Determining the Risk Factors Associated with Recurrent Episodes of Diabetic Ketoacidosis In Pediatric Patients With Type 1 Diabetes Mellitus

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 ABSTRACT

Objective: To find out risk factors associated with recurrent episodes of DKA in type 1 Diabetes Mellitus in pediatric population.

Methods: It was a hospital based, cross sectional, observational study, performed in a tertiary care hospital to assess the risk factors associated with recurrent DKA episodes in pediatric population (6m to 18 yrs). It was performed over a period of one year in Department of Paediatric Medicine, SMS Medical College, Jaipur. Prior permission from the institutional ethical committee was obtained. The purpose of the current study was to determine the risk factors for repeated episodes of DKA and the relationship between the severity of DKA and HbA1C in children with type 1 diabetes mellitus.

Results - In our study out of the 104 study participants, maximum 59 patients (56.7%) had 2 episodes of DKA followed by 27 (26.0%) had 3 episodes of DKA, 14 (13.5%) had 4 episodes of DKA and >4 episodes were found in 4 (3.8%) Participants. In current study, mean age of the study participants who had 2 episodes of DKA was 10.98 ±4.3 years and mean age of the study participants who had >2 episodes of DKA were 12.5±3.8 years. Out of the 59 participants who had 2 episodes of DKA, maximum 22 were from age group of 10-15 years

followed by 15 were from >15years and out of the 45 participants who had >2 episodes of DKA, maximum 22 were from age group of 10-15 years followed by 13 in >15 years. In our study, a statistically significant increase was found in HbA1c with number of episodes of DKA. In our study, mean HbA1c of the study participants who had 2 episodes of DKA was 9.6±2.1 gm% and mean HbA1c of the study participants who had >2episodes of DKA was 12.7±3.1 gm%. Among 104 participants, most common preceding factors responsible for recurrent DKA was poor education status [45(43.3%)], followed by infection and Lack of counseling at time of discharge in 40 (38.5%) participants each, 37 (35.6%) had deliberate omission of insulin due to lack of supply or shift to other therapy, lipodystrophy was responsible in 15(14.4%) and psychiatric factors in 12(11.5%) participants.

Conclusion: Our study concluded that Poor education status, lack of counseling at time of discharge, infections followed by deliberate omission of insulin and lack of supplies were common preceding factors for the recurrent DKA and severity of it was associated with HbA1c and duration of diabetes.

Key words: Type 1 DM, Recurrent DK

INTRODUCTION

The International Society for Pediatric and Adolescent Diabetes states that a patient with diabetes has DKA if all of the following are present: Hyperglycemia – Blood glucose >200 mg/dL (11 mmol/L),Metabolic acidosis – Venous pH <7.3 or serum bicarbonate <15 mEq/L (15 mmol/L) and Ketosis – Presence of ketones in the blood (>3 mmol/L beta-hydroxybutyrate) or urine ("moderate or large" urine ketones).[1]DKA can occur in patients with diabetes due to number of reasons, such as poor adherence to insulin therapy, although most frequently happens in those who already have the disease. In other situations, DKA may be the first sign of previously undiagnosed diabetes.[2-3]Recurrent-DKA in patients with established diabetes mellitus (DM) is still a significant issue in pediatrics globally. The probability of DKA in children with known diabetes is 1-10% per patient per year, according to the International Society of Pediatric and Adolescent Diabetes.[4] The quality of medical care and socioeconomic conditions vary widely around the world, which has an impact on the occurrence of recurrent DKA. The most common cause of death in adolescents with T1DM is diabetic ketoacidosis.[4] Risk factors for recurrent DKA are –Noncompliance (deliberately or otherwise) with insulin treatment, precipitating infections, poor follow-up due to poor socioeconomic status or illiteracy, psychiatric co morbidity, lipodystrophy of insulin site.

METHODS

This cross-sectional observational study was conducted at Sri Padamwat Neonatal and Child Health institute, Jaipur, attached to Swai Man Singh Medical College. The patients of DKA who got admitted in various wards of SPMCHI were included in study according to inclusion and exclusion criteria and the detailed assessment was done. Study duration was from APRIL 2021 to NOVEMBER 2022(over the course of one year) or till completion of sample size. Sample size was calculated at 95% confidence level, alpha error 0.05 expecting in 30.1% infectious illness as one of the risk factors for recurrent DKA among children with type 1 diabetes mellitus. At 9% absolute allowable error the required sample size was 104 with type 1 diabetes mellitus hospitalised for DKA. This sample size was large enough to include all other associated risk factors in the study. Pediatric patients with 6th month to 18th year of age with type 1 Diabetes Mellitus presenting with recurrent episode of DKA was included in the study. Recurrent episodes was defined as more than one episode of DKA . A questionnaire was prepared to assess the patients in detail. The questionnaires were initially checked for completeness. Collected data was cleaned for errors and missing values. The corrected data was then entered into Microsoft Excel after preparing a Master-chart. After data entry of every ten questionnaires, one random form was picked and data entry was re-checked. An independent person verified data entry of two randomly chosen forms after entry of every 5th questionnaire. Data analysis was done using licensed SPSS software version 21.0 (Chicago, Illinois). Univariate analyses were done initially and the results were presented with the help of tables, text, bar-diagrams and pie-charts. Descriptive statistics were used to calculate frequencies of categorical variables, and measures of central tendencies and dispersion were used to describe continuous variables. Independent t-test was used to compare the continuous variable and chi-square test was used for categorical variables. A p-value <0.05 was considered as statistically significant.

RESULTS

In our study, out of the 104 participants, maximum 59 participants had 2 episodes of DKA followed by 27 had 3 episodes, 14 had 4 episodes and >4 episodes were found in 4 participants. The mean age of the study participants who had 2 DKA episodes was 10.98±4.3 years and mean age of the study participants who had >2 DKA episodes was 12.5±3.8 years. This difference was not found to be statistically significant. Out of the 59 participants who had 2 DKA episodes, maximum 22 were of age group of 10-15 years followed by 15

participants were of >15 years age. Out of the 45 participants who had DKA episodes >2, maximum 22 were in age group of 10-15 years followed by 13 in >15 years. This difference was not found to be statistically significant. Out of the 59 participants who had 2 DKA episodes, 37 were female children and 22 were male children and out of the 45 participants who had >2 DKA episodes, 25 were female and 20 were male children. This difference was not found to be statistically significant. Out of the 59 participants who had 2 DKA episodes, 35 belongs to rural area and 24 were belongs to urban area and out of the 45 participants who had >2 DKA episodes, 25 belongs to rural area and 20 were belongs to urban area. This difference was not found to be statistically significant. In our study, mean weight, height and BMI of the study participants who had 2 DKA episodes was 33.5±12.7 kg, 133.9±18.8 cm and 18.1±3.0 kg/m^2 respectively and mean weight, height and BMI of the study participants who had >2 DKA episodes was 36.0±12.1 kg, 137.9±19.8 cm and 18.4±2.8 kg/m^2 respectively. This difference was not found to be statistically significant. Out of the 59 participants who had 2 DKA episodes, maximum 28 were diagnosed DKA at age of <5 years followed by 14 were diagnosed in age of 5-7 years and out of the 45 participants who had >2 DKA episodes, maximum 14 were diagnosed DKA at age of 7-10 years followed by 12 were diagnosed in age of 5-7 years. This difference was found to be statistically significant. The mean HbA1c of the study participants who had 2 DKA episodes was 9.6±2.1 gm% and mean HbA1c of the study participants who had >2 DKA episodes was 12.7±3.1 gm%. This difference was found to be statistically significant. In our study, a statistically significant increase was found in HbA1c with number of episodes of DKA (Table A). Out of the 59 participants who had 2 DKA episodes, 5 had history of diabetes in first degree relative and out of the 45 participants who had >2 DKA episodes, 8 had history of diabetes in first degree relative. This difference was not found to be statistically significant. Out of the 59 participants who had 2 DKA episodes, 15 were having diabetic education and out of the 45 participants who had >2 DKA episodes, 3 were having diabetic education. This difference was found to be statistically significant. Among 104 participants, most common preceding factors responsible for recurrent DKA was poor education status [45(43.3%)], followed by infection and Lack of counseling at time of discharge in 40 (38.5%) participants each, 37 (35.6%) had deliberate omission of insulin due to lack of supply or shift to other therapy, lipodystrophy was responsible in 15(14.4%) and psychiatric factors in 12(11.5%) participants. (Table B)

Table A: HbA1c distribution of study participants according to DKA episodes:

Number of DKA episode	Mean	SD	Median	Minimum	Maximum	p-value
2	9.64	2.08	9.90	6.60	13.80	
3	11.66	2.84	12.46	6.60	15.30	
4	12.51	2.58	13.23	6.75	15.60	0.0001
>4	17.91	1.88	18.85	15.10	18.85	
Total	10.98	2.97	11.25	6.60	18.85	

Table B: Distribution of preceding factors of DKA among study participants.

Preceding factors for recurrent DKA	Number	%
Infections	40	38.5
1. URTI	30	28.8
2. GIT and other infection	17	16.3
Deliberate Omission of insulin	37	35.6
1. Lack of supplies	22	21.2
2. Shifting to other therapy	15	14.4
Psychiatric factors	12	11.5
Lipodystrophy	15	14.4
Poor education status	45	43.3
Lack of counselling at time of discharge	40	38.5

DISCUSSION

In our study, mean HbA1c of the study participants who had 2 episodes of DKA was 9.6±2.1 gm% and mean HbA1c of the study participants who had >2 episodes of DKA were 12.7±3.1 gm%. So current study showed a significant association with HbA1c and found to be significantly increases with the episode of DKA. Similar to current study, Al-Hayek et al[5], also found a significant association of DKA with HbA1c. In this study, compared with adolescents who had HbA1c ≤9, significant differences were found in adolescents with HbA1c >9. Bui et al[6], found no difference in HbA1c levels between relapsers (>1 episode of DKA per year) or non-relapsers (1 episode of DKA per year). Yet they stated that the levels of control seen in both relapsers and non-relapsers were significantly worse than the mean HbA1C reports of 8.6% seen in other Australian and international centres. Fritsch M et al et

al[7], also revealed that comparing patients without, with one or recurrent (≥2) DKA, age at manifestation, HbA1c, and insulin dose were significantly higher in patients with recurrent DKA.

In our study, out of the 59 participants who had 2 episodes of DKA, 5 had history of diabetes in first degree relative and out of the 45 participants who had >2 episodes of DKA, 8 had history of diabetes in first degree relative. This difference was not found to be statistically significant. However, in the present study a significant association of DKA was found with diabetic education and out of the 59 participants who had 2 episodes of DKA, 15 had history of diabetic education and out of the 45 participants who had >2 episodes of DKA, 3 had history of diabetic education. Education on self-managing diabetes in order to prevent DKA, is essential to reduce the risk of developing this acute complication. Al-Hayek et al[5], also mentioned about diabetic education and revealed that 7.8% participants had history of diabetic education however it did not mention about the association of it.

Among 104 participants, most common preceding factors responsible for recurrent DKA was poor education status [45(43.3%)], followed by infection and Lack of counseling at time of discharge in 40 (38.5%) participants each, 37 (35.6%) had deliberate omission of insulin due to lack of supply or shift to other therapy, lipodystrophy was responsible in 15(14.4%) and psychiatric factors in 12(11.5%) participants.

Al-Hayek et al[5], also found that discontinuation of insulin therapy (65%) was the major precipitating cause of recurrent DKA followed by infection (30.1%) and unknown reasons for stopping insulin was the major reason followed by sickness. Similar to our study, Randall et al[8], also stated that that poor adherence to insulin therapy is the leading precipitating cause of DKA and lack of adherence to insulin treatment relates to a multitude of socioeconomic and psychosocial factors. Amiel SA et al[9], also stated that greater personal responsibility in diabetes management and less parental monitoring in adolescents may lead to a deterioration of metabolic control in this group.

CONCLUSION

Our study concluded that Poor education status, lack of counselling at time of discharge, infections followed by deliberate omission of insulin and lack of supplies were common preceding factors for the recurrent DKA and severity of it was associated with HbA1c and duration of diabetes.

RECOMMENDATIONS:

Socioeconomic inequalities, specifically low education and a lack of counseling, were linked to an increased risk of recurrent DKA at T1D diagnosis. Based on the findings of this study, future research should focus on identifying barriers to early diagnosis of T1D in children under the age of 15, particularly in families with higher socioeconomic inequalities. Such studies could provide information on both structural barriers and the educational needs of this specific population. Future interventions aimed at improving the health outcomes of children with T1D in India may be more effective as a result of this information.

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