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## DIABETIC KETOACIDOSIS AS AN INITIAL PRESENTATION OF TYPE-1 DIABETIC CHILDREN IN ASEER REGION OF SAUDI ARABIA

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### ABSTRACT

**Objective:** This study aimed to determine the frequency of diabetic ketoacidosis (DKA) as initial presentation among patients with type-1 Diabetes Mellitus (DM-1) following in Aseer Diabetes Center of Aseer Region, Southwestern of Saudi Arabia.

**Patients and Methods:** Retrospectively we reviewed and analyzed medical records of type-1 DM children who were less than 15 years and diagnosed with DKA at initial presentation, over period of 7 years from February 2006 till January 2013.

**Results:** Out of 508 diabetic patients, 244 (48%) patients had DKA at the initial presentation. The mean age was 8.5 years. 120 (49.1%) with DKA were males and 124 (50.9%) females. Six patients with type-1 DM were less than one year and 5 (83.3%) of them were in DKA, compared with the 239 patients (47.6%) of the remaining 502 patients beyond this age. Generally, frequency of DKA among patients from (1-5) year was 51.7% (N=176) and more than 5 years was 46.9% (N=153). No death, renal failure or permanent neurological damage was reported at the initial presentation.

**Conclusion:** A significantly high percentage of children with newly diagnosed DM-1 still have DKA at the onset of DM. This calls for health education and awareness of the parents / public and primary health care physicians through continuous medical education and mass media to achieve early diagnosis of type-1 DM before the development of DKA.

**Key words:** Type-1 DM, Diabetic ketoacidosis (DKA), Cerebral edema, Autoimmune, Beta-cells.

### INTRODUCTION

Worldwide, diabetes mellitus (DM) is currently a major health problem. Type-1 DM is the most common type of diabetes in children and may present initially as diabetic ketoacidosis (DKA). Patients with type-1 DM are more susceptible to develop DKA than those with type-2 DM. DKA is a metabolic disorder characterized by hyperglycemia, acidosis and ketosis which occur in the presence of low levels of circulating insulin. The underlying cause of type-1 DM is insulinopenia (low or absolute zero levels of insulin) due to either autoimmune destruction of pancreatic B-cells or idiopathic<sup>1,4</sup>. This type of

diabetes and its association with DKA carries high rate of morbidity, mortality and health cost<sup>5,6</sup>. WHO DIAMOND project group and other studies have clearly mentioned that type-1 DM or insulin dependent diabetes mellitus (IDDM) is the most prevalent and common chronic childhood disease in industrialized countries<sup>7,8</sup>. DKA as initial presentation in type-1 DM has been reported worldwide with varying prevalence as high as 67% and also up to 80% have been reported<sup>9,12</sup>. High rate of DKA, morbidity, and complications are due to the fact that most of the families are unaware of the symptoms of DKA. Parents and public awareness of these symptoms will lead to

timely diagnosis of DM and prevention of DKA which is considered as acute complication of DM-1. The classic symptoms at initial presentation of type-1 DM are usually gradual, and include polyuria, polydipsia, polyphagia and weight loss. The symptoms of DKA may be mild starting with vomiting, polyuria and dehydration symptoms. DKA in severe cases may present with abdominal pain mimicking acute appendicitis or pancreatitis and sometimes presents with rapid breathing and Kausssmaul's breathing followed by obtundation of consciousness and ultimately coma. In Saudi Arabia, families with inadequate knowledge about diabetes, especially in pediatric age groups, fail to recognize symptoms of DM. Hence, their children may persist to suffer from the disease and fail to seek medical advice until they present with DKA. Furthermore the primary health care providers may miss these symptoms especially in the presence of common acute infections such as URTI, GE or UTI. This is alarming as DKA carries high risk and complications if not timely diagnosed<sup>13,15</sup>. There are few studies from Saudi Arabia (Northwest and Madina Regions) and also Gulf Region for DKA at initial presentation<sup>16,19</sup>. However, there are no large scale studies at tertiary care diabetes center from Aseer Region of Saudi Arabia. So, we aimed from this study is to review the patients in Aseer Region who presented with DKA as an initial presentation of type-1 DM.

## METHODS

This is a retrospective analytical study done in Aseer Diabetes Center of Aseer Central Hospital which is the largest tertiary care diabetes center in Aseer Region (Southwestern) of Saudi Arabia. Diabetic patients from all primary health care centers (PHCCs) are usually referred to Aseer Diabetes Center (ADC) for follow up after initial diagnosis. ADC has catchment area of 20 secondary care hospitals and 285 primary health care centers. ADC is equipped with all modern health care facilities.

In this 7 year study, retrospectively we reviewed and analyzed the records of diabetic patients seen regularly in Aseer Diabetes Center, from February 2006 till January 2013. The study was approved by the hospital research committee.

Only type-1 DM children (aged  $\leq 15$  years) were included in the study. Patients who were considered to have DKA if they had a random blood sugar (RBS) greater than 300 mg/dl, pH less than 7.3, bicarbonate less than 15, glucosuria and ketonuria<sup>20,22</sup> or if the patient had medical report from referring hospital documented with DKA as initial presentation (according to the above mentioned criteria). Patients with incomplete data for DKA were excluded from the study. Patients' data were categorized for DKA presentation as less than 1 year, 1-5 years and more than 5 years of age.

## RESULTS

The medical records of 508 patients with type-1 DM were reviewed. Of these 508 patients, 244 patients (48%) had DKA at initial presentation of illness while 264 patients did not present with DKA. Out of 244 patients, 120 patients (49.1 %) were males. The mean age was 8.5 years. In the patients with DKA, those who are less than one year have higher chance to present with DKA comparing with other age groups, 5 patients of 6 patients (83.3%) in comparison with 239 patients (47.6%) beyond that age. The frequency of DKA in children 1-5 years of age is 51.7% (91 out of 176) compared with 46.9% (153 out of 326) in older children as demonstrated in table 1 and figure 1. There was no mortality, permanent neurological or renal damage.

## DISCUSSION

Type 1 DM represents about 5% of all types of DM<sup>22</sup>. The frequency of DKA at onset of diabetes varies by geographic location<sup>9,12,16,19</sup>. In well-developed countries such as the United States, around 25% of type-1 DM will first present in DKA<sup>23</sup>. By reviewing the other international

studies, we found that it ranges between 16-80%<sup>24,28</sup>.

In our study, we found that 48% of our patients presented initially in DKA which is considered relatively high and may reflect a delay in diagnosing DM. This figure is similar to a previously reported figure (55%) from other region of Saudi Arabia<sup>16, 17</sup>, and from Kuwait which was 49%<sup>19</sup>. Although this percentage is alarming, none of our patients with DKA developed permanent neurological damage, renal failure or mortality. However, it is known that a delay in the diagnosis of DKA may result in cerebral edema with its complications such as renal failure, hypokalemia or hyperkalemia, arrhythmias and/or other electrolyte abnormalities. It will also necessitate admission to the pediatric intensive care unit and prolong the hospital stay. The younger the child at the onset of DM, the higher the chance of having DKA at initial presentation; this may be explained by the fact that infants have non-specific symptoms such as excessive crying, irritability and excessive diaper changes<sup>29,30</sup>, which may be interpreted as being secondary to infections, particularly urinary tract infection. Furthermore, dehydration and acidosis develop quickly in young children which may explain the high frequency of DKA<sup>30</sup>.

In our data, there were 6 patients with age less than 1 year and 5 of them (83.3%) developed DKA. The remaining one patient did not develop DKA and was diagnosed early because the family was already aware about the symptoms of DM and the patient's brother was previously diagnosed as type 1 DM.

Although inadequate knowledge of DM among the family members play a role in delaying the diagnosis which leads to high frequency of DKA at onset. Other factors should be considered for example, symptoms of DM may be overlooked by the primary care physician as well. The presentation with symptoms and signs of coexisting common childhood infections like gastroenteritis, otitis media, flu-like illness,

respiratory infections and urinary tract infections may mask the DM symptoms leading to a delay in the diagnosis of type-1 DM or DKA<sup>31</sup>. In such cases, diagnosis of type-1 DM can be judged simply by the lower serum C-peptide level in infants suggesting a more aggressive beta-cell destruction<sup>26</sup>.

Although DKA related mortality used to be high over 50 years ago, it has decreased significantly over the last few decades<sup>6</sup>. The reported mortality rate in Ontario (Canada) was 0.18% for all DKA admissions<sup>32</sup>, in comparison with 0.31% in UK<sup>13</sup>. In our study, no mortality was encountered which is in correlation with other reports from the gulf region<sup>19</sup> and from the West<sup>11</sup>. This should not be overestimated as these rates reflect mortality for DKA admissions, and do not include DKA mortality outside the hospital; this consideration is particularly important in developing countries where DKA mortalities outside the hospital are undiagnosed. Diabetic children are missed and might be attributed to common infections like enteritis, viral influenza or encephalitis. The leading cause of mortality is cerebral edema accounting for 57-87% of DKA deaths<sup>13</sup>. The mortality from cerebral edema might be diminished by early diagnosis and management.

The relatively high frequency of DKA at initial presentation necessitates further studies to uncover other possible causes. Since the incidence of DM in general is increasing worldwide, we should emphasize the need for more public health education programs using the media and schools, beside evaluation of the children health care system; interventional measures like refreshing courses, workshops and training of medical and paramedical staff in the primary health care units are highly needed<sup>33, 34</sup>. Physicians should be aware of high index of suspicion of type-1 DM symptoms especially in infants.

## CONCLUSION

Among type-1 DM patients from above study and data were obtained, DKA carries a high risk of

morbidity and mortality. As type-1 DM represents lower percentage than type-2 DM which could lead to late diagnosis among junior doctors and parents. In particular, the early detection of symptoms of type-1 DM by parents / public and health care physicians is required at primary care levels to reduce hospital admissions, complications and the cost of health care, especially in young age group. The awareness and education of public and general practitioners are still highly recommended through continuous medical education and mass media to decrease the occurrence of DKA in newly diagnosed type 1 diabetic children.

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#### Conflict of interest

The authors declare no conflict of interest.

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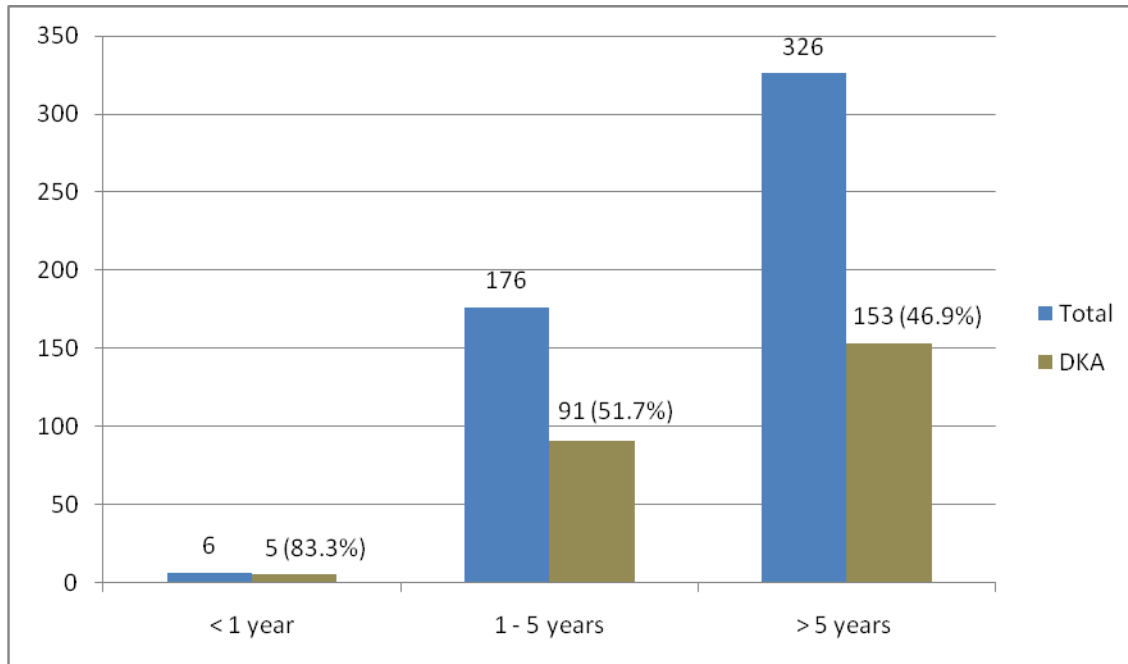
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**ILLUSTRATIONS**

**Table-1: Characteristics of patients presented with DKA as initial presentation of Type-1 DM.**

Patients Characteristics	Numbers (%)
Total No. of Patients	508 (100%)
Patients with DKA	244 (48%)
Mean Age at presentation	8.5 years
Sex Distribution	Male = 120 (49.1%) Female = 124 (50.9%)
DKA presentation for < 1 year of Age	Total = 6 With DKA = 5 (83.3%)
DKA presentation for age of 1 - 5 years	Total = 176 With DKA = 91 (51.7%)
DKA presentation for > 5 years	Total = 326 With DKA = 153 (46.9%)
No. of patients with DKA from 1- 15 years	Total = 502 With DKA = 239 (47.6%)



**Fig.1. Age wise distribution of patients with DKA**