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CLINICAL PROFILE, AND SERUM ELECTROLYTES OF CHILDREN WITH DKA AND ITS ASSOCIATION WITH CLINICAL OUTCOME

Paediatric Medicine

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ABSTRACT

Objective: To evaluate the clinical profile and electrolyte up to 48 hours of admission and its association with duration of insulin infusion, duration of hospital stay and mortality in children with diabetic ketoacidosis (DKA). **Study Design:** A hospital based prospective cohort study **Setting:** Pediatric intensive care unit (PICU) of a tertiary care center teaching hospital in north India **Study Period**: November 2021 to October 2022 **Methods:** Sixty consecutive children with DKA admitted to PICU were included in the study excluding partially treated children elsewhere. Serum electrolyte, renal function test, blood gas, blood glucose and urine ketone levels were estimated at the time of admission and then subsequently at 4 hr,12 hr, 24 hr, 36 hr and 48 hr. **Results:** The mean (SD) age of the study population was 8 (3.9) yr (range, 0.7–13 yr). There were 32 males (53%) which was slightly more than 28 females (47%). Most patients (34 cases; 57%) had pre-existing diabetes, whereas 26 (43%) cases were diagnosed at admission. Most children presented with acidotic breathing, anorexia, and polyuria. Median duration of insulin infusion was 25 (IQR 17-35) hours in patients with abnormal electrolytes at 24 hours as compared to 4 (IQR 3-6.5) hours in children with normal electrolytes (p<0.001). Similarly, duration of hospital stay was more in patients with abnormal electrolytes at 24 hours (12 days (IQR 5-15)) as compared to the children with normal electrolytes at 24 hours (6 days (IQR 4.5-11.5)) (p=0.034). **Conclusion:** Boys and girls were equally affected. Duration of insulin infusion for the treatment of DKA was more in patients with abnormal electrolytes at 24 hours. Abnormal electrolytes at 24 hours were associated with longer duration insulin infusion and hospital stay.

KEYWORDS

Diabetic Ketoacidosis, Electrolyte, Blood Gas, Outcome

INTRODUCTION

Diabetic ketoacidosis (DKA) is a major complication of the childhood type 1 diabetes mellitus (T1DM) and is associated with increased risk of morbidity and mortality. About 25 to 40% of the newly diagnosed T1DM children present with DKA whereas the risk of developing DKA in established T1DM children is 1 to 8% per patient per year (1). In small children, it may be hard to recognize the classical symptoms and signs of Type 1 diabetes, such as polyuria, polydipsia, and weight loss. Many of those symptoms could be attributed to other, commoner illnesses, delaying diagnosis, and resulting in a late presentation. Studies from developing countries observed that renal failure, shock, sepsis, and cerebral edema are the major risk factors for mortality (2). Considering the scarcity of studies from India, a prospective cohort study was planned to evaluate the clinical profile and electrolytes in children with DKA.

METHODS

This hospital based prospective cohort study was conducted on 60 consecutive children with DKA admitted to pediatric intensive care unit (PICU) of a tertiary care center teaching facility between November 2021 and October 2022. Ethical approval was obtained from the institute ethics committee. The objectives of the study were to evaluate the clinical profile, blood gas and electrolyte up to 48 hours of admission and its association with duration of insulin infusion, duration of hospital stay and mortality. Children who were partially treated for the same elsewhere were excluded from the study. After obtaining parental consent, all the children were subjected to clinical history including the details of pre-existing diabetes and its control, physical examination, and evaluation of precipitating factors. Serum electrolyte, renal function test, blood gas, blood glucose and urine ketone levels were estimated at the time of admission and then subsequently at 4 hr,12 hr, 24 hr, 36 hr and 48 hr. DKA was categorized as mild (venous pH <7.30; bicarbonate <15 mmol/L), moderate (pH 7.2; bicarbonate <10 mmol/L), and severe (pH: <7.1; bicarbonate: <5 mmol/L).

IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, N.Y., USA) was used for the analysis. Proportions were compared using Chi-square test while mean values were compared using Independent 't' test. The confidence limit of the study was kept at 95% hence a “p” value less than 0.05 was considered statistically significant.

RESULTS

The mean (SD) age of the study population was 8 (3.9) yr (range, 0.7–13 yr). Most patients (N=42; 70%) were above 5 years of age, while there were only 4 patients (6%) less than 1 year of age. There were 32 males (53%) which was slightly more than 28 females (47%). Most patients (34 cases; 57%) had pre-existing diabetes, whereas 26 (43%) cases were diagnosed at admission. Clinical features and laboratory parameters at admission are shown in table 1.

Table 1: Clinical manifestations

Clinical signs	Number (percentage) N=60
Polyuria	40 (67)
Anorexia	30 (50)
Acidotic breathing	40 (67)
Seizures	3 (5)
Hypotension	12 (20)
CNS	
• Normal	20 (33)
• Irritable	7 (11)
• Drowsiness	18 (30)
• Unconsciousness	15 (25)

Table 2: Laboratory parameters at admission and at 48 hours of treatment

Sl. No.	Parameters	At admission	At 48 hours
1.	Serum electrolytes, Number (percentage)		
	• Hypokalemia	14 (23)	9 (15)
	• Hyperkalemia	19 (31)	0
	• Hyponatremia	18 (30)	0
	• Hypernatremia	9 (15)	4 (7)
	• Hypocalcemia	48 (80)	0
	• Hyperchloremia	10 (16)	4 (7)
3.	Blood glucose (mg/dl), mean (SD)	427 (37)	172 (37)
4.	Urine ketone, median	4+	Nil

28% (N=17) of children recovered within 12 hours of insulin infusion, another 33% children needed infusion up to 24 hours, still 18 patients (30%) took infusion up to 48 hours, and only 5 children (9%) required insulin infusion beyond 48 hours. 87% (N=52) of patients were discharged, while 8 children (13%) succumbed to the illness. Most patients (40%) stayed in the hospital between 1 and 2 weeks. 17% stayed beyond 2 weeks. 6 children (10%) stayed less than 3 days, whereas the remaining 20 children (33%) stayed less than a week.

Duration of insulin infusion was more in patients with abnormal electrolytes at 24 hours. The median duration (inter-quartile range) of insulin infusion required for the abnormal electrolytes group was 25 (IQR 17-35) hours and normal electrolytes group was 4 (IQR 3-6.5) hours. This difference was statistically significant (p<0.001) (figure 1). Similarly, duration of hospital stay was more in patients with abnormal electrolytes at 24 hours. The median (inter-quartile range) duration of stay for the abnormal electrolytes group was 12 (IQR 5-15) days and

for normal electrolytes group was 6 (IQR 4.5-11.5) days and the difference was statistically significant (p=0.034) (figure 2).

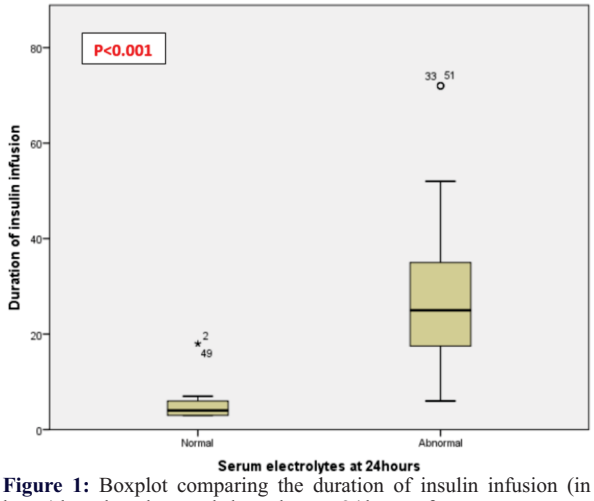

Figure 1: Boxplot comparing the duration of insulin infusion (in hours) based on abnormal electrolytes at 24 hours of treatment.

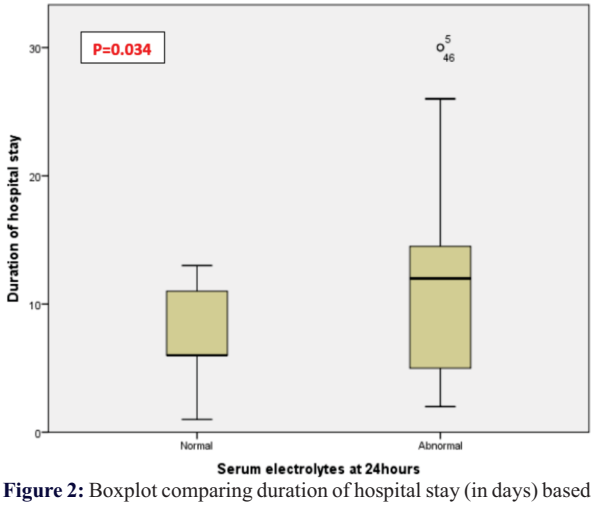

Figure 2: Boxplot comparing duration of hospital stay (in days) based on abnormal electrolytes at 24 hours of treatment.

DISCUSSION

DKA accounts for nearly 0.6% of total intensive care admissions in PICU (3). DKA admissions in PICU are increasing not only because of increasing prevalence of T1DM but they are often missed due to inherent difficulties in diagnosing diabetes mellitus for the first time in children. The classical history of diabetes is generally unavailable in children leading to more chance of missed diagnosis and ultimately ending up in DKA. Lack of awareness regarding signs and symptoms of T1DM among the general population and primary care physicians contributes to T1DM complicating as DKA.

Ideal management of sodium and fluid balance during DKA treatment in children has been a subject of controversy (4,5). Pediatric DKA protocols frequently recommend monitoring trends in sodium concentrations and adjusting intravenous fluids to maintain an upward trend in the measured serum sodium concentration as the blood glucose level decreases, thereby preventing declines in the glucose-corrected sodium concentration and associated reductions in osmolality.

The mean (SD) age of the study population was 8 (3.9) yr (range, 0.7–13 yr). This was like another study from north India (6). Most patients (34 cases; 57%) had pre-existing diabetes, whereas 26 (43%) cases were diagnosed at admission. In that same study, two thirds of children with diabetic ketoacidosis had new-onset diabetes, and 13.2% died (6). Clinical manifestations were polyuria (67%), anorexia (50%), acidotic breathing (67%) and hypotension (20%). Respiratory distress and vomiting were less common than reported in other South Asian children (7). The mortality despite good care was similar (13%) to that reported in available literature (8). A study from India reported hypernatremia in 20%, hypokalemia in 10.9% and hyperkalemia in 27.3% at admission (9) like the current study. While another study from India reported hypokalemia in 60% of children at admission (6). Abnormal electrolytes at 24 hours of admission were significantly associated with prolonged duration of hospital stay as well as increased duration of insulin infusion requirement.

This study further highlights the need for increasing awareness of the problem among the general population and general care physicians. The limitations of the presented study are that it is a small observational study. As our centre is a tertiary care centre for treating children, it is difficult to comment on the incidence of DKA in the country. A central registry along with prospective studies conducted countrywide, would provide the true figures of prevalence of type-1 diabetes and the frequency of DKA.

CONCLUSIONS

Duration of insulin infusion for the treatment of DKA was more in patients with abnormal electrolytes at 24 hours. Abnormal electrolytes at 24 hours was associated with longer duration insulin infusion and hospital stay.

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