Original Research Article

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DKA as initial presentation in children with Type 1 diabetes mellitusrisk factors: a case control study

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ABSTRACT

Background: Diabetic keto acidosis (DKA) is a serious complication of pediatric diabetic patients, which leads to increased morbidity and mortality in children. Objective of the present study was to assess the risk factors associated of DKA for initial presentation among pediatric type 1 diabetes mellitus (T1DM) patients and its poor outcome.

Methods: A case control study was designed and conducted at the Institute of Child Health and Hospital for children, Madras Medical College, Chennai from February 2013 to February 2015. All children admitted with new onset T1DM either with or without DKA were enrolled for this study.

Results: Out of 72 cases of T1DM, 47 children with DKA were considered as cases and 25 children without DKA were considered as controls. On comparing both the groups Age, gender, place of residence, BMI were similar .Major risk factors for presentation as DKA were lack of family history of diabetes, shorter duration of illness and delayed diagnosis in the form of higher number of medical visits prior to DKA diagnosis. Six among 47 DKA died while none in control group died.

Conclusions: Short duration of illness and missing the diagnosis was significantly associated with initial presentation as DKA among children with Type 1 diabetes.

Keywords: DKA, Outcome, T1DM, Risk factors,

INTRODUCTION

Diabetic keto acidosis (DKA) is an acute serious medical complication among children with type 1 diabetes mellitus (T1DM).DKA is a major cause for increased morbidity and mortality in Type 1 DM. and characterized by hyperglycemia, acidemia and ketonaemia or ketonuria. 1,2 As per the reports of International diabetes federation, one among the every newly diagnosed T1DM children is found to be an Indian. 3 The occurrence of T1DM among the children of 0 to 14 years is on the rise. Lesser the prevalence of diabetes in the community higher is the chance of Type 1 diabetic children presenting with DKA. 4 Scenario of mortality of children

with DKA in developing countries like India, Pakistan and Bangladesh is quite high and there is a need to understand the cause and risk factors of the disease.¹

Literature reveals different rates of initial presentation of DKA at diagnosis among new onset diabetes mellitus in children. ^{5,6} Understanding the risk factors for poor outcome in DKA at the initial presentation of T1DM children will help us to improve knowledge about the disease and management of such children to reduce morbidity and mortality as well. Objective of the present study was to evaluate the risk factors associated with DKA as the initial presentation and its poor outcome.

METHODS

A case control study was designed and conducted at the Institute of Child Health and Hospital for children, Chennai from February 2013 to February 2015. All children admitted with new onset T1DM either with or without DKA were enrolled for this study.

Diabetic children ≤12 yrs of age with new onset DM and DKA were included as cases and those without DKA were included as controls. Children with established diabetes, neonatal diabetes, hyperglycemia other than diabetes, children treated outside prior to admission and whose initial details and lab parameters were not available were excluded from the study.

Children were enrolled on the basis of inclusion criteria after obtaining written informed consent from the parents /caregivers. History, initial physical examination findings, prehospital medical consults, time duration between diagnosis and therapy, and initial lab parameters

obtained at the time of diagnosis were entered in the data collection form. Diagnosis of T1DM and DKA was done based on the standard definitions. Investigations and treatment was as per hospital protocols. All children in the study group were followed up to discharge from hospital or death in case of mortality. Study was undertaken after the Institutes ethics approval.

Statistical analysis

Data was analyzed using SPSS version 15. Qualitative variables were shown as numbers and percentages and quantitative variables were demonstrated as means \pm SD. The chi-square test and Fisher's exact test were used to compare the qualitative data.

Comparison between DKA and non DKA group was compared for significant difference and P<0.05 was considered significant. Regression analysis was done to identify the significant risk factor(s) associated with the development of DKA at the time of initial diagnosis.

Table 1: Comparison of study parameters among those with and without DKA.

Study parameters		DKA (n=47)	Type 1 DM (n=25)	Chi square; p value
Age	<5 Yrs	11 (23.40%)	10 (40.00%)	$\chi^2=2.176$;
	>5 Yrs	36 (76.60%)	15 (60.00%)	p=0.140
Sex	Male	20 (42.60%)	6 (24.00%)	$\chi^2 = 2.435$;
	Female	27 (57.40%)	19 (76.00%)	p=0.119
Residence	Rural	22 (46.8%)	14 (56.0%)	$\chi^2 = 0.551;$
	Urban	25 (53.2%)	11 (44.0%)	p=0.458
Body mass index	Normal	19 (40.40%)	12 (48.00%)	$\chi^2=1.420;$ p=0.492
	Low	25 (53.20%)	10 (40.00%)	
	High	3 (6.40%)	3 (12.00%)	
Family history of DM	Present	13 (27.70%)	14 (56.00%)	$\chi^2=5.593;$ p=0.018
	Absent	34 (72.30%)	11 (44.00%)	
Duration of illness (Days)	<3	11 (23.40%)	1 (4.00%)	$\chi^2=9.636;$ p=0.008
	3-10	21 (44.70%)	7 (28.00%)	
	>10	15 (31.90%)	17 (68.00%)	
Missed diagnosis at first visit	Missed	42(89.36%)	12(48%)	$\chi^2 = 14.62$
	Diagnosed	5(10.63%)	13(52%)	p=0.0002
Medical visits prior to diagnosis	0	5 (10.60%)	13 (52.00%)	
	1	17 (36.20%)	8 (32.00%)	
	2	14 (29.80%)	3 (12.00%)	-
	3	9 (19.10%)	1 (4.00%)	
	5	1 (2.10%)	0 (0.00%)	-
	6	1 (2.10%)	0 (0.00%)	
Time interval between diagnosis and treatment (in hours)	<1	26 (55.30%)	8 (32.00%)	χ ² =11.072; p=0.004
	1-4	11 (23.40%)	2 (8.00%)	
	>4	10 (21.30%)	15 (60.00%)	
Time taken to reference to centre (in hours)	<1	15 (31.90%)	5 (20.00%)	χ ² =11.463; p=0.003
	1-4	17 (36.20%)	2 (8.00%)	
	>4	15 (31.90%)	18 (72.00%)	

RESULTS

Out of 72 children with T1DM, 47 children presented with DKA.25 children presented without DKA. Comparison of the study characteristics of all the children is presented in Table 1. Among the study group, 76.6% were >5 years of age among children with DKA whereas 60% among those without DKA. 57.6% were girls among the DKA group and 76% were girls among the non DKA group.

Urban or rural residence and BMI were not significantly different between the two groups. 56% of children without DKA had a family history of diabetes and 28% of those with DKA had a family history of diabetes and this was statistically significant with a p value of 0.018. The duration of illness, was significantly shorter in children with DKA. The number of children with missed diagnosis was significantly higher in DKA group. Children in the DKA group had initiation of specific treatment in less than 4 hours after diagnosis in comparison to the group without DKA (Table 1).

Table 2: Logistic regression for risk factors for DKA at onset.

Variables	Odds ratio	95%confidenceinterval for odds ratio
Duration	5.97	4.93-19.79
Missed diagnosis	1.32	1.31-1.82

Mortality rate in DKA was 12.8% with no mortality among children with type 1DM.Logistic regression analysis revealed shorter duration of illness and missed diagnosis prior as significant risk factors for initial presentation as DKA among children with Type 1 DM (Table 2). The odds of presentation as DKA is 5.97times higher if the duration of illness is short. The presentation as DKA is 1.32 times higher in children who had their diagnosis missed at first clinician visit.

DISCUSSION

A case control study was designed and conducted in Institute of Child Health and Hospital for Children between the periods of February 2013 to February 2015 with an objective to assess the risk factors associated of DKA for initial presentation. In this study, 72 children admitted for T1DM were included according to the inclusion criteria, in which 47 (65.3%) children presented with DKA and were enrolled as cases, 25 (34.7%) children presented without DKA and were enrolled as controls. Usher-Smith et al reported in their study, the frequency of DKA varies from 12.8% to 80% in different countries, with highest incidence in the UAE, Saudi Arabia and lowest in Sweden and Canada.5 This varying incidence of DKA may be because of highest background incidence of type 1 DM and increased awareness. Literature shows varied reports on the relationship

between the incidence of DKA at onset and the prevalence of diabetes in the community.

Family history of diabetes was found to have a protective role against DKA, since less number of patients with positive family history presented with DKA and this difference was found to be statistically significant. A study done by Usher-Smith et al had shown that having 1st degree relative with T1DM is protective against DKA. Increased awareness among the family members with diabetes may be a contributory factor for an earlier diagnosis with symptoms before decompensation into DKA.

Duration of illness was shorter (<10days) in 68% of children with DKA, comparison to T1DM children. Whether the disease process is severe and rapid due to environmental or other factors needs further research. Delay in diagnosis- that is more than one medical visit prior to appropriate diagnosis was significantly present in DKA group compared to non DKA group. In this study group only 10.6% of children presented with DKA were diagnosed as DKA during their first medical visit. Other reported inappropriate diagnosis included acute abdomen, acute severe asthma, urinary tract infection and vaginal candidiasis. Similar diagnosis has been reported in literature among children who missed their diagnosis at the physician visits. As reported by Usher-Smith et al 1/3rdof children who presented with DKA had more than one visit before proper diagnosis.⁶ In a study done by Kamal Alanani et al observed that almost half of the children with DKA had delayed diagnosis.⁷Pawlowiczmet et al and PCB Sundaram et al observed DKA was significantly more frequent in children with delayed diagnosis.^{8,9}

In this study group $2/3^{rd}$ of children with DKA were referred early and started on specific treatment compared to T1DM children, because of the severity of illness. In as much as $2/3^{rd}$ of T1DM treatment was not initiated immediately, and this issue has to be addressed. Though T1DM is not an emergency condition, treatment has to be initiated as soon as it is diagnosed otherwise they can rapidly present as DKA.

In this study group the mortality rate was 12.8% in DKA. Basavanthappa et al observed in his study that the mortality rate in DKA was 11.5% and cerebral edema was the commonest cause for fatality. Mortality rates varies in different settings. ¹⁰ Satti et al observed in a study that there was no mortality in DKA. ¹¹ Murunga et al observed in a study that misdiagnosis of DKA was associated with increased morbidity and mortality ¹². Missed diagnosis of DKA is a serious cause for concern in children with type 1 Diabetes at its initial presentation. ¹³ Data from India revealed mortality rates in DKA similar to this study. ¹⁴

In conclusion, the incidence of DKA was high (65.3%) at initial presentation of Type 1 DM. Family history of

diabetes was more common in children who presented with hyperglycemia at diagnosis without DKA. Shorter duration of illness and missed diagnosis was significantly associated with initial presentation as DKA among children with Type 1 Diabetes mellitus. Age at diagnosis, gender and place of residence were not significantly associated with initial presentation as DKA.

Small sample size in this study is a limitation. Larger study group is the need of the hour to identify the risk factors associated with initial presentation as DKA among children with Type 1 Diabetes. Awareness should be created among parents and doctors to identify the symptoms of diabetes. Proper training should be given to doctors for early appropriate diagnosis.

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Institutional Ethics Committee

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