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Student's Section

A retrospective case study of clinical profile of hospitalized children with type 1 diabetes mellitus at a tertiary health care center in northern India

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ABSTRACT

Background: Type 1 diabetes mellitus (T1DM) mostly presents as diabetic ketoacidosis (DKA) and is a common pediatric endocrine emergency. There is dearth of literature on clinical profile of T1DM from North India.

Objectives: 1. To identify the clinical profile of patients admitted with T1DM at a tertiary care hospital. 2. To assess the predictors of adverse outcome in patients with T1DM.

Methods: A retrospective case series. Clinical and laboratory data were analyzed from hospital records of all patients with confirmed diagnosis of T1DM using standard guidelines admitted in Department of Pediatrics, King George's Medical University, Hospital, Lucknow, from January 2010 to October 2012. Adverse outcome was defined as death or refusal for treatment.

Results: In this duration of 34-month 40 patients were admitted. There were 22 (55%) females, 24 (60%) were <10 years of age (mean age 8.12 years $\pm$ 3.7), 32 (80%) of rural origin, 21 (52.5%) presented in winter season and majority of patients 32 (80%) were diagnosed in the current hospitalization. Symptoms observed were fever in 18 (45%), polyuria/polydipsia in 26 (65%), vomiting in 22 (55%), respiratory distress in 31 (77.5%) and altered sensorium in 22 (55%). History of abdominal pain and weight loss in 11 (27.5%), sluggishness in 7 (17.5%), diarrhea and seizure in 4 (10%) and visual problem in 3 (7.5%). Family history of T1DM was present in 2 (5%) patients. Acidotic breathing, dehydration and features of shock were seen in 33 (82.5%), 31 (77.5%) and 11 (28%) respectively. DKA was present in 37 (92.5%), of which 24/37 (64.9%) had severe DKA. All DKA patients received oxygen, IV fluid, insulin infusion by using standard guidelines. Adverse outcome was seen in 7 (17.5%) patients. Statistically significant clinical features and laboratory parameters associated with adverse outcome were fever (OR = 10.50; 95% CI = 1.12–97.9; p = 0.017), polyuria/polydipsia (OR = 6.66; 95% CI = 1.09–40.73; p = 0.026), capillary refill time >3 s (OR = 33.6; 95% CI = 3.29–342.2; p < 0.000), raised serum creatinine (p = 0.011) and leukocytosis (OR = 10.93; 95% CI = 2.16–55.24; p = 0.003) and use of vasopressors (OR = 93.0; 95% CI = 7.2–196.69; p < 0.000). The mean duration of hospital stay was 8.6 days $\pm$ 5.6.

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Conclusion: Most of patients admitted here were newly diagnosed and majority presented with DKA. Adverse hospital outcome was associated with fever, polyuria/polydipsia, capillary refill time >3 s, raised serum creatinine and leukocytosis. Hence attempts must be made for early diagnosis and appropriate treatment of T1DM.

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1. Introduction

Type 1 diabetes mellitus (T1DM) mostly presents as diabetic ketoacidosis (DKA) and is a common pediatric endocrine emergency. T1DM is a state of absolute or relative insulin deficiency aggravated by ensuing hyperglycemia, dehydration and acidosis-producing derangements in the intermediary metabolism. About 25–40% of the newly diagnosed T1DM children present with DKA whereas the risk of developing DKA in established T1DM children is 1–8% per patient per year.¹ The mortality rate for DKA in children in the developed countries has declined to 0.15%–0.31%.^{2,3} However, in places with less developed medical facilities, the risk of death from DKA is greater, and children may die before receiving appropriate treatment. There are few studies available from India that has looked at the clinical profile and outcomes of DKA in the pediatric age group. In order to improve existing management protocols for DKA in children, it is first important for physicians to be aware the clinical profile of T1DM in children and to be cognizant of the current trends in outcomes resulting from this condition. This report describes our 34-month experience of clinical profile and outcomes in patients of T1DM in a pediatric population at a tertiary care hospital in Lucknow, India.

2. Methods

This was a retrospective study of children admitted with T1DM between January 2010 to October 2012 in the Department of Pediatrics of King George's Medical University, Lucknow, India. This is a tertiary care teaching hospital. We abstracted the information from hospital records, keeping the identity of the patients anonymous. Information such as demographics, presenting symptoms and signs at admission, precipitating factors like intercurrent illnesses, investigations including hemoglobin, total leukocyte counts, serum electrolytes, blood urea, serum creatinine, and arterial blood gases was noted. Data was also abstracted on serial venous blood sugar as well as treatment given and outcome of patients during hospitalization.

DKA was defined as presence of hyperglycemia (blood glucose >200 mg/dL) with a venous pH < 7.3 and/or bicarbonate <15 mmol/L with associated glycosuria, ketonuria, and ketonemia.⁴ 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).⁴ Hypernatremia and hyponatremia was defined as value >145 mmol/L and <135 mmol/L respectively.⁵ Similarly hyperkalemia and hypokalemia was defined as value >5.5 mmol/L and <3.5 mmol/L respectively.⁵ Leukocytosis

was defined as total leukocyte count >11000/cu mm.⁶ Adverse outcome was defined as death or refusal for treatment.

Data was entered in Microsoft excel and analyzed using SPSS version 16.0. In the descriptive analysis, the mean, standard deviations and percentages were computed. Associations were evaluated using chi-square test or Fisher's exact test. Odd's ratios were calculated for associations with a 95% confidence interval. A *p*-value of <0.05 was considered statistically significant, unless otherwise specified. All ethical considerations were ensured throughout the study.

3. Results

A total of 40 children were admitted during the period of 34 months. All the patients received appropriate management using standard guidelines.⁷ It was observed that females were 22 (55%), 24 (60%) were <10 years of age and 32 (80%) were of rural background. At the time of presentation mean age was 8.12 years ± 3.7. In winter months (November, December, January) there were 21 (52.5%) admission while 5 (12.5%) were in spring (February, March, April), 11 (27.5%) were in summer (May, June, July) and 3 (7.5%) were in autumn season (August, September, October). Newly diagnosed T1DM accounted for 32 (80%) cases whereas 8 (20%) cases previously diagnosed. Among the 40 admitted patients 33 (82.5%) improved and were discharged. Adverse outcome was seen in 7 (17.5%) patients, of which 5 (12.5%) died and 2 (5%) left against medical advice in very low general condition.

Table 1 shows clinical profile of all patients at admission as well as comparison between those with good versus adverse outcome. Statistically significant clinical characteristics associated with adverse outcome were fever (OR = 10.50; 95% CI = 1.12–97.91; *p* = 0.032), polydipsia/polyuria (OR = 6.66; 95% CI = 1.09–40.73; *p* = 0.039) and capillary refill time >3 s (OR = 33.6; 95% CI = 3.29–342.27; *p* < 0.000).

DKA was most common presentation of all hospitalized patients. It was seen in 37 (92.5%) patients. Among these 4/37 (10.8%) were mild DKA, 9/37 (24.3%) were moderate DKA and 24 (64.8%) fell into severe DKA.

Table 2 shows laboratory parameters of all patients at presentation as well as comparison between those with good versus adverse outcome. The statistically significant investigation parameters for adverse outcome were raised serum creatinine levels (*p* = 0.011) and leukocytosis (OR = 10.93; 95% CI = 2.16–55.24; *p* = 0.003).

For the management of all admitted patients of T1DM, we followed standard guidelines.⁷ Intravenous fluid, oxygen inhalation and insulin infusion was required in 35 (87.5%), 34 (85%) and 35 (87.5%) patients respectively. Vasopressors and

Table 1 – Clinical characteristics of patients (N = 40) with T1DM at admission as well as comparison between those with good versus adverse outcome.

Clinical characteristics	Total (N = 40) n (%)	Good outcome (N = 33) n (%)	Bad outcome (N = 7) n (%)	p-Value
Fever	18 (45%)	12 (36.4%)	6 (85.7%)	0.032
Polydipsia/polyuria	26 (65%)	24 (72.7%)	2 (28.6%)	0.039
Diarrhea	4 (10%)	2 (6.06%)	2 (28.6%)	0.134
Abdominal pain	11 (27.5%)	10 (30.3%)	1 (14.3%)	0.649
Vomiting	22 (55%)	16 (48.5%)	6 (85.7%)	0.104
Weight loss	11 (27.5%)	9 (27.3%)	2 (28.7%)	1.000
Abscess or boils	1 (2.5%)	1 (3.03%)	0 (00.00%)	1.000
Sluggishness	7 (17.5%)	5 (15.2%)	2 (28.6%)	0.584
Respiratory distress	31 (77.5%)	26 (78.8%)	5 (71.4%)	0.644
Altered sensorium	22 (55%)	16 (48.5%)	6 (85.7%)	0.104
Seizure	4 (10%)	2 (6.06%)	2 (28.6%)	0.134
Visual disturbances	3 (7.5%)	2 (6.06%)	1 (4.34%)	0.447
Diagnosed first time	32 (80%)	26 (78.8%)	6 (85.7%)	1.000
Family history of T1DM	2 (5%)	2 (6.06%)	0 (00.00%)	1.000
Capillary refill time >3 s	11 (27.5%)	5 (15.2%)	6 (85.7%)	0.000
Dehydration	33 (82.5%)	26 (78.8%)	7 (100%)	0.316
Abnormal respiratory pattern (acidotic, gasping)	34 (85%)	27 (81.8%)	7 (100%)	0.567
DKA	37 (92.5%)	30 (90.9%)	7 (100%)	1.000

Abbreviations: T1DM = Type 1 Diabetes Mellitus, N = Numbers, DKA = Diabetic Ketoacidosis.

antibiotics was required in 8 (20%) and 36 (90%) patients respectively.

Response to treatment of patients is given in Table 3. Statistically significant association was seen with vasopressors support (OR = 93; 95% CI = 7.2–196.69; $p < 0.000$) in adversely affected children. Duration of hospital stay ($p = 0.022$) was statistically significant less in patients with adverse outcome.

4. Discussion

In this retrospective case series we evaluated the clinical profile and outcome of 40 children of T1DM hospitalized in a tertiary care teaching hospital in India.

In this study fever was seen in 45% and altered sensorium in 55% patients. Our finding is similar to that reported from

Table 2 – Laboratory investigations of patients with T1DM at admission (N = 40) as well as comparison between those with good versus adverse outcome.

Continuous variables	Total (N = 40) mean $\pm$ SD	Good outcome (N = 33) mean $\pm$ SD	Bad outcome (N = 7) mean $\pm$ SD	p-Value
Blood sugar (mg/dL)	459.22 $\pm$ 79.8	441.24 $\pm$ 75.9	501.12 $\pm$ 81.5	0.560
pH	7.07 $\pm$ 0.18	7.09 $\pm$ 0.17	6.97 $\pm$ 0.18	0.606
Pco ₂ (mm Hg)	17.5 $\pm$ 7.8	17.94 $\pm$ 8.03	15.57 $\pm$ 6.70	0.099
HCO ₃ (mmol/L)	9.1 $\pm$ 5.8	9.71 $\pm$ 5.93	6.29 $\pm$ 4.64	0.161
Lactate (mmol/L)	2.28 $\pm$ 0.94	2.02 $\pm$ 0.87	2.59 $\pm$ 0.99	0.121
Serum Na ⁺ (mmol/L)	133.4 $\pm$ 9.5	132.88 $\pm$ 7.96	135.57 $\pm$ 15.38	0.501
Serum K ⁺ (mmol/L)	4.02 $\pm$ 0.95	4.1 $\pm$ 1.02	3.6 $\pm$ 0.45	0.226
Serum urea (mg/dL)	42.28 $\pm$ 18.6	40.97 $\pm$ 12.06	48.43 $\pm$ 37.7	0.342
Serum creatinine (mg/dL)	0.96 $\pm$ 0.51	0.88 $\pm$ 0.31	1.40 $\pm$ 0.956	0.011
Hemoglobin (g/dL)	10.6 $\pm$ 2.3	11.4 $\pm$ 2.6	9.8 $\pm$ 2.5	0.187
Total leukocyte counts	11,594.25 $\pm$ 8832	10,678.76 $\pm$ 7697	18,034.65 $\pm$ 10,466	0.345
Categorical variables	Total (N = 40) n (%)	Good outcome (N = 33) n (%)	Bad outcome (N = 7) n (%)	p-Value
Hypernatremia (S. Na ⁺ > 145 mmol/L)	4 (10%)	1 (3.03%)	3 (42.8%)	0.060
Hyponatremia (S. Na ⁺ < 135 mmol/L)	20 (50%)	14 (42.4%)	6 (85.7%)	0.700
Hyperkalemia (S. K ⁺ > 5.5 mmol/L)	16 (40%)	10 (30.3%)	6 (85.7%)	0.635
Hypokalemia (S. K ⁺ < 3.5 mmol/L)	4 (10%)	2 (6.06%)	2 (28.6%)	0.578
Leukocytosis (TLC > 11,000/mm ³)	11 (27.5%)	4 (12.12%)	7 (100%)	0.003

Abbreviations: T1DM = Type 1 Diabetes mellitus, N = Numbers, SD = Standard Deviation, Pco₂ = Partial pressure of carbon dioxide, HCO₃ = Bicarbonate, S. Na⁺ = Serum Sodium, S. K⁺ = Serum Potassium, TLC = Total leucocyte count.

Table 3 – Response to treatment and length of hospital stay according to outcome.

Treatment parameters	Total (N = 40) mean $\pm$ SD	Good outcome (N = 33) mean $\pm$ SD	Bad outcome (N = 7) mean $\pm$ SD	p-Value
Duration for correction of ketoacidosis in hours	24.8 $\pm$ 2.8	20.7 $\pm$ 1.9	29.87 $\pm$ 3.7	0.780
Duration of time to attain venous blood glucose to <250 mg/dL in hours	9.7 $\pm$ 8.1	8.5 $\pm$ 7.7	11.7 $\pm$ 9.8	0.340
Duration of hospital stay in days	8.6 $\pm$ 5.58	9.52 $\pm$ 5.39	4.29 $\pm$ 4.61	0.022

Abbreviations: SD = Standard Deviation, N = Numbers.

Delhi where fever was seen in 40% and altered sensorium in 50.9%.⁸ Since almost half of the patients of T1DM present with fever and altered sensorium, this can result in their being misdiagnosed as acute infection of central nervous system (CNS). This can delay initiation of appropriate management of T1DM. We also found respiratory distress to be a common presenting symptom in 77.5% cases. Hence clinical presentation patients of T1DM can also be confused with the acute respiratory tract infection. Therefore in patients with suspected acute infections of either CNS or respiratory tract, bedside blood glucose levels must be monitored on admission to identify T1DM early and thus prevent potentially fatal complication like DKA.

Classical symptom of T1DM like polydipsia/polyuria were present in 65% cases here which was slightly higher than 54.5% reported from Delhi.⁸ Unlike findings from Northern India a study done in Saudi Arabia reported that 96% of cases there had polyuria/polydipsia.⁹ Similarly classical symptom like loss of weight was seen in 27.5% in the study which was considerably lower than 76.6% reported from Saudi Arabia (76.6%).⁹

In our study majority (92.5%) of patients of T1DM presented with features of DKA. Unlike our findings only 41.9% patients were admitted with DKA in China.¹⁰ Majority of patients 32 (80%) in our study were diagnosed for first time as T1DM and possibly a delay in diagnosis may have led to development of DKA. Hence delayed diagnosis of patients being admitted in our hospital may be the most likely cause of their progressing on to DKA. Further multi-site, multi-country research is needed to access if there is a true site-to-site variation in presentation in T1DM.

Intercurrent infection is one of the most important precipitating factors for DKA.⁷ We found possible intercurrent infection in 45% who presented with fever. Fever was also found to be associated with adverse outcome (OR = 10.50; 95% CI = 1.12–97.91; p = 0.032). Hence physician must have a high index of suspicion for precipitating infection in patients of T1DM with DKA and treat it appropriately and early.

Strength of the study is that this study is probably one of the first few studies being reported from India to assess the clinical profile and associates of adverse outcome of T1DM in hospitalized patients. Also in our setup standard management protocol is followed. Limitations of this study are that the sample size is relatively small as the incidence of T1DM in this region is less.⁷ In Pakistan the incidence of T1DM is 0.7/100,000 per year as compared to 40/100,000 per year in Finland.⁷ Also very few patients with T1DM reach our center as they are

often misdiagnosed due to overlapping of clinical picture with acute encephalopathy and acute respiratory illnesses. This study has an inherent weakness of a retrospective study, so there could be measurement bias and issues of quality control of diagnostic tests. Such types of studies are also needed from other parts of India so that the actual clinical presentation and trend of T1DM in children in India is understood. Also there is a need for large global multi-centric prospective studies to find out the clinical profile and associates of adverse outcome of children with T1DM.

5. Conclusion

Most of the patients of T1DM admitted here were newly diagnosed and majority presented with DKA. Adverse hospital outcome were seen in about one-fifth patients and associated with fever, polyuria/polydipsia, capillary refill time >3 s, raised serum creatinine and leukocytosis. Hence attempts must be made for early diagnosis and appropriate treatment of T1DM.

Conflicts of interest

All authors have none to declare.

REFERENCES

1. Faich G, Fishbein H, Ellis E. The epidemiology of diabetic acidosis: a population-based study. *Am J Epidemiol.* 1983;117:551–558.
2. Curtis JR, To T, Muirhead S, Cummings E, Daneman D. Recent trends in hospitalization for diabetic ketoacidosis in Ontario children. *Diabetes Care.* 2002;25:1591–1596.
3. Edge JA, Ford-Adams ME, Dunger DB. Causes of death in children with insulin dependent diabetes 1990–96. *Arch Dis Child.* 1999;81:318–323.
4. Dunger DB, Sperling MA, Acerini CL. ESPE/LWPES consensus statement on diabetic ketoacidosis in children and adolescents. *Arch Dis Child.* 2004;89:188–194.
5. Greenbaum LA. Electrolyte and acid-base disorders. In: Kliegman, Stanton, St. Geme, Schor, Behrman, eds. *Nelson Textbook of Pediatrics.* 19th ed. Philadelphia: Elsevier Saunders; 2012:212–224.
6. Pesce MA. Reference range for laboratory tests and procedures. In: Kliegman, Behrman, Jenson, Stanton, eds. *Nelson Textbook of Pediatrics.* 18th ed. Philadelphia: Elsevier Saunders; 2012:2943–2949.

7. Alemzadeh R, Ali O. Diabetes mellitus. In: Kliegman, Stanton, St. Geme, Schor, Behrman, eds. *Nelson Textbook of Pediatrics*. 19th ed. Philadelphia: Elsevier Saunders; 2012:1968–1997.
8. Kanwal SK, Bando A, Kumar V. Clinical profile of diabetic ketoacidosis in Indian children. *Indian J Pediatr*. 2012;79: 901–904.
9. Al-Magamsi MS, Habib HS. Clinical presentation of childhood type1 diabetes mellitus in the Al-Madina region of Saudi Arabia. *Pediatr Diabetes*. 2004;5:95–98.
10. Xin Y, Yang M, Chen XJ, et al. Clinical features at the onset of childhood type 1 diabetes mellitus in Shenyang, China. *J Pediatr Child Health*. 2010;46:171–175.