



Diabetic Ketoacidosis in Children at the Mother and Child Academic Hospital, N'djamena Chad

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Abstract

Introduction: Diabetic ketoacidosis is the most common acute complication of diabetic children. **Objective:** To determine the frequency of diabetic ketoacidosis in children, describe the evolutionary profile, and identify factors associated with death. **Patients and Method:** A retrospective, descriptive, analytical study was conducted between January 2018 and November 2019. Children aged 5 to 15 years with a discharge diagnosis of diabetic ketoacidosis were included. Variables studied were age, sex, history of diabetes, clinical signs on admission, precipitating factors, blood glucose level, and outcome. The statistical test used was χ^2 . **Results:** a total of 35 patients were admitted for ketoacidosis or 0.14%. They were boys $n = 20$ (57.1%) and girls $n = 15$ (42.9%) with a median age of 10.9 years. Children aged 10 to 15 years $n = 26$ (74%) were the most represented. The main clinical manifestations were kussmaul breathing $n = 33$ (94.5%), dehydration $n = 27$ (77%), and digestive disorders $n = 26$ (74%). Malaria 25 (71.4%) and urinary tract infection $n = 15$ (42.8%) were the triggering factors. Death was noted in 14 (40%) patients. Malaria ($p: 0.03$), children aged 10 - 14 years ($p: 0.01$), inaugural nature ($p: 0.04$) were associated with death. **Conclusion:** Diabetic ketoacidosis in children is relatively frequent, and the relative mortality is high. Its reduction requires early diagnosis. Also, communication for behaviour change and improving socio-economic and cultural conditions are the axes of prevention.

Subject Areas

Diabetes & Endocrinology

Keywords

Ketoacidosis, Diabetes, Children, Death, CHU-ME, N'Djamena

1. Introduction

Diabetes, the first endocrinopathy in children, has a constantly increasing incidence worldwide. Diabetic ketoacidosis, the most frequent and dreaded acute complication of diabetes, is the consequence of a profound insulin deficiency. It reveals diabetes in 15% to 70% of cases and complicates it in 1% to 10% [1] [2] [3]. It is Africa's leading cause of hospitalisation, morbidity, and mortality of diabetic children. It is a significant public health problem with a mortality of 1% - 2% [4]. In Congo, ketoacidosis reveals diabetes in 57.1% and complicates it in 42.8% with lethality of 18.2% [5]. In Chad, 98% of diabetic children hospitalised in 2017 were for ketoacidosis [6]. Having been an Academic Hospital in N'Djamena for more than eight years, this work was carried out to improve the management of childhood diabetes and ketoacidosis, the most frequent complication. The objectives were: to determine the frequency of diabetic ketoacidosis, to describe the sociodemographic and clinical characteristics of the study population, as well as the outcome and to identify the factors associated with death.

2. Patients and Methods

It was a retrospective, descriptive and analytical study conducted in the paediatric emergency department of the Mother and Child Academic Hospital between January 2018 and November 2019. The study population consisted of children hospitalised in the paediatric emergency department. For those aged 5 to 15 years whose discharge diagnosis included the item "diabetic ketoacidosis", children whose records were usable were included. Children hospitalised for a complication of diabetes other than DKA were omitted.

2.1. Study Sampling

It was a comprehensive sample. The inclusion criteria were for all records of patients admitted with a final diagnosis of Diabetic Ketoacidosis.

2.2. Study Method

The data sources were the medical records and hospitalisation register of the department. All data were collected in a predefined form.

2.3. Study Variables

The variables studied were age, sex, origin, age of diabetes, clinical signs, precipitating factors, urine dipstick data, blood count data, thick blood drop, blood ionogram, c-reactive protein, urea, creatinine, and evolutionary profile.

2.4. Operational Definitions

The definition of ketoacidosis used is that of the ISPAD [7], *i.e.*, a blood glucose level of 2 g/l (11 mmol/l) with glycosuria++, ketonuria++ and a PH 7.3 or alkaline reserve of 15 mmol/l (in the absence of blood gas analysis) associated with at least one of the following clinical signs: vomiting, abdominal pain, Kussmaul

breathing, signs of dehydration and disturbances in consciousness.

2.5. Statistical Analysis

Data were entered and analysed using SPSS software 18. The statistical test used was χ^2 with a significant threshold of 5%.

3. Results

3.1. Descriptive Study

3.1.1. Epidemiological Aspects: Frequency, Age, and Sex

Of 24,750 children hospitalised during the study period, 35 were hospitalised for diabetic ketoacidosis, *i.e.*, a hospital frequency of 0.14%. They had a mean age of 10.9 years, with extremes of 5 and 15 years. They were 5 to 9 years old, $n = 9$ (26%), 10 to 15 years old, and $n = 26$ (74%). They were boys $n = 20$ (57.1%) and girls $n = 15$ (42.8%), *i.e.*, a sex ratio of 1.33.

3.1.2. Clinical and Para-Clinical Aspects

It was an inaugural ketoacidosis of diabetes 65.7% ($n = 23$), the age of diabetes was one year 14.3% ($n = 5$), two years 8.6% ($n = 3$), three years 2.8% ($n = 1$), four years 8.6% ($n = 3$) (**Figure 1**).

Clinical signs were: kussmaul breathing 94.3% ($n = 33$), acetone breath 82% ($n = 29$), dehydration 77% ($n = 27$), coma 62.8% ($n = 22$), fever 51.4% ($n = 18$) and hemodynamic disorder 40% ($n = 14$) (**Table 1**).

The precipitating factor identified was infectious, including malaria 71.4% ($n = 25$), urinary tract infection 42.8% ($n = 15$), pneumonia 5.7% ($n = 2$), skin infection 5.7% ($n = 2$) and interruption of treatment 5.7% ($n = 2$) (**Table 2**).

Biologically, the average blood glucose level was 4.47 g/l, with extremes of 2.56 and 6 g/l. Ketonuria was two crosses 40% ($n = 14$), three crosses 48.6% ($n = 17$), four crosses 11.4% ($n = 4$) and glucosuria two crosses 2.8% ($n = 1$), three crosses 62.8% ($n = 22$) and four crosses 34.3% ($n = 12$). The outcome was favourable for 24 (60%) and 14 (40%) children died (**Figure 2**).

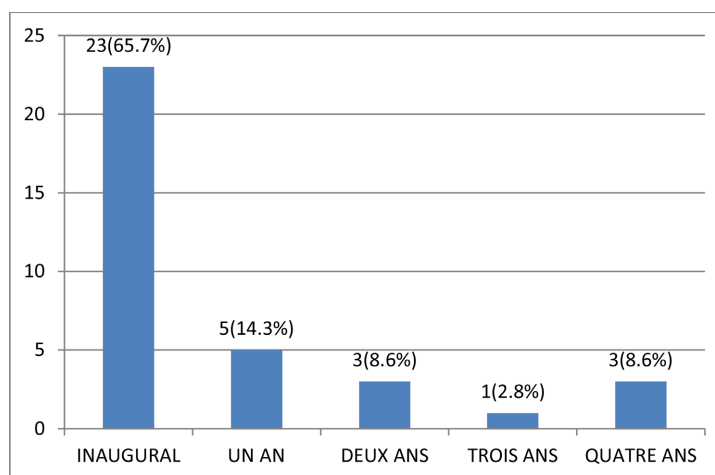


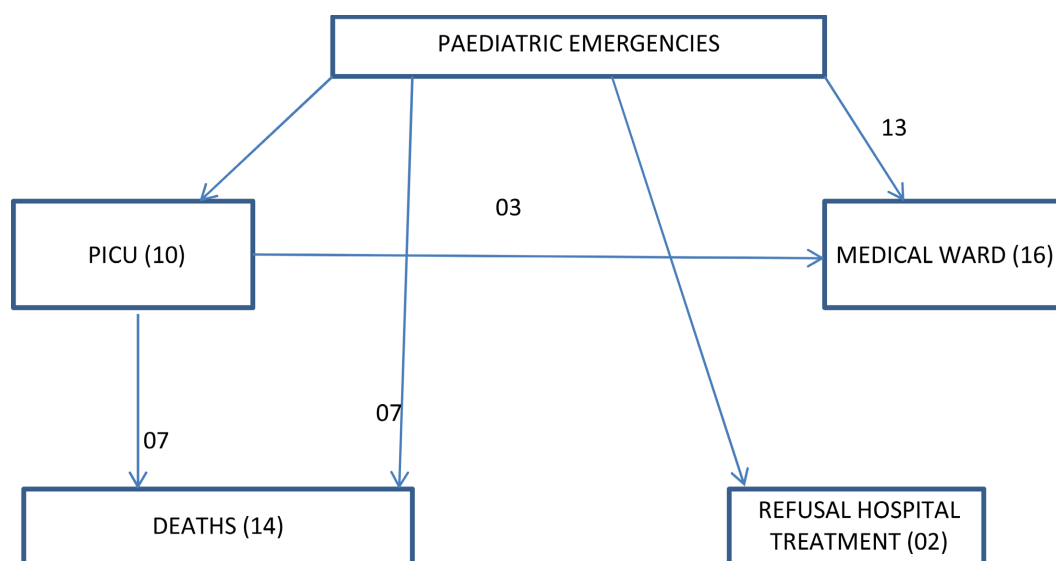
Figure 1. Distribution according to the duration of the diabetes.

Table 1. Distribution by clinical manifestation.

| CLINICAL SIGNS | CASES | PERCENTAGE |
|-----------------------|-------|------------|
| Coma | 22 | 62.7% |
| Dehydration | 27 | 77.1% |
| Hemodynamic disorders | 14 | 40% |
| Digestive disorders | 26 | 74.3% |
| Kussmaul breathing | 33 | 94.3% |
| acetonc breath | 29 | 82.5% |
| Fever | 18 | 51.4% |

Table 2. Distribution according to factors triggering diabetic ketoacidosis.

| TRIGGERING FACTORS | CASES | PERCENTAGE |
|----------------------------------|-------|------------|
| Malaria | 25 | 71.4% |
| Urinary tract infection | 15 | 42.8% |
| Pneumonia | 2 | 5.7% |
| Insulin interruption | 2 | 5.7% |
| Skin infection | 2 | 5.7% |
| Infection au foyer non determine | 12 | 34.28% |

**Figure 2.** Diabetic ketoacidosis outcome.

Therapeutically, 35 patients were hydrated with saline then glucose serum, insulin therapy at 0.1 IU/kg/h was started 1 hour after hydration for each patient. According to the triggering factors, 25 (71.4%) patients were treated with injectable artesunate and 17 (48.5%) patients had received Ceftriaxone IV and Gentamycin IV.

Table 3. Distribution according to clinical manifestations and death.

| Manifestations cliniques | Décès | | P |
|--------------------------|-------|-----|-------|
| | oui | Non | |
| kussmaul breathing | 14 | 19 | 0.23 |
| Dehydration | 14 | 13 | 0.009 |
| Coma | 12 | 10 | 0.02 |
| Hemodynamic disorders | 8 | 6 | 0.02 |
| Digestive disorders | 11 | 15 | 0.63 |

3.2. Analytical Study

Death-related factors were age between 10 and 15 years, comorbidity with malaria, undetermined infectious focus, and urinary tract infection. Other associated factors were Kussmaul breathing, coma, dehydration, and hemodynamic disorders (**Table 3**).

4. Discussion

Diabetic ketoacidosis, an absolute medical emergency, is frequent in children in N'Djamena. The hospital frequency of diabetic ketoacidosis in children, estimated at 0.14%, is worrying but relatively low compared to the data in the literature, whose reported frequencies are 0.7% and 6.49% [1] [8].

These disparities are explained by the sample size and the characteristics of the study population. As already reported, ketoacidosis is often observed in children between 8 and 10 years of age, as in this study, where the mean age was 10.9 years [9]. Some authors report higher frequencies in children under 10 years of age [10]. In this study, those aged 5 to 10 years represented 25.7% and those aged 10 to 15 years 74.3% of the study population. Our results differ from those of Fikaden BH *et al.* [10], who reported 34% for the 5 - 9-year-old age group and 40% for the 10 - 15-year-old age group, respectively. The difference is since in this study, only children aged 5 to 15 years were included, unlike the study by A. N. Onyiriuka *et al.*, which included infants and children aged 0 to 15 years [11]. Diabetic ketoacidosis is more common in boys [1] [12], representing 57.1% of our study population—Oko *et al.* in Congo Brazzaville report data contrary to ours concerning sex [3]. Ketoacidosis often reveals diabetes, as was the case in this study where it was inaugural in 65% of cases, and in the work of Oko and Henri GM with 67% and 79.3% [3] [5].

The symptomatology of diabetic ketoacidosis classically includes signs related to hyperglycaemia associated with nausea and vomiting and, especially in children, abdominal pain [1]. In our study, the signs noted, all related to a more severe decompensation, are the same as elsewhere [13] [14]. They are Kussmaul breathing, acetone breath, dehydration, and coma. All these signs have as a common denominator the delay in the decision to consult and transfer to specialised structures. The corollary of the delay in consultation is the high blood

glucose level [3]. As in this study, the median level on admission was 4.47 g/l with transient electrolyte disturbances, including hyponatraemia and hypokalaemia during diabetic ketoacidosis, which is well known [15].

The triggers of diabetic ketoacidosis in Sub-Saharan Africa, the same as those reported in this study, are dominated by bacterial infections, malaria, and non-adherence to insulin therapy [16] [11] [17].

Therapeutically, 35 patients were hydrated with saline then glucose serum, insulin therapy at 0.1 IU/kg/h was started 1 hour after hydration for each patient [7].

The treatment of triggering factors, 25 (71.4%) patients were treated with injectable artesunate [18] and 17 (48.5%) patients had received Ceftriaxone IV and Gentamycin IV.

The average length of hospital stays, evaluated at 7.6 days, is similar to that reported by Sarr A. [19] and Mohamed A. Life-threatening condition due to diabetic ketoacidosis varies from country to country and according to the state of the health system. It is 1 to 2% in the West [20], 18% in Congo according to OKO [5], 25% by Neal Ramesh P. in India [21] and 40% for us. Death-related factors were in our study as those found in the African literature. They are depth of coma ($p = 0.02$), infection ($p = 0.000$), dehydration (0.009) and the probable inefficiency in the correction of hydro-electrolytic disorders [5].

Our study is the first devoted specifically to diabetic ketoacidosis in children in N'Djamena. The precariousness of the parents of the patients, no ECG to screen for hypokalaemia, the ionogram was not carried out systematically because of financial difficulties. The high mortality rate is explained by the limits in the quality of care.

We note that there were no conflicts of interest in this study.

5. Conclusion

Diabetic ketoacidosis in children is frequent and severe in N'Djamena because of the high case fatality rate. It is more frequent in older children and often inaugurates diabetes. Bacterial infections, especially urinary tract infections and malaria, are the primary triggers. Coma, dehydration, hemodynamic disorders, children aged 10 to 15 years, malaria and infections of unspecified sites are associated with death. The challenge is to decrease the frequency of DKA in children by making the diagnosis earlier in the course of the disease.

Conflicts of Interest

The authors declare no conflicts of interest.

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Appendix. Data Collection Sheet

I. Epidemiological aspects

- Sex, age, place of origin (province or N'Djamena);
- Duration of diabetes

II. Clinical manifestations

- Fever:
- Coma:
- Kusmaul's dyspnoea:
- Signs of dehydration:
- Dipstick:
- Digestive disorders:
- Hemodynamic disorders:
- Acetone breath:
- Triggering factors:

III. Paraclinical manifestations

- NFS;
- malaria test,
- Blood ionogram
- Urea:
- Creatinine

IV. medical care

- Rehydration;
- Insulin therapy
- Treatment of the risk factor

V. Evolution aspects

- Favorable evolution;
- Duration of hospitalization
- Death