Original Article

Clinical Profile and In- Hospital Outcome of Diabetic Ketoacidosis in Adults

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Abstract

Background: Diabetic ketoacidosis (DKA) is a serious complication of diabetes that occurs globally, leading to elevated rates of hospital admissions, as well as increased morbidity and mortality. Consequently, it is crucial for healthcare professionals to promptly and effectively recognise and manage this condition. A triad of hyperglycemia, ketosis, and acidosis characterises DKA. Early identification of symptoms and signs of DKA is pivotal for timely treatment and improved outcomes. The objective is to study the clinical profile and in-hospital outcome of Diabetic Ketoacidosis in adults with Diabetes Mellitus. **Material and Methods:** The study was conducted on patients with Diabetic Ketoacidosis who fulfilled the inclusion criteria and were admitted to the Department of General Medicine and Critical Care at St. John's Medical College Hospital, Bangalore, over a period of 18 months. **Results:** The study included 42 patients with a mean age of 47.5 years, predominantly males (62%). Most patients (78%) had Type 2 Diabetes, and 88% were people with known diabetes. Poor medication compliance was noted in 50% of patients. Infections, especially lower respiratory tract and urinary tract infections, were the most common precipitating factors. Approximately 74% of patients required ICU admission, and 59.5% needed mechanical ventilation. The mortality rate was 4.8%, with all deceased patients having HbA1c levels >10%. Higher HbA1c levels were associated with longer hospital stays and worse outcomes. **Conclusion:** DKA remains a serious complication of diabetes with varied clinical presentations and significant morbidity. Infections are the leading precipitating factor. Poor glycemic control and non-compliance with therapy are major contributors. Prompt recognition, intensive care, and infection management are essential to reduce mortality. Elevated HbA1c correlates with poorer outcomes and longer hospital stays.

Keywords: Diabetic ketoacidosis, Diabetes Mellitus, Infection, Hospital Mortality.

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Introduction

Diabetes mellitus encompasses a group of metabolic disorders characterised by persistent hyperglycaemia, arising from insufficient insulin secretion, impaired insulin action, or a combination of both.[1]

It is considered among the 21st century's fastest-growing global health concerns. In 2021, approximately 537 million individuals were estimated to have diabetes, with projections forecasting this number to increase to 643 million by 2030 and 783 million by 2045.[2]

Diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic state (HHS) are the two most critical acute metabolic complications associated with diabetes. DKA accounts for over 500,000 hospital admissions annually.[3] With the total direct medical costs and indirect expenses reaching an estimated 2.4 billion USD per year.[2,4]

Diabetic ketoacidosis (DKA) is a serious metabolic complication of Diabetes Mellitus that notably increases the risk of illness and death. In adult patients experiencing DKA, the overall mortality rate is reported to be around 5%, particularly among the elderly and those with other severe medical conditions.[5,6] DKA can present in a wide variety, ranging from vomiting and abdominal pain to altered sensorium and coma; therefore, it is important to know the common clinical presentations of DKA to identify and treat the illness promptly.[7] Only a few studies have been conducted on the clinical presentation, precipitating factors, and in-hospital outcomes of Diabetic Ketoacidosis in the Indian population, especially in South India.

Communicable diseases show a declining trend from 1990 to 2016 in India,[8] therefore, it is essential to study the role of infections as precipitating factors of DKA. Hence, the study will shed light on the various presentations of DKA, the factors that lead to it, and its outcomes, helping to create greater awareness and develop effective preventive and treatment strategies.

Objectives

- Primary Objective - To study the clinical profile of Diabetic Ketoacidosis in adults with Diabetes Mellitus.
- Secondary Objective - To study the In-Hospital outcome of

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Diabetic Ketoacidosis in adults with Diabetes Mellitus.

Materials and Methods

This descriptive, cross-sectional study was conducted on inpatients admitted to the department of General Medicine and Critical Care at St. John's Medical College Hospital, Bangalore. The study was conducted over 18 months.

Patients diagnosed with Diabetic Ketoacidosis based on JOINT BRITISH DIABETES SOCIETIES (2023) criteria for diagnosis of DKA. The inclusion and exclusion criteria were as follows.

Inclusion criteria:

- All patients with Diabetes Mellitus who fulfil the JOINT BRITISH DIABETES SOCIETIES (2023) criteria for diagnosis of DKA.[9]

Diagnostic criteria: all three of the following must be present:

- capillary blood glucose above 11 mmol/L
- capillary ketones above 3 mmol/L or urine ketones ++ or more
- venous pH less than 7.3 and/or bicarbonate less than 15 mmol/L
- Age >18 years

Exclusion criteria:

Pregnant Women

Data Collection

Data were collected using a structured proforma, including the following parameters: Demographic details, Clinical Features, Laboratory investigations, precipitating factors, Microvascular complications, Co-morbidities, Outcome: Duration of hospital stay, need for ICU stay, Duration of ICU stay, Need for mechanical ventilation, and outcome of illness.

Written informed consent was obtained from all patients or legal guardians in case of unconscious patients.

Statistical Analysis

Information was input into Microsoft Excel and analysed using SPSS (version 29). Descriptive statistics are reported as mean ± standard deviation (SD) for continuous variables and as percentages for categorical variables. For comparative analysis, the Mann-Whitney U test was used for continuous variables, and the Pearson Chi-square test was used for categorical variables. Multivariate logistic regression was conducted to identify predictors of severity, specifically ICU admissions and mortality. A p-value of less than 0.05 was deemed statistically significant.

Sample size estimation:

Based on the study by Shamili D et al 2018,[10] and using the formula

$$n = \frac{Z\alpha^2 pq}{d^2}$$

Where Zα = Standard table value for 95% confidence interval

p= proportion of patients having complication of NPDR= 43.1%

q= 100-p = 56.9%

d = precision= 15%

$$n = \frac{Z\alpha^2 pq}{d^2}$$

$$n = (1.96)2 \text{ X } 43.1\text{X } 56.9 = 41.87$$

152

n~42

Total Sample Size: 42

Results

Among the 42 patients included in the study, males accounted for 62% and females for 38%. The average age is approximately 47.86 years, while the median age is 47.5 years. The youngest recorded age is 19 years, whereas the oldest is 89 years. About 40% of the study population were obese according to their BMI whereas 32 % were overweight,18% had normal BMI and 10 % were underweight. Among the 42 patients included in the study, 37 patients were known Diabetics, accounting for 88% whereas five patients were newly detected cases of Diabetes Mellitus. About 66.7% of patients had HbA1c>10, as shown in [Figure 1], with a mean HbA1c of 11.86. In 3 individuals, HbA1C was not performed due to anaemia.

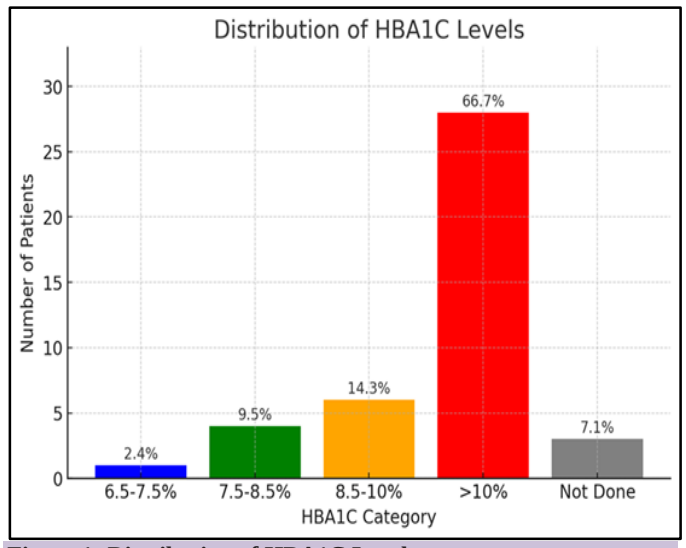
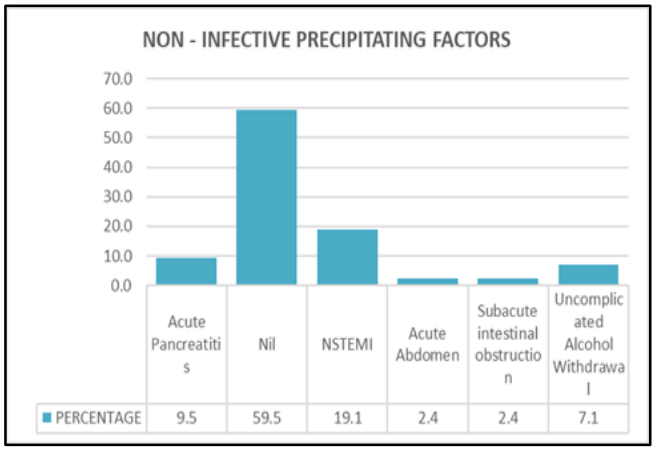
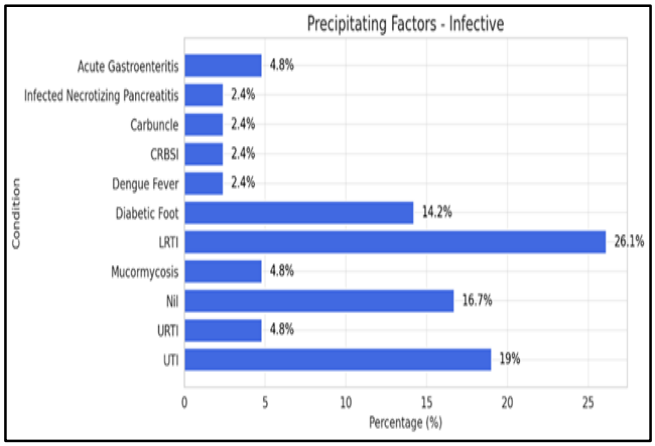


Figure 1: Distribution of HBA1C Levels

The study included patients with both Type 1 and Type 2 Diabetes Mellitus. Thirty-three patients representing 78% of the study population were diagnosed cases of type 2 diabetes mellitus, and nine patients representing 21% of the study population were diagnosed cases of Type 1 diabetes mellitus. In our study, it was found that only about 50% of the patients were compliant with their medications, and a lack of awareness about the disease is the commonest cause for poor compliance among the patients.

Among the presenting complaints, fever is the commonest complaint (61.9%), followed by abdominal pain and vomiting (28.5%), whereas only 4.8% of patients had polydipsia, polyuria, and dyspnea as presenting complaints. NSTEMI is the most common non-infective precipitating cause, seen in 8 patients (19.1%). This was followed by Acute pancreatitis and Alcohol withdrawal. Among the infective precipitating factors, LRTI was the most common focus of infection, seen in 11 individuals, followed by UTI and Diabetic foot. Non-infective and Infective precipitating factors are represented in [Figure 2 & 3], respectively.





Microvascular complications were studied, and the majority of the study population did not have any. Neuropathy, Nephropathy, and Retinopathy were observed in 8 individuals. Among the study population, 19 % had chronic kidney disease, whereas 38% had acute kidney injury. About 57 % of the study population had dyselectrolytemia, and hypokalaemia was the most common electrolyte imbalance found. 31 of 42 patients required ICU stay, and about 25 (59.5%) required mechanical ventilation. The mean duration of ICU stay was 6.2 days. The majority of the patients recovered from the illness; however, two patients succumbed to the disease. It was observed that higher HbA1C was associated with a longer hospital stay, a higher proportion requiring ICU, a longer ICU stay, and a worse outcome. Both patients who expired had an HbA1C of >10%. [Table 1] shows HBA1C and its relationship with clinical outcomes.

HbA1c Levels & Clinical Outcome

HbA1c Group	Patients (n)	Avg. Hospital Stay (Days)	ICU Admission Rate	Avg. ICU Stay (Days)	Recovered (%)	Discharged Against Advice (%)	Expired (%)
6.5-7.5%	1	5.5	0%	0	100%	0%	0%
7.5-8.5%	4	6.3	25%	3.5	83%	17%	0%
8.5-10%	6	7.8	50%	5.0	67%	33%	0%
>10%	28	9.2	75%	7.5	54%	32%	14

Discussion

In our study, the mean age of presentation was 47.5 years, which is similar to previous studies done by Devi S et al and Saini et al.[10,11] Among the 42 participants in the study, 26 were male, accounting for 62% of the study population. However, data from various Indian studies show variable gender distributions, including a study by Saini. K et al showing female preponderance.[11] In our study, the majority of the patients were known cases of type 2 Diabetes Mellitus. 9 participants out of the 42 had Type 1 Diabetes Mellitus. This result was similar to previous studies conducted in India by Pankaj Seth et al.[12] The most common presenting complaint was infection symptoms, observed in 62% of patients, followed by abdominal pain and vomiting, observed in 28.5% of the study population. The results of our studies contrasted with the available data from other studies, in which vomiting and abdominal pain were the predominant presenting complaints.[10-12]

Previous studies by Sainiet. Sachin et al. showed that infections were the most common precipitating factors.[11,13] which is similar to our research. Among the non-infective precipitating factors, ACS-NSTEMI was the most common. Among the infections, Lower respiratory tract infection was the most common, followed by Urinary tract infection and diabetic foot. These results were similar to previous studies done in India.[10,11,14] Our research observed that higher HbA1C levels were associated with prolonged hospital stays, a higher proportion requiring ICU stays, and longer ICU stays. Both patients who expired had HbA1c levels>10. This result contrasts with the study by Saini et al, in which no significant correlation between HbA1C levels and hospital stay duration was observed.[15] The study revealed that 2 out of the 42 study participants succumbed to the disease, accounting for 4.8%. This result was similar to that obtained in the survey conducted by Seth et al, in which 50 subjects were studied, of whom three succumbed to the illness.

Conclusion

This study highlights that Diabetic Ketoacidosis continues to be a major cause of acute hospitalisation among adults with diabetes, particularly in those with poor glycemic control and suboptimal treatment adherence. The majority of the cases were seen in individuals with Type 2 Diabetes, contrary to the traditional association of DKA with Type 1 Diabetes. The predominant precipitating factor was infection, with lower respiratory tract infections and urinary tract infections being the most common.

A significant proportion of patients required intensive care and mechanical ventilation, indicating the severity of their presentation. Poor compliance with diabetic medications and elevated HbA1c levels were found to be associated with worse clinical outcomes. This emphasises the need for better outpatient diabetes management, patient education, and preventive strategies to reduce the incidence of DKA.

The study findings suggest that improved glycemic control and early intervention during infections could play a pivotal role in reducing DKA incidence and improving outcomes.

Limitations

1. Single-center Study: Being conducted in a single tertiary care hospital limits the generalizability of findings to the wider population.
2. Small Sample Size: Only 42 patients were included, which may limit statistical power and robustness of subgroup analyses.
3. Cross-sectional Design: The study design precludes long-term follow-up and outcome assessment post-discharge.
4. Selection Bias: Only hospitalized patients were studied; milder DKA cases managed in outpatient settings may have been missed.
5. Self-reported Compliance: Treatment compliance was assessed based on patient recall, which is subject to reporting bias.

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Conflicts of interest
There are no conflicts of interest.

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