

# Precipitating factors for diabetic ketoacidosis

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## ABSTRACT

**Objective:** The aim of this study is to identify the precipitating factors from a medical and social point of view, in addition to discussing some clinical and laboratory aspects of diabetic ketoacidosis

**Method:** Sixty-eight patients were admitted to King Abdulaziz University Hospital, Jeddah, Kingdom of Saudi Arabia, over a 2 year period, (April 1999 through to April 2001). Diagnosis of diabetic ketoacidosis was based on: clinical features, serum sugar >12 mmol/L with ketonuria, bicarbonate and base deficit.

**Results:** The mean age was 22.5 years (0.5-87) years with a male to female ratio of 1.4:1. Poor compliance to continue the treatment and infection were the most common precipitating factors being responsible for 54.4% and 28% cases. A low mortality rate of 2.9% in our study

compared favorably with other studies, which contributed to a high level of medical care in King Abdulaziz University Hospital.

**Conclusion:** Diabetic ketoacidosis is a fatal complication among our diabetic patients. Implementing a patient education program to increase awareness of the disease is the most important step in the prevention of this complication. The authorities should ensure availability of insulin to all patients, either free or at lower prices. The role of cultured and socioeconomic factors in aggravating or precipitating diabetic ketoacidosis should always be considered and where possible, eliminated

**Keywords:** Diabetic ketoacidosis.

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Diabetic ketoacidosis (DKA) is one of the potentially fatal complications of diabetes mellitus, with a mortality of 2%-5%. Although many DKA associated deaths are due to concomitant illnesses such as overwhelming infection or infarction, delay in presentation or diagnosis or error in management. In the KSA, with a change in life style and increasing prevalence of obesity, diabetes is reaching epidemic proportions. An important step to minimize the complications of DKA is to identify the precipitating factors, as many of these are potentially avoidable by simple measures such as providing insulin to patients and educational programs causing awareness of the disease and its implication in the community. Social, cultures and economics are important precipitating factors adversely affecting

DKA. The aim of this study was to determine the precipitating factors from a medical and social point of view, in addition to discussing some clinical and laboratory aspects of DKA.

**Methods.** King Abdulaziz Unveristy Hospital (KAUH), Jeddah, KSA is a 400 bed teaching, governmental hospital providing health care to a multinational population of mixed socioeconomic status. All patients admitted with the diagnosis of DKA over a 2 year period, April 1998 through to April 2001 were included in the study. The diagnosis of DKA was established on the following criteria, 1. Clinical features, 2. Hyperglycemia (more than 12 mmol/L), 3. Ketonuria mostly 4+ (carried out by

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acetate tablets), 4. PH, bicarbonate and base deficit. Patient's records were reviewed for clinical characteristics (sex, nationality, age, clinical presentation, initial laboratory investigations including arterial PH, bicarbonate, blood sugar, sodium, potassium). The main precipitating factors for DKA were determined including data regarding the social history and status of diabetic education from well written records.

Statistical analysis was carried out using the statistical package for social science (SPSS 7.5). T test and Chi-square was used appropriately. Results were considered significant if the p value is less than 0.05.

**Results.** During the 2 year period from, April 1999 through to April 2001, 68 patients were admitted with DKA either to the medical or pediatric wards. The mean age at presentation was 22.5 years (0.5–87). Patients included in the study were 40 males and 28 females with a M:F ratio of 1.4:1. Thirty-three (48.5%) were Saudi while 35 (51.5%) were non-Saudi. Forty-eight patients were known cases of insulin-dependent DM, 8 were non-insulin-dependent DM, while in 12 patients DKA was the first manifestation of DM. Forty-six patients had only one admission with DKA, while 22 (54.5%) patients accounted more than one episode. The admission rate ranged from 2 episodes in 11 patients to 10 episodes in 2 patients. Average age of patients with multiple admissions was 21 years (7-50 years). Males and females were equal in number with a ratio of M:F equalling 1:1 The mean age of females with repeated admission was 26.8 years (19 -53 years), whereas the mean age of males was 15.5 years (9- 38 years). Thus the P 0.035 between the 2 groups is statistically significant. Poor compliance and inadequate treatment were the main precipitating factor in 37 cases 54.4%. This was due to discontinuation of treatment due to financial reasons as well as lack of supply of medications from the hospital to outpatients. Infection was the 2nd most common precipitating factors accounting for DKA in 19 patients (28%) (**Table 1**). In 12 of 68 patients (17.7%) DKA was the first manifestation of DM.

**Duration of hospital stay.** The average duration of hospital stay was 8.7 days, ranging from one to 35 days.

**Mortality.** There were 2 (2.9%) deaths in our study group. Cause of one death was gram-negative septicemia and adult respiratory distress syndrome, while the 2nd one was due to septicemia from necrotizing fasciitis. Clinical manifestation and laboratory results are demonstrated in **Tables 2 & 3**.

Information regarding the social history and health education was not documented in the records. Lack of awareness of the disease contributed to poor control of blood sugar. Only 10 patients (14.8%) had regular blood sugar monitoring, as a consequence of

**Table 1** - Precipitating factors in diabetic ketoacidosis.

| Precipitating factors                    | N (%)           |
|--|-----------------|
| Poor compliance and inadequate treatment | 37 (54.4)       |
| Chest infection                          | 2 (2.9)         |
| Upper respiratory tract infection        | 7 (10.3)        |
| Urinary tract infection                  | 2 (2.9)         |
| Necrotizing fasciitis                    | 1 (1.5)         |
| Meningitis                               | 2 (2.9)         |
| Myocardial infarction                    | 1 (1.5)         |
| Others                                   | 4 (5.9)         |
| First presentation                       | 12 (17.7)       |
| <b>Total</b>                             | <b>68 (100)</b> |
| N=number                                 |                 |

**Table 2** - Clinical manifestations of diabetic ketoacidosis and laboratory results.

| Clinical manifestations | N (%)     |
|-------------------------|-----------|
| Coma                    | 4 (5.9)   |
| Drowsiness              | 26 (38.2) |
| Vomiting                | 44 (64.7) |
| Abdominal pain          | 30 (4.4)  |
| Polyuria, polydipsia    | 4 (5.9)   |
| Hypovolumic shock       | 13 (19)   |
| N=number                |           |

**Table 3** - Laboratory results.

| Lab results        | Average     | Range           |
|--------------------|-------------|-----------------|
| Sodium             | 134 mmol/L  | 122-150 mmol/L  |
| Potassium          | 4.4 mmol/L  | 2.6-6.7 mmol/L  |
| PH                 | 7.11 kpa    | -               |
| Random blood sugar | 32.9 mmol/L | 17.3-7.6 mmol/L |
| kpa=kilo paster    |             |                 |

which blood sugar were well controlled during their follow-ups in the clinic. Whereas 62% of patients had no home blood sugar monitoring with repeatedly high blood sugars during follow-up. Sixteen patients (23.5%) were lost to follow up after discharge.

**Discussion.** The prevalence of DM is increasing worldwide,<sup>1</sup> and in the KSA it has increased from 4.9% in 1985 to 7.4% in 1995.<sup>2,3</sup> Diabetic ketoacidosis was universally fatal especially before the days of insulin in the 1920s, after that, the overall mortality decreased to relatively low figures but there is still the potential of case fatality from DKA either from acidosis or as a complication of therapy.<sup>4,5</sup> A quarter of DKA admission in this study occurred as the first manifestation of DM, a finding consistent with other studies in the KSA.<sup>6</sup> There were a predominance of males in our study, and DKA episodes in males was more severe and more frequent which is different from the universal findings, this could be explained by the fact that that our male patients cope less well with their DM than their counterpart females due to either psychological factors or easy access to hospitals due to the privilege of car driving.<sup>7</sup>

Our study revealed poor compliance and inadequate therapy as the main precipitating factors of DKA in 54.4%, this is in similarity to other studies carried out in the Kingdom<sup>8,9</sup> and other neighbouring Arab countries.<sup>10-13</sup> The high percentage of non-compliance in this study is probably multifactorial, lack of patient education and awareness of the disease and failure to comply with diet and therapy. Lack of supply from the hospital and the high cost of insulin therapy poses a financial burden on our patients who are either expatriates or from low socioeconomic class. To overcome this situation they either decrease the dose of insulin or discontinue it altogether leaving them at risk for DKA. This emphasizes the need of efficient social service set up to provide care to such group of patients.

The efficacy of insulin is also questioned by some patients who are not able to afford a refrigerator and may lose the motivation for optimal control. Personality, social and domestic factors may contribute to poor compliance especially in female patients. Some difficult teenage patients intentionally induce DKA to admit to seek social attention. Anxiety, depression and simple forgetfulness were other percolating factors in older patients. Psychological counseling or social organizations in diabetic care is likely to be beneficial. Illiteracy, lack of health education, and dominance of wrong belief especially regarding insulin also adversely affects diabetic control. Sixty-two percent of patients had no blood sugar monitoring at home and their blood sugars were repeatedly high during follow-ups in the clinic. Sixteen of them were lost to follow up and did not have a single visit in the clinic after

discharge. These patients may have the misconception of being cured from the disease once symptoms improve on discharge and they do not show up, even for single visits to the clinic. Good blood sugar control during clinic follow-up and home glucose monitoring was observed in 10 patients. Seven of them had DKA as their initial manifestation of DM and many stop their antidiabetic therapy soon after symptoms improved, thinking that they been cured from diabetes. Excessive intake of sugar such as chocolates, sweets, soft drinks is also reported to be a DKA precipitating factor. Consumption of these sugars is very common among our teenagers.<sup>14,15</sup>

Infections are important DKA precipitators in 19 patients. The most frequent is upper respiratory tract infection. Most patients presented with nausea, vomiting and abdominal pain, which was interpreted as an indication to reduce or stop their insulin or oral hypoglycemic drugs. This is a deep-rooted belief shared by some doctors and diabetic educators. The situation is made worse when such patients consume large amounts of sugar rich fluid to counteract a presumed hypoglycemia.<sup>16,17</sup>

The low mortality rate of 2.9% in our study compared favorably with 4.1% and 3.5% in 2 previous studies from the KSA. This could be attributed to a high level of medical care in KAUH. Diabetic ketoacidosis is a fatal complication among our diabetic patients. Implementing a patient education program to increase awareness of the disease is the most important step in the prevention of this complication. The authorities should ensure availability of insulin to all patients, either free or at lower prices. The role of cultured and socioeconomic factors in aggravating or precipitating DKA should always be considered and where possible eliminated.<sup>18,19</sup>

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