

Original Research Article

Risk factors for poor outcome in diabetic keto acidosis at the initial presentation among children with type 1 diabetes mellitus

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ABSTRACT

Background: Diabetic keto acidosis (DKA) is a serious metabolic disorder among children with new onset Type 1 Diabetes mellitus and is associated with high morbidity and mortality. Objective of the present study was to assess the risk factors associated with mortality in DKA at its initial presentation among children with new onset type 1 diabetes mellitus (T1DM).

Methods: A case control study was designed and conducted in the Institute of child Health and Hospital for children, Madras Medical College, Chennai from February 2013 to February 2015. All children admitted with DKA as initial presentation of type 1 Diabetes mellitus were enrolled for this study.

Results: Out of 72 new cases of T1DM, diagnosed during the study period 47 children had DKA and 25 children presented without DKA. Of the 47 children 6 children died. On comparing risk factors for mortality in DKA at the initial presentation, delayed treatment(p-0.002), altered sensorium at presentation(p-0.04), high urea(p-0.014) creatinine(p-0.042), lower bicarbonates (p-0.035), higher sodium(p-0.025) and lower pH(p-0.009) were found to be significantly associated with mortality. Overall mortality in DKA at its initial presentation is 12.8%.

Conclusions: Delay in therapy for DKA and presence of features of severe disease at admission are significant risk factors for mortality.

Keywords: DKA, T1DM, Risk factors, Mortality

INTRODUCTION

Type 1 DM is on the rise with the annual increase in the incidence being 3-4%.¹ Diabetic keto acidosis (DKA) is a common metabolic disorder in children with type 1 diabetes mellitus. Initial presentation as DKA among children with Type 1 DM is related to the prevalence of the disease in the community. Delayed presentation could be a contributory factor for presentation as DKA.²

Level of awareness on childhood diabetes among the physicians and the public might be a significant contributory factor to prevent DKA.³ Occurrence of DKA in children with established diabetes is a preventable

health care failure in children. Prevention of initial presentation as DKA and identifying risk factors of mortality in DKA at its initial presentation may be the options for reduction of mortality in DKA at its onset. Literature is much scarce from India in relation to the factors associated with mortality in DKA at its initial presentation.

With the existing high mortality among children with Diabetic keto acidosis, there is an urgent need to study the factors contributing to high mortality in DKA at its initial presentation. This study was undertaken to identify the risk factors for mortality in DKA at initial presentation among children with new onset Type 1 DM.

METHODS

A prospective study was designed and conducted in the Institute of child Health and Hospital for children, Madras Medical College, Chennai from February 2013 to February 2015. Study population included all children admitted with initial presentation of T1DM with DKA during the study period.

Diabetic children ≤ 12 yrs of age with DKA were included as cases. Children with neonatal diabetes, hyperglycemia other than diabetes, treated outside prior to ICH and whose initial details and other study parameters were not available, were excluded from the study.

Children were enrolled for study after obtaining the written informed consent from the parents / guardians. The children enrolled for the study were followed up till discharge from the hospital or till death in case of mortality. Diagnosis of DKA was done based on the standard definitions. Children were managed for DKA as per unit protocol. History, physical examination, initial lab parameters at admission, severity of DKA, associated shock, duration of hospital stay, and outcome were entered in the data collection form. Study parameters included clinical and laboratory parameters at the time of admission.

Statistical analysis

The data was analyzed statistically using Epi Info version 7.2. Frequencies, mean, percentage, standard deviations, chi square, co-efficient of correction values and p value were calculated.

RESULTS

Out of 72 children who were diagnosed as T1DM, 47 children presented with DKA and 25 children presented without ketoacidosis. The comparison of the characteristics of study group with and without DKA is presented in Table 1-3. 23% of those with DKA were less than 5 years of age. Girls were more than boys with a ratio of 1.3:1. Among the patients with DKA, 53.2% had low BMI.

Family history of DM of the patients was also reported. 72.30% patients with DKA had no family history of diabetes. However, among those without DKA significantly higher number had a family history of diabetes ($p=0.018$). Medical visits prior to diagnosis revealed that 17 patients out of 47 had one medical visit followed by 14 who had two visits prior to diagnosis. 50% of the study group had the specific treatment for DKA commenced within 1 hour of diagnosis. Mortality rate in DKA was 12.8%.

Table 1: Comparison of risk factors among the survivors and non-survivors.

Risk factors		Discharge (n=41)	Death (n=6)	p value
Age	<5 Years	8	3	p=0.099
	>5 Years	33	3	
Sex	Male	16	4	p=0.201
	Female	25	2	
Geography	Rural	17	5	p=0.055
	Urban	24	1	
Duration of illness (days)	<3	8	3	p=0.249
	3-10	19	2	
	>10	14	1	
Initial diagnosis	Appropriate	14	2	p=0.969
	Inappropriate	27	4	
Time interval between diagnosis and treatment (in hours)	<4	32	0	p=0.002
	>4	9	6	

Analysis of DKA and its outcomes with respect to the patient's characteristics at the time of admission is given in Table 2. 33 patients with DKA of >5 years of age were discharged.

Among the death patients 3 were from >5 years and 3 were from <5 years. Among the discharged patients 25 were females and 4 patients were males among the death

cases. Among the discharged patients, 24 were from urban and 5 among the death cases were from rural. 19 patients among the discharged cases were having duration of illness 3-10 days. Out of total discharge patients, 14 had single medical visit prior to diagnosis followed by 13 patients had two medical visits. Out of six children who died, three had single medical visits prior to diagnosis.

Table 2: Comparison of symptoms and signs among survivors and non-survivors.

Risk factors		Discharge (n=41)	Death (n=6)	p value
Polyphagia	Present	19	1	P=0.170
	Absent	22	5	
Breathlessness	Present	32	4	P=0.539
	Absent	9	2	
Abdominal pain	Present	21	3	p=0.955
	Absent	20	3	
Fever	Present	19	4	p=0.352
	Absent	22	2	
Vomiting	Present	24	2	p=0.246
	Absent	17	4	
Weight loss	Present	30	5	p=0.332
	Absent	11	1	
Headache	Present	10	2	p=0.639
	Absent	31	4	
ALOC	Present	26	6	p=0.042
	Absent	15	0	
Dehydration	Present	30	5	p=0.332
	Absent	11	1	
Heart rate	Normal	16	4	p=0.201
	Tachycardia	25	2	
Respiratory rate	Normal	10	1	p=0.588
	Tachypnea	31	2	
	Bradypnea	0	3	
Blood pressure	Normal	31	4	p=0.118
	Hypertension	6	0	
	Hypotension	4	2	
CRT	< 2 seconds	20	1	p=0.085
	> 2 seconds	21	5	
Sodium	Normal	16	2	p=0.182
	Hypernatremia	13	4	
	Hyponatremia	12	0	
Potassium	Normal	15	3	p=0.471
	Hyperkalemia	11	2	
	Hypokalemia	15	1	
Chloride	Normal	8	0	p=0.152
	Abnormal	33	6	
Urea	Normal	34	1	p=0.014
	High	7	5	
Sr. creatinine	Normal	15	0	p=0.042
	High	26	6	

DISCUSSION

Prior to the era of insulin, DKA was associated with 100% mortality and subsequently a mortality rate has come down and is now, 0.15%-0.35% in developed countries and from 3.4% to 13.4% in developing countries like India, Pakistan and Bangladesh.⁴⁻¹⁴ In this study group the mortality rate was 12.8%. The socio demographic factors like age group, sex, geographical area, consanguinity of parents was not significantly associated with mortality in this study. Factors like duration of illness, medical visits prior to diagnosis,

initial diagnosis whether appropriate or inappropriate, were not significantly associated with mortality. However delayed treatment was found to be significantly higher among those who died. Various factors have been found to be associated with mortality in DKA prior to admission, at admission and during therapy. Among them the reasons for increased mortality at admission have been found to be delayed diagnosis and fluid refractory shock and higher fluid boluses at admission to be risk factors for DKA mortality at admission.¹³⁻¹⁶ Recently published study from the same center has identified altered sensorium and higher osmolality and delayed diagnosis to be risk factors for mortality.¹⁷ Young people

diagnosed at the threshold of adulthood are at increased risk for mortality.¹⁸ Younger age, newly diagnosed diabetes, longer duration of symptoms, pH<7.1 at admission were identified as factors with poor prognosis in children with DKA.¹⁹ These were not identified as significant risk factors in the present study.

Table 3: Comparison of lab parameters among the survivors and non-survivors.

Parameter	Mean± SD	Range	P value
Blood sugar	493.14±78	447- 471	0.052
	511±44.4	500-528	
Bicarbonate	8.52±2.36	1.8-11.4	0.035
	4.16±1.65	1.8-5.5	
Sodium	140.9±12.5	134-169	0.025
	153.5±14.5	142-181	
Potassium	3.93±0.83	2.1-5.4	0.285
	4.3±0.65	3.1-4.9	
Chloride	108.9±11.3	88-137	0.028
	122.6±17.4	109-157	
pH	7.11±0.155	6.7-7.29	0.009
	6.89±0.197	6.7-7.19	
Pco2	18.99±8.45	4-37	0.307
	15.66±9.26	5-32	

Majority of the studies have not addressed the risk factors of mortality in DKA at its initial presentation. Among the new onset DKA in this study group, altered sensorium in the form of being verbal, unresponsive or pain responsive at admission was identified as a risk factor for mortality. This might be due to varied reasons in DKA. Presence of severe shock, cerebral edema, severe acidosis can contribute for altered sensorium in DKA. The same has been identified by previous studies from the India. Delayed diagnosis, another risk factor identified has been proved by other studies on DKA elsewhere. This may be a significant risk factor among children with new onset DKA. Presence of high urea, creatinine and sodium indicate severe dehydration at admission. Lower bicarbonate and lower pH at admission indicate severe acidosis and an earlier intervention for DKA might help prevent this significant mortality.

CONCLUSION

Delayed treatment altered sensorium, lower bicarbonate, lower pH, elevated urea, elevated creatinine, higher sodium levels at admission are significant risk factors for mortality among children with Diabetic keto acidosis at initial presentation. Majority of these factors signify severe disease, and this could be aggravated by delay in recognition and treatment. Overall mortality among children presenting with DKA as the initial presentation in Type 1 Diabetes mellitus is 12.8%. There is an urgent need to prevent the delay in the diagnosis by increasing the awareness about the disease among the public as well as the physicians to avoid delay in therapy.

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