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Type 1 Diabetes in Bobo-Dioulasso: Clinical Features and Treatment Issues

Diabète de type 1 à Bobo-Dioulasso : particularités cliniques et difficultés thérapeutiques

Bagbila Wend PAH[1,3], Sagna Y[1,3], Drabo AL[2], Ilboudo A[1], Guira O[2,4], Kyelem CG[1,3]. Yaméogo TM[1,3], Ouédraogo SM[1,3], Drabo YJ[2,4]

[1] Service de Médecine Interne, Centre Hospitalier Universitaire Souro-Sanou, Bobo-Dioulasso, Burkina Faso.
[2] Service de Médecine Interne, Centre Hospitalier Universitaire Yalgado Ouédraogo de Ouagadougou, Burkina Faso.
[3] Institut Supérieure des Sciences de la Santé de Bobo-Dioulasso/ Université Nazi Boni, Burkina Faso.
[4] UFR/SDS, Université Joseph Ki-Zerbo, Ouagadougou, Burkina Faso.

Auteur correspondant : Bagbila Wend Pagnangdé Abraham Hermann
Mail: bagbilaabraham@gmail.com
Phone: +22678005736
Address: 01 BP 799 Bobo-Dioulasso (Burkina Faso)

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ABSTRACT

Background. Type 1 diabetes in Africa poses a problem of diagnostic and therapeutic delay related to poverty and insufficient technical facilities in health services. The objective was to determine the clinical characteristics and therapeutic difficulties related to the management of type 1 diabetes in Bobo-Dioulasso. **Materials and Methods.** This was a cross-sectional study of type 1 diabetic patients followed as outpatients in the internal medicine department of the CHU-SS over a 2-year period. All diabetic patients aged less than 35 years at the time of discovery of diabetes, whose diagnosis of diabetes mellitus was retained based on the WHO criteria for the diagnosis of diabetes mellitus and who met the clinical criteria for type 1 diabetes were included. **Results.** A total of 55 patients with type 1 diabetes were included. The sex ratio was 1.75. The mean age of the patients was 21.5 years. Leanness and overweight were noted in 27.3% and 14.5% of patients, respectively. Microangiopathy was present in 5.45% of patients. Diabetes was unbalanced in 74.4% of patients. Therapeutic difficulties were dominated by poor insulin storage (12.7%), therapeutic breakthrough (10.9%) and break in follow-up (25.5%). Death was noted in 3.6% of patients. **Conclusion.** Type 1 diabetes in Bobo has a male and adult face and difficulties marked by poor insulin conservation, therapeutic and follow-up failure.

RÉSUMÉ

Introduction. Le diabète de type 1 en Afrique pose un problème de retard diagnostique et thérapeutique lié à la pauvreté et au plateau technique insuffisant des services de santé. L'objectif de ce travail était de déterminer les caractéristiques cliniques et les difficultés thérapeutiques liées à la prise en charge du diabète de type 1 à Bobo-Dioulasso. **Matériels et Méthodes.** Il s'est agi d'une étude transversale chez des patients diabétiques de type 1 suivis en ambulatoire dans le service de médecine interne du CHU-SS sur une période de 2 ans. Était inclus tout patient diabétique âgé de moins de 35 ans à la découverte du diabète, dont le diagnostic de diabète sucré a été retenu sur les critères OMS du diagnostic du diabète sucré et satisfaisant aux critères cliniques du diabète de type1. **Résultats.** Au total, 55 patients diabétiques de type 1 étaient inclus. Le sex ratio était de 1,75. L'âge moyen des patients était de 21,5 ans. Une maigreur et une surcharge pondérale ont été notées respectivement chez 27,3% et 14,5% des patients. Une microangiopathie était présente chez 5,45% des patients. Le diabète était déséquilibré chez 74,4% des patients. Les difficultés thérapeutiques ont été dominées par la mauvaise conservation de l'insuline (12,7%), la rupture thérapeutique (10,9%) et la rupture de suivi (25,5%). Un décès a été constaté chez 3,6% des patients. **Conclusion.** Le diabète de type 1 à bobo a un visage masculin et adulte. Les difficultés de traitement étaient souvent liées àr la mauvaise conservation de l'insuline, la rupture thérapeutique et de suivi.

INTRODUCTION

Type 1 diabetes is an autoimmune disease caused by the destruction of the beta cells of the islets of Langherans of the pancreas. It represents 5 to 10% of cases of diabetes mellitus [1]. According to the International Diabetes Federation, the prevalence of type 1 diabetes was 600,900 and 1,110,000 for the under-15 and under-19 age groups respectively [2].

The prevalence of type 1 diabetes varies from one region to another, ranging from 12.2 per 10,000 people in America to 12.2 per 10,000 people in Europe, 6.9 per 10,000 people in Asia and 3.5 per 10,000 people in Africa[3]. The role of viral infections is well known in the pathogenesis of type 1 diabetes[4–6]. One would expect a high prevalence of the disease in the African continent given the high frequency of infectious diseases. On the contrary, Africa has the lowest prevalence of T1DM in the world[3]. Several factors are involved. First, clinical and treatment data for type 1 diabetes are scarce. They suggest a low prevalence and a later age of onset of the disease[7]. In addition, the 5-year survival of

type 1 diabetes is low, around 1%. This is due to the fact that the diagnosis and management of type 1 diabetes is very difficult; access to insulin is often limited and health services are insufficient [3]. Several studies report an early onset of complications, particularly renal and ocular [8]. The main problems associated with type 1 diabetes in African and other developing countries are late presentation of patients to health care centers, delayed and undiagnosed diabetes, expensive insulin, and poor glycemic control[8]. In addition to this, the lack of technical facilities and the high cost of laboratory examinations add to the burden of care. Mortality is thus early.

The lack of recent data on type 1 diabetes in Burkina Faso motivated this study, which aimed to describe the clinical characteristics and therapeutic difficulties encountered during the ambulatory follow-up of type 1 diabetic patients in the Internal Medicine Department of the CHU-Souro Sanou (CHU-SS) of Bobo-Dioulasso.

MATERIALS AND METHODS

Type of study

This was a retrospective cross-sectional study in type 1 diabetic patients followed as outpatients in the internal medicine department of CHU-SS between January 1, 2019, and December 31, 2020. A literature review was performed from the patients' consultation records.

Inclusion criteria

Any diabetic patient aged less than 35 years at the time of discovery of diabetes, whose diagnosis of diabetes mellitus was retained on the WHO criteria for the diagnosis of diabetes mellitus, was included [9]. Patients who presented the following elements suggestive of type 1 diabetes were included :

- a rapid and noisy onset
- a lean weight at the time of discovery of diabetes mellitus
- a major hyperglycemia higher than 3g/l at discovery
- ketosis+/- ketoacidosis at the time of discovery of diabetes
- absence of degenerative complications at diagnosis
- insulin tolerance at the time of discovery of diabetes (weight loss, asthenia, amyotrophy)
- having had recourse to insulin at the time of discovery of diabetes mellitus

Patients who did not meet at least 1 of the above requirements were not included.

Variables

Variables included sociodemographic characteristics, personal and family history, lifestyle, and anthropometric parameters (weight, height, waist circumference, body mass index, blood pressure). The clinical data collected were: circumstances of discovery of diabetes, age of discovery of diabetes, age of diabetes, acute complications (ketoacidosis, hypoglycemia, lactic acidosis, hyperosmolar hyperglycemia syndrome), chronic complications (macroangiopathies and microangiopathies), therapeutic data (insulin type, insulin dose, diabetes treatment regimen, diabetes control, therapeutic breakthrough, dietary and therapeutic errors, poor insulin storage), diabetes control status, patient outcome (patients in follow-up, lost to follow-up, or deceased)

Children were defined in our study as ages 0-19 years as of December 31, 2020, and adults as ages greater than 19 years (WHO).

Obesity was investigated using the Quételet body mass index (BMI) relating weight to the square of height. An adult was considered overweight when the BMI was greater than or equal to 25 kg/m2 and less than 30 kg/m2, and obese when the BMI was greater than or equal to 30 kg/m2.For patients aged 0 to 19 years, the BMI/age curve was used. Abdominal obesity was defined as a waist circumference greater than or equal to 94 cm in men and 80 cm in women.

Statistical analysis

Data are expressed as headcount, percentage, and/or mean±standard deviation from the mean. A descriptive analysis of the data was performed.

Ethical considerations

Data collection and processing was done in strict compliance with the patients' anonima. Patient names have been replaced by order numbers.

RESULTS

Table 1 summarizes the sociodemographic, clinical, and paraclinical characteristics of the type 1 diabetes patients in the study.

Table 1: Distribution of patients by socio-demographic characteristics

		Children	Adults	Total
Type 1 diabetes		19	36	55
Mean Age (years)		16,3	23,5	21,4
Sex	Men	10	25	35
	Women	6	14	20
Occupation	Student	13	17	30
	Merchant	1	6	7
	Cultivator	0	4	4
	Housewife	1	6	7
	Unemployed	1	3	4
	Dressmaker	0	3	3
Residence	Urban	11	27	38
	Rural	5	12	17
Level of study	Not attending school	1	17	18
	Primary	4	2	6
	Secondary	11	16	27
	Superior	0	4	4

Sociodemographic data

A total of 55 patients with type 1 diabetes were included. The mean age of the patients was 21.5 years +/-4.5 years (extremes: 12 - 35 years). The age groups 15-20 and 20-25 were the most represented with 41.8% (n=23) and 30.9% (n=17) of the patients, respectively. There were 35 males and 20 females for a sex ratio of 1.75. The study population was composed of 34.5% (n=19) children and 65.5% (n=36) adults under 35 years of age. Students were the dominant occupation with 54.5% (n=30). The most represented level of education was

high school with 49.1% (n=27). Most patients came from Bobo-Dioulasso (69.1%, n=38).

Clinical and paraclinical features

Table 2 summarizes the clinical and paraclinical characteristics of the type 1 diabetes patients in the study. The mean age of onset of diabetes was 17.7 +/-5.0 years (extremes: 6 -31 years). In 47.3% (n=26), the age of onset was less than 18 years. The mean duration of diabetes was 41.8 +/-30.4 months (3.5 years) (extremes: 1 - 158 months). The mean duration of diabetes follow-up was 24.9 +/-15.2 months (Extremes: 1 and 71 months). A family history of diabetes and hypertension was found in 9.1% (n=5) and 5.5% (n=3) of patients, respectively. The main circumstance for the discovery of diabetes was ketoacidosis, 76.4% (n=42). The mean weight was 57.4 +/-14.1 kg (extremes:30- 92kg). The mean body mass index (BMI) was 20.9 +/-3.9 kg/m2 (extremes: 11.9 - 31.1 kg/m2). BMI was normal in 58.2% (n=32). Leanness was noted in 27.3% (n=15) of patients and overweight in 14.5% (n=8). One patient had hypertension. Ketoacidosis complicated the diabetes in 27.3% (n=15) of patients. Microangiopathy was present in 5.45% (n=3) of the patients with diabetic nephropathy, 3.6% (n=2) and diabetic retinopathy, 1.8% (n=1).

Glycated hemoglobin was performed in 39 patients (70.9%). Diabetes was unbalanced in 74.4% (n=29) of them.

Table 2: Distribution of patients by clinical and paraclinical characteristics

		Children	Adults	Total
Family Background	Diabetes Mellitus	0	5	5
	High Blood Pressure	0	3	3
Body Mass Index	Underweight	10	5	15
	Normal	10	22	32
	Overweight	1	7	8
	Obesity	0	1	1
Diabetic Microangiopathy	Retinopathy	1	0	1
	Nephropathy	1	1	2
	Neuropathy	0	0	0
Diabetes Control	HbA1C less than 7.5%	4	10	14
	HbA1C less than 7.5%	4	6	10

Therapeutic characteristics

Table 3 summarizes the therapeutic characteristics of the type 1 diabetic patients in the study. All patients were treated with human insulin. They received therapeutic education for insulin self-administration and capillary glucose monitoring. NPH and regular insulin mixtures were used in the majority, 90.9% (n=50). The average total daily dose was 42.7 IU +/- 15.1 (extremes: 12 -80 IU). Mean dosage was 0.8 IU/Kg/day +/- 0.3 (Extremes: 0.3-1.6 IU/Kg/day). The 2- and 3- injection basal-bolus regimens were used in 76.4% (n=42) and 23.4% (n=13) of patients, respectively. Patients monitored their capillary glucose levels 3 times a day in 34.5% (n=19) of cases and twice a day in 18.2% (n=10) of patients. No monitoring was performed in 40% (n=22) of patients. Insulin was kept in the refrigerator in 30.9% (n=17) of patients and in a cooler with ice in 67.3% (n=37). Dietary errors were noted in 14.5% (n=8) and therapeutic errors in 12.7% (n=7). Poor asepsis with arm abscesses was noted in 1.8% (n=1). Poor insulin storage was noted in 12.7% (n=4) of patients, therapeutic failure in 10.9% (n=6) and follow-up failure in 25.5% (n=14). Over the 2 years evaluated, 25.5% (n=14) of patients were lost to follow-up and 3.6% (n=2) died of ketoacidosis due to discontinuation.

Table 3: Distribution of patients by therapeutics characteristics

		Children	Adults	Total
Insulin Regimen	2 injections	12	30	42
	3 injections	4	9	13
Capillary Blood Glucose	None	4	18	22
	1 time	0	4	4
	2 time	2	8	10
	3 time	10	9	19
Insulin storage method	Refrigerator	7	10	17
	Icebox	12	25	37
	Canary	0	1	1
Poor insulin storage		4	1	5
Dietary error		3	6	9
Therapeutic error		2	5	7
Poor asepsis		0	1	1
Therapeutic break		2	4	6
Break in follow-up		2	12	14
Evolution	Lost to view	1	13	14
	In process of follow-up	14	25	39
	Death	1	1	2

DISCUSSION

The limitations of our study are essentially the non-realization of autoantibodies specific to type 1 diabetes. This is due to the lack of technical facilities and the high cost of these tests for our population. Despite these limitations, our study revealed a profile of type 1 diabetics followed at the University Hospital of Bobo-Dioulasso: they are more often boys, on average 21 years old, diagnosed 3.5 years ago on average, whose diabetes occurred on average at the age of 17.8 years and who have been followed at the University Hospital of Bobo-Dioulasso for an average of 2 years.

The prevalence of type 1 diabetes varies from one geographical region to another and according to the age group studied in the literature[10]. The incidence increases from birth and decreases after puberty with a peak between 10-14 years of age [10,11]. In Africa, few data exist, limited to hospital series and not generalizable to the whole population[8,12]. The mean age at diagnosis of type 1 diabetes in our study was 17.8 years. This age is higher than that of Pambou Damiens et al in 2019 in Gabon of 16 years[1] and that of Al Rashed et al in 2011 in Saudi Arabia of 12.3 years[13]. It is lower than those of the South African and Ethiopian series which were 22 and 19.4 years respectively[14]. This difference could be

related to a difference in methodology between the different studies. Indeed, some studies have studied diabetes mellitus in children [15,16] and others on type 1 diabetes [1,17]. Other studies have also studied diabetes mellitus exclusively in children and adolescents [15,18]. The literature agrees that the age of onset is later in Africa than elsewhere and the reasons for this remain unknown [19]. In our study, type 1 diabetes was discovered after hospitalization for diabetic ketoacidosis in 76.4% (n=42). In developed countries such as France, in 75% of cases, it is diagnosed in front of a cardinal syndrome associating polyuro-polydipsia, polyphagia and weight loss and in 25% of cases in front of ketoacidosis [20]. The difference could probably be related to a delay in diagnosis in our country [1].

Chronic complications such as microangiopathies noted in 5.45% (n=3) of patients were diabetic nephropathy in 3.6% (n=2) of patients and diabetic retinopathy in 1.8% (n=1) of patients. Al Rashed in 2011 [13] reported a prevalence of chronic complications such as retinopathy in 1.3% (n=4), neuropathy in 0.6% (n=2) of patients, coronary artery disease in 0.6% (n=2) and nephropathy in 0.4% (n=1) over a 12-year period. After a 12-year period following diagnosis, Huang-Tz Ou et al in 2017 [21] reported a cumulative incidence of retinopathy at 65.2%, followed by nephropathy at 30.2%, neuropathy at 23.7%, and cardiovascular disease at 4.1%. Chronic microangiopathic complications are specific to diabetes mellitus and are the cause of retinopathy and nephropathy usually occurring within 5 years of the discovery of type 1 diabetes[22]. No macroangiopathy was reported in our study. This may be due to the short average duration of progression, less than 5 years, in our study. It is commonly accepted in the literature that type 1 diabetes in adolescents is balanced for an HBA1c of less than 7.5% and in adults for an HBA1C of less than 7% [23–25]. Type 1 diabetes requires the use of insulin without which death is inevitable [1]. The objectives of treatment are to prevent acute and chronic complications while promoting normal growth, especially in adolescents and children [27]. In our study, only 23.1% (n=6) were balanced. This high glycemic imbalance of 76.9% (n=49) could be related either to a lack of capillary blood glucose monitoring, or to poor insulin storage or therapeutic breaks. Indeed, self-monitoring of blood glucose has a positive impact on glycemic control [26]. Therapeutic education has a predominant place in the management of diabetes mellitus. Glycemic control is related to the quality and intensity of therapeutic education [24].

The average dosage of insulin therapy is less than 1 IU/kg/day. This could be due to the absence of capillary glucose monitoring in 40.0% (n=4) of patients, which is an obstacle to the optimization of insulin therapy. In fact, one of the major challenges of insulin therapy is the conservation of insulin[28]. In our context, the absence of a refrigerator due to poverty leads our patients to resort to the use of a cooler supplied with ice. Moreover, in our study, the main method of insulin storage was the ice box supplied with ice in 67.3% (n=37) of cases. Indeed, the pharmacodynamics and pharmacokinetics of insulin mixtures are affected by the temperature of the insulin vials[29]. Both 2- and 3-injection basal-bolus regimens were prescribed to the patients in our study. Glycemic control does not depend on the number of daily injections and can be achieved even with two daily injections[18]. During the two years of the study 3.6% (n = 2) of deaths were reported in our study. Pambou et al in 2019 in Gabon reported a hospital prevalence of 7%[1]. Keiko et al in 2003 in Japan reported a mortality of 9.7% over a period of 15 years[30]. Mortality in Africa is higher than in developed countries[20] and could be linked to several factors, in particular the inadequacy of the technical platform, the accessibility of health care services, the high cost of diabetes mellitus management; this leads to a delay in management which causes acute complications including ketoacidosis and the death that may follow. All these obstacles to management raise several questions.

What is the effect of therapeutic education on the management of type 1 diabetic patients? What is the role of national leaders and politicians in the management of type 1 diabetic patients? These are all questions that could be the subject of new studies.

CONCLUSION

Type 1 diabetes in Burkina Faso, like in other African countries, presents clinical and therapeutic particularities marked by a higher age of discovery than in the West, a predominantly acute complication, a glycemic imbalance with several imbalance factors such as therapeutic rupture, follow-up rupture, poor insulin conservation, therapeutic and dietary errors. The intervention of national and international policies is necessary for an efficient management.

Conflicts of interest

The authors do not declare any conflict of interest.

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