

# Determining Factors of Mortality by Acute Metabolic Complications of Diabetes in the Emergency Department, Hospital of Soavinandriana, Madagascar

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**Abstract:** Introduction: Acute metabolic complications expose diabetic patients to hospital morbidity and mortality. Our study aims to describe the mortality due to these complications in the emergency department in the hospital of Soavinandriana and to determine the factors involved. Methods: This was a cross-sectional analytical study of diabetic patients admitted for acute metabolic complications in the Emergency Department of the Hospital of Soavinandriana, during a period of 24 months. Results: One hundred and five diabetics by three thousand diabetics admitted were selected for the study, giving a prevalence of 3.50%. Diabetes was type 2 in 96.19% of cases, with an average duration of evolution of 8.95 years, forty percent did not follow any treatment. The duration of diabetes between 10 and 15 years were the most frequently affected. Glycated haemoglobin was  $\geq 7\%$  in 70.30% of cases. Ketoacidosis was the most found acute metabolic complication (43.80%), followed by hypoglycemia (28.57%) and hyperosmolar hyperglycemic syndrome (27.62%). With a rate of 26.66%, in-hospital mortality was significantly associated with advanced age, impaired consciousness with glasgow scale less than 12, very high blood glucose, 3+ glucosuria and hypokalemia. Conclusion: Therapeutic education of patients and improvement of accessibility to care are key points to minimize the occurrence of these complications.

**Keywords:** Diabetic Ketoacidosis, Hyperglycemic Hyperosmolar Nonketotic Coma, Hypoglycemia, Madagascar, Mortality

## 1. Introduction

Acute metabolic complications of diabetes include diabetes ketoacidosis (DKA), hyperosmolar hyperglycemia syndrome (HHS), hypoglycemia and lactic acidosis. They are important causes of mortality in diabetic patients. In Africa, their mortality rates are alarming, respectively 10 to 30% for DKA [1], forty-one percent for HHS [2].

The more fatal context of diabetes and its more pronounced susceptibility to acute decompensations is

particular to the African continent, all this because of a problem of technical platform and a wide habit to consult traditional practitioners but also the higher frequency of other types of atypical diabetes: African diabetes and diabetes related to malnutrition on this continent [3, 4].

No study grouping all these acute metabolic complications has been performed in Madagascar, which motivated us to carry out the present study.

The objective of the present study was first to describe the frequency and mortality due to acute metabolic complications

of diabetes. Secondly, to determine the factors associated with mortality due to these acute metabolic complications.

## 2. Methods

This is a cross-sectional and analytical study carried out in the emergency department of the Hospital of Soavinandriana, which is one of the major hospitals in the capital of Madagascar. Our study population was known or newly detected diabetic patients admitted to this service during the period from January 1, 2019 to December 31, 2020 (24 months). Known or newly diagnosed diabetic and having the required examinations for the diagnosis of one of these acute metabolic complications of diabetes were selected.

We used the following diagnostic criteria to diagnose these different metabolic complications:

DKA is retained in the presence of capillary ketonemia greater than 0.5 mmol/L or frank ketonuria, associated with a metabolic acidosis with a high anion gap and a blood glucose level greater than 250 mg/dL [5]. HHS is in front of hyperglycemia  $\geq 600$  mg/dL and plasma osmolality  $> 350$  mosmol/l and no acidosis. Hypoglycemia is retained in front of a capillary glycemia  $\leq 70$  mg/dl verified in each patient admitted [6]. A lactic acidosis is retained in case of A metabolic acidosis a decrease in alkaline reserve and pH with or without ketosis (arterial pH lower than 7.25); a presence of an anion gap (filled by lactic acid) and a very increased arterial lactacidemia (higher than 5 mmol/l) [7]. Diabetes typing and diagnostic criteria was done according to the recommendation

of the American diabetes association [8].

The variables studied were age, type and duration of diabetes, associated comorbidities, type of metabolic complication, presence of consciousness and respiratory disorders at entry, diabetes progression, diabetes control for previously known diabetics, biological examination elements and patient outcome, number of deceased. The data were collected using a pre-established questionnaire filled in from the patients files.

Data processing was done on MS Excel® 2016 and SPSS® software version 25.0. The statistical test used was Pearson's Chi-square test. The significance level of p-value was less than 0.05.

## 3. Results

Among the 3000 diabetics admitted to the study site, one hundred and five individuals had one of the acute metabolic complications and were retained, giving an overall prevalence of 3.50%. The mean age of our patients was  $62.28 \pm 2.5$  years with an extreme of 15 years to 84 years. The most represented age group was 60 years and over (58.09%). A female predominance was found (sex ratio=0.7). Type 2 diabetes predominance was found (sex ratio=0.7). Type 2 diabetes predominated in terms of frequency (n=101, 96.19%). The remaining patients had type 1 diabetes (n=4; 3.81%). Diabetes that had progressed between 10 and 15 years was the most common (Figure 1).

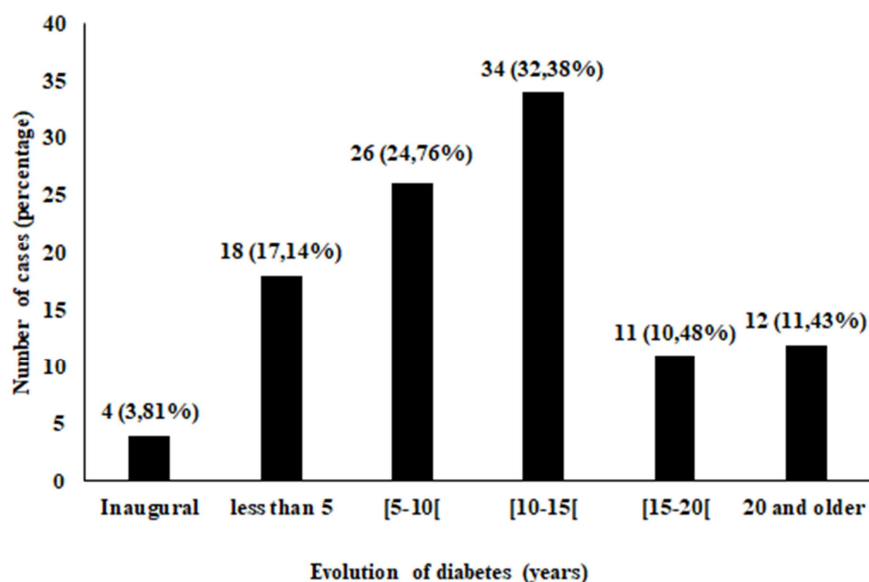


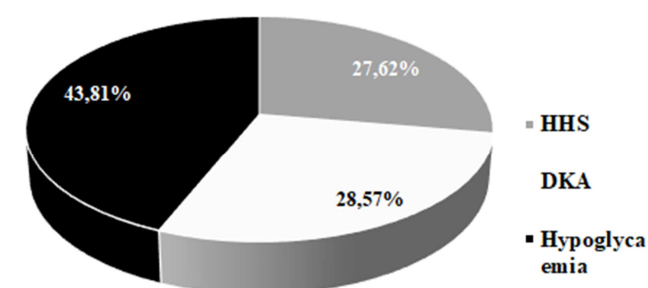
Figure 1. Evolution of diabetes.

Of the 101 patients previously known to be diabetic before admission, forty-two patients had not been treated (40%). For the remaining 63 patients, thirty-eight had at least one oral antidiabetic in their treatment and twenty-five had at least insulin. It should be noted that one patient could have several anti-diabetic drugs in his therapeutic arsenal.

Only 30 patients (25.67%) among these previously known

diabetics had a glycated hemoglobin level  $< 7\%$ , all the rest (n= 71; 70.30%) had a level  $\geq 7\%$ .

Hypoglycemia was the most frequently presented acute metabolic complication with a frequency of 43.81%. It was followed by DKA (28.57%) and HHS (27.62%) (Figure 2). None of the patients had presented with lactic acidosis.

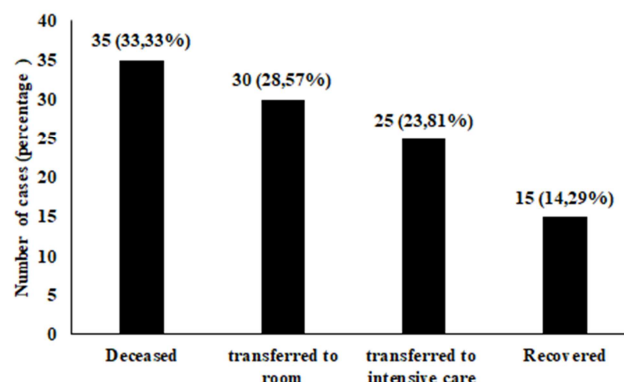


DKA: diabetic ketoacidosis; HHS: hyperosmolar hyperglycemia syndrome

**Figure 2.** Frequency of acute metabolic complications of diabetes.

Consciousness disorders (n=93; 88.57%) such as coma or obtundation and respiratory disorders (n=65; 61.90%) were the most common signs of acute metabolic complications.

Mortality due to acute metabolic complications of diabetes was found to be 33.33%. The different outcomes of the patients are shown in figure 3.



**Figure 3.** Issue of patients.

Concerning the determining factors of mortality by this acute metabolic complication of diabetes: advanced age, disorders of consciousness, high blood glucose levels over 500 mg/dL, glycosuria +++, and hypokalemia were found significantly (Table 1).

**Table 1.** Determining factors of mortality by acute metabolic complications of diabetes.

	Alive	Deceased	p-value
Age (years)			
[15-30]	4 (3,81%)	0 (0%)	---
[30-45]	4 (3,81%)	0 (0%)	---
[45-60]	30 (28,54%)	6 (5,7%)	---
60 and older	38 (36,19%)	23 (21,90%)	0,01
Admission reason			
Disturbances of consciousness	75 (71,43%)	30 (28,57%)	0,001
Respiratory disorder	92 (87,62%)	13 (12,38%)	0,067
Blood glucose level (mg/dl)			
High	30 (28,57%)	24 (22,85%)	0,0001
[250 -500]	19 (18,09%)	2 (1,94%)	---
[70 -54]	4 (3,80%)	3 (2,85%)	---
[54-	13 (12,38%)	0 (0%)	---
Low	4 (3,80%)	6 (5,71%)	---
Glycosuria			
2 +	22 (20,95%)	3 (2,85%)	---
3 +	18 (17,14%)	32 (30,47%)	0,0003
Dyskalemia			
Hyperkalemia	5 (8,10%)	0 (0%)	---
Hypokalemia	34 (32,67%)	19 (57,06%)	0,018

## 4. Discussion

Despite the monocentric nature of the study and given the small size of the unrepresentative sample, recruitment bias could arise but also a more in-depth statistical analysis was not possible.

The frequency of acute metabolic complications of diabetes found in our study, which was 3.50%, was similar to that found in the literature [9]. The age of the patients was higher in terms of average of  $62.28 \pm 2.5$  years [15 to 84 years] compared to that of a study dealing only with DK carried out in another hospital of Antananarivo which found an average of  $46.3 \pm 17.3$  years [10]. This finding is quite logical because DK preferentially affects patients with type 1 diabetes who are often younger.

The frequency of type 2 diabetes is no longer a surprising

situation because despite the great heterogeneity of diabetic states, type 2 remains at the top in terms of frequency.

The duration of diabetes between 10 and 15 years were the most frequently affected. After 5 years of evolution, diabetics generally develop acute metabolic complications according to the World Health Organization [11], the decline of beta-cellular function could be an explanation for type 2 diabetes [12].

The frequency of non-adherence to antidiabetic treatment, which amounts to 40%, is not surprising, as an association between poor adherence and poor metabolic profile has been well demonstrated [13]. But also a higher susceptibility to diabetic imbalance in African Americans could explain the situation [13]. Diabetes imbalance in the 70.30% of patients is still based on the notion of non-compliance and irregularity of follow-up. The absence of a clear explanation has been found as a determinant of this problem of adherence of patients to

their antidiabetic treatment according to a Malagasy study [14], without ruling out financial problems which are often at the forefront of the obstacles preventing patients from continuing treatment [14] in a country without social security system such as Madagascar.

The higher frequency of hypoglycemia could be a sign of inadequate treatment: following a lack of follow-up or a problem of therapeutic education. According to Raheison et al [15], the presence of nephropathy, which has been neglected for a long time, is a more frequent cause of hypoglycemia in Malagasy diabetics.

Concerning the determining factors of mortality by this acute metabolic complication of diabetes: advanced age, consciousness disorders, high blood glucose levels of more than 500 mg/dL, glycosuria +++, and hypokalemia have been significantly found.

The mortality determinants found in our study were also those found in the literature. In particular, advanced age and dyskalemia [16-18]. The advanced age implies a long evolutionary diabetes which is certainly multi complicated, these complications are probably under diagnosed because of a lack of medical follow-up. Boucai et al underlines that the severity of acute complications, especially hypoglycemia, is related to the comorbidities associated with diabetes [17].

We suggest a specific tray adapted to therapeutic education or even a diabetes school for patients, all this in order to prevent these dreaded complications of diabetes that could wreak havoc on African soil.

## 5. Conclusion

Acute metabolic complications expose diabetic patients to significant morbidity and mortality. A problem of therapeutic education and accessibility and/or continuity of antidiabetic treatment make them more frequent in a country like Madagascar. The level of understanding and acquisition of knowledge useful for diabetes self-management is probably low. The evaluation of this knowledge must be done to reduce mortality due to these complications. The creation of a social security system and health insurance system could also contribute to this.

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