headache” to 46% in the placebo group versus 21%

Table 7 Patterns and types of acute neurological conditions during Ramadan fasting

Authors (year)	Study variables	Settings	Findings/Conclusion
Drescher et al, 2012 ⁷⁰	189 on etoricoxib vs. 92 on placebo for "first of Ramadan" headache	DBPC: 90 mgs etoricoxib	Etoricoxib reduced the incidence of headache
Bener et al, 2006 ⁷¹	335 patients were hospitalized for stroke; 29 cases in the month before, 30 during Ramadan, 29 in the month after Ramadan	Retrospective review of 13-year stroke database; Doha, Qatar	No significant difference in hospitalizations for stroke during Ramadan compared with the non-fasting months. Risk factors were not different
Assy et al, 2019 ⁷²	220 patients diagnosed with cerebrovascular stroke during Ramadan, 1 month before and 1 month after	Medical ICU (Zagazig, Egypt)	No increase in stroke in patients with diabetes during RF with nonsignificant trend for more ischemic than hemorrhagic stroke
Saadatnia et al, 2009 ⁷³	Impact of RF on cerebral venous (162) and sinus thrombosis (33)	Neurocenters, Isfahan, (2001–2006)	Significant increase in cerebral venous sinus thrombosis events in RF
El-Mitwalli et al, 2009 ⁷⁴	517 Muslim patients admitted either in Ramadan or the month before in two consecutive years	Systematic reviews of all major databases	RF has no effects on stroke frequency, type, and severity
Salama and Belal, 2014 ⁷⁵	1,062 cerebral stroke patients admitted during Ramadan and the month before	University hospitals (Mansoura, Egypt)	No significant differences apart from high mortality rate, hematocrit, and hyperlipidemia among fasting persons
Magdy et al, 2022 ⁷⁶	Observational study of the effect of fasting on seizure type and frequency. 320 patients in 3 months including Ramadan	Cairo University Hospitals, Cairo, Egypt	No difference in generalized tonic-clonic seizures in the 3 months. RF may improve effect on active focal, myoclonic, and absence seizures

Abbreviations: DBPC, double-blind placebo-controlled; ICU, intensive care unit; RF, Ramadan fasting.

in the etoricoxib group (OR 3.19; $p < 0.0001$). The difference was evident in the first week only.

Bener et al in a 13-year observational study, did not find any significantly increased risk factors in hospitalized patients with stroke between Ramadan and other nonfasting months.⁷¹ Similarly, Assy et al came to the same conclusion.⁷² However, Saadatnia et al found a significant increase in cerebral venous and sinus thrombosis during Ramadan (5.5 patients per month in Ramadan vs. 1.95 in nonfasting months).⁷³ El-Mitwalli et al found no correlation between fasting duration and stroke frequency and type. RF does not affect stroke frequency, type, and severity.⁷⁴ Similarly, another prospective study studied 1,062 cerebral stroke patients admitted to university hospitals (Mansoura, Egypt) 1 month before (BR), during (DR), and after (AR) Ramadan over three consecutive years.⁷⁵ However, during Ramadan, most ischemic stroke onset was around noon (9 a.m. to 4 p.m.).

The effect of RF on the seizure type in a prospective observational study on Muslim patients with active epilepsy intending to fast during Ramadan, 1 month before, and 1 month after, in 2019, found that the frequency of generalized tonic-clonic seizures did not significantly differ between the 3 months.⁷⁶ RF may have an improving effect and a postfasting effect on active focal, myoclonic, and absence seizures.

Acute Hematological Conditions

The three studies that considered the acute disturbances of hematological conditions were related to anticoagulation therapy during RF.^{77–79} RF effect on the international normalized ratio (INR) variations was assessed in 30 patients (mean age 65 years; equal sex) treated with acenocoumarol in a prospective monocentric study.⁷⁷ Mean INR was significantly higher during RF than baseline (3.51 vs. 2.52; $p < 0.0001$). There were also more overdoses during RF than at baseline (9 vs. 0; $p = 0.014$). Also, the changes in the INR and the percentage of time within the therapeutic range (%TTR) were evaluated before, during, and after Ramadan in stable warfarin-used fasting patients.⁷⁸ Among 32 participating patients, the mean INR increased by 0.23 ($p = 0.006$) during RF from the pre-Ramadan month and decreased by 0.28 ($p < 0.001$) after Ramadan. There was no significant difference ($p = 1.000$) in mean INR between the non-Ramadan months. %TTR declined from 80.99% before Ramadan to 69.56% during Ramadan ($p = 0.453$). The first out-of-range INR was seen around 12.1 days after the start of RF and returned to the range at approximately 10.8 days after. The time above range increased from 10.8% pre-Ramadan to 29.9% during Ramadan ($p = 0.027$), while the time below range increased from 0.57% during Ramadan to 15.49% post-Ramadan ($p = 0.006$). No bleeding or

thrombotic events were recorded. Furthermore, the INR values and time within the TTR were examined during pre-RF, RF, and post-RF periods in 101 fasting warfarin-treated adults (mean age 55.8 years; 52.4% females). Finally, the target INR range for 62.4% was 2 to 3, while 37.6% had a target INR range of 2.5 to 3.5. An upward trend in the proportion of patients with therapeutic INR was noticed during Ramadan (59.4%) as compared with the pre- (56.4%) and post-Ramadan periods (53.5%), respectively.⁷⁹ Additionally, the proportions of patients with supratherapeutic and subtherapeutic INR were the highest and lowest, 23 and 24%, respectively, post-Ramadan compared with other periods. Based on target INR categorization, achieving therapeutic INR during RF was more feasible with the low INR (2–3) compared with the high INR (2.5–3.5) target patients, 63.5% versus 52.6%, respectively. TTR estimation revealed that 62.4 and 37.6% of the patients had good and poor anticoagulation status throughout the study period. These studies suggest that close monitoring of INR values may be needed during RF, particularly in patients with a high hemorrhagic risk, even in medically stable patients.

Bioethical Considerations

Several bioethical challenges need to be considered when considering the interplay between RF and the needs of a patient attending an ED while fasting. Clinical literature has increased the awareness of the importance of proper communication between doctor and patient to determine the diagnostic-therapeutic plan, especially in individuals with different linguistic and intercultural differences. Two groups from different parts of the world reflected on various relevant issues. Leo et al reported their experience with multiculturalism in Italy.⁸⁰ Health care professionals must address anthropological, moral, religious, and political issues implied in populations and cultures different from their own. RF is an excellent example of how a deep understanding of intercultural values is vital to meet the health care needs of individuals with different cultural norms. In addition, Erbay et al used a sample case encountered by ambulance staff in the basic principles of medical ethics.⁸¹ The encounter follows a motor vehicle accident during Ramadan, and the patient is fasting. The patient states that he is fasting and will be broken, and his religious practice will be disrupted if the serum is administered. The ambulance doctor and the

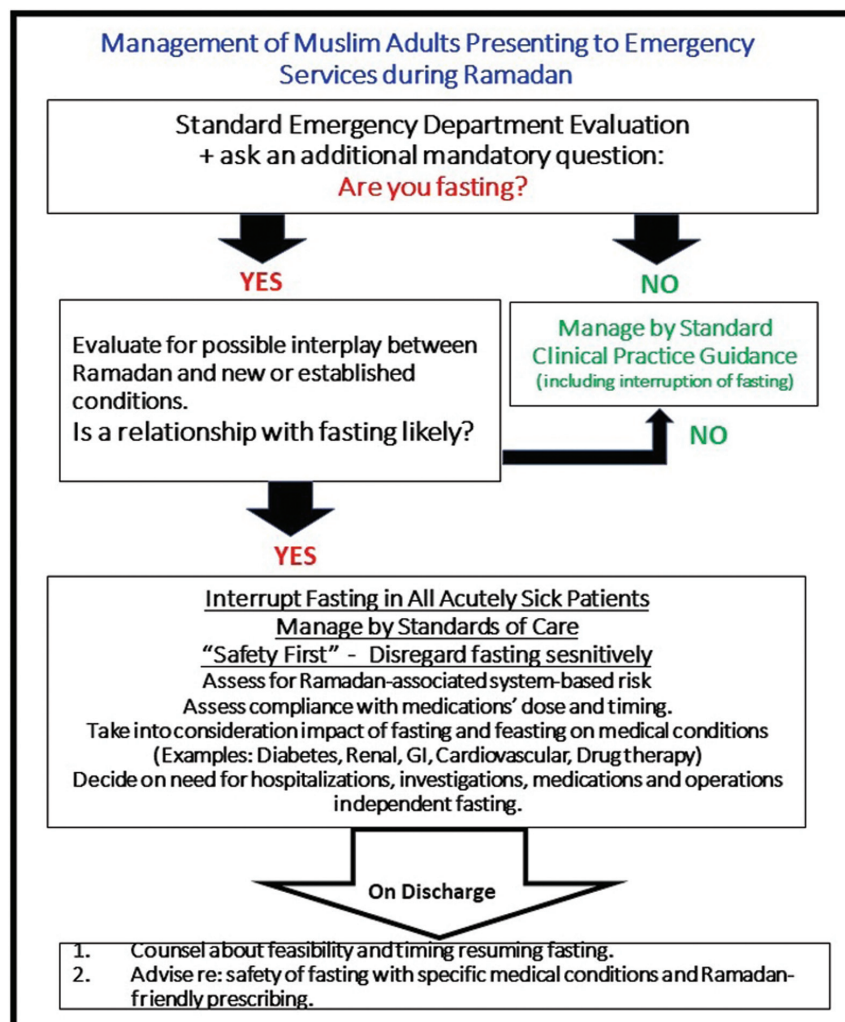


Fig. 1 Management of Muslim patients during Ramadan.

patient argue opposite viewpoints. The ambulance physician has little time to decide. The authors use the scenario to deliberate on treating the patient. Which type of behavior will create the least erosion of his values? The physician's experience and the case illustrate that multiethnicity allows health care professionals to adopt new cultural and social skills and tools to cope with diverse patients.

Conclusion

A review of the literature illustrated the interplay between RF and medical emergencies. These observations need to be considered when assessing a fasting patient attending an emergency department (►Fig. 1). Several themes emerged from the available literature for the management of patients attending EDs during Ramadan. Variable impact in the burden and time distribution of emergency services and hospitalization during RF may require readjustment of resource allocation. Studies of the risk of accidents and injuries may be increased overall or at specified times around Iftar time. A classical impact of emergencies has been the risk of worsening PUD. RF impacts diabetic emergencies such as severe hypoglycemia, hyperglycemia, and DKA, particularly in type 1 diabetes and poorly controlled patients before RF. Glucocorticoid replacement therapy may represent a challenge to patients and physicians that require education and dose adjustment. Acute neurological conditions of interest during Ramadan include the "first day of Ramadan headache," epilepsy, and strokes. Several studies evaluated the risk of ACS and heart failure with inconsistent findings. RF may impact the renal and urological systems through stone disease, RC, and AKI, perhaps in high-risk patients only. However, results may need to be clarified by environmental factors. The impact on hematological conditions was mostly focused on the safety of anticoagulant therapy during Ramadan. Emergencies during RF may provide opportunities to allow a holistic and ethnically sensitive approach to medical care under circumstances where decisions have to be taken with no delay. Future studies must be large and comprehensive to allow in-depth analysis of all observations taking into consideration any confounding personal and environmental factors.

Author Contributions

The authors contributed equally to the manuscript's conception, drafting, and revision. All authors reviewed and approved the final version.

Compliance with Ethical Principles

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