

Frequency of Ketoacidosis in Newly Diagnosed Type 1 Diabetic Children

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Abstract

Objectives: Diabetic ketoacidosis (DKA) is the leading cause of morbidity and mortality in children with type 1 diabetes mellitus (T1DM). Many patients with newly diagnosed type 1 diabetes present with DKA. The aim of this study is to determine the frequency and the clinical presentation of diabetic ketoacidosis at the diagnosis of type 1 diabetes mellitus in youths in Hamadan, Western Province of Iran.

Methods: The Clinical and laboratory data of a total of 200 patients under 19 years of age with newly diagnosed type 1 diabetes mellitus between 1995-2005 were retrospectively reviewed. Statistical analysis was performed using SPSS 11.

Results: 48 (24%) of the children were presented in a state of ketoacidosis. Severe form of DKA ($\text{pH} \leq 7.2$) was observed in 54.5% of patients. The mean age at diagnosis was 7.3 ± 5.15 years in DKA group and 8.59 ± 3.07 in non-DKA group ($p=0.22$). 60.4% of patient with DKA were female whereas in the non-DKA group, 53.3% of patients were female, the difference was not significant ($p=0.38$). The duration of symptoms before diagnosis

was 14.84 ± 8.19 days in patients with DKA and 22.39 ± 2.27 in the non-DKA group, ($p=0.11$). No significant difference was found between the age, sex and duration of the symptoms and occurrence of DKA. Polydipsia (85.4%) polyuria (83.3%), weakness (68.8%) and abdominal pain (52.1%) were the most frequently notified symptoms among the patients. In two cases, diagnosis of DKA was preceded by acute appendicitis and the patient underwent appendectomy.

Conclusion: Frequency of DKA at onset of type 1 diabetes mellitus was significant in the studied region. However, it was lower than other regions in Asia. Polydipsia, polyuria, fatigue and abdominal pain were the most common symptoms on presentation.

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Introduction

Diabetic ketoacidosis is the leading cause of morbidity and mortality in diabetic children. It accounts for more than 100,000 hospital admissions and at least 4000 deaths per year in the US.^{1,2} In the year 2000, the International Society for Pediatric and Adolescent Diabetes (ISPAD) stated that even nowadays DKA is the most common cause of diabetes-related death in children.³⁻⁶ The mortality appears to be greatest among patients at first presentation.⁷

The frequencies of DKA ranges between 15-70% in Europe, Australia, and North America U.S.^{8,9} Approximately 30% of newly -onset diabetic children present with ketoacidosis.¹⁰⁻¹³ The economical burden associated with DKA treatment is also significant. Maldonado showed that the average cost of treating one hospital admission for DKA was approximately \$10,875.78 in the USA.^{14,15} There is considerable variation in the prevalence of DKA at onset of diabetes mellitus in different countries. Diabetic ketoacidosis has been reported to be more common in developing countries.^{8,9}

This study aims to determine the frequency, and to describe the clinical characteristics of ketoacidosis at onset of childhood type 1 diabetes mellitus (T1DM) in Hamadan, Western Province of Iran. This study will also compare the findings with similar

studies in particular those reported from Asia.

Methods

Hamadan with almost 1,700,000 inhabitants is a North Western Province of Iran. Ekbatan is a tertiary-care referral teaching hospital in the capital city of Hamadan.

The inclusion criteria for the sample for this retrospective study included; age <19 years, all participants were diagnosed with type 1 diabetes mellitus and discharged with insulin treatment in Ekbatan hospital. Hospital records for all subjects were reviewed to study subjects who initially presented with DKA. Demographical data including age, gender, duration of symptoms, clinical features of the disease, presence and severity of DKA at diagnosis were collected. Specific initial laboratory data including blood glucose level and arterial blood gas were also recorded. The data was divided into four age groups: 0-5, 5-10, 10-15 and 15-20 yrs.

The diagnosis of T1DM was established according to the WHO criteria, DKA was defined by glucose >250 mg/dL, arterial $\text{pH} < 7.30$, blood bicarbonate <15 mmol/L and ketonuria greater than (2+) in dipstick urine test with recent positive history of polyuria, polydipsia, nocturia and weight loss.³

Severity of diabetic ketoacidosis (DKA) was defined by serum pH and categorized into three groups; mild as $7.2 \text{ pH} < 7.3$, moderate as $7.1 < \text{pH} < 7.2$ and severe as $\text{pH} < 7.1$.

There were no identify cases of type 2 Diabetes Mellitus in this study. The exclusion criteria included any error in hospital records.

The study was conducted in accordance with The National Ethical Committee at the Ministry of Health and Medical Education of Iran. The Committee of ethics in research of Hamadan University of medical sciences, reviewed and approved the study in 2004.

Statistical data analysis was performed using SPSS 11. Associations between DKA and sex were evaluated using the Chi-squared test. Independent T-test was applied to compare the age and duration of symptoms before diagnosis in the DKA and the non-DKA groups. P-value less than 0.05 was defined as statistically significant.

Results

During this 5 year period, a total of 200 subjects were hospitalized in Ekbatan center with newly-onset T1DM. At diagnosis, approximately 48 (24%) of the children presented with DKA (Fig. 1). Among all patients who fulfilled the inclusion criteria for DKA, 54.5% were in the severe group. The mean age at diagnosis was 7.3 ± 5.15 years. There was no significant correlation between age and the occurrence of DKA ($p=0.22$). 29 patients with DKA were females. Although girls presented more frequently (60%) with DKA than did boys (40%), the difference was not significant ($p=0.38$).

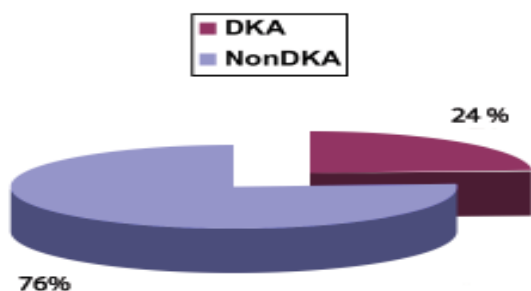


Figure 1: Frequency of DKA at the time of diagnosis of type 1 diabetes mellitus

The mean duration of symptoms before diagnosis was 14.84 ± 8.19 days in patients with DKA (ranging from 6 to 40 days) and 22.39 ± 2.27 (ranging from 6-120 days) in patients without DKA, the difference was not statistically significant ($p=0.11$). There was also no significant difference between the age, sex and duration of the symptoms before diagnosis and DKA. The Patient characteristics with and without DKA are summarized in Table 1. The majority of the study patients were aged between 5-10

years in both groups (Fig. 2). Some of the signs and symptoms were similar in both groups except for abdominal pain and impaired consciousness, which were not associated with the non-DKA groups (Table 2). Comparisons of clinical symptoms before diagnosis of patients with DKA and those without are shown in Table 2.

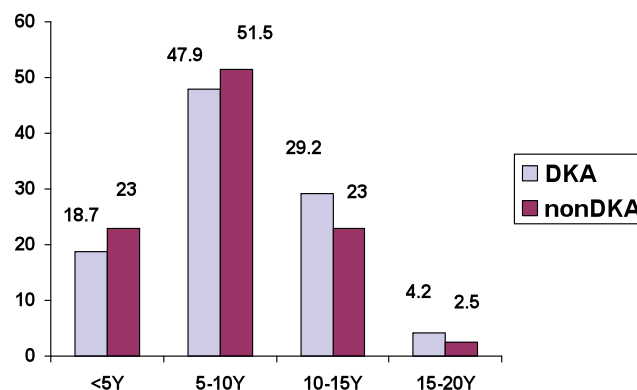


Figure 2: Comparison of age group in DKA and non DKA patients

Table 1: Clinical characteristics between subjects with or without DKA at presentation of T1 DM

	DKA N=48	Non DKA N=152	p value
Frequency	24%	76%	
Age(years)	7.3 ± 5.15	8.59 ± 3.07	$p=0.22$
Gender	29 (60%)	81 (53.3%)	$p=0.38$
Duration of symptoms (days)	14.84 ± 8.19	22.39 ± 2.27	$p=0.11$
Mean serum glucose (mg/dl)	429.9 ± 170.2	392.6 ± 136.3	
5-10years	47.9%	51.5%	

Table 2: Comparisons of the Clinical symptoms in patients with or without DKA at onset of T1 DM(N=200)

	DKA N=48		Non DKA N=152	
	Number	Percent	Number	Percent
Polyuria	41	85.4	143	94.5
Polydipsia	40	83.3	142	93.5
Fatigue	33	68.8	64	42
Nausea	16	33.3	39	26
Polyphagia	23	47.9	39	26
Abdominal pain	25	52.1	0	0
Impaired consciousness	23	47.9	0	0

No deaths were recorded among the study population. The findings from this study also indicated that diagnosis was missed in two cases of DKA (the patients had been suspected of having appendicitis and underwent laparotomy).

Discussion

This is the first report to determine the frequency and clinical presentation of diabetic Ketoacidosis at onset of T1DM in this region of Iran.

The major finding from this study was that a approximately one-quarter of the children presented with ketoacidosis at the time of initial diagnosis in which most of them were in the severe group. This finding is consistent with previous studies reported by Neu et al. in Germany (26.3%), Rewers in the USA (25.5%) and Jasiński in Poland (25%).^{3,11,16}

However, in Iran and in Asia, frequency of DKA was lower than other previous studies which have reported from Asia. Alvi showed that young Asian children in Birmingham had an eightfold increased risk of presenting with DKA as did non-Asian children.¹⁷ In a study by Habib, 55.3% and Al Magamsi 55.2% of diabetic children presented with ketoacidosis at diagnosis in Saudia Arabia.^{18,19} Similarly, 65% of the 304 patients in Taiwan and 49% of newly diagnosed diabetic children in Kuwait presented with diabetic ketoacidosis.^{20,21} The lower incidence of DKA in the current study compared with other Asian populations may be due to geographical and racial variations or environmental factors. It may also be due to better access to medical advice and early diagnosis of diabetes by physicians. The following interpretation most likely, hence there is urgent need for treatment of the newly diagnosed diabetic children. This is a view also strongly considered by their parents.

In agreement with other studies polydipsia, polyuria, weakness, and abdominal pain were the most frequently reported clinical symptoms at diagnosis. Similar results have been reported in studies by Al Magamsi and Iofs.^{19,22}

In terms of the duration of symptoms before diagnosis, the DKA group exhibited shorter duration of symptoms compared with the non-DKA groups. It would seem that the course of the disease was particularly progressive and fulminant as others have previously assumed in their studies.^{3,23}

This study revealed that the majority of cases were admitted to hospital in serious states of ketoacidosis. However, recovery was well without complications, hence no deaths were reported as a result of ketoacidosis. It is interesting to note that the hospital was the referral center, therefore it may be due to increased medical awareness in appropriate and efficient management of patients

with DKA. The hypothesis supports the study of Levy-Marchal.⁸ However, it may be due to the relatively small sample size. Therefore, further studies with longer study periods are required to confirm this hypothesis .

It is noteworthy that despite previous studies, the risk of DKA was not higher among patients <5 year old in the current study.^{24,25} Similar data has been reported by Lévy-Marchal and Al magami.^{8,19}

In this study, two of cases, DKA was misdiagnosed as appendicitis. This indicates that when the diagnosis of acute abdomen is suspected, an attempt should be made to consider DKA in differentiation among children. It is also recommended that all surgeons dealing with acute abdomen conditions in children have a high index of suspicion of DKA before laparotomy.

One of the limitations of this study was the small sample size. A larger study is being designed with a large sample size and 15 years of data collection.

Conclusion

The frequency of diabetic ketoacidosis in newly diagnosed Type 1 diabetic children was significant in this region of Iran. However, it is comparable to other parts of the developed countries and lower than other regions in Asia. In addition, it was observed that polydipsia, polyuria, weakness and fatigue were the most frequent clinical symptoms reported at diagnosis. Overall, there was no correlation between sex, age and duration of symptoms and presentation at DKA state.

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