DIABETIC KETOACIDOSIS IN CHILDREN – AN EXPERIENCE IN A TERTIARY HOSPITAL

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Abstract

A retrospective study was done in the in-patient department of paediatrics, BIRDEM from January 2002 to November 2006 to determine the clinico-laboratory features, precipitating factors and outcome of diabetic ketoacidosis. Over the five year period, 344 diabetic patients were hospitalized. Among them, 54 (15.6%) had diabetic ketoacidosis (DKA). Among those, 50 were Type I, one was Fibrocalculous Pancreatic Diabetes (FCPD) and 3 were of other specific types. More than half (51.9%) of the patients were newly diagnosed. Amongst the precipitating factors, 28% had missed insulin and 48% had overt infection. Infections, particularly those of the respiratory tract, were the main precipitating cause for the DKA. There was h/o both infection and missed insulin injections in 11.5% patients. The mean age of patients with DKA was 11.2 $\pm$ 4.4 years. Those in the age range 10-14 yrs suffered most frequently ($p < 0.0001$) from ketoacidosis (n= 38, 70.4%) compared with those aged 0-4 yrs (9%) and 5-9 yrs. (20%). There was a significant difference between those newly diagnosed (group I) and known diabetics (group II) ($p < .029$). The frequency of DKA was higher in girls than in boys (66.7% vs. 33.3%; $p = .0001$). The median duration of polyuria and/or polydipsia was variable between newly diagnosed and known diabetics (3.2 - 25d) ($p < .001$). All patients presented with altered levels of consciousness and 35 (67.3%) were unconscious of different grades. Mean random blood glucose (RBG) and HbA1c were 27.6mmol/L and 13.4%. Complications noted were acute renal failure (n=2, 3.7%) and cerebral edema (n = 4, 7.5%). The outcome of treatment in the whole group was good, 46 (86.7%) patients recovered without complications, but 7 (13.4%) patients died.

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Key words: Ketosis, children, diabetes, BIRDEM

Introduction

Children with type 1 diabetes inevitably died of diabetic ketoacidosis before the discovery of Insulin. Despite major advances in the care of diabetes, DKA remains a leading cause of hospitalization and the leading cause of death and morbidity in children and adolescents with type 1 diabetes[1,2]. At diagnosis, 25% of children present with diabetic ketoacidosis and this proportion is 40% under four years of age[3]. DKA occurs in children with known diabetes who omit insulin doses or who do not successfully manage an intercurrent illness[4]. Although the clinical picture of ketoacidosis at the time of diagnosis is well known, there are not many recent studies based on a large number of cases. There is a wide geographical variation in the frequency of DKA at diabetes onset and rates correlate inversely with regional incidence of type I DM[5]. In Bangladesh, no epidemiological study on childhood diabetes or DKA has been done so far. In a one-year review, the proportion of diabetics under 18 years of age was found to be 1.34% among the registered cases of BIRDEM[6].

BIRDEM is a tertiary level referral hospital. It is expected that childhood diabetics who visit this hospital represent the population (childhood diabetics) of Bangladesh as patients come to this hospital from almost all parts of the country. In this study we have reviewed the experience of a major paediatric diabetes

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care service over the last five years in respect of admissions for DKA, its etiology and outcome.

Methods

Data were collected from case records of the patients during the course of hospital stay. Criteria for the diagnosis of DKA was defined as any child with heavy glycosuria and ketonuria, blood glucose > 11mmol/L, pH < 7.3 and a serum bicarbonate level < 15mmol/l, and who are 5% or more dehydrated ± vomiting ± drowsy[7]. Patients' records were reviewed to ascertain age, sex, documented etiology of DKA, adverse events and outcome. Patients were sub classified into those with newly diagnosed diabetes mellitus who presented with DKA (Group I) and those with known diabetes who subsequently developed DKA (Group II). Precipitating factors of DKA were retrieved from case notes. Cerebral oedema was defined as persistence of impaired consciousness despite improvement in pH to ≥ 7.3 and blood glucose to < 300 mg/dl or deterioration in the level of consciousness accompanied by one or more signs of increased intracranial pressure such as hypertension and bradycardia, abnormal breathing pattern, papillary abnormalities, decerebrate or decorticate posturing or respiratory arrest having occurred if a clinical diagnosis was made and the patient treated with intravenous mannitol[3].

Results have been reported as mean ± SD. The detailed case records of the children were analyzed by SPSS programme. A p value of less than .05 was considered to be significant.

Results

Over the five year period, a total of 344 diabetic children were hospitalized in the department of Paediatrics. Fifty four (15.6%) of these admitted patients presented with diabetic ketoacidosis (DKA). Among them, 50 were Type I, one was Fibrocalculous Pancreatic Diabetes (FCPD) and three were of other specific types. Among other types one had Down's syndrome with hypothyroidism, one had Thalassaemia and one had Freiderich's ataxia. More than half (51.9%) of the patients were newly diagnosed (group I).

Amongst the newly diagnosed patients with DKA with documented etiology, only two episodes were precipitated by infection and no cause being documented in 26 of the admissions. Precipitating

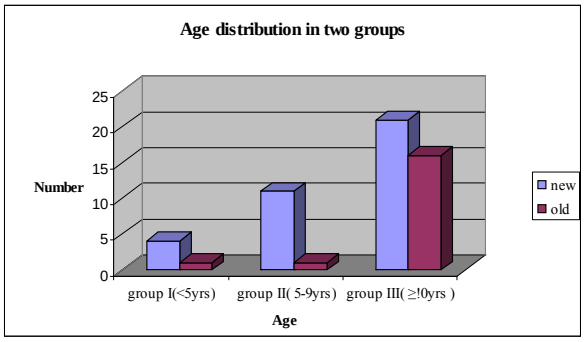

Fig-1: *Age distribution in children with DKA*

factors among known diabetics were analyzed. Infections, particularly those of the respiratory tract, were the main precipitating cause for the DKA. UTI, septicaemia and otitis media were other types of infections. The other precipitating factor was omission of insulin (28%). There was h/o both infection and missed insulin injections in 11.5% patients. The mean age of patients with DKA was 11.2 ± 4.4 years. Those in the age range 10-14 yrs suffered most frequently ($p < 0.0001$) from ketoacidosis (n= 38, 70.4%) compared with those aged 0-4 yrs (9%) and 5-9 yrs. (20%). There was a significant difference between those newly diagnosed (group I) and known diabetics (group II) ($p < .029$).

The frequency of DKA was higher in girls than in boys (66.7% vs. 33.3%; $p = .0001$). Female and male ratio was 2:1. Females were predominant (though not statistically significant) in the newly diagnosed patients.

The median duration of polyuria and/or polydipsia varied between newly diagnosed and known diabetics (3.2 - 25d) ($p < .001$). Among other symptoms, 57.8 % had vomiting and 35.7% had abdominal pain. All patients presented with altered levels of consciousness and 35 (67.3%) were unconscious of different grades.

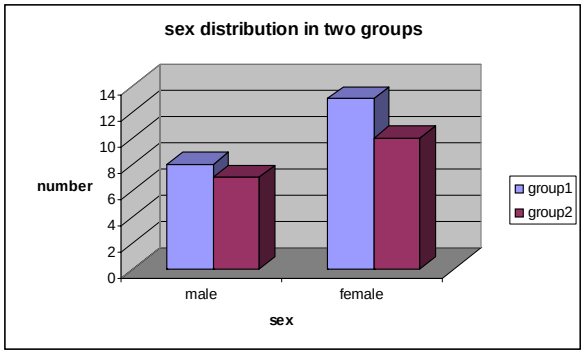

Fig-2: *Sex distribution in the two groups*

Table-1: *Glycaemic status in two groups*

	Group I	Group II
RBS	31.4 ±11.1	24 ± 8.4
HbA_{1C}	13.8 ± 2.9	12.8 ± 2.6

Random blood glucose was high in all patients, but it was significantly higher in the newly diagnosed compared to known diabetics ($p < .024$). Mean HbA_{1C} was 13.4 ± 2.8. There was no significant difference in both the groups.

Blood urea was higher in the newly diagnosed patients but was not significant between the two groups ($p < .738$). Serum creatinine was higher in group I than group II ($p < .031$). Cholesterol level was also higher in group I than group II ($p < .034$). Mean pH was 7.18 ± 0.14 and HCO_3 was 8.94 ± 6.6. There was no statistical difference between two groups. Complications noted were acute renal failure and cerebral edema. Three patients developed acute renal failure which improved after peritoneal dialysis. There were four episodes of cerebral oedema with two associated deaths.

The outcome of treatment in the whole group was good, 46 (86.7%) patients recovered without complications. Five patients died, with the causes of death being septicaemia (n = 2), cerebral oedema (n = 2) and pneumonia (n = 1). There was no significant difference in between the two groups regarding outcome ($p < .707$).

Discussion

This study provides a different picture regarding types of diabetes presenting with DKA. One FCPD and three secondary types presented with DKA which is different compared to the western world where mostly type 1 diabetic children present with DKA[9]. The frequency of DKA at onset of diabetes varies considerably from country to country. In our study, half of the patients presented with ketoacidosis which is similar to different studies where 25% to 40% of children are newly diagnosed[10,11]. Amongst the precipitating causes, infection was the commonest (50%) which is similar to a study in Sudan where acute infections accounted for 38% of the episodes[12]. In our study those in the age range 10-14 years suffered from DKA which was significant between the two groups and the mean age was 11.2 ± 4.4 years. The percentage of DKA cases in boys and girls is usually considered to be the same[11,13]. In our study, girls faced an increased risk of developing DKA at onset of diabetes mellitus. A study from Australia was analogous in many ways: Bui *et al.*[14] found a ratio of 1.3:1.0 in newly diagnosed patients with DKA. Whilst newly diagnosed patients appeared to have a very short duration (3.2 days) of polyuria and polydispia, the known diabetics had a longer duration (25 days) in our study. Approximately 50% of the newly diagnosed patients had experienced polyuria and/or polydipsia for more than 2 wks[14].

Table-2: *Cause of deaths in children with DKA*

Cause of death	Group I	Group II
Septicaemia	0	2
Pneumonia	1	0
Cerebral oedema	1	1
Total	**2**	**3**

Mean random blood glucose was high (27.4±10.3) which was significantly higher in group I patients ($p < .024$). Mean HbA1c was 13.4±2.8 but there was no significant difference in between the two groups. The poor value of HbA1c was found in other centers[14, 15-17] too. Serum creatinine was higher in group I compared to group II ($p < .031$). Elevation of blood urea nitrogen and creatinine concentrations could be explained by diminished renal perfusion[9]. Three patients developed acute renal failure that improved after peritoneal dialysis. Renal failure is one of the rare but most serious complications of DKA[18]. There were four episodes of cerebral oedema with two associated deaths. Cerebral oedema is the most common cause of mortality in children with DKA[19-21].

The outcome of treatment in the whole group was good in 46 (86.7%) patients who recovered without complications. Five patients died, the causes of death being septicaemia (n= 2), cerebral oedema (n-2) and pneumonia (n=1). There was no significant difference in between the two groups regarding outcome ($p < .707$). Sepsis and cerebral oedema have been reported as cause of death in DKA patients in India[22].

Conclusion

The greater number of females than males in this study may be due to a greater likelihood of family conflict or deprivation in females. The increased number of newly diagnosed patients presenting with DKA in our experience indicates that focus should be given upon

earlier diagnosis and intervention of diabetes to reduce the occurrence of DKA.

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