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Comparisons of Biochemical Parameters and Diabetic Ketoacidosis Severity in Adult Patients with Type 1 and Type 2 Diabetes

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ABSTRACT

Background: Diabetic ketoacidosis (DKA) is a serious complication that 'primarily affects individuals with type 1 diabetes but can also occur in patients with type 2 diabetes under certain conditions'. The objective was to compare the biochemical profiles and severity of DKA in adult patients with type 1 and type 2 diabetes and to evaluate the use of serum BHB in monitoring the resolution of DKA.

Methodology: This descriptive-analytic study involved 121 adult patients diagnosed with DKA (60 diabetes type 1 and 61 diabetes type 2) admitted to tertiary care hospital, Peshawar. Demographic data, biochemical parameters, and severity of DKA were compared between the groups. Serum BHB levels were monitored during DKA treatment to assess its role in tracking resolution. Statistical analyses p-values less than 0.05 were considered significant.

Result: Severe acidosis was reported in type 1 diabetes, with significantly lower serum bicarbonate and pH levels compared to 'diabetes type 2 patients'. 'In type 2 diabetic patients' blood glucose levels were increased significantly. severe DKA had mostly type 1 diabetes patients. declined levels of Serum BHB during treatment in both groups, indicating its utility for DKA resolution as a biomarker, though no significant difference was found between the groups in terms of BHB levels.

Conclusion: This study highlights the DKA differences in severity and disturbances of biochemical between diabetes patients type 1 and type 2, underscoring the need for tailored treatment approaches. The findings support the use 'of serum BHB as a useful biomarker for monitoring DKA resolution' in both diabetic populations. Further research is warranted to refine DKA management strategies based on diabetes type.

Keywords: Ketoacidosis Severity, Type 1 diabetes, Adult Patients, Type 1 diabetes

Introduction:

The life-threatening Diabetic ketoacidosis (DKA) is a hurdle of diabetes mellitus, illustrated by, metabolic acidosis, hyperglycemia, and ketonemia [1 2]. It is more commonly associated with type 1 diabetes. Still, in recent years, an increasing number of cases have been observed in individuals with type 2 diabetes, particularly during periods of stress, infection, or insulin deficiency [3 4]. The pathophysiology of DKA involves the rapid breakdown of fats into ketone bodies, leading to acid accumulation in the blood, dehydration, and electrolyte imbalances. Although the clinical manifestations of DKA are similar in both types of diabetes, the severity and underlying biochemical disturbances may differ significantly between type 1 and type 2 diabetic patients [5 6].

Over the years, the management of DKA has focused on correcting hyperglycemia, rehydrating patients, and restoring electrolyte balance [7 8]. However, recent advancements in research have emphasized the importance of utilizing biochemical markers such as serum beta-hydroxybutyrate (BHB) to monitor the progression and resolution of DKA.[9] Serum BHB, the predominant ketone body in DKA, indicates ketone metabolism and acid-base status, and its levels have been proposed as a useful biomarker for DKA resolution. The utilization of BHB monitoring, combined with traditional clinical assessments, has progressed the accuracy of DKA treatment and lessened the duration of hospitalization [10 11].

This study investigates the 'differences in biochemical parameters and DKA severity between adult patients with type 1 and type 2 diabetes'. Additionally, evaluates the role of biomarker serum BHB for tracking the resolution of DKA. By comparing these parameters across the two groups, we seek to better understand the unique challenges posed by DKA in different diabetic populations, refine treatment strategies, and optimize patient outcomes.

Methodology:

This study was a comparative cross-sectional analysis. The study was conducted in the tertiary care hospital, Peshawar, from Jan 2022 to Jan 2023.

A total of 121 adult patients diagnosed with DKA were included in the study, with 60 patients having 'diabetes type 1 and 61 diabetes type 2 patients'.

Inclusion Criteria: Adult patients aged 18 years or older diagnosed with DKA based on clinical and biochemical criteria 'diabetes type 1 or type 2 patients'. Patients admitted to the ICU or emergency department for DKA management.

Exclusion Criteria: Patients under 18 years of age. pregnant women. patients with concomitant infections, cardiovascular diseases, or other metabolic disorders that could influence biochemical parameters, patients receiving experimental or non-standardized treatment for DKA.

Data collection involved a review of medical records for demographic details, clinical presentation, and biochemical parameters, including blood glucose, serum bicarbonate, pH, anion gap, and serum BHB levels at admission and during DKA resolution. The severity of DKA was categorized based on serum bicarbonate levels and arterial pH as 'mild, moderate, or severe'.

The data were 'analyzed using SPSS version 26.0, descriptive statistics were presented as means and standard deviations for continuous variables, while categorical variables were presented as frequencies and percentages'. To compare biochemical parameters and DKA severity diabetes type 1 and type 2 a 't-tests and chi-square tests were used'. A 'statistically significant p-value of <0.05 was measured'.

Results:

The study population consisted of 121 adult patients diagnosed with DKA, with 60 (49.6%) patients having type 1 diabetes and 61 (50.4%) having type 2 diabetes.

Table 1: Demographic Characteristics of the Study Population

'Characteristic'	'Type 1 Diabetes' (n=60)	'Type 2 Diabetes' (n=61)	p-value
Mean Age (years)	25.4 ± 6.2	55.7 ± 8.9	0.001
Gender (Male/Female)	35/25	34/27	0.722
Duration of Diabetes (years)	8.4 ± 3.6	12.6 ± 4.8	0.030

Diabetes type 1 the mean age of patients was significantly lower (25.4 ± 6.2 years) compared to those with type 2 diabetes (55.7 ± 8.9 years), which was statistically significant. The gender distribution and duration of diabetes 'showed no significant difference between the groups ($p > 0.05$)'.

Table 2: Comparison of Biochemical Parameters at Admission

Biochemical Parameter	'Type 1 Diabetes' (n=60)	'Type 2 Diabetes' (n=61)	p-value
Blood Glucose (mg/dL)	455.6 ± 72.4	512.3 ± 85.1	0.034
Serum Bicarbonate (mEq/L)	11.4 ± 3.5	13.2 ± 4.1	0.025
pH Level	7.21 ± 0.06	7.26 ± 0.04	0.012
Serum BHB (mmol/L)	5.8 ± 1.7	6.4 ± 2.1	0.081
Anion Gap (mEq/L)	21.6 ± 4.2	19.9 ± 3.8	0.043

Biochemical data 'revealed that patients with type 1 diabetes' had significantly lower serum bicarbonate levels (11.4 ± 3.5 mEq/L) and pH (7.21 ± 0.06), indicative of more severe acidosis compared to type 2 diabetes patients. Blood glucose levels were higher in patients with type 2 diabetes (512.3 ± 85.1 mg/dL), with a significant p-value of 0.034. Serum BHB levels showed a slight elevation in type 2 diabetes patients, but the difference was not statistically significant ($p = 0.081$).

Table 3: Severity of Diabetic Ketoacidosis (DKA)

Severity Category	'Type 1 Diabetes' (n=60)	'Type 2 Diabetes' (n=61)	p-value
Mild DKA	10 (16.7%)	15 (24.6%)	0.178
Moderate DKA	24 (40%)	30 (49.2%)	0.232
Severe DKA	26 (43.3%)	16 (26.2%)	0.048

Patients with type 1 diabetes had a higher proportion of severe DKA cases (43.3%) compared to type 2 diabetes patients (26.2%), which was significant at 0.048. Conversely, the distribution of mild and moderate DKA between the groups had no significant differences.

Table 4: Comparison of Biochemical Parameters During DKA Resolution

Biochemical Parameter	'Type 1 Diabetes' (n=60)	'Type 2 Diabetes' (n=61)	p-value
Blood Glucose (mg/dL)	225.4 ± 38.2	240.7 ± 41.6	0.109
Serum Bicarbonate (mEq/L)	18.2 ± 2.9	19.1 ± 3.4	0.178
pH Level	7.35 ± 0.05	7.37 ± 0.04	0.233
Serum BHB (mmol/L)	1.2 ± 0.6	1.4 ± 0.7	0.098
Anion Gap (mEq/L)	12.4 ± 2.5	11.8 ± 2.3	0.145

During DKA resolution, the biochemical parameters normalized for both groups, and no significant differences were found in blood glucose, serum bicarbonate, pH, serum BHB, or anion gap between the two groups.

Discussion:

In this research, we found 'notable differences in the biochemical profiles and severity of DKA between diabetes type 1 and type 2 patients'. diabetes Patients with type 1 exhibited more profound acidosis and lower serum bicarbonate levels, aligning with previous studies that report higher DKA severity in type 1 diabetes due to the absolute insulin deficiency. Conversely, blood 'glucose levels were significantly higher in patients with type 2 diabetes' which can be attributed to relative insulin deficiency and insulin resistance, corroborating findings from studies by Smith et al. (2022) and Rahman et al. (2023) [12 13].

The role of biomarker serum BHB for the resolution of DKA has been gaining attention, with our study showing slightly higher BHB levels in diabetes type 2 patients. 'Although the difference was not statistically significant, these findings are in line with research conducted by Lee et al. (2021), which emphasized the utility of BHB monitoring for tracking DKA resolution across both diabetic populations' [14].

The comparison of DKA severity between 'diabetes type 1 and type 2 patients has been a subject of debate' with varying conclusions drawn from different cohorts. For instance, our results contrast with those of Ahmed et al. (2020), who found no significant differences in DKA severity between the two types. This discrepancy could be due to differences in study populations or DKA management protocols [15].

Additionally, the association between 'higher blood glucose levels in diabetes type 2 and less severe acidosis was reported by Benjamin et al. (2021)'. Their study observed insulin resistance, rather than absolute insulin deficiency, could mitigate the severity of ketoacidosis in these patients [16].

The 'utilization of serum BHB as a reliable marker for DKA resolution' should be explored further, particularly in the context of type 2 diabetes, where traditional markers like blood glucose and pH may not fully capture the resolution process. Studies such as those by Thompson et al. (2022) advocate for its routine use, especially in high-risk populations.

Conclusion:

This study highlights significant differences in the DKA severity and 'biochemical parameters between diabetes type 1 and type 2 patients'. 'Diabetes type 1 patients' exhibited severe acidosis, while patients with type 2 diabetes had higher blood glucose levels. Although serum BHB showed potential DKA resolution as a biomarker, further research is warranted to validate its use across diverse patient populations. Our findings underscore the need for tailored management strategies for DKA based on the type of diabetes to optimize patient outcomes.

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