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Childhood Diabetes Mellitus at the University Teaching Hospital of Bouaké(Côte d'Ivoire) about 25 Cases

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Abstract

***Background:** In Côte d'Ivoire, more and more cases of diabetes are being discovered in children in Bouaké. The aim of the study was to describe the main epidemiological, clinical, therapeutic and evolutionary aspects of this condition for the improvement of prognosis.*

***Methods:** This is a cross-sectional, descriptive study conducted in pediatrics wards at the Bouaké University Hospital from January 2012 to December 2017. It included all children with diabetes diagnosed on the basis of clinical-biological arguments. The variables studied were epidemiological, clinical, therapeutic and progressive.*

***Results:** 26,130 admissions recorded, including 25 cases (16 females, 9 males) of diabetes or 1 case/1,000 admissions. The average age of discovery was 11.6 years (3 years - 17 years). Ketoacidosis revealed the disease in 72%. The other signs were: polyuro polydypsia syndrome (92%), weight loss (64%), fever (48%), coma (44%), diarrhea & vomiting (36%), collapse (12%), initial average initial blood sugar and glycated hemoglobin were 4.9 g /l[2.7 g/l-9.5 g/l] and 11.5%[5.2%-18%] respectively. Insulin therapy was instituted in 100% of cases. The favourable trend and lethality were 72% and 16% respectively. Factors associated with death were collapse (p = 0.001), coma (p = 0.026) and infection (p = 0.002).*

***Conclusion:** Diabetes mellitus mainly affects school-age children. It is revealed by ketoacidosis in the majority of cases with high lethality. To improve prognosis, resource capacity must be strengthened and parents must be made aware of the need to consult the hospital early.*

Keywords: *Child, Diabetes, Insulin therapy, Evolution, Côte d'Ivoire.*

Introduction

Diabetes mellitus, a consequence of a lack of insulin action or secretion [1], is defined by the World Health Organization [2] and the American Diabetes Association (ADA) [3] as follows: i) fasting blood glucose greater than or equal to 126 mg/dl (7 mmol/l) twice; ii) postprandial or occasional blood glucose greater than or equal to 200 mg/dl (11.1 mmol/l) in the presence of clinical signs of diabetes; iii) glycosylated hemoglobin greater than 6.5%. It is a chronic metabolic disease whose incidence in children is increasing in many countries around the world. About 86,000 children develop diabetes each year worldwide [4]. Childhood diabetes is primarily represented by type 1 diabetes (T1DT), insulin-dependent, of autoimmune origin[5]. The exact causes of T1DT are not yet known with certainty, but studies have shown the existence of genetic factors on which environmental factors combine to trigger the disease [6, 7]. Conversely, type 2 diabetes occurs mainly in obese children with a family history of type 2 diabetes or born to a diabetic mother [7]. In Côte d'Ivoire, the first cases of childhood diabetes were described in 1995 by Lokrou et al [8] from a series of 83 cases collected over 11 years. In 2016, Agbre-Yace et al [9] reported a prevalence in the city of Abidjan of 0.4%. These various studies did not sufficiently describe the profile of the diabetic child. This is an obstacle to

improving the prognosis of childhood diabetes in Côte d'Ivoire. The paediatric ward of the Bouaké University Hospital is the reference hospital in the Gbêké region. It has an endocrinology unit that provides care for diabetic children. The objective of the study was to describe the main epidemiological, clinical, therapeutic and progressive aspects of these diabetic children treated for prognostic improvement.

Methods

Type, Location and Period of the Study

This was a descriptive cross-sectional study carried out in the endocrinology unit of the paediatrics department of the University Teaching Hospital of Bouaké from January 1, 2012 to December 31, 2017. Before 2017, the parents were responsible for the care of the diabetic child. But since 2017, with the Changing Diabetes in Children project supported by the pharmaceutical company Novo Nordisk A/S in collaboration with the Ministry of Health and Public Hygiene, care has become free. The unit is supplied, as part of the project, with insulin and consumables (insulin syringes, lancets, blood glucose meters, blood glucose and urine strips, glycated haemoglobin reagents). In addition to insulin, the diabetic child receives a free glucose meter with test strips for self-monitoring of blood glucose levels. The team of the unit in charge of diabetic children is composed of 4 doctors; 3 nurses and 1 nurse's assistant. This team provides day care for diabetic children as part of follow-up visits and also emergency care in the event of diabetic ketoacidosis or severe hypoglycemia.

Study Population

The study population consisted of children in care for diabetes diagnosed according to the diagnostic criteria of the World Health Organization and the American Diabetes Association (ADA) [2, 3].

Inclusion and Non-Inclusion Criteria

We included any child or adolescent admitted and cared for in the diabetes unit selected at the end of clinical and paraclinical investigations. Children with diabetes with inoperable records or who died early after admission were not included in the study.

Sampling and Study Sample

The sampling was exhaustive and the sample consisted of all cases meeting the inclusion criteria during the study period,

Conduct of the Study

Diabetic children with ketoacidosis were admitted to pediatric emergency rooms and received first rehydration for 2 hours after admission before insulin therapy began. Insulin therapy began with rapid insulin at a dose of 0.05 U/kg/h for children under 5 years of age and 0.1 U/kg/h for children over 5 years of age as a direct intravenous injection, concomitant with the electrolyte-enriched saline or glucose serum hydroelectrolysis based on hourly monitoring data for glycosuria, ketonuria and the child's clinical condition. The relay with intermediate insulin was done 6 hours after the negativation of ketonuria and glycosuria. The therapeutic education of the child and his parents was done in hospital a few days before discharge in case of a favourable evolution of the patient. Subsequent follow-up of the child was done during routine visits to assess glycemic control and growth, adapt insulin therapy, and strengthen therapeutic education. All information about the child and his or her family, the care provided and the progress under treatment was recorded in a medical file.

Data Collection

For data collection, we developed a survey sheet providing information on epidemiological, clinical, therapeutic and evolutionary aspects and then completed the survey sheet with an anonymity number.

Variables Studied

The variables studied concerned the:

- socio-demographic characteristics: age, sex, educational level of the child and parents, place of residence, place of residence, nationality, father/guardian's profession, family diabetes,
- clinical and paraclinical characteristics: clinical (age and circumstances of discovery of diabetes, reason for consultation, symptoms and clinical signs), paraclinical (blood glucose, HbA1C),
- therapeutic management and evolution: treatments (insulin therapy, specific and non-specific), duration of hospitalization, iatrogenic hypoglycemia and evolution.

Ethical Considerations

A prior investigation authorization had been obtained from the Scientific Medical Directorate of

the University Hospital with amplification to the Head of the Paediatrics Department. The information collected in the study was made anonymous by a coding system.

Statistical Analysis

The data entry and processing were done on the Epi info version 7 software. The statistical analysis was descriptive. It consisted in calculating numbers, determining averages and comparing proportions. For this comparison we used the Chi-square test or the exact Fisher test with a significance threshold of 5%.

Results

Epidemiological Aspects

During the study period, 26,130 children were admitted to paediatrics, including 28 cases of diabetes mellitus, representing a hospital prevalence of 1 per thousand admissions. Of the 28 cases of diabetes, 25 cases were selected for the study. There were 9 boys and 16 girls, a sex ratio of 0.56. The average age was 12 years with extremes of 4 and 17 years. The age group 10 - 14 years represented 64% of the study population. School-age children were enrolled in school in 54.2% of cases. The mother and father of the diabetic child were illiterate in 84% (21/25) and 68% (17/25) respectively. The mother was a housewife in 60% (15/25) of cases and the father was working without a fixed salary in 84% (21/25) of cases. Family diabetes was found in 12% (3/25) of cases. It was a diabetes found in the siblings. The main socio-demographic characteristics of the diabetic child and the parents are shown in Table I.

Table I. *Socio-demographic characteristics of the child and mother*

Socio-demographic characteristics	Number	Percentage
Child		
Gender		
Male	9	36
Female	16	64
Age groups		
0-4	1	4
5-9	3	12
10-14	16	64
15-19	5	20
Place of residence		
Urban	20	80
Rural	5	20
Level of education		
Not of school age	1	4
Primary school	7	28
Secondary school	6	24
Not in school	11	44
Family diabetes		
Yes	3	12
No	22	88
Mother		
Educational level		
Primary school	0	0
Secondary school	2	8
Superior	2	8
Not in school	21	84
Profession		
Housewife	15	60
Trader	7	28
Civil servant	3	12
Father		

Educational level		
Primary school	3	12
Secondary school	2	8
Superior	3	12
Not in school	17	68
Profession		
Activity with fixed remuneration	4	16
Activity without fixed remuneration	21	84

Diagnostic Aspects

The age at which diabetes was discovered was 11.6 years with extremes of 3 and 17 years. The main reasons for consultation were hyperglycemia (28%) and convulsions/coma (20%). Ketoacidosis was the circumstance of diabetes discovery in 72% (18/25). The reasons for consultation and the circumstances of discovery are presented in Tables II and III respectively. Polyuro-polydiptic syndrome (92%), weight loss (64%) and fever (48%) were the main functional signs found during the interview. The main signs found on physical examination were weight loss (56%), dehydration (52%), coma (44%) and fever (28%). The mean blood glucose level was 4.9 g/l [2.7 - 9.57] and the mean glycated hemoglobin was 11.58% [5.2-18]. The clinical characteristics of diabetic children are illustrated in Table IV.

Table II. *Reason for consulting diabetic children*

Reasons	Number	Percentage
Hyperglycemia	7	28
Convulsions/Coma	5	20
Respiratory distress	3	12
Ketoacidosis	3	12
Digestive disorder	2	8
Slimming	2	8
Adynamics	2	8
Polyuro-polydipsic syndrome	1	4
Total	**25**	**100**

Table III. *Circumstances of diabetes discovery*

Functional signs	Frequency of occurrence	Percentage
Polyuro-polydipsic syndrome	23	92
Slimming	16	64
Fever	12	48
Diarrhea - Vomiting	9	36
Convulsions/ Coma	5	20
Respiratorydifficulty	3	12
Adynamics	2	8
Abdominal pain	2	8

Table IV. *Physical signs*

Physical signs	Frequency of occurrence	Percentage
Slimming (BMI <18)	14	56
Dehydration	13	52
Coma	11	44
Fever (T ≥ 38º)	7	28
Respiratorydistress	5	20
Dermatosis	5	20
Cardiovascular collapse	3	12
Crackling rails	3	12
Inflammatory eardrum	2	8
Acetoticodour of breath	2	8

Therapeutic and evolutionary aspects

In the study, 84% of diabetic children were treated as outpatients and 16% as outpatients. Children received insulin therapy with mixed insulin and rapid insulin in 96% and 76% respectively. Rehydration was done in 76% of cases and antibiotic therapy was instituted in 52% of cases. Hospitalized children had iatrogenic hypoglycemia in 43%. The average blood glucose level in hypoglycemia was 0.29 g/l [0.15 - 0.53 g/l]. The average length of hospitalization was 11.3 days [1-35 g/l]. The trend was favourable in 72% of cases. Lethality was 16%. Factors significantly associated with death were infection, collapse and coma (Table V).

Table V. *Factors associated with the death of the diabetic child*

Variables		Death		*P value*
		Yes n	No n	
Sex	Girls	3	13	0.686
	Boys	1	8	
Age	<5years	0	1	0.840
	≥ 5years	4	20	
Place of residence	Urban	4	16	0.383
	Rural	0	5	
Schooling of the child	Schooled	3	10	0.557
	Not in school	1	10	
Schooling of the mother Schooled mother	Schooled	0	4	0.635
	Not in school	4	17	
Father's Schooling Schooling	Schooled	2	6	0.074
	Not in school	2	15	
Remuneration of the fixed father	Fixed	0	4	0.473
	No Fixed	4	17	
Infection	Yes	4	3	0.002*
	No	0	18	
Cardiovascular collapse	Yes	3	0	0.001*
	No	1	21	
Coma	Yes	4	7	0.026*
	No	0	14	
Initial blood glucose	< 5g/L	1	13	0234
	≥ 5g/L	3	8	

* p significant at the threshold <5%

Discussion

This cross-sectional descriptive study carried out in the paediatric ward of the University Hospital of Bouakéaims to describe the main epidemiological, diagnostic, therapeutic and progressive aspects of childhood diabetes in Bouaké, the second largest city in Côte d'Ivoire. The work shows a hospital prevalence of diabetes mellitus in children of 1 case per thousand admissions. The average age of children at diagnosis is 11.6 years [3 years - 17 years] with a sex ratio of 0.56. The notion of family diabetes is present in 12% of cases and diabetes is revealed by ketoacidosis in 72% of cases. The evolution under treatment is favourable in 72% of cases. Lethality is 16%. Factors associated with death are infection (p=0.0027), collapse (p=0.0017) and coma (p=0.0260). These results must be qualified because of the retrospective nature of the study, which exposes the study to missing data and selection bias. Despite the methodological limitation, this work provides for the first time a database on childhood diabetes in the Gbêkê region and raises the following points for discussion:

At the Epidemiological Level

The hospital prevalence of childhood diabetes in this work is 1/1000 children. The prevalence of childhood diabetes varies from study to study. In the same country, Agbré-Yacé et al. [9] reported a rate of 4 per 1000 admissions in 2016. Elsewhere in Africa, particularly in Nigeria, the prevalence of diabetes in the reported child was 3.1/1000 children

respectively [10]. In Egypt, the prevalence of diabetes in children and adolescents aged 0-18 years in 2011 was 0.15/1000 children [11]. In the United States, the reported prevalence was 0.34/1000 children [12]. The varying prevalence of the different studies reported could be explained by a methodological bias inherent in each study.The sex ratio (male/female) in this work is 0.56 in favour of girls. Gender is a factor to be considered in diabetes because studies clearly establish a link between gender and blood glucose control [13, 14]. This female predominance found in the study has been reported by other authors in the literature [9, 11, 15, 16]. Some authors, on the other hand, reported male predominance [12, 17, 18] while others reported no gender difference [10, 13, 19]. These gender differences depend on the extent of the disease's incidence. Thus, high-incidence countries, such as some European countries, have more boys affected, while girls are more affected in low-incidence countries [20]. The average age of the children at the time of the study was 12 years. Authors in the literature report an average age at the time of study that ranges from 11 to 13 years [15,19,21]. The average age of the child at diagnosis was 11.6 years. The average age at diagnosis varies according to the authors. Indeed, Adeleke et al. [10] in Nigeria report an average age of 10 years while Ngwiri et al. [13] in Kenya report 4.4 years. Other authors in the literature report an average age around 7-8 years at diagnosis [15, 16, 22, 23]. Age plays an important role in the management of childhood diabetes. Several studies have found that fasting at an age is associated with better glycemic control that can be attributed to greater parental supervision [19, 24]. Educational level is a key factor in understanding the disease and in its management. According to a study in France, low educational attainment may be associated with communication difficulties with comprehension or verbalization problems that may lead to delayed diagnosis and even difficulty in diabetes management [25]. In our work, 45.5% of school-age children did not attend school compared to 76% of parents. In the study by Agbre-Yace et al. [9] in Abidjan, children and parents had no level of education in 22.5% and 27.7% respectively. The socio-economic level of the parents was unfavourable with 92% of fathers working without fixed remuneration, when we know that in African societies, the financial burden of the family falls almost exclusively on the father. This observation was made by Adeleke et al. [10] and Moussavou et al. [21] with 72.7% and 80.9% respectively of unfavourable socio-economic level. This unfavourable socio-economic level is associated with inaugural diabetic ketoacidosis in children [26] and the severity of ketoacidosis [25].

At the Diagnostic Level

The main circumstance of diabetes discovery in this work is ketoacidosis (72%) followed by polyuro-polydiptic syndrome (20%). Many authors in the literature have also reported ketoacidosis as the main circumstance of discovery with frequencies ranging from 54.2% to 71.4%[16, 21, 22, 25]. On the other hand, Ben Becher et al. [23] in Tunisia found polyuro-polydiptic syndrome as the main circumstance of discovery This high proportion of inaugural ketoacidosis is explained by several factors. On the one hand, the delay in diagnosis due to diagnostic errors and lack of knowledge of the signs of diabetes by healthcare providers[27] and on the other hand, the low socio-economic level of the family[26].The main functional signs of anamnesis are dominated by polyuro-polydipsic syndrome (92%), weight loss (64%) and fever (48%). Polyuropolydiptic syndrome and weight loss have been reported in Hong et al. [22] in 98% and 70.4% respectively in symptomatic patients without ketoacidosis. On physical examination, the main signs identified are weight loss (56%), dehydration (52%) and coma (44%). Adeleke et al. [10] in Nigeria mentioned weight loss in 91%. The average blood sugar level in diabetic children is 4.9 g/l. Our results are similar to those of Adeleke et al. [10] in Nigeria and Demirbilek et al. [16] in Turkey who reported an average blood glucose level of 5.1 g/l and 6g/l respectively. The average glycated hemoglobin in the study is 11.6%, comparable to that of Noorani et al (11.1%)[12]. Demirbilek et al. [16] reported an average glycated hemoglobin of 13.8%.

On the Therapeutic and Evolutionary Level

In this work, insulin therapy with mixed and rapid insulin was performed in 96% and 76% respectively. Children who died in hospital were not able to benefit from mixed insulin. All children in the series of Moussavou et al.[21] and Ngwiri et al.[13] received insulin therapy. Initial rehydration before insulin therapy is performed in 76% of patients with ketoacidosis as in the Ben Becher et al. series[23]. Iatrogenic hypoglycemia is observed in 43% of cases with an average blood glucose level of 0.29 g/l. This is

due to the absence at the beginning of the opening of the endocrinology unit of the blood glucose meter in the emergency room for hourly monitoring of blood glucose, thus not allowing the type of infusion solution to be adapted according to the hourly blood glucose level Ngwiri et al.[13] observed severe hypoglycemia in 53.6% of cases.

The average length of hospitalization is 11 days (1 day - 35 days), close to the 10 days (3 days - 25 days) reported by Ben Becher et al.[23]. The trend is favourable in 72% of cases. The study also revealed 12% of discharges against medical advice and 16% of death rates. Adeleke et al. [10] in Nigeria and Monabeka et al. [28] in Congo reported death rates of 9.1% and 18.2% respectively. The high lethality of the study could be explained by the poor prognostic factors identified as collapse, coma and infection. To this could be added the lack of financial resources for parents, the lack of a technical platform and the lack of qualified personnel in the daily management of diabetes.

Conclusion

Childhood diabetes mellitus is most prevalent in school-aged children. Ketoacidosis is the usual mode of disclosure and lethality is high. Factors associated with death are coma, collapse and infection. Improving prognosis requires strengthening the capacity of the hospital's staff and technical platform as well as raising parents' awareness of the need to consult the hospital early as soon as the first clinical signs dominated by polyuro polydipsia syndrome appear.

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