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Diabetes & its Complications

Comparative Study of the Diagnostic and Prognostic Value of Ketonuria and Capillary Ketonemia in Diabetic Ketoacidosis at the Abass Ndao Hospital in Dakar

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ABSTRACT

Background: *Diabetic ketoacidosis (DKA) is an acute metabolic complication of diabetes resulting from absolute or relative insulin deficiency associated with elevated counter-regulatory hormones, leading to excessive ketone body production and metabolic acidosis. Early diagnosis relies on the detection of ketone bodies using either urinary ketone testing or blood ketone measurement.*

Objective: *To compare the diagnostic performance of semi-quantitative urinary acetoacetate measurement using conventional urine dipsticks with quantitative capillary blood 3-beta-hydroxybutyrate (3-HB) measurement in the diagnosis of diabetic ketoacidosis.*

Methods: *This prospective, observational, comparative, and analytical study was conducted between March 1 and June 1, 2025, at Medical Clinic II of Abass Ndao Hospital. A total of 54 patients admitted with capillary blood glucose levels ≥ 2.5 g/L were included and equally divided into two groups: patients with DKA and patients with isolated hyperglycemia (IHG)*

Results: *The mean age was 46.28 ± 16.12 years, with a male predominance (sex ratio: 1.4). Type 2 diabetes mellitus predominated in both groups. Patients with DKA more frequently presented with altered consciousness, Kussmaul respiration, and anorexia. At admission, mean blood glucose levels were higher in the DKA group (4.54 g/L vs. 3.50 g/L). Mean blood ketone levels were significantly higher in the DKA group (5.13 mmol/L vs. 0.38 mmol/L). Urinary ketone levels exceeded two crosses in all patients with DKA. During treatment, blood glucose, blood ketone levels, and urinary ketones decreased significantly and in parallel, with earlier normalization of blood ketones observed within the first eight hours. Urinary ketone testing demonstrated higher sensitivity (100%) than blood ketone measurement (96.4%), whereas blood ketone measurement showed perfect specificity (100%), thereby reducing false-positive diagnoses of DKA.*

Conclusion: *Although widely available, urinary ketone testing is less accurate and slower than capillary blood ketone measurement and may inadequately reflect DKA severity. Blood ketone measurement enables earlier and more accurate diagnosis and monitoring of DKA and may help reduce intensive care unit length of stay.*

Keywords

Diabetic ketoacidosis, Blood ketones, Urinary ketones, Diabetes mellitus.

Introduction

Diabetes is a heterogeneous group of metabolic disorders characterized by chronic hyperglycemia resulting from defects in insulin secretion and/or insulin action [1]. It is now a major public health concern, and its prevalence continues to rise.

According to estimates from the International Diabetes Federation (IDF), approximately 589 million adults aged 20 to 79 years were living with diabetes worldwide in 2025. This number is expected to continue increasing, reaching nearly 783 million by 2045 [2] .The steepest rise is anticipated in low- and middle-income countries, which currently account for nearly 80% of cases, particularly in sub-Saharan Africa [2].

In Senegal, the STEPS surveys conducted in 2015 and 2025 showed that the prevalence of diabetes increased from 3.4% to 4.2% [3]. This rise is part of an epidemiological transition driven by urbanization and lifestyle changes [2].

Diabetes can lead to serious complications, representing a major global health challenge with substantial socioeconomic consequences. Some of these complications, particularly acute ones, can be life-threatening.

Among acute metabolic complications, diabetic ketoacidosis (DKA) [1] stands out because of its severity and potentially fatal outcome. It results from an absolute or relative insulin deficiency combined with excessive secretion of counterregulatory hormones such as glucagon, cortisol, and catecholamines [4]. Biochemically, DKA is characterized by a triad consisting of hyperglycemia exceeding 2.5 g/L, ketosis, and metabolic acidosis (pH < 7.3) [5].

Although it is classically associated with type 1 diabetes, its occurrence in patients with type 2 diabetes, particularly in Africa, has been frequently reported [6,7].

The prognosis of diabetic ketoacidosis remains poor, with an overall in-hospital mortality rate estimated at 5%, rising to as high as 15% in cases of ketoacidotic coma or multi-organ failure [8]. In resource-limited settings, outcomes are further compromised by diagnostic delays and limited access to continuous laboratory monitoring.

Early diagnosis of DKA traditionally relies on the detection of ketonuria using nitroprusside reagent strips [9]. However, this method has several important limitations: it measures only acetoacetate, while β-hydroxybutyrate (3-HB), the predominant ketone body during the acute phase, is not detected; it is associated with a diagnostic delay, with a 2- to 4-hour lag between increases in blood ketone levels and their appearance in urine; and it is susceptible to analytical interference, resulting in false-positive results (e.g., sulfhydryl-containing medications) or false-negative results (e.g., improper storage of test strips).

Given these limitations, capillary blood 3-HB measurement represents a promising alternative. It allows rapid and accurate quantification of 3-HB within approximately 10 seconds and demonstrates a strong linear correlation (r= 0.97) with laboratory-based assays [10]. Nevertheless, its use remains limited in Africa because of economic and logistical constraints.

In this context, we conducted a prospective comparative study to evaluate the diagnostic concordance between urinary ketone testing (Keto-Diastix®) and capillary blood ketone measurement (FreeStyle Precision®), as well as the mean time to positivity for each method following the onset of clinical symptoms.

Patients and Methods

This was an observational, comparative, and analytical study with prospective data collection, conducted from March 1 to June 1, 2025, at Medical Clinic II of Abass Ndao Hospital in Dakar. The primary objective was to compare the performance of semi-quantitative acetacetate measurement using conventional urine test strips with that of quantitative measurement of the primary ketone body, 3-beta-hydroxybutyrate (3-HB), performed using capillary ketone test strips, for the diagnosis of diabetic ketoacidosis.

The study included all adult patients (≥ 15 years of age) with hyperglycemia ≥ 2.5 g/L at admission during the recruitment period. Participants were divided into two groups: the ACD group, comprising patients with ketoacidosis, and the HGP group, comprising patients with isolated hyperglycemia. The groups were matched for age and sex. The study followed a comparative design aimed at evaluating the two methods of ketone detection in all patients meeting the inclusion criteria.

For patients in the ACD group, the sensitivity and specificity of urine test strips and capillary ketone meters were compared at time points H0, H6, and H12 to analyze changes in the performance of these tests over the course of follow-up.

We first assessed the correlation between the number of ketonuria crosses and ketone levels expressed in mmol/L.

This was an observational, comparative, analytical study with prospective data collection conducted from March 1 to June 1, 2025, in the Department of Medical Clinic II at Abass Ndao Hospital, Dakar, Senegal. The primary objective was to compare the performance of semi-quantitative acetoacetate measurement using conventional urine dipsticks with that of quantitative measurement of the main ketone body, 3-beta-hydroxybutyrate (3-HB), using capillary blood ketone testing for the diagnosis of diabetic ketoacidosis (DKA).

The study included all patients aged ≥15 years who presented with hyperglycemia ≥2.5 g/L at admission during the recruitment period. Participants were divided into two groups: the DKA group, consisting of patients diagnosed with diabetic ketoacidosis, and the HGP group, consisting of patients with isolated hyperglycemia. The groups were matched for age and sex. The study followed a comparative design aimed at evaluating the two ketone detection methods in all patients meeting the inclusion criteria.

For patients in the DKA group, the sensitivity and specificity of urine dipsticks and capillary blood ketone measurements were compared at baseline (H0), 6 hours (H6), and 12 hours (H12) to

assess changes in the diagnostic performance of these tests during follow-up.

We first evaluated the correlation between the semi-quantitative ketonuria score (expressed as crosses) and blood ketone levels measured in mmol/L. Table 1 shows the relationship between blood ketone levels and the corresponding ketonuria grades.

Table 1: Equivalence between ketone levels and the number of plus signs for ketonuria.

Number of ketone crosses	Ketone level (mmol/l)	Clinical interpretation
Traces +/-	< 0.5	Mild or early ketosis
1 cross	0.5-1.5	Mild or early ketosis
2 crosses	1.5-3	Moderate ketosis
3 crosses	3-5	Severe ketosis
4 crosses	>5	Risk of ketoacidosis

The diagnostic performance of urinary ketone testing and capillary blood ketone measurement was assessed by calculating standard measures of diagnostic accuracy. Sensitivity, defined as the proportion of true-positive results among patients with diabetic ketoacidosis (DKA), and specificity, defined as the proportion of true-negative results among patients with isolated hyperglycemia (IHG), were calculated using standard formulas.

Positive and negative predictive values, as well as positive and negative likelihood ratios, were also determined to evaluate the clinical utility of each diagnostic method.

The variables studied included:

- **Socio-demographic characteristics**: Age, sex, occupation, marital status, educational level, and lifestyle factors;
- **Clinical characteristics**: Medical history, cardiovascular risk factors, diabetes profile, type and duration of diabetes, family history of diabetes, previous treatment, and clinical signs at admission;
- **Paraclinical characteristics**: Laboratory findings, electrocardiographic (ECG) data, and imaging findings;
- **Clinical and biological outcomes**: Monitoring of blood glucose, blood ketone levels, and ketonuria at 6 and 12 hours, as well as the mean length of stay in the intensive care unit (ICU) and the occurrence of complications.
- **Test performance:** Comparison of the kinetics and time to positivity of urinary ketone testing and capillary blood ketone measurement, as well as their sensitivity and specificity over time.

Data were collected using an electronic questionnaire developed on the KoboToolbox platform, ensuring standardized data collection and minimizing transcription errors. The data were subsequently anonymized and exported to a Microsoft Excel database for statistical analysis.

Statistical analyses were performed using R software (version 4.3.0), ensuring rigorous and reproducible data processing. Descriptive statistics were used to summarize the study variables. Comparisons between groups were conducted using Pearson's chi-square test or Fisher's exact test, as appropriate. Means and standard deviations were calculated for quantitative variables.

Results

Epidemiological Characteristics

A total of 54 patients were enrolled in the study and equally distributed between two groups : the DKA group, comprising 27 patients (50%) with diabetic ketoacidosis, and the IHG group, comprising 27 patients (50%) with isolated hyperglycemia.

A male predominance was observed in both groups, with men accounting for 59.3% of patients in the DKA group and 55.6% in the IHG group.

The mean age of the study population was 46.3 ± 16.1 years. Regarding socioeconomic status, 25.9% of the patients were unemployed, whereas 38.9% worked in the informal sector. With respect to educational attainment, most participants (61.1%, n = 33) had never received formal schooling.

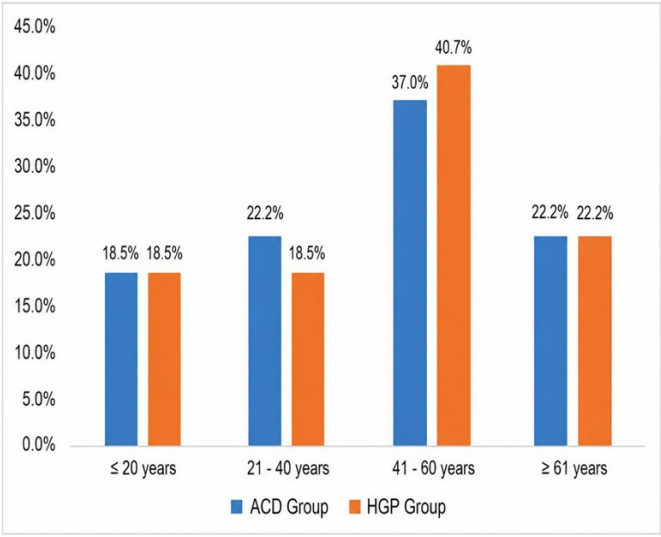

Figure 1: Distribution of patients according to age groups in years (n = 54).

Medical History and Cardiovascular Risk Factors

Regarding lifestyle-related risk factors, only 7.4% of patients were current smokers, and alcohol consumption was reported by only one female patient.

Among patients admitted with diabetic ketoacidosis (DKA), 22.2% had a history of at least one previous episode of ketoacidosis.

With respect to cardiovascular risk factors, hypertension was the most prevalent, affecting 24.1% of patients, followed by physical inactivity, observed in 18.5%, and obesity, present in 7.4% of participants.

Concerning the diabetes profile, type 2 diabetes predominated, accounting for 66.7% of cases. However, type 1 diabetes was proportionally more frequent in the DKA group, affecting 44.4% of patients.

The duration of diabetes varied between the two groups. In the DKA group, disease durations of 0–5 years and more than 10 years were the most common, accounting for 66.7% and 25.9% of cases, respectively. In contrast, in the isolated hyperglycemia (IHG) group, a duration of 5–10 years was the most frequent, representing 29.6% of patients.

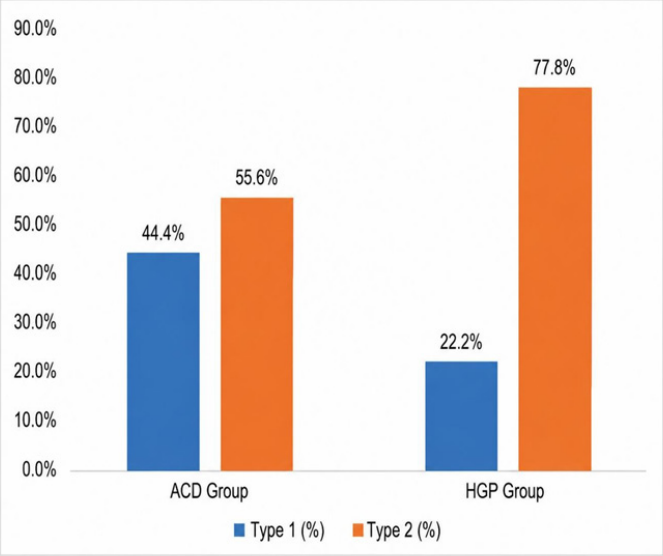

Figure 2: Distribution of patients by type of diabetes.

Clinical Signs at Admission

At admission, the most common clinical manifestation was the polyuria–polydipsia syndrome, which was present in 92.6% of patients in the DKA group and in all patients in the isolated hyperglycemia (IHG) group. Weight loss was the second most frequently reported symptom, affecting 73.1% of patients in the DKA group and 92.6% of those in the IHG group. Kussmaul respiration was observed in 59.3% of patients with DKA. Table II presents the distribution of clinical signs at admission.

Triggering Factors

Several triggering factors could coexist in the same patient. However, infection was the most common precipitating factor among patients with diabetic ketoacidosis (DKA), occurring in 42.3% of cases compared with 7.4% in patients with isolated hyperglycemia (IHG). This was followed by treatment-related factors, particularly poor adherence to therapy or discontinuation of insulin treatment.

Table 2: Clinical signs at admission in patients with diabetic ketoacidosis (DKA) and isolated hyperglycemia (IHG).

Clinical Sign	DKA Group n (%)	IHG Group n (%)
Anorexia	19 (70.3 %)	15 (55,5%)
Polyuria-polydipsia	25 (92,3 %)	27 (100,0 %)
Polyphagia	8 (29,6 %)	0 (0,0 %)
Weight loss	20 (74,1 %)	25 (92,3 %)
Kussmaul respiration	16 (59,3 %)	1 (3,7 %)
Acetone breath odor	10 (37,0 %)	0 (0,0 %)
Nausea and vomiting	14 (51,9 %)	4 (14,8 %)
Abdominal pain	14 (51,9 %)	3 (11,1 %)
Altered consciousness	14 (51,9 %)	0 (0,0 %)
Déshydratation		
- Mild	11 (40,7%)	13 (48,1 %)
- Moderate	10 (37,0%)	1 (3,7 %)
Headache	10(38,5%)	5(18,5%)

Physical Examination

Hyperthermia was more frequently observed in patients with diabetic ketoacidosis (DKA) than in those with isolated hyperglycemia (IHG), affecting 18.5% and 7.4% of patients, respectively. Hypothermia was observed exclusively in the DKA group, where it affected 14.8% of patients. The mean body temperature was 37.7°C in the DKA group compared with 36.5°C in the IHG group.

At admission, blood glucose levels ranged from 2.5 to 6.0 g/L in 61.1% of patients. The mean blood glucose concentration was higher in the DKA group (4.54 g/L) than in the IHG group (3.50 g/L).

Regarding glucosuria, most patients presented with marked glycosuria, corresponding to three or four crosses on urine dipstick testing. This pattern was observed in 70.3% of patients in the DKA group and 63.0% of those in the IHG group.

With regard to ketonuria, 70.3% of patients in the ACD group had ketonuria of ≥ 3 crosses, whereas in the HGP group, ketonuria did not exceed one cross.

An electrocardiogram was performed on all patients hospitalized for ACD. Among them, abnormalities were detected in 29.6% of patients, primarily conduction disturbances, including bradycardia and repolarization abnormalities.

Laboratory and Imaging Findings

Laboratory investigations were performed exclusively in patients with diabetic ketoacidosis (DKA). Following confirmation of the diagnosis, these patients were hospitalized and underwent intensive clinical and laboratory monitoring, including hourly assessments.

The mean serum sodium concentration was 124 mmol/L, while the mean serum potassium concentration was 4.28 mmol/L. Serum creatinine levels were within the normal range in 60% of patients, whereas elevated C-reactive protein (CRP) levels were observed in 53.8%.

Regarding imaging findings, chest radiography revealed abnormalities in 2 of the 27 patients with DKA (7.4%). All radiographic abnormalities were consistent with pneumonia.

Clinical and Biological Outcomes

A marked reduction in blood glucose levels was observed at both the 6-hour and 12-hour assessments, accompanied by decreases in blood ketone levels and ketonuria. Blood ketone levels normalized more rapidly than ketonuria.

The mean length of stay in the intensive care unit (ICU) was 2.73 days, with a range of 1 to 8 days.

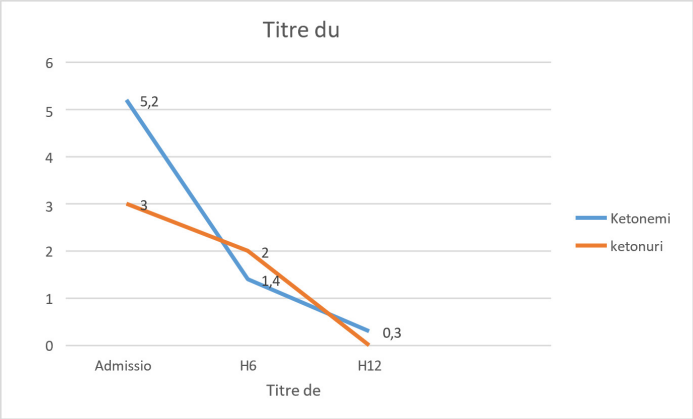

Figure 3: Comparative evolution of ketonuria and blood ketone levels.

Complications

Only one complication was recorded: severe hyperkalemia associated with renal impairment, which resulted in death.

Analysis of Time to Ketone Negativity at 6 Hours

A statistically significant difference was observed between the two methods in their ability to detect ketone body normalization after six hours of treatment. The results showed that blood ketone levels became negative earlier than ketonuria, indicating a more rapid detection of ketosis resolution by capillary ketonemia.

Comparative Evaluation of the Diagnostic Performance of Urinary and Blood Ketone Measurements

Analysis of the diagnostic performance of the two methods revealed distinct profiles. Urinary ketone testing demonstrated a sensitivity of 100%, enabling the identification of all cases of diabetic ketoacidosis (DKA) in the study population. However, this excellent sensitivity was associated with a lower specificity (85.2%), indicating that approximately one in six patients could be falsely classified as having DKA. These false-positive results are likely attributable to the persistence of urinary ketone bodies despite correction of the underlying metabolic disturbance.

In contrast, capillary blood ketone measurement demonstrated a specificity of 100%, thereby eliminating false-positive results. This excellent specificity is attributable to the direct quantitative measurement of β-hydroxybutyrate, the predominant ketone body during ketoacidosis. Its sensitivity was 96.3%, remaining very high and reflecting an excellent ability to identify true cases of DKA, with only a minimal risk of false-negative results.

Table 3: Comparison of the diagnostic performance of urinary ketone testing and capillary blood ketone measurement for the diagnosis of diabetic ketoacidosis.

	Capillary Ketonemia	Ketonuria	Clinical Interpretation
Sensitivity	96,3 %	100,0 %	Ability to identify true cases of diabetic ketoacidosis
Specificity	100,0 %	85,2 %	Ability to exclude false-positive results
RV+	∞	6,75	Probability of disease when the test result is positive
RV−	0,037	0	Probability of absence of disease when the test result is negative

Discussion

Socio-demographic Characteristics

Our study included 54 patients, equally distributed between an isolated hyperglycemia (IHG) group and a diabetic ketoacidosis (DKA) group, over a three-month period.

The sample size of our cohort was larger than that reported by M.Etoa et al. [9], who investigated the monitoring of blood ketone and urinary ketone levels in patients hospitalized for DKA and included only 20 patients over an approximately eight-week period. This difference may be explained by the fact that the study by M. Etoa et al. focused exclusively on patients with type 1 diabetes, a form of diabetes whose prevalence remains relatively low worldwide and particularly in sub-Saharan Africa [11].

Males predominated in both groups, accounting for 59.3% (n = 16) of patients in the DKA group and 55.6% (n = 15) of those in the isolated hyperglycemia (IHG) group. These findings are consistent with those reported by Sall SA [12] in Senegal and Bonkoungou et al. [13] in Ouagadougou, who found male proportions of 53.7% and 51.5%, respectively, among patients with diabetic ketoacidosis.

This male predominance has been reported in several studies conducted in Africa and Asia and may be related to the higher prevalence of diabetes among men in these regions.

The mean age of the patients included in our study was 46.3 ± 16.1 years, with a median age of 49.5 years. The 41–60-year age group was the most represented, accounting for 37.0% of patients in the DKA group and 59.3% of those in the isolated hyperglycemia (IHG) group.

These findings are consistent with those reported by M. Etoa et al. [9], who observed a mean age of 46 ± 13 years among patients with diabetic ketoacidosis. Similarly, Leye Yakham [14], in an epidemiological and diagnostic study of DKA conducted at the

CHNP, reported that the majority of patients were between 45 and 59 years of age.

In contrast, Jouini et al. [15], in a study investigating the epidemiological profile of DKA in Tunisia, reported a lower mean age of approximately 38 years. The predominance of the middle-aged age group observed in our cohort may be related to the relatively high prevalence of ketosis-prone diabetes in sub-Saharan Africa, estimated at between 5% and 20% [16]. This diabetes phenotype is commonly associated with ketoacidotic decompensations and may therefore contribute to the high frequency of diabetic ketoacidosis observed in this population.

Lifestyle Factors

In our cohort, four patients (7.4%) were current smokers, three of whom belonged to the DKA group. This relatively low prevalence, compared with reports from other studies, may be explained by cultural and religious factors specific to our population.

According to the literature, nicotine exerts direct toxic effects on pancreatic β-cells and insulin receptors, contributing to hyperglycemia, insulin resistance, and impaired insulin secretion, all of which may promote the development of diabetic ketoacidosis [17].

Only one patient in our study reported alcohol consumption, representing 1.9% of the study population. Both tobacco and alcohol have deleterious effects on glucose metabolism, exacerbating glucose intolerance and reducing insulin sensitivity, thereby increasing the risk of diabetes-related complications over time.

Cardiovascular Risk Factors

In our study, hypertension was the most common cardiovascular risk factor, affecting 13 patients (24.1% of the cohort). This prevalence was substantially lower than those reported by Senghor NS [18] in a study investigating the epidemiological and clinical profile of newly diagnosed patients with type 2 diabetes in a hospital setting (49%), and by the French ADDITION study [19], which focused on stepwise diabetes screening and the identification of individuals at high but modifiable risk of coronary heart disease.

Furthermore, a study conducted in Algeria by Nibouche WN et al. [20] on hypertension at the time of diagnosis of type 2 diabetes in adults reported prevalence rates of 73% and 66.7%, respectively.

This difference may be explained by the relatively short duration of diabetes among our patients, most of whom had been diagnosed for less than five years. Disease duration is a major determinant of the development of atherosclerosis and hypertension. Furthermore, no cases of diabetic nephropathy, a common cause of hypertension in patients with diabetes, were identified in our cohort.

Physical inactivity was observed in 18.5% of patients, a prevalence markedly lower than that reported by Sissoko MK [21] in a study on electrocardiographic abnormalities among patients with type 2 diabetes in Mali (70.23%). This discrepancy may be attributable to differences in the study populations or in the criteria used to define physical inactivity. Assessment of dyslipidemia was not possible because of limited resources.

Despite the relatively low prevalence of physical inactivity observed in our cohort, it remains a well-established risk factor for diabetes and its complications. Only 7.4% of patients presented with grade 2 obesity, all of whom were admitted with diabetic ketoacidosis (DKA).

This low prevalence may be explained by the weight loss commonly associated with insulin deficiency before hospital admission, which may have led to an underestimation of the patients' pre-morbid body weight and, consequently, their true obesity status.

Type of Diabetes and Duration of Disease

In our cohort, 33.3% of patients had type 1 diabetes, whereas 66.7% had type 2 diabetes. These findings are consistent with those reported by Mahamane [22], who investigated factors associated with the occurrence of diabetic ketoacidosis at the National Hospital of Niamey and found that 64.8% of patients had type 2 diabetes.

In contrast to the situation observed in Africa, most studies conducted in Western countries focus predominantly on patients with type 1 diabetes. This difference may be explained by the high prevalence of ketosis-prone type 2 diabetes among African populations [23].

Most patients, whether presenting with diabetic ketoacidosis (DKA) or isolated hyperglycemia (IHG), had a relatively short duration of diabetes (<5 years), with a higher proportion observed in the DKA group (66.7%). This finding may be partly explained by the fact that approximately one-third of DKA admissions occurred at the time of diabetes diagnosis, with ketoacidosis representing the initial presentation of the disease.

Clinical Signs at Admission

Polyuria and polydipsia were the most common presenting symptoms, observed in 92.6% of patients with diabetic ketoacidosis (DKA) and in all patients with isolated hyperglycemia (IHG). These findings are consistent with those reported by Sall SA [12], who found a prevalence of 92% for this cardinal clinical syndrome.

Kussmaul respiration was observed in 59.3% of patients with diabetic ketoacidosis (DKA), while altered consciousness was present in 51.9% of cases. These findings are consistent with those reported by Leye Yakham [14].

However, these proportions remain lower than those reported by Marracki et al. [24] in Morocco and Diedhiou et al. [25] in Senegal, who found frequencies of 79% and 82.1%, respectively, among intensive care patients and individuals with type 1 diabetes.

This discrepancy may be explained by differences in the study populations, as both studies included predominantly or exclusively patients with type 1 diabetes, who are generally younger (mean age <30 years) and may be more likely to present with altered consciousness due to delayed diagnosis or treatment.

The mean blood glucose concentration at admission was 4.54 g/L in the DKA group and 3.50 g/L in the isolated hyperglycemia (IHG) group. These values are consistent with those reported by M. Etoa et al., Mahamane, and Kuru [9,22,26], who observed mean blood glucose levels of 4.1 ± 0.9 g/L, 3.83 ± 0.95 g/L, and 3.09 ± 1.31 g/L, respectively.

Precipitating Factors

In our study, infections were the leading precipitating factor for diabetic ketoacidosis (DKA), accounting for 40.7% of cases. Skin infections, particularly acute bacterial dermohypodermitis and diabetic foot gangrene, were the most frequently identified infectious causes. Treatment-related factors, including poor adherence to therapy and discontinuation of insulin treatment, were the second most common precipitating factors, each accounting for 33.3% of cases.

These findings differ from those reported by Leye Yakham [14] in Pikine, where infections—predominantly pulmonary infections—were by far the most frequent precipitating factor. This discrepancy may be explained by the role of Abass Ndao Hospital as a national referral center for the management of diabetic foot complications, resulting in a higher proportion of severe skin and soft tissue infections in our cohort.

Speed of Resolution

In our study, appropriate management of diabetic ketoacidosis (DKA) resulted in a marked reduction in blood glucose levels at both 6 and 12 hours, accompanied by parallel decreases in blood ketone levels and ketonuria. However, capillary β-hydroxybutyrate normalized more rapidly (within 7 hours) than ketonuria, which resolved only after approximately 10 hours. These findings are consistent with those reported by M. Etoa et al. [9].

Similarly, Mosnier [27], in a prospective study involving 16 patients hospitalized for ketosis or ketoacidosis, reported shorter times to normalization, with mean durations of 3 hours 14 minutes ± 2 hours 45 minutes for ketonuria and 1–2 hours for ketonemia. This difference may be explained by the predominance of patients with type 1 diabetes in his cohort, who generally exhibit lower insulin resistance and therefore require lower insulin doses to achieve metabolic control.

Our findings also suggest that the earlier normalization of ketonemia may contribute to a shorter intensive care unit (ICU) stay. In our study, the mean ICU length of stay was 2.73 days, compared with the longer durations reported by Laffel et al. [28] (5.8 days for ketonemia-guided monitoring and 6.3 days for ketonuria-guided monitoring). This discrepancy may be attributable to differences in study populations, particularly the predominance of patients with type 1 diabetes and potentially more severe clinical presentations requiring prolonged management.

Sensitivity and Specificity

Analysis of the diagnostic performance of the two methods revealed distinct profiles. Urinary ketone testing demonstrated a sensitivity of 100%, allowing the identification of all cases of diabetic ketoacidosis (DKA) in our cohort. However, this excellent sensitivity was associated with a lower specificity (85.2%), resulting in a risk of false-positive diagnoses. This limitation is likely attributable to the persistence of urinary ketone bodies despite correction of the underlying metabolic disturbance.

In contrast, capillary blood ketone measure ment demonstrated a specificity of 100%, thereby eliminating false-positive results. This excellent specificity is attributable to the direct quantitative measurement of β-hydroxybutyrate, the predominant ketone body during ketoacidosis and the most reliable biochemical marker of ketosis.

Although its sensitivity was slightly lower (96.3%), capillary blood ketone measurement maintained excellent diagnostic performance, demonstrating a high ability to identify true cases of diabetic ketoacidosis (DKA), with only a minimal risk of false-negative results.

Taboulet et al. [27], in their evaluation of methods for ketone body detection, reported comparable sensitivities for ketonuria and ketonemia (89%), findings that differ from those observed in our study. In contrast, Guerci et al. [27] reported a higher sensitivity for capillary ketonemia (80.4%) than for ketonuria (63%), while Chalon et al. [27] found equivalent sensitivities of 100% for both methods.

The discrepancies between our findings and those reported in the literature may be explained by the clinical characteristics of our study population, which included a high proportion of patients presenting with dehydration (77%) and vomiting (51.9%). Both conditions are likely to increase urinary acetoacetate concentrations, thereby enhancing the positivity rate of urinary ketone testing and potentially inflating its apparent sensitivity [30].

With regard to specificity, the 100% value observed for capillary ketonemia in our study is consistent with previous reports and further supports its superiority over urinary ketone testing in terms of diagnostic accuracy [27,29].

Conclusion

Capillary blood ketone measurement based on β-hydroxybutyrate determination appears to be a more reliable and specific method than urinary ketone testing for the diagnosis and monitoring of diabetic ketoacidosis (DKA). Although urine dipsticks remain widely available and inexpensive, they are associated with a risk of false-positive results and do not accurately reflect the severity or

resolution of ketoacidosis.

In contrast, capillary blood ketone measurement enables earlier detection of ketoacidosis and provides a more accurate assessment of treatment response and metabolic recovery. Its use may therefore facilitate more timely, targeted, and effective management of patients with DKA.

The findings of this study support the integration of capillary ketonemia measurement into routine clinical practice, particularly in settings where rapid and accurate assessment of ketoacidosis is essential.

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