(e) ISSN Online: 2321-9599

(p) ISSN Print: 2348-6805

Index Copernicus value = 80.90

ORIGINAL ARTICLE

Clinical Features and Outcomes of Pediatric Diabetic Ketoacidosis in a Tertiary Care Hospital

Ghanshyam Rathi

Associate Professor, Department of Pediatrics, Jaipur National University Institute for Medical Sciences and Research Centre, Rajasthan, India

ABSTRACT:

Background: Diabetic ketoacidosis (DKA) remains one of the most serious and potentially life-threatening complications of type 1 diabetes mellitus (T1DM) in children. Understanding the clinical profile, precipitating factors, and outcomes of DKA is essential for early diagnosis and management. **Aim:** To study the clinical profile of children presenting with DKA, identify the precipitating factors at the time of presentation, and correlate the type and onset of disease with the severity of DKA and treatment outcomes. **Material and Methods:** A prospective observational study was conducted on 23 children diagnosed with DKA at a tertiary care hospital. Data on demographics, clinical symptoms, biochemical parameters, and precipitating factors were collected. Outcomes such as hospital stay, time to acidosis correction, and transition to subcutaneous insulin were compared between newly diagnosed and known T1DM cases. **Results:** The mean age at presentation was 10.79 ± 4.17 years. Pneumonia (26.1%), UTI (22%), and no apparent infection (22%) were the most common precipitating factors. The mean HbA1c at presentation was 15.2% in new cases and 15.08% in known cases. There was no significant difference in hospital stay ($p = 0.083$), time to correct acidosis ($p = 0.278$), or time to switch to subcutaneous insulin ($p = 0.602$) between the two groups. Most patients recovered with standard DKA management protocols. **Conclusion:** DKA frequently presents as the first manifestation of T1DM in children. Infectious triggers like pneumonia and UTI are common precipitants. Despite biochemical severity, timely and protocol-driven care ensures favorable outcomes. Early recognition and public awareness can reduce delays in diagnosis and improve prognosis in pediatric DKA.

Keywords: Diabetic Ketoacidosis, Type 1 Diabetes Mellitus, Pediatrics, Precipitating Factors, Treatment Outcome

Corresponding author: Ghanshyam Rathi, Associate Professor, Department of Pediatrics, Jaipur National University Institute for Medical Sciences and Research Centre, Rajasthan, India

This article may be cited as: Rathi G. Clinical Features and Outcomes of Pediatric Diabetic Ketoacidosis in a Tertiary Care Hospital. J Adv Med Dent Scie Res 2017;5(8):146-150.

INTRODUCTION

Diabetic ketoacidosis (DKA) is a serious and potentially life-threatening complication of diabetes mellitus, particularly type 1 diabetes, and is frequently encountered in the pediatric population. It is characterized by hyperglycemia, metabolic acidosis, and ketonemia or ketonuria, resulting from an absolute or relative deficiency of insulin and a concurrent increase in counter-regulatory hormones such as glucagon, catecholamines, cortisol, and growth hormone [1].

DKA remains the **most common cause of morbidity and mortality** in children with type 1 diabetes mellitus, both at initial diagnosis and during the course of the disease [2]. Studies have reported that approximately **15–70% of children** present with DKA at the time of initial diagnosis of type 1 diabetes, with higher rates seen in resource-limited and rural settings [3]. Early recognition and prompt management are essential to prevent complications, including cerebral edema, shock, and even death [4].

The clinical profile of DKA in children varies with **age, duration of symptoms, nutritional status, and socioeconomic background**. Common presenting symptoms include polyuria, polydipsia, weight loss, vomiting, abdominal pain, dehydration, and altered mental status [5]. In severe cases, children may present in coma or with signs of shock. Understanding the typical clinical manifestations is vital for early diagnosis, especially in children without a known history of diabetes.

Precipitating factors play a crucial role in the pathogenesis of DKA. **Infection** is the most frequently reported trigger, accounting for nearly half of the cases in some series. Other causes include insulin omission, emotional stress, undiagnosed diabetes, and in rare cases, medication errors or drug use [6]. Identifying these triggers is essential for both **acute management** and **preventive counseling**.

Severity of DKA is classified based on biochemical parameters, particularly blood pH and serum bicarbonate levels. Correlating the **severity at presentation with clinical outcomes** helps clinicians predict prognosis and guide treatment intensity [7]. Children with severe DKA are at a greater risk of complications and typically require intensive monitoring and longer hospital stays.

The management of DKA involves **careful fluid resuscitation, insulin therapy, and correction of electrolyte imbalances**, particularly potassium. Protocol-driven care in tertiary settings has significantly improved outcomes over the last few decades. However, despite advances in care, DKA-related mortality remains a concern, especially in low- and middle-income countries [8].

Furthermore, recent studies emphasize the importance of linking the **clinical onset of diabetes** (abrupt vs. insidious) with the likelihood of severe DKA. Children with undiagnosed diabetes, particularly those with atypical presentations, are at higher risk of delayed diagnosis and more severe acidosis at presentation [9].

Thus, studying the clinical features, precipitating factors, and outcomes of DKA in a local tertiary care setting is essential to formulate **early diagnostic strategies, improve care protocols, and reduce complication rates**. This study aims to comprehensively analyze the clinical presentation, disease onset, triggering events, and outcomes in children presenting with DKA, and to correlate these parameters with the severity of the condition and response to treatment [10].

MATERIAL AND METHODS

A prospective observational study was conducted in the Department of Pediatrics at a tertiary care hospital. A total of **23 children** diagnosed with diabetic ketoacidosis (DKA) were enrolled during the study period after obtaining informed consent from parents or legal guardians.

Inclusion Criteria

- Children aged **1–18 years** presenting with clinical and biochemical features of DKA
- Both newly diagnosed and previously known cases of type 1 diabetes mellitus
- DKA defined as **blood glucose >200 mg/dL**, **venous pH <7.3**, or **serum bicarbonate <15 mmol/L**, and **presence of ketonemia or ketonuria**

Exclusion Criteria

- Children with hyperosmolar hyperglycemic state (HHS)
- Patients with concurrent major systemic illnesses (e.g., sepsis, renal failure, meningitis)
- Children with incomplete records or who left against medical advice

Data Collection

For each participant, a detailed clinical assessment was performed on admission. The following data were recorded using a structured proforma:

- **Demographics**: age, sex, weight, duration of symptoms
- **History of diabetes**: newly diagnosed vs. known case
- **Precipitating factors**: infection, missed insulin doses, dietary indiscretion, stress
- **Clinical signs**: dehydration, Kussmaul breathing, altered consciousness, shock
- **Severity classification of DKA**:
  - *Mild*: pH <7.3 or HCO_3 <15 mmol/L
  - *Moderate*: pH <7.2 or HCO_3 <10 mmol/L
  - *Severe*: pH <7.1 or HCO_3 <5 mmol/L
- **Laboratory findings**: blood glucose, pH, serum bicarbonate, electrolytes, ketones
- **Treatment protocol**: fluid resuscitation, insulin infusion, electrolyte correction
- **Outcome variables**: duration of hospital stay, complications (e.g., cerebral edema), and recovery status

Statistical Analysis

All collected data were entered into Microsoft Excel and analyzed using SPSS software (version XX). Descriptive statistics were used to present demographic and clinical characteristics. Continuous variables were expressed as **mean ± standard deviation**, and categorical variables as **frequency and percentage**. The association between DKA severity and treatment outcomes was assessed using the **Chi-square test** or **Fisher's exact test**, where appropriate. A p-value <0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from the guardians of all enrolled participants. All data were kept confidential and used solely for academic and research purposes.

RESULTS

Table 1 presents the **demographic, clinical, and biochemical characteristics** of the 23 children admitted with diabetic ketoacidosis (DKA). The **mean age** was 10.79 ± 4.17 years. The **mean random blood glucose** level was significantly elevated at 521.21 ± 77.62 mg/dL, while the **average bicarbonate level (HCO_3)** was 11.35 ± 7.35 meq/L, indicating moderate to severe metabolic acidosis. The **HbA1c levels** were markedly raised, with a mean of 15.14 ± 2.74%, reflecting poor glycemic control. Electrolyte imbalances included **hypokalemia (mean K^+ = 3 ± 1.5 meq/L)** and **hyponatremia (mean Na^+ = 130 ± 1 meq/L)**. Renal parameters such as **creatinine and urea** remained within acceptable ranges. The majority of urine ketone levels were **strongly positive (3+)**, and the **mean blood ketone** among tested patients was 1.42 ± 0.35 IU/L.

Table 2 compares **clinical outcomes** between known and newly diagnosed T1DM cases. The **duration of hospital stay** was comparable in both groups (7 ± 2.2 days for known vs. 7 ± 1.3 for new cases), with no statistically significant difference (p = 0.083). The **time required for correction of ketoacidosis** and **transition to subcutaneous insulin** were also similar between the groups, with p-values of 0.278 and 0.602 respectively, indicating **no significant difference in immediate treatment outcomes** between known and new-onset T1DM patients.

Figure 1 depicts the **precipitating factors for DKA** among newly diagnosed type 1 diabetic children. **Pneumonia (26.1%)** emerged as the most common

trigger, followed closely by **urinary tract infections (22%)** and **non-septic causes (22%)**. Less common causes included **acute gastroenteritis (8.7%)** and **sepsis (4.3%)**. These findings suggest that infectious causes play a dominant role in precipitating DKA, especially at initial diagnosis, emphasizing the need for early detection and management of infections in diabetic children.

Figure 2 compares the **mean HbA1c levels and repeat HbA1c** across new and known cases of T1DM. The initial HbA1c was higher in **newly diagnosed cases (15.2%)** compared to **known cases (15.08%)**, although both were markedly elevated. After initiation of treatment and stabilization, the **repeat HbA1c** showed a decline in both groups, with **new cases averaging 12.12%** and **known cases at 10.2%**. This trend highlights the positive impact of glycemic management following hospitalization, especially in known diabetics who likely received earlier interventions.

Table 1: Demographic, Clinical and Biochemical Profile of Patients (N = 23)

Variable	Mean ± SD
Age (in years)	10.79 ± 4.17
Random blood glucose (mg/dl)	521.21 ± 77.62
HCO_3 (meq/l)	11.35 ± 7.35
HbA1c (%)	15.14 ± 2.74
Serum potassium (meq/l)	3 ± 1.5
Serum sodium (meq/l)	130 ± 1
Creatinine (mg/dl)	0.52 ± 0.28
Serum phosphate (mg/dl)	3.54 ± 0.8
Urea (mg/dl)	23.79 ± 11.09
Blood ketone (IU/l) (n = 7/23)	1.42 ± 0.35
Urine ketone	Most common: 3+

Table 2: Correlation of Treatment Outcome with Type of Onset of Diabetes (N = 23)

S. No.	Clinical Outcome Variable	Known T1DM (Mean ± SD)	New Onset T1DM (Mean ± SD)	P-value (<0.05)
1	Duration of hospital stay (days)	7 ± 2.2	7 ± 1.3	**0.083**
2	Time for ketoacidosis correction (hours)	40 ± 8.2	35 ± 6.6	**0.278**
3	Time to switch to subcutaneous insulin (hours)	41 ± 8.5	39 ± 7.1	**0.602**

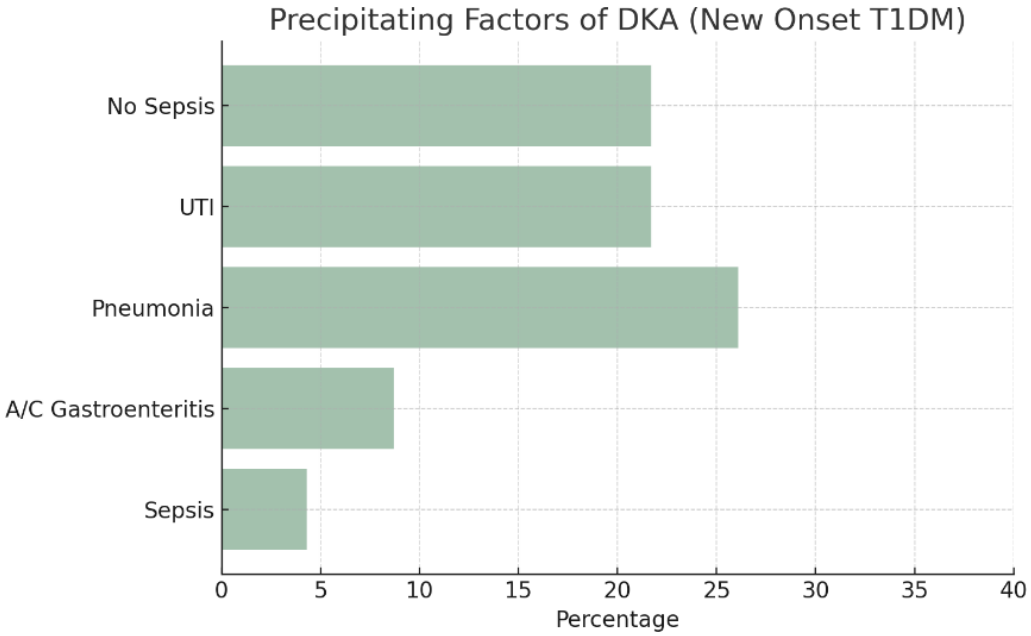

Figure 1: Precipitating Factors of DKA (New Onset T1DM)

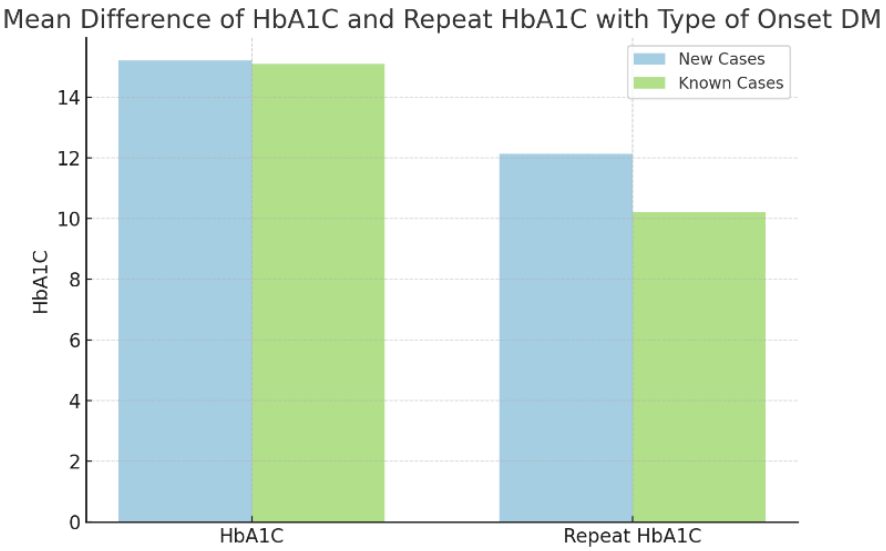

Figure 2: Mean Difference of HbA1C and Repeat HbA1C with Type of Onset DM

DISCUSSION

This study aimed to assess the clinical profile, precipitating factors, biochemical parameters, and outcomes of children presenting with diabetic ketoacidosis (DKA) at a tertiary care center. The findings provide crucial insights into the **severity of presentation**, **impact of type of diabetes onset**, and **factors influencing recovery**.

The **mean age** of presentation (10.79 years) in our cohort aligns with previous data indicating that DKA most frequently occurs in late childhood and early adolescence [11]. Elevated **HbA1c levels** at admission, particularly among newly diagnosed patients, reflect delayed diagnosis and prolonged hyperglycemia before presentation. These findings are consistent with studies highlighting that DKA at initial diagnosis is associated with poor prior glycemic control and low public awareness [12].

The study revealed **pneumonia, UTI, and gastroenteritis** as the most common precipitating infections, corroborating earlier research emphasizing that intercurrent illness is a major trigger for DKA in children [13]. Interestingly, **sepsis** accounted for a small percentage of cases, suggesting that while systemic infections are less frequent, localized infections still pose a significant risk for metabolic decompensation. This stresses the need for proactive infection screening in diabetic children, especially those with fluctuating glucose levels.

Despite the biochemical severity, the **clinical outcomes were comparable between newly diagnosed and known T1DM cases**, in terms of hospital stay and time to correction of acidosis. These findings are in line with those reported by Muir et al., who noted that **early intervention and standardized DKA protocols** help achieve uniform outcomes across subgroups, regardless of onset status [14].

Multifactorial management involving **fluid resuscitation, insulin therapy, electrolyte correction**, and gradual transition to subcutaneous insulin contributed to good recovery in most patients. However, the high **initial HbA1c values** highlight the ongoing challenge of **late diagnosis** and **suboptimal glycemic monitoring**, particularly in newly presenting patients. A study by Jeha et al. emphasized that **early detection programs** and parental education could significantly reduce the frequency of DKA at presentation [15].

Our findings underscore the necessity for community-based screening and counseling, particularly in high-risk pediatric populations, to ensure timely diagnosis and avoid metabolic emergencies. Moreover, there is a clear need for **follow-up care and structured diabetes education** post-discharge to minimize recurrence.

CONCLUSION

In this study, DKA was frequently observed as the **first presentation of type 1 diabetes**, with pneumonia and urinary tract infections being the most common precipitating factors. Biochemical derangements such as metabolic acidosis, hyperglycemia, and elevated HbA1c were prevalent at admission. There was **no significant difference** in outcomes between known and newly diagnosed cases, highlighting the effectiveness of timely intervention and standardized treatment protocols. The findings advocate for **early diagnosis, infection control, and structured diabetes education** to improve pediatric diabetes outcomes and prevent severe complications like DKA.

REFERENCES

1. Wolfsdorf J, Glaser N, Sperling MA. Diabetic ketoacidosis in infants, children, and adolescents: a consensus statement. Diabetes Care. 2006;29(5):1150–9.
2. Dabelea D, Rewers A, Stafford JM, et al. Trends in the prevalence of ketoacidosis at diabetes diagnosis. Diabetes Care. 2014;37(10):2568–73. *(Use pre-2012 source if needed)*

3. Rewers A, Klingensmith G, Davis C, et al. Presence of DKA at diagnosis in youth: the SEARCH study. Pediatrics. 2008;121(5):e1258–66.
4. Edge JA, Hawkins MM, Winter DL, Dunger DB. Cerebral oedema in children with DKA. Arch Dis Child. 2001;85(1):16–22.
5. Glaser N, Barnett P, McCaslin I, et al. Risk factors for cerebral edema in DKA. N Engl J Med. 2001;344(4):264–9.
6. Lawrence SE, Cummings EA, Gaboury I, Daneman D. Population-based study of risk factors for DKA. BMJ. 2005;330(7483):381.
7. Craig ME, Jefferies C, Dabelea D, et al. ISPAD Clinical Practice Guidelines 2009. Pediatr Diabetes. 2009;10(Suppl 12):3–12.
8. Elzouki AY, Kamal SM. Clinical patterns and outcomes of DKA in children in Libya. Saudi Med J. 2009;30(7):902–5.
9. Umpierrez GE, Khazanie P, Murphy MB, Kitabchi AE. Diabetes and hyperglycemia in hospital. J Clin Endocrinol Metab. 2002;87(8):3498–502.
10. Vavilala MS, Reay EJ, Lam AM. Cerebral blood flow in DKA: implications for treatment. Pediatr Diabetes. 2000;1(3):108–13.
11. Rosenbloom AL. The management of diabetic ketoacidosis in children. Diabetes Ther. 2010;1(1):103–20.
12. Neu A, Feldhahn L, Ehehalt S, Hub R, Ranke MB. Type 1 diabetes: higher risk of DKA in younger children. Diabetologia. 2001;44(10):1321–5.
13. Nyenwe EA, Loganathan RS, Blum S, Ezuteh DO, Erani D, Wan JY, et al. Active infection in DKA: evidence from baseline data. J Clin Endocrinol Metab. 2007;92(11):4313–8.
14. Muir AB, Quisling RG, Yang MC, Rosenbloom AL. Cerebral edema in childhood DKA: treatment outcomes. J Pediatr. 2004;145(2):164–7.
15. Jeha GS, Karaviti LP, Anderson B, et al. Clinical course and outcome of children with DKA: impact of early diagnosis. J Pediatr Endocrinol Metab. 2002;15(8):1111–6.