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Outcomes of Children and Adolescents Admitted with Diabetic Ketoacidosis in a Single Center Study

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ABSTRACT
Background: *Diabetic ketoacidosis (Diabetic ketoacidosis) is an acute, major, life-threatening complication that mainly occurs in patients with type 1 diabetes mellitus and is the foremost cause of death in these children. Overall mortality in children with Diabetic ketoacidosis varies from 3.4% to 13.4% in developing countries. There is a need to understand outcomes among children with Diabetic ketoacidosis in sub-Saharan African countries.*
Objectives: *To determine the death rate and clinical outcomes of children and adolescents aged 0-18 years managed for Diabetic ketoacidosis at Ashiyan Medical College Hospital, Dhaka, Bangladesh. Study Methods.*
Methods: *This was a retrospective study carried out among children aged 0– 18 years admitted with Diabetic ketoacidosis at Ashiyan Medical College Hospital, Dhaka, Bangladesh between November 2017 and October 2023. The study site was the central records department at Ashiyan Medical College Hospital, Dhaka, Bangladesh. The inclusion criteria were children aged 0-18 years admitted with a diagnosis of Diabetic ketoacidosis based on the ISPAD guidelines biochemical criteria.*
Results: *Out of the 159 files reviewed, the median age of children was 13 years (IQR 1015). 41.1% of patients had severe Diabetic ketoacidosis while 35.7% had moderate Diabetic ketoacidosis. We reported a mortality of 6.9% while 93.1% of children recovered and were discharged home. The median duration of hospital stay was 8 days. High risk of mortality was reported among children who had high serum creatinine (OR 5.8 (95% CI 1.6-21.2)), decreased urine output (OR 9.0 (95% CI 2.2-37.3)), and altered level of consciousness (OR 5.2 (95% CI 1.1-25.1)).*
Conclusion: *Diabetic ketoacidosis-associated mortality in our study was low at 6.9%. High serum creatinine, decreased urine output, and altered level of consciousness were associated with a significantly higher risk of mortality.*
Keywords: *Diabetic ketoacidosis (DKA), Children and adolescents, Mortality rate, Risk factors for mortality, ISPAD guidelines*

I. Introduction

The primary consequence of type 1 diabetes mellitus in children and adolescents that has been identified as a potentially lethal emergency is diabetic ketoacidosis (DKA). In order to prevent this potentially fatal consequence of diabetes, people with newly diagnosed diabetes must receive early detection and treatment [1]. DKA presents with a clinical trial of biochemical abnormalities that include hyperglycemia (blood glucose level > 11mmol/L or 200mg/dL), venous pH of < 7.3 or serum bicarbonate level < 15mmol/L, and ketonemia (bloodβ−hydroxybutyrate ≥ 3mmol/L) or ketonuria [2]. Ketoacidosis may be the initial symptom of the illness in patients, especially in children and adolescents [3]. In sub-Saharan Africa, the majority of children who are initially diagnosed with DKA do so after an easy diabetes diagnosis was missed [4]. DKA is the leading cause of mortality for children with type 1 diabetes, and its most frequent consequences include secondary infections, cerebral edema, and compromised renal function [5]. The mortality rate associated with DKA among children in industrialized countries has declined to 0.15%-0.31% [6,7]. However, in less developed countries, the risk of death from DKA remains high at 3.4% to 13.4%, and children may die before receiving adequate treatment or during treatment [7–9]. Timely recognition of DKA and appropriate subsequent management are important to minimize complications and death. The objectives of this study were to determine the death rate and clinical outcomes of children and adolescents managed for DKA at KNH and describe the average length of stay in hospital and factors associated with mortality among this group of children.

The primary cause of death for children with type 1 diabetes mellitus is diabetic ketoacidosis (DKA), an immediate, serious, and potentially fatal consequence. In underdeveloped nations, the overall death rate for children with DKA ranges from 3.4% to 13.4%. Understanding the results for children with DKA in sub-Saharan African nations is necessary.

II. Methods

This retrospective observational study analyzed children aged 0 to 18 years diagnosed with diabetic ketoacidosis (DKA) at Kenyatta National Hospital from February 2013 to February 2018. Patients were identified using ISPAD biochemical criteria, and data on demographics, clinical presentations, biochemical parameters, treatments, and outcomes were collected from electronic medical records. Inclusion criteria comprised all DKA cases, while exclusion criteria included incomplete records or other diabetes types. Descriptive and comparative statistics were utilized for data analysis, with ethical approval obtained from the institutional review board and confidentiality maintained throughout the study.

III. Results

Table 1: Baseline characteristics of children admitted with DKA

Patient characteristics	**n**	**(%)**
Median age (IQR) in years	13	10-15
Age categories		
≤6 years	5	20.0
>6 years	20	80.0
Sex		
Male	7	28
Female	18	72
Admission ward (n=159)		
Pediatrics	4	16.0
Medical	5	20.0
Pediatric ICU	7	28.0
Main ICU	9	36.0
Time of diabetes diagnosis		
Previously diagnosed	15	60.0
Newly diagnosed	10	40.0
Type of insulin treatment (previously diagnosed n=25)		
Mix Tard	19	76.0
Lantus with short - acting insulin	5	20.0
Missing record	1	4.0
Missed insulin (n=103)		
Yes	7	28.0
No	18	72.0
Distribution based on DKA severity (n=5)		
Mild	1	20.0
Moderate	2	40.0
Severe	2	40.0
Distribution of DKA severity for children aged≤6years (*n*=3)		
Mild	1	33.3
Moderate	2	66.6
Severe	0	0.0

Table 3: Association between age less than 6 and risk of mortality

Category (n)	Died n (%)	Variable Recovered n (%)	OR (95% CI)	p value
≤6 years [16]	0	3	Ref	
>6 years (143)	0	22	1.13 (0.13- 9.43)	1.0

Table 4: Association between the time of diabetes onset and risk of mortality

Variable	Category (n)	Mortality, n (%)	Recovered, n (%)	OR (95% CI)	p value
Time of diabetes diagnosis	Previously diagnosed (103)	8 (5)	95 (59.8)	1.5 (0.38-5.85)	0.75
	Newly diagnosed (56)	3 (1.9)	53(33.3)	Ref	

Table 5: Respondents duration of hospital stay

Ward	Median length of hospital Stay	IQR
Pediatric ward	10	6-14
Medical ward	8	5-10
Pediatric ICU	5	3-7
Main ICU	5	3-10
Overall duration of hospital stays	8	5-13

IV. Discussion

In this study, out of 159 children admitted with DKA, we pared to that reported in studies from developed countries children admitted with DKA [6, 7]. Although the death rate in our study is similar to the reported death rates, we ascribed the high death rate to the fact that KNH is a tertiary hospital and that the majority of study participants were referred from lower-level facilities and had severe DKA at the time of enrollment. Since it was not recorded in many of the patients' medical records, information on the patients' domicile and usage of alternative medications before presentation was not gathered. However, it is noteworthy that the majority of the population served by KNH comes from low-socioeconomic urban areas in Nairobi and its environs, with just a tiny percentage from the middle class. Delays in obtaining care are believed to have contributed to the high death rate.

According to our study's findings, children who had anuria had a nine-fold increased risk of dying, while those with high serum creatinine had a five-fold increased risk. Studies carried out in India and other countries have mostly shown renal failure as an independent risk factor for death in DKA [9, 10]. Intrinsic renal failure was reported to have occurred in 11.5% of children with DKA in South India, with associated case fatality rates of 40% to 72% [11]. Children with DKA are at risk for acute renal damage due to excessive urine and volume depletion caused by elevated blood glucose levels. Renal failure may result from fluid restriction in a kid with sepsis and hypovolemic or septic shock during the treatment of DKA out of concern for cerebral edema. Poor fluid management during the early phases of DKA may have contributed to AKI in our research. Even though KNH's pediatric and medical wards have the ISPAD protocol guidelines for managing DKA, and healthcare staff are taught on how to utilize them, there has been evidence of poor adherence to these rules.

In our analysis, altered awareness was independently linked to a five-fold increased risk of death (OR 5 (95% CI 1.1-25.1)). In impoverished nations, cerebral edema frequently manifests as altered consciousness, which has been linked to a 43% fatality rate for children with DKA [7, 12]. Cerebral edema has been identified in studies as the primary cause of altered consciousness in children with DKA, despite the fact that we were unable to report on additional clinical symptoms of cerebral edema in children because of inadequate documentation.

Cerebral edema was seen in 26% and 24% of the study population in a cohort of children hospitalized to a pediatric critical care unit in north India and another research in Chennai, India, respectively [13,14]. Out of 76 patients who had altered consciousness, 11.8% died which is a lower proportion compared to that reported from other developing countries [7].

We noted a lower mortality rate of 3.1% among older children and adolescents admitted to the medical wards compared to 3.8% among younger children admitted to the pediatric ward; however, this difference in mortality was not statistically significant. Although mortality in children younger than 6 years was low at 0.6%, we had only 16 children within this age category with 1 death reported. A study done by Kao et al. on the incidence and trends of DKA in children and adolescents with type 1 diabetes in British Columbia, Canada, reported that younger age at diagnosis (<5 years) was associated with a greater risk of DKA at the time of diabetes diagnosis [15]. Additionally, we did not report any ICU deaths, which we ascribed to careful patient monitoring and the timely implementation of the right therapies in the case of clinical deterioration.

Temperature above 37.5 degrees, an indicator of possible infection, was not independently associated with mortality in our study. This finding contradicts what was reported in the study conducted in Chennai, India, where infection was identified as a significant risk factor and a contributor to poor outcomes in children with DKA [16]. We reported severe DKA in 41.1% of children which is higher compared to the study done in Italy by

Rabbone et al. where severe DKA was reported in 15.3% of children aged <18 years [17]. It was also higher than what was reported in another study by Cherubini et al. on DKA frequency at diagnosis of type 1 diabetes mellitus (T1DM) among children aged < 15 years. Cherubini reported DKA in 40.3% of children at diagnosis of TIDM and severe DKA in 11.2% of children [18]. The study by Rabbone reported severe DKA in 16.7% of the children aged < 6 years, and we reported a similar proportion of children with severe DKA in this age group [17]. Contrary to the findings from previous studies, we did not find any association between DKA severity, age, sex, type of insulin, missed insulin doses, and mortality, and this could be explained by the fact that the examination for mortality-associated factors was a secondary objective in our study and our sample size may not be adequate to assess for this. This is confirmed by the wide confidence intervals that we reported for most of the associations.
We sought to determine the length of hospital stay (LOS) as a proxy indicator of the quality of DKA management offered at KNH. The median duration of hospital stay was 8 days and was similar at 8 (IQR 6-14) and 10 (5–10) days for the pediatric and medical wards, respectively. The duration of hospital stay in our study is comparable to that reported in a chart review of 151 patients admitted with DKA in Ethiopia by Desse et al. where nearly half of the patients (47%) had a long hospital stay of >7 days [19]. However, our study's LOS was much longer than the appropriate LOS of 3.4 days found in US research linked to the delivery of high-quality treatment [20]. Longer hospital stay among DKA patients in the study by Desse et al. was related to poor DKA management setup, DKA management protocol, and patient characteristics [19]. However, our study was unable to determine whether the length of hospital stay was only related to the standard of treatment or if it was caused by additional variables such the severity of DKA or budgetary constraints.

V. Conclusion

DKA-associated mortality in our study was high at 6.9%. In our setting, elevated serum creatinine, reduced urine production, and altered awareness were all substantially linked to a high death rate. With a median stay of seven days, we found that children hospitalized with DKA had lengthy hospital stays. Preventing DKA itself by early detection, assistance, and monitoring, as well as appropriate blood glucose management in those with existing diabetes, is the key to achieving a favorable outcome and preventing death. Healthcare professionals who treat children and adolescents with diabetes and DKA should adhere to the DKA management recommendations.

References

[1]. S. E. Lawrence, "Diagnosis and treatment of diabetic ketoacidosis in children and adolescents," Pediatrics & Child Health, vol. 10, no. 1, pp. 21–24, 2005.
[2]. J. I. Wolfsdorf, N. Glaser, M. Agus et al., "ISPAD Clinical Practice Consensus Guidelines 2018: Diabetic ketoacidosis and the hyperglycemic hyperosmolar state," Pediatric Diabetes, vol. 19, pp. 155–177, 2018.
[3]. A. N. Onyiriuka and E. Ifebi, "Ketoacidosis at diagnosis of type 1 diabetes in children and adolescents: frequency and clinical characteristics," Journal of Diabetes & Metabolic Disorders, vol. 12, no. 1, p. 47, 2013.
[4]. A. N. Murunga and P. M. O. Owira, "Diabetic ketoacidosis: an overlooked child killer in sub-Saharan Africa?" Tropical Medicine and International Health, vol. 18, no. 11, pp. 1357–1364, 2013.
[5]. L. Arlan, "The management of diabetic ketoacidosis in children," Diabetes Therapy, vol. 1, no. 2, pp. 103–120, 2010.
[6]. J. R. Curtis, T. To, S. Muirhead, E. Cummings, and D. Daneman, "Recent trends in hospitalization for diabetic ketoacidosis in Ontario children," Diabetes Care, vol. 25, no. 9, pp. 1591–1596, 2002.
[7]. V. Poovazhagi, "Risk factors for mortality in children with diabetic keto acidosis from developing countries," World Journal of Diabetes, vol. 5, no. 6, pp. 932–938, 2014.
[8]. B. Zabeen, J. Nahar, F. Mohsin, K. Azad, and N. Nahar, "DKA in children - an experience in a tertiary hospital," Ibrahim Medical College Journal, vol. 2, pp. 17–20, 1970.
[9]. M. Syed, F. B. Khawaja, T. Saleem, U. Khalid, A. Rashid, and K. N. Humayun, "Clinical profile and outcomes of pediatric patients with diabetic ketoacidosis at a tertiary care hospital in Pakistan," The Journal of the Pakistan Medical Association, vol. 61, no. 11, pp. 1082–1087, 2011.
[10]. V. Poovazhagi, P. Senguttuvan, and R. Padmaraj, "Outcome of acute renal failure in children with diabetic keto acidosis (DKA)," Pediatric Oncall, vol. 8, pp. 63–65, 2011.
[11]. V. Poovazhagi, "Factors associated with mortality in children with diabetic ketoacidosis (DKA) in South India," International Journal of Diabetes in Developing Countries, vol. 36, No. 3, pp. 295–302, 2016.
[12]. E. A. Nyenwe, L. N. Razavi, A. E. Kitabchi, A. N. Khan, and J. Y. Wan, "Acidosis: The prime determinant of depressed sensorium in diabetic ketoacidosis," Diabetes Care, vol. 33, no. 8, pp. 1837–1839, 2010.
[13]. L. K. Tiwari, J. Muralindharan, and S. Singhi, "Risk factors for cerebral edema in diabetic ketoacidosis in a developing country," Pediatric Critical Care Medicine, vol. 13, no. 2, pp. e91–e96, 2012.
[14]. P. Varadarajan and S. Suresh, "Delayed diagnosis of diabetic ketoacidosis in children-a cause for concern," International Journal of Diabetes in Developing Countries, vol. 35, no. 2, pp. 66–70, 2015.
[15]. K.-T. Kao, N. Islam, D. A. Fox, and S. Amed, "Incidence trends of diabetic ketoacidosis in children and adolescents with type 1 diabetes in British Columbia, Canada," The Journal of Pediatrics, vol. 221, pp. 165–173.e2, 2020.
[16]. P. Varadarajan and S. Suresh, "Role of Infections in Children With Diabetic Ketoacidosis- A Study from South India," International Journal of Diabetes and Clinical Research, vol. 1, no. 2, p. 2, 2014.
[17]. I. Rabbone, G. Maltoni, D. Tinti et al., "Diabetic ketoacidosis at the onset of disease during a national awareness campaign: a 2- year observational study in children aged 0-18 years," Archives of Disease in Childhood, vol. 105, no. 4, pp. 363–366, 2020.
[18]. V. Cherubini, J. M. Grimsmann, K. Åkesson et al., "Temporal trends in diabetic ketoacidosis at diagnosis of paediatric type 1 diabetes between 2006 and 2016: results from 13 countries in Three continents," Diabetologia, vol. 63, no. 8, pp. 1530–1541, 2020.

[19]. T. A. Desse and T. C. Eshetie, "Determinants of long hospital stay among diabetic patients admitted with diabetic ketoacidosis at Jimma University Specialized Hospital," Journal of Traumatic Stress Disorders & Treatment, vol. 6, no. 1, 2016.
[20]. Centres for Disease Control and Prevention, Average length of stay in days of hospital discharges with diabetic ketoacidosis as first-listed diagnosis, United States, 1988-2009, Diabetes Public Health Resource, 2016.