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Research Article

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Prevalence and Characteristics of Diabetes Mellitus in Patients Living with HIV (PLHIV) in Dakar (Senegal)

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Summary

Objectives: *Determine prevalence of diabetes mellitus in patients on or not on antiretroviral (ARV) therapy and describe the epidemiological, clinical, evolutionary and therapeutic aspects.*

Patients and Methods: *This was a study carried out from 1 January 2006 to 31 May 2014 in PLHIV followed at four health care facilities dedicated to HIV patients treatment in Dakar, known to be diabetic, naïve or not to ARV treatment.*

Results: *Fifty-two cases of diabetes mellitus were included among 4370 HIV cases, representing a hospital prevalence of 1.2%. Average age of patients was 50.83 ± 8.72 years and sex ratio 1.26. In 28 patients (54%), diabetes was discovered accidentally, 23 patients were not reported (44%) and one patient found during complication. In 98.1%, diabetes was non-insulin-dependent. In 23 (44%), diabetes mellitus was diagnosed after HIV infection, 23 before and 6 (12%) at the same time. The mean time for diabetes mellitus diagnosis during follow-up of HIV infection was 47.83 months ± 33 months and 43.4 months ± 30.9 months after initiation of ARV therapy. At initial examination, average CD4 T cell count was 297.4 cells ± 257.9 cells / mm3 and average blood glucose at empty stomach was 1.75 ± 0.73 g/l. The number of pathologies occurring during follow-up period was 1.08 ± 0.88. Four patients died.*

Conclusion: *Despite low prevalence of diabetes in PLHIV in Dakar, burden of relating co-morbidity is heavy and raises two main concerns namely management of HIV infection and metabolic disorders.*

Keywords: Diabetesmellitus, Hiv, Prevalence, Dakar

Introduction

Diabetes is a non-communicable disease and is among the WHO nine priority targets. At the world level, the prevalence of diabetes was estimated at 10% in 2014 [1]. Diabetes can occur before the diagnosis of HIV infection, among people living with HIV simultaneously or during the infection. According to studies conducted by Brown *et al*. in 2005 in America and Bonfanti *et al*. in 2007 in Europe, diabetes mellitus was four times more widespread among HIV-positive people under antiretroviral therapy [2, 3]. The same finding was made in a Tanzanian study in East Africa in 2015 [4]. In 1996, the introduction of a new therapeutic class, anti-proteases brought a significant change in the management of patients living with HIV (PLHIV) [5]. It resulted in a significant reduction in morbidity and mortality as well as longer life expectancy [5]. However, taking these antiretroviral molecules induced many side effects and metabolic disorders: lipodystrophy and dyslipidemia [5], glucose intolerance related to insulin resistance in 10% of cases [6].

This study was carried out in that context, the objectives of which are to determine the prevalence of diabetes mellitus in patients under antiretroviral therapy (ARV) or not and to describe the epidemiological, clinical, therapeutic and evolving aspects of those patients.

Patients and Methods

A retrospective study took place from January 1st, 2006, to May 31st, 2014, in the treatment units of People Living with HIV in three hospitals in Dakar: the National University Hospital Center of FANN, the National University Hospital Aristide LE DANTEC, Dakar PRINCIPAL Hospital. People living with HIV were assigned according to treatment categories in the different hospitals and health centers. Table I shows patient distribution by health structure.

Table I: Patient distribution by health structure. Prevalence and characteristics of diabetes mellitus in patients living with HIV (PLHIV) in Dakar (Senegal)

Department / hospital	Number of files	Number of cases found	Percent (%)
Department of Infectious Diseases / HPD	0411	02	0,5
Department of Infectious Diseases / FANN	1400	13	0,9
Outpatient treatment center (CTA)/FANN	2312	31	1,3
Department of Dermatology / Le Dantec	0247	06	2,4
Total	4370	52	1,2

Inclusion Criteria

Patients concerned are any People Living with HIV known diabetic or whose diabetes mellitus status was discovered during follow-up from a testing of fasting glucose level superior or equal to 1.26 g/l (7mmol/l) on at least two occasions, naïve or on antiretroviral therapy regardless of age, sex, circumstances or period of discovery of either disease. The data collected on a survey file contained the following parameters: socio-demographic data (age, sex, occupation, marital status, access mode to HIV / AIDS care), the patients' background research (HIV / AIDS serological profile, Clinical data (initial body mass index – BMI - , WHO stage), para-clinic data (CD4 count, viral load, Blood Cell Count, blood glucose, transaminases, urea, serum creatinine, Total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides), therapeutic data (ARV regimens, dietary measures, oral antidiabetic treatment, insulin intake), evolving data (infectious pathologies , Metabolic complications and other pathologies during follow-up, semi-annual BMI, CD4 T-cell counts, fasting blood glucose, those loss-to –follow up in this trial meaning more than ninety (90) days elapsed after a missed appointment (WHO) and those who died).

Non-Inclusion Criteria

Any diabetic patient whose clinical record was not documented enough.

Data Analysis and Entry

All data were processed on a standard questionnaire and analyzed by SPSS 20 (Statistical Packages for Social Sciences). Percentages were compared by the chi2 test and a $p < 0.05$ value considered significant.

Results

Epidemiological Aspects

During our study period, 52 diabetic patients under retrovirosis ARV were included among 4370 cases of patients living with HIV/AIDS followed in Dakar; it represents an overall prevalence of 1.2%. The average age of patients was 50.83 ± 8.72 years and the most affected age group was 50-59 years with 26 cases (50%). The sex ratio (M / F) was 1.26. Thirty eight patients (73.1%) were married, eight widowed (15.3%), five divorced (9.6%) and one was single (1.9%). In 23 patients (44%), diabetes was discovered after HIV infection, in 23 patients (44%) before HIV infection and in six patients (12%) concomitantly with HIV / AIDS. The circumstances relating to the discovery of diabetes were as followed: fortuitous, 28 patients (54%), not informed 23 patients (44%) and diabetic pre -coma status for one patient. 51 of them (98.07%) were non-insulin-dependent diabetes and only one was insulin-dependent.

Almost all diabetic patients infected with HIV meaning 47 patients (90%) were HIV-1; four were HIV-2 (8%) and one had a double profile (2%). The gateway to HIV care was mainly: oral and oesophageal candidiasis for 16 patients (30.8%), chronic diarrheoa or shingles (respectively 9 or 17.3%), pulmonary tuberculosis (5 9.6%) and others (13 or 25%). The average time for diabetes to develop in patients not having received any ART yet was 47.83 ± 33 months with extremes of one and 96 months. Among those patients, six (26.1%) had diabetes mellitus diagnosed in between one to 12 months of follow-up. The average time to diagnose diabetes mellitus after initiation of ARV therapy was 43.4 ± 30.9 months with extremes of one and 88 months. Among those patients, five (25%) were diagnosed diabetes mellitus just after initiation of treatment, within one to 12 months after their ARV initiation therapy. The most commonly associated cardiovascular risk factors were tobacco in eight patients (15.3%) and hypertension in five patients (9.6%). Table II shows the distribution of patients according to cardiovascular risk diagnosed during initial examination.

Table II: Distribution of patients by Cardiovascular Risk Factors at Initial Screening. Prevalence and characteristics of diabetes mellitus in patients living with HIV (PLHIV) in Dakar (Senegal)

Risk Factors	Number	Percent (%)
Active tobacco	08	15,40
High Blood Pressure	05	09,60
Dyslipidemia	04	07,70
Alcohol	02	03,90
Obesity	01	01,92
Sedentary lifestyle	00	00,00

Clinical Aspects

The average Body Mass Index (BMI) at initial examination was 21.74 ± 4.58kg/m^2 with extremes of 10.64 kg/m^2 and 30.10 kg / m^2. Twelve patients (23.1%) were overweight and one was obese; Twelve others were skinny with a BMI <18.50 kg/m^2. Diabetes mellitus was diagnosed after HIV / AIDS infection in 43.5% of patients with a BMI in between 18.5-24.49 kg/m^2.

Patients mostly reached WHO stage 3 or 4 (15 patients, or 28.8%,

respectively); Eight (15.4%) were at stage 1 and 12 (23.1%) at stage 2. For two patients, the stage was not reported.

Para clinical Aspects

In these diabetic patients infected with HIV, the average fasting blood glucose at the time of diagnosis of diabetes mellitus was 1.75 g/L ± 0.73 g/L with extremes of 1.26 g/L and 3.75 g / L. The average glycaemia at the time of the initial examination was 1.35 g/L ± 0.592 g/L. HbA1c glycated hemoglobin rate was available for only two patients. At initial examination, average lipid parameters (total cholesterol, LDL, HDL, triglycerides), renal function (creatinine), hepatic function (ASAT, ALT) and hematological parameters (NFS-platelets) was within the normal level for all patients.

Regarding HIV infection, the average rate of CD4 + T lymphocytes at the time of initial examination was 297.39 cells/mm^3 ± 257.916 cells/mm3 with extremes from 1 to 964 cells/mm^3. Most patients (22 cases or 42.3%) had a T CD4 + lymphocytes level inferior to 200 cells/mm^3; 11 (21.2%) had one between 200 and 349 cells/m3; Seven had one between 350 and 499 cells/mm^3, and for the remaining, the level was superior to 500 cells/mm^3. Viral load was not available for only seven patients.

Therapeutic Aspects

All in all, forty-eight patients out of fifty-two (92.3%) were on the first-line antiretroviral therapy treatment. For 42 patients, the prescribed antiretroviral regimen was based on 2INTI + 1INNTI; for six other patients, 2INTI + 1IP boosted. Most patients (22/45.8%) were under AZT + 3TC + EFV regimen. Table III shows the distribution of patients according to the prescribed regimens.

Among the 23 patients whose diabetes mellitus was diagnosed after HIV infection, three were ARV therapy naïve whereas 20 were receiving a tritherapy. The mostly prescribed treatment regimen was AZT + 3TC + EFV with 12/20 patients (60%) followed by AZT + 3TC + NVP (for 2 patients, 10%), AZT + 3TC + LPV/r (for 2 patients that is 10%); three (15%) and one (5%) respectively under TDF + 3TC + EFV and TDF + FTC + EFV.

In the 23 patients whose diabetes mellitus was diagnosed earlier than that of HIV infection, one was ARV treatment naïve and 22 were under ARV treatment. Among them, eight patients were under AZT + 3TC + EFV therapy, five under TDF + FTC + EFV, and three under AZT + 3TC + NVP.

In the six patients whose diabetes mellitus was diagnosed simultaneously with HIV infection, antiretroviral regimens were decided as follows: two under AZT + 3TC + EFV, two under TDF + FTC + EFV, one under AZT + 3TC + LPV/r and one under TDF + 3TC + EFV.

When it comes to the treatment of diabetes mellitus in most patients, 30 patients (57.7%) applied only hygienic-dietary measures (HDM) to obtain a balanced glycaemia, 13 (25%) HDM added to oral anti-diabetic medication (OADs); and seven (13.5%) on HDM combined with insulin therapy. The most commonly used oral anti-diabetic drug was metformin alone or in combination with other hypoglycemic molecules (glibenclamide or glimepiride: 9 out of 13 patients).

Table III: Distribution of patients according to therapeutic regimen. Prevalence and characteristics of diabetes mellitus in patients living with HIV (PLHIV) in Dakar (Senegal)

Therapeutic regimen	Number	Percent (%)
AZT/3TC/EFV	22	45,8
AZT/3TC/LPVr	04	08,3
AZT/3TC/NVP	05	10,4
D4T/3TC/EFV	01	02,1
TDF/3TC/ATV	01	02,1
TDF/3TC/EFV	05	10,4
TDF/3TC/LPVr	01	02,1
TDF/3TC/NVP	01	02,1
TDF/FTC/EFV	08	16,7
Total	48	100

Evolutive Aspects

Thirty-seven patients (71%) presented, at least, an infectious pathology during the follow-up. The number of infectious pathologies occurred during this follow-up averaged 1.08 ± 0.88 with extremes of zero and three. Tuberculosis with pulmonary localization was the dominant infectious pathology during this period with seven cases (13.5%). Table IV shows the distribution of patients according to the occurrence of infectious complications. Among other pathologies or complications noted during follow-up, four patients (7.7%) had dyslipidemia, one had arthropathic psoriasis, and one other patient had Graves' disease. While undergoing treatment, the BMI of all patients remained within normal range (18.5 Kg / m^2 to 24.49 Kg/m^2) until the 90th month. This was followed by overweight thereafter. The CD4 + T lymphocytes average rate increased progressively in a step-like till the 96th month. The average level of fasting plasma glucose was greater than 1.26 g / l until the 96th month.

At the end of the study, forty-three patients (82.7%) were still being monitored. Five patients (9.6%) had been lost from sight and four patients (7.7%) died. The causes of death were known for two patients respectively by cerebral toxoplasmosis and multi-resistant tuberculosis. For the two others, the circumstances of death were not reported.

Table IV: Distribution of patients according to the occurrence of infectious pathologies during follow-up. Prevalence and characteristics of diabetes mellitus in patients living with HIV (PLHIV) in Dakar (Senegal)

Infectious diseases	Number	Percent(%)
Toxoplasmosis cerebral	01	01,9
Oral Candidiasis	04	07,7
Acute Broncho-Pneumonia	02	03,9
Shingles	02	03,9
Pulmonary tuberculosis	07	13,5
Viral Hepatitis B	03	05,8
Purulent otitis	01	01,9
Ulcerative pyoderma	01	01,9
Poor plantar perforation	01	01,9

Discussion

Epidemiological Aspects

According to preliminary results obtained from the first Senegalese national survey "STEPS" on risk factors for non-communicable diseases, 2.1% of the general population are diabetic, 24% have high blood pressure and 6.4% are obese. There are disparities because the rate of diabetes mellitus prevalence is 5% among people aged 45 to 49 (according to data from the Ministry of Health and Social Action in 2016).In a study conducted in decentralized settings, in Saint-Louis-Senegal 260 km from Dakar, the prevalence of diabetes was 10.4% [7].

An increasing number of people living with HIV also have Type 2 Diabetes. This is due to HIV-specific risk factors, but also to other factors such as overweight, family history of diabetes, lack of physical activity, usually associated with diabetes. The 1.2% hospital prevalence of diabetes mellitus found in people living with HIV, antiretroviral therapy naïve or not in Dakar is similar to that found by Sawadogo *et al*. [8]. However, this figure is considerably lower than that of 6.4% found by Mohammed in Ethiopia and 7.1% by Mouffok in Algeria [9, 10]. In Senegal, Diouf *et al*. found a prevalence of 14.5% but it was related to an observational cohort solely concerning HIV-infected patients under ARV therapy [11]. In another study conducted by the same author, the prevalence of diabetes in patients of the cohort after a median time of treatment of 9 years was 14%. This revealed a direct relationship between treatment duration and diabetes [12]. These findings emphasize the importance of systematic screening for these abnormalities during HIV patients' follow-up process.

The average age of our patients was higher than that of other studies conducted among the general population as well as specifically in PLHIV [7, 13]. In our study, the age factor did not have much influence in diabetes diagnosis but was significant in the study conducted by Mohammed [9]. Likewise, Diouf demonstrated in his study that [11], in addition to older age, duration of ARV therapy ≥ 119 months, high BMI and high total cholesterol were high risk factors associated with the occurrence of diabetes mellitus in PLHIV.

Contrary to the study of Mbaye [7], which showed a sex ratio in favor of women, a male predominance is observed in our work as in most studies of the literature [14, 15]. For some authors, this male predominance of diabetes mellitus may be due to low plasma testosterone levels; thus lower the rate, greater is the risk of developing diabetes mellitus. With age, men suffer from a testosterone deficiency and chances of increased risk of type 2 diabetes [16]. Although sex did not influence the diagnosis of diabetes mellitus in our study, it was the case in the study of Mohammed [9].

In our study, the circumstances of the discovery of HIV/AIDS infection are globally similar to those of most studies conducted elsewhere where the entry point to health care is dominated by opportunistic infections because patients often come to consult at a late stage [13, 14].

In our study, for most patients, diabetes mellitus were accidentally discovered. In a Beninese series, Monteiro found that the cardinal syndrome was more represented with 41.3% of cases and fortuitous discovery in 8.9% of cases [17]. This difference could be explained by the fact that in Benin, the study was carried out in a reference center in the field of diabetes while ours was carried out in centers of reference in infectious or dermatological pathologies. The fact that these centers are not centers of reference in diabetes could lead medical staff to limit information on diabetes mellitus.

In our series, 44% of diabetes mellitus was diagnosed after HIV/AIDS infection, further to an average follow-up period of 47.83 ± 33 months and 43.4 ± 30.9 months after initiation of ARV therapy. In 25% of cases, this delayed diagnosis after ARV treatment was between one and 12 months. This delay varies from one series to another. In France, in the study of Bardonnet diabetes mellitus was diagnosed within a period of one to seven months [18]. Indeed, antiretroviral treatment during HIV/AIDS infection has revolutionized the prognosis of patients at the cost of sometimes unexpected effects. In 1997, the French Medicines Agency warned clinicians on the chances of developing diabetes mellitus during treatment with anti-proteases [18]. In 90% of cases, patients presented with an HIV-1 serological profile. These results are found in nearly all African series.

Most of our patients had non-insulin-dependent diabetes, like in the study of Diallo with 99.96% [19]. The pathophysiology of this hyperglycemia is not clearly understood. However, the absence of ketonuria and the favorable response to oral anti-diabetics argue for a mechanism that is similar to non-insulin-dependent diabetes [18]. Type 2 diabetes can remain long asymptomatic, therefore many people are unaware of their diabetic condition.

Besides the classic types of type 1 and type-2 diabetes, the existence of atypical forms of diabetes has been described in black subjects specially a particular form called Malnutrition Related Diabetes Mellitus (MRDM). MRDM includes fibro-calcular pancreatic diabetes (FCPD) and protein-deficient pancreatic diabetes (PDPD) [20]. Clinical characteristics common to MRDM are: young age (before 30 years), history of malnutrition, low weight (body mass index less than 19 kg/m^2), and high daily insulin requirements (greater than or equal to 1, 5U / kg / day), severe hyperglycemia (greater than 11.1 mmol / L) and in most cases absence of ketosis with the insulin injection stop. [20, 21]

Diabetes mellitus is rarely isolated. The other vascular risk factors in the Senegalese study by Mbayeet coll [7]. were dyslipidemia (64.6%), physical inactivity (64%), more frequent in women than in men ($p < 0.001$); High blood pressure (46%); Obesity (23%), predominantly female; Tobacco (5.8%) and alcohol were less frequent. In Mohammed's study on PLvHIV, age, duration of ARV treatment, hypertension, and LDL level were significantly associated with diabetes [9].

Clinical Aspects

Body mass index is an important parameter in the follow-up of people living with HIV but also in the follow-up of diabetics. It was one of the factors associated with the presence of diabetes mellitus in a study conducted in Senegal [11]. It has also been associated with an increased risk of diabetes regardless of the antiretroviral pretreatment status [22].

It is difficult to correlate the occurrence of diabetes mellitus with BMI in our study as evidenced in other studies. Indeed, the short-term gain of BMI following initiation of antiretroviral therapy appears to increase the long-term risk of cardiovascular complications, but only in those with prior BMI in the normal range [22]. In our work, it was

noted that most patients were in stages 3 and 4 of W.H.O standards as in most African studies [22, 23]. These results can be explained by the fact that patients consult at a late stage but also because they refuse to be consulted. In a study conducted at IbrahimaDiop Mar Clinic of Infectious Diseases at FANN National University Hospital, Manga reported that 97% of patients were diagnosed at the stage of AIDS [23], unlike in the study of Mohammed [9] where, the majority of participants (85.8%) were at stage 1 of the W.H.O, standards and 7.1% were diabetics.

Paraclinical Aspects

In 52.2% of the cases in our study, diabetes mellitus was diagnosed after HIV / AIDS infection in patients with a CD4 + T cell count less than 200 cells/mm3 as in other studies [10]. During follow-up, the rate of CD4 increased gradually. In the study of Indira [13], PLHIV, diagnosed with diabetes had a better CD4 count than non-diabetic PLHIV even though ARV therapy was prescribed at the same time in both groups. Diabetic PLHIV could benefit from more frequent follow-up visits, which may have the indirect impact of better adherence to antiretroviral therapy leading to a higher CD4 count.

The viral load could not be exploited in this work because it was only available for a few patients. Yet it is currently the benchmark for good follow-up of patients living with HIV even in Africa. The average fasting blood glucose levels at the time of diagnosis of diabetes mellitus was 1.75 ± 0.73 g/l. In the Mouffok series [10], the average blood glucose index was 2.6 g/l with extremes of 1 to 6 g/l. In the study of Diallo [19], average fasting blood levels at the time of diagnosis of diabetes mellitus was 1.98 ± 0.72 g / l with extremes of 1.26 and 3.78 g/l.

HbA1C is another parameter that could not be exploited in our work. It is a cumulative reflection of the average blood glucose levels of four to six weeks (up to three months) prior to dosing and is used in routine practice to retrospectively evaluate the treatment's efficiency [24].

HbA1c can have several advantages for its use in African populations on glucose-based measurements such as HGPO. HbA1c does not require fasting overnight, potentially a major obstacle in rural areas where long distance travel to healthcare facilities is common. In addition, it does not require immediate laboratory handling and can be easily stored and transported [25]

However, the use of HbA1c has several limitations within populations in sub-Saharan Africa. First, it is expensive. Secondly, being a blood marker, any condition that affects the production of blood or blood cells could affect the HbA1c test, such as sickle cell anemia. In addition, chronic infections such as HIV can affect the performance of HbA1c. Finally, this test also requires laboratories and standardized equipment and, although this is becoming more frequent in the region, access is still limited [26]. On the other hand, as a diagnostic tool for diabetes and pre-diabetes, contradictory studies during HIV infection show that HbA1C underestimates blood glucose in HIV-infected patients and is linked to the use of the NRTIs [27]. Other researchers suggest that the inclusion of HbA1C as a criterion for the diagnosis of diabetes mellitus in PLHIVs increases the accuracy of diagnosis in the presence of other associated diagnostic means [28].

Therapeutic Aspects

Most of the patients, 48 cases (92.3%), were under ARV treatment including 20 whose diabetes was discovered after HIV infection and 28 before. In six patients, diabetes mellitus was diagnosed at the same time as HIV/AIDS infection and among the 23 patients whose diabetes mellitus was diagnosed after ARV treatment, 20 among them were on triple antiretroviral therapy.

The mostly prescribed regimens were AZT/3TC/EFV in 22 patients (45.8%) and 6 patients (12.5%) under triple therapy including 2 NRTI + 1 PI. Our study is similar to the Mouffok series [10], in which 67% of the patients were under the association 2INTI + 1INNTI and 33% of patients were under 2INTI + 1IP. This is in line with the recommendations of the WHO, but the preferred option since June 2013 is the association TDF + 3TC (or FTC) + EFV in case of HIV-1.

Of the 23 patients with diabetes mellitus diagnosed after HIV/AIDS, two were on protease inhibitors and developed diabetes mellitus. In the literature, inhibitors of the protease are more incriminated in the onset of diabetes mellitus on ARV [6, 18]. Insulin resistance and hyperlipidemia are induced by these protease inhibitors, regardless of changes in HIV-infected patients [29]. This disorder of glucose metabolism in this field is multifactorial, but in addition to protease inhibitors (PI), the role of nucleoside reverse transcriptase inhibitors (NRTIs) leading to diabetes mellitus has been demonstrated in prospective studies [30]. NITTI also alter adipocyte metabolism by decreasing lipid levels and inducing mitochondrial dysfunction, which certainly contributes to apoptosis [2]. The use of d4T increases the risk of type 2 diabetes. In addition, it has been demonstrated that it causes peripheral insensitivity to insulin in healthy individuals. Moreover its use was to be avoided as much as possible since it would also contribute to metabolic complications as well as to lipoatrophy. Exposure to stavudine + didanosine and cumulative exposure ≥ 1 year to zidovudine were associated with a risk of diabetes [31]. Studies suggest that AZT may also contribute directly to the onset of insulin insensitivity and lipodystrophy [32, 33].

Studies of the NNRTI class show a low atherogenic profile compared to NP and/or NRTI in naïve patients [34]. However, NNRTIs such as efavirenz and nevirapine were significantly associated with diabetes, arterial hypertension and dysglycemia during follow-up in the Abrahams' study [35].

However, the proportion of patients who developed diabetes mellitus in our series despite the absence of ARV treatment is not to be neglected. For three out of four naïve ARV patients, the diagnosis of diabetes mellitus was made during the follow-up. This emphasizes the presence of other factors besides triple antiretroviral therapy such as genetic predisposition, the notion of familial stigma that was not reported in our study.

Evaluative Aspects

As for HIV infection, the ability of diabetes mellitus to suppress cell-mediated immunity is known, as well as the ability to increase infections frequency [36]. Thirty-seven patients had developed at least an infectious pathology during follow-up and the average of infectious pathologies during follow-up was 1.08 ± 0.88 with extremes of 0 and 3 infectious pathologies. Among the infectious diseases occurring during follow-up, tuberculosis with pulmonary localization was more represented with seven cases (13.5%) followed

by four cases of oral thrush (7.7%). Tuberculosis is the number one opportunistic infection in developing countries. It is the most common opportunistic infection, as such, it causes a mortality rate of 25% in patients with AIDS and diabetes is an associated risk factor [37, 38]. In the study of Kra in Côte d'Ivoire [39], the three main diseases were tuberculosis (34.2%), cerebral toxoplasmosis (17.9%) and neuromeninging cryptococcosis (8%). In the study of Indira [13], in the groups, patients with diabetes were older and all PLHIV with diabetes had at least one opportunistic infection, with one third having more than one. Although PLHIV with diabetes had a higher proportion of oral candidiasis and meningeal cryptococcosis than their counterparts, this study did not identify a significant difference in the profile of opportunistic infections among PLHIV with and without diabetes.

Viral hepatitis B was found in three patients, (5.8%). The search for infection with hepatitis B virus is important because its positivity compels us to re-evaluate the patient and adopt a particular therapeutic attitude. On the other hand, the search for hepatitis C was not carried out in our series. This research cannot be systematic in the follow-up of patients living with HIV in Senegal because it is the responsibility of the patient who, in most cases, is very poor. However, the chronic hepatitis C virus (HCV) infection is associated with an increase in the incidence of insulin resistance and diabetes mellitus.

Depending on the level of liver function's disorder, the number of patients with chronic HCV infection with diabetes mellitus is estimated to range from 10% to 30% [40]. However, the association of infection with HCV with diabetes in the context of HIV has been questioned. In the Swiss cohort study [41], HCV infection was associated with a 1.1-fold higher risk of DM incident in HIV-infected patients who were not statistically significant. The VACS study found a 1.34-fold increase in HCV infection with widespread DM [42]. After stratification by HIV status, the association remained significant in the HIV-infected group only. These results suggest a combination of HCV with diabetes mellitus in HIV, which is modest compared to combinations of traditional risk factors such as advanced age, obesity and a DM family history.

Other pathologies such as purulent otitis, ulcerative pyoderma, and perforating ulcer of the foot occurred in our study population, but this phenomenon may be understandable because they represent infectious complications that are not uncommon in patients with diabetes.

No complications of micro angiopathy or macro-angiopathy type due to diabetes were found in our study. Yet populations of African origin are known to have the highest rate of micro vascular complications [43]. Macro vascular attacks would be less frequent than in Western countries, but their incidence increases with changes in people's lifestyles. Their development is facilitated by smoking, dyslipidemia and arterial hypertension [44]. In our work, the retrospective nature of the data collection probably influenced the results. Careful and systematic research of those complications linked to diabetes in people living with HIV even in a non-specialized setting, or even initiating a multidisciplinary medical treatment would benefit patients.

Among the metabolic complications that occurred during follow-up in our study, dyslipidemia was found in 4 patients (7.7%). This could be explained by dietary habits, genetic susceptibility and also the side effects of ARVs. According to Doupa in Saint-Louis-Senegal, the prevalence of hypercholesterolemia, hyperLDLemia [45], hypoHDLemia, hypertriglyceridemia and mixed hyperlipidemia were respectively 56%, 22.5%, 12.4 %, 7.11% and 1.9% in the general population of St. Louis. In addition, one person out of four was obese (BMI> 30 kg/m^2) and 34.8% had abdominal obesity. The main factors significantly associated with dyslipidemia were obesity, urban dwelling, physical inactivity and a family history of dyslipidemia.

The average CD4+T lymphocytes rate increased steadily during follow-up. Indeed, the immunological response is characterized by an average CD4 + T lymphocyte gain of the order of 248.72cell/mm^3 after 30 months of follow-up. The immunological and biological response to triple antiretroviral therapy in poor countries may be comparable to that of rich countries. The quality of this response is highly dependent on early care, the provision of adequate medical care through the training of medical personnel, instruction and patient education for adherence to treatment. [46]. The semiannual evolution of the average fasting glucose for the 52 patients resulted in a level that remained higher than 1.26 g/l until the 96th month except in the 18th month of age at 1, 06 g/l. There is no explanation for this fall at the 18th month. In our series, 7.7% of patients died, 9.6% lost to follow-up and 82.7% were being followed up. In the Zouiten series [14], 68.5% of patients were being monitored, 15.9% died and 15.9% were lost to follow-up. Delayed treatment of HIV/AIDS and opportunistic infections, non-adherence to therapies are factors associated with this mortality. A large proportion of this mortality rate could be prevented by the early initiation of antiretroviral therapy. In a study carried out in the department of infectious diseases, Diop found that the main causes of patients lost to-follow up were mainly due to financial reasons related to the associated costs of the follow-up, social conditions are also associated [47].

Conclusion

The combination of diabetes mellitus and HIV infection is not unusual in our context of resource-limited countries. Screening and management of diabetes mellitus should be integrated into routine HIV care. This screening must be performed in any patient infected with HIV but also at once before and after the start of antiretroviral therapy. Patients infected with HIV with glycaemia ≥ 1 g / l should also undergo a special monitoring since they are undergoing antiretroviral treatment.

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