Comparison of Incidences, Hospital Stay and Precipitating Factors of Diabetic Ketoacidosis in Ramadan and the Following Month in Three Major Hospitals in United Arab Emirates. A Prospective Observational Study

Short Title: DKAR study

Elamin I E Abdelgadir1*, Khadija Hafidh2, Alaedldin M K Basheir1, Bachar O Afandi1, Fatheya Alawadi1, Fauzia Rashid1, Lina Majd3, Sana Roubi3 and Mohamed M Hassanein1

1Dubai Hospital, Dubai Health Authority, Alkhaleej road, Dubai
2Rashid Hospital, Dubai Health Authority, Alryadh road, Dubai
3Tawam Hospital, Health Authority of Abu Dhabi, Al-Ain, UAE

Abstract

1.7 billion Muslims worldwide obey religious commands of fasting for a month. This may increase morbidity in people with diabetes.

Objective: Comparing the rate and duration of admissions with diabetic ketoacidosis and the leading precipitating factors during Ramadan and in the following month (Shawal) were our primary and secondary endpoints, respectively.

Design and methods: This was a prospective study that included all Muslims who were admitted with DKA to three major hospitals in United Arab Emirates during Ramadan and Shawal. Demographics, clinical, and laboratory indices were collected and analyzed to assess primary and secondary end points.

Results: 48 patients were admitted during the study duration, 20 were admitted during Ramadan and 28 in Shawal. All those admitted during Ramadan were people with type1 diabetes while 4 of those admitted during Shawal were people with type 2 diabetes. 75% of those admitted during Ramadan did not receive structured education program on diabetes management in Ramadan. Urinary tract infections represented the commonest cause for admission in both months. Hospital stay was longer during Ramadan compared to Shawal (p=0.04). The average HbA1c was lower in Ramadan group; moreover, frequency of DKA admissions in 6 months period before Ramadan was higher in Ramadan group (P= 0.05).

Conclusion: Our study showed lower rate of DKA admissions, but longer hospital stay during Ramadan compared to the following month. The average HbA1c was lower in patients admitted during Ramadan; moreover, frequency of DKA admissions in 6 months period before Ramadan was higher in Ramadan group (P=0.05).

Keywords: Ramadan; Diabetes; Diabetic ketoacidosis; UAE; DKAR

Introduction

Ramadan is a lunar month in which Muslims follow the religious command of fasting from dawn to dusk. This period of fasting varies between different latitudes and range between 14-18 hours. Despite the fact that ill people and pregnant ladies were exempted from fasting, many of them insist to fast. This might increase their risk of complications and rates of hospital admissions. Data about admission rates during the month of Ramadan is very limited; the first paper ever published about diabetes and Ramadan was published in 1979 [1], unfortunately no data about hospital admissions were included in that paper.

In the following years small prospective and some retrospective studies were conducted to evaluate admissions during the month of Ramadan. One study from Qatar evaluated the frequency of strokes in the diabetic during Ramadan in a thirteen consecutive periods, period (1991-2003), where they found no difference of the stroke incidences during and out of Ramadan [2]. Another study from Turkey, evaluated the demographic of emergency room visits of medical illnesses during Ramadan over the period of 2000 to 2004, where they found higher incidences of hypertension and uncomplicated headache, but no higher frequency of Diabetes related visits [3]. Another study showed higher incidences of epileptic attacks in people with diabetes who fasted during the month of Ramadan, and they explained this phenomenon to the changes of the daily rhythms, stress, and the fatigue of the daylong fasting [4]. Acute Coronary Syndrome (ACS) incidences during Ramadan and after Ramadan were observed over the period between 1991 to 1997, and interestingly, the number of the ACS cases were statistically significantly lower during Ramadan (P=0.03), the authors called for further studies in this field [5].

Diabetic ketoacidosis (DKA), is one of the serious complications, it takes place in almost 3.3% of type 1 diabetic patients [6,7] in which the body uses the fat to generate energy, consequently ketone bodies are overproduced as waste of this process, accumulation of Ketones lead to DKA. DKA was found to be the leading cause of death in people with...
type 1 diabetes under the age of 40 years [8]. Furthermore, reports from Health and Social Care Information Centre showed the likelihood of mortality within 21 months after having an incidence of DKA is 2.764 fold than normal population [9]. Nonetheless, almost third of DKA patients (31%) might have another admission within a year with DKA, and this might further increases the risk of the mortality and morbidity [10].

A landmark study in the field of diabetes and Ramadan, EPIDIAR study, shed light on the need for evaluating the special circumstances of Diabetes during fasting; it showed higher incidences of hypoglycemia, hyperglycemia and DKA incidences during Ramadan [11]. The ADA recommendations for treating diabetes in this period focused on risk categorization of patients, for example Type 1 diabetes, Ketoacidosis within the last 3 months prior to Ramadan, Hyperosmolar hyperglycemic coma within the previous 3 months, and patients with sustained poor glycemic control; as they are among those considered to be high risk group and they are advised not to fast [12]. Despite explicit advice from physicians about not fasting, the EPIDIAR study stated that 42.8% of patients with type 1 diabetes and 78.7% with type 2 diabetes did fast for a minimum of 15 days [11].

In this study, we wanted to assess the difference in DKA admissions between the holy month of Ramadan and the following month, which we are going to refer to it as Shawal (the name of the Lunar month after Ramadan).

Our study was conducted in three major tertiary hospitals in United Arab Emirates (UAE), all of all of which adopted unified treatment protocols for the management of DKA. In addition each hospital is equipped with highly trained staff in the Diabetes unit staff. These institutions are the main governmental hospitals in the City of Dubai and Alain.

UAE is one of the countries with highest prevalence of diabetes, the latest International Diabetes federation Atlas 2014 reported prevalence of 10.68% of the total population, highlighting the need for future series of studies in the field within the region [13].

Aims of the Study

We primarily aimed to compare the incidences and duration of DKA admissions during Ramadan compared to the following month (Shawal). Our secondary objective was to assess the differences incidence of DKA between the two months in terms of precipitating factors, fasting practices in people admitted with DKA and gender differences.

Patients and Methods

We assessed all adult patients admitted with DKA to Dubai, Rashid, and Tawam Hospitals, covering the population of Dubai and Al-Ain.

Data were collected upon admission of the patient to the hospital, and previous health records were reviewed to record the previous admissions and whether the patient had received a diabetes and Ramadan related education program in our centers prior to Ramadan. Our data collection Performa included data on patients’ demographics (age, gender), details of diabetes (type of diabetes, duration of diabetes, medications used), and frequency of DKA admissions over the last 6 months, DKA precipitating factors, current medications, duration of the acidosis (time from admission to resume the subcutaneous insulin) and diabetes related comorbidities.

DKA was diagnosed according to the following criteria:

- Ketonaemia (3 mmol/L and over), or significant
- Ketonuria (more than 2+ on standard urine sticks).
- Blood glucose over 11 mmol/L or known diabetes mellitus.
- Bicarbonate below 15 mmol/L and / or venous PH less than 7.3.

Statistical analysis

All data was entered in an excel sheet and the statistical calculation was done by IBM computer using SPSS (statistical program for social science version 12.0.) We conducted both descriptive quantitative and qualitative analysis. Chi-square test, Fisher exact test and unpaired t-test were used in different areas of the analysis process. P value of <0.05 was considered significant, and <0.01 was considered highly significant.

Results

Total Number of patients who were admitted with DKA was 48 patients, 20 during Ramadan (41.66%) and 28 during the following month (Shawal) (58.33%). The average monthly admission over the preceding 6 months in 2014 across the three centers for DKA was 15+/-3.

All Ramadan patients were having Type 1 Diabetes, while 4 out of 28 were having type 2 diabetes in the month of Shawal. 75% of Ramadan patients were females in comparison to 57.1% in Shawal (p 0.16), and the mean age in both months was 21.8 ± 7 and 22.8 ± 6.7. There was no statistical difference in the demographic distribution of the patients between the two months (Table 1). Out of the 20 patients who had DKA during Ramadan, only 8 patients were fasting (40%) but that did not affect the length of stay, morbidity and mortality. 75% of the Ramadan group (n 15) did not receive a structured Diabetes education program, but they had one to one education by their diabetes teams. Interestingly, Ramadan group had more frequent DKA admission over the preceding 6 months, while 5 of the Shawal group had recurrent DKA during the same period (1.75+/-0.6 VS 1.27+/-0.45) with a significant P value of 0.05, which confirms the recommendation for those with recent DKA and those with recurrent DKA not to fast.

The commonest precipitating factor was urinary tract infection, 35.7% of the total number of patients (41.7% in Ramadan and Shawal respectively, with a p value of 0.68). Other precipitating factors included missed insulin doses (33.3%, 31.2% in Ramadan and Shawal respectively, P 0.68), Gastroenteritis, foot abscess, and gum abscesses were distributed in different percentages (Figure 1). HbA1c was high in both groups although, Shawal group had higher levels 11.1 ± 2.5%(98 mmol/l) vs 10.3% ± 2.1 (98 mmol/l) with a p value of 0.05, which confirms the recommendation for those with recent DKA and those with recurrent DKA not to fast.

| Variables | During N=20 | After N=28 | P value |
|-----------|------------|-----------|---------|
| Gender    |            |           |         |
| Male      | 5(25%)     | 12(42.9%) | 0.16    |
| Female    | 15(75%)    | 16(57.1%) | NS      |
| Type of DM|            |           |         |
| Type I    | 20(100%)   | 24(75%)   | 0.08    |
| Type II   | 0          | 4(25%)    | NS      |
| DM duration (years) | 8.1+4 | 6.6+3 | 0.21 NS |
| Age       | 21.8+7     | 22.8+6.7  | 0.79 NS |

Table 1: comparison between both groups as regard general data.
significant (3 ± 0.3 vs. 2 ± 0.2 days, P 0.040). This did not differ among fasting and non-fasting persons during Ramadan. Patients on basal bolus insulin regimen had more DKA incidences during Ramadan than Shawal (55% and 32.1% respectively) with a p value of 0.15, while the other regimens (including Insulin Mixtard, Oral hypoglycemic agents) had lower incidences of DKA in Ramadan (45%) while in Shawal (67.9%). None of our DKA patients required referral to the Intensive Care Units (ICU) after being admitted to the medical ward and there was no mortality among our 48 patients.

**Discussion**

The study data were collected via the same Performa that has been...


agreed upon by all team members, this provides high consistency of data collection. As the participating institutes are the main governmental hospitals in the Cities of Dubai and Al Ain, where most of the cases with medical emergencies attend or referred to by the ambulance service, we assume our study cohort provides a reflection of outcomes in the real life in these cities, as well as a reflection of the country wide incidences.

The results of this study was not very surprising, but rather confirms the findings of older studies that showed no higher incidences of DKA in Ramadan, except EPIDIAR study, one of the biggest studies on diabetes and Ramadan, that showed an increase of DKA incidences during Ramadan [11]. Indeed, the average DKA admissions during Ramadan and Shawal were higher than the monthly admissions over 2014 across the three centers (average monthly admission 15 ± 3 across the three centers). The increased DKA admission in Shawal compared to Ramadan was surprising and may be it reflects that higher HbA1c in Shawal. This might reflect on worsening of glycemic control during Ramadan for those admitted with DKA in Shawal and or the festivities after Ramadan during Eid. It would be recommended for future studies to look into glycemic control during Ramadan. Certainly, it is important to observe if this is repeated in future Ramadan or was observed in other centers as well.

The additional information derived from our study is the longer duration of the DKA episode during Ramadan compared to Shawal. This could be partially explained by the dehydration due to fasting, moreover, even if the individual is not fasting, the surrounding atmosphere of food and drink abstinence, plus the lack of availability of food outlets during the day, in conformity with local practices might push the non-fasting individuals into relative dehydration. However, it is important to note that the length of hospital stay during Ramadan was equal between fasting and non-fasting patients.

Most of our patients in this study had poor glycemic control even before Ramadan. This was even higher pre-Shawal, which perhaps might be due to inappropriate dose reduction and defensive eating before fasting.

There is no obvious reason to the observation of higher DKAs in the basal bolus group. While we didn’t look into the causes of this, it could be explained by higher frequency of missing doses during the day, erratic meal schedules or the fact that multiple doses insulin regimen usually prescribed for those with more complex diabetes. This calls for prospective larger scale studies in the future to assess this observation.

In a region of Muslim majority, such as the Middle East, we found only few studies that have evaluated the effects of Ramadan on diabetic individuals; in a study was conducted in Saudi Arabia, 20 of people with type 1 diabetes patients aged 8 to 14 years, with a duration of diabetes of more than 1 year, 12 of them did fast and the rest were control group, none of the two groups had DKA during Ramadan, and the changes of the HbA1c was not statistically significant [14]. The design of this study is very different from ours. Furthermore, in this study, the age group is different from our cohort, and the duration of Diabetes was quite short, as well as the parameters tested were only DKA incidences and the HbA1c difference. Another study in Benghazi, Libya; in which they retrospectively analyzed all the admissions to Benghazi hospitals from January 2007 to January 2008, they found that only 15 episodes occurred during Ramadan while an average of 19.5 took place in the rest of the Lunar months (P=0.001), there was neither significant difference in the mean age, length of the hospital stay, nor the mortality rate among the two groups. The commonest cause of DKA during Ramadan was infection (Respiratory tract infections were the commonest 42.2%) followed by missing Insulin dosages [15]. Unlike Elmehdawi results [15] our patients took a longer period during Ramadan before resolution of acidosis, and this was definitely reflected on the length of the hospital stay. In comparison to them we had higher percentage of infection related DKA admissions (55%). Nevertheless, we had similar results with their study concerning the rate of DKA admissions during Ramadan, which was not higher than the other Lunar months, and rather lower in some other studies [16,17].

Conclusion

Our study did not show higher rates of DKA during Ramadan in comparison to the following Lunar month, Shawal. However, the rates of DKA for those two months were much higher in comparison to the average monthly DKA admission. The duration of acidosis was longer, average HbA1c was lower, and patients on a MDI had higher rate of DKA during Ramadan in comparison to Shawal. More than 75% of the patients did not receive structured education about diabetes and fasting Ramadan.

Limitations

Although we are the main governmental medical institutes in two major cities in UAE; our sample size was relatively small. We plan to have collaboration across the whole UAE in the future to obtain a larger cohort and more detailed statistical analysis. In depth analysis of DKA before Ramadan would be also worthwhile.

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