Predisposing and Risk Factors of Hyperglycemia in Human Immunodeficiency Virus Infected Persons Receiving Care at Bali District Hospital, Cameroon

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ABSTRACT

Introduction: The Human Immunodeficiency Virus (HIV) is a virus that gradually attacks the immune system, which is our body's natural defense against illness. Antiretroviral Therapy (ART) changed the course of the HIV epidemic when in 1996, as part of potent combination therapy [often referred to as Highly Active Antiretroviral Therapy (HAART)]; they were able to extend significantly life span of those living with HIV. Our study aimed at assessing the predisposing and risk factors of hyperglycemia in HIV patients in a rural district hospital in Cameroon.

Methods: A cross sectional hospital-based study was carried out on 110 HIV patients, 14 males and 96 females. The ages of participants ranged from 22-71 years, with a mean age of 42 years. Capillary blood sample was collected from each patient by means of finger prick and the Fasting Blood Sugar (FBS) level measured using a glucometer. The glucometer was calibrated using glucose oxidase reagent method. Hyperglycemia was defined as FBS>110 mg/dL. Fasting Blood Sugar levels ranged from 52-175 mg/dL with mean FBS of 108.9 mg/dL.

Results: Hyperglycemia varied significantly with low BMI (p=0.008). Male gender (OR 1.7) and those with CD4 counts less than 500 cells/mm³ (OR 2.1) are more likely to develop hyperglycemia than the female gender and those with CD4 greater than 500 cells/mm³ respectively. A majority of the study participants, 73(66.4%) had CD4 count less than 500, 37(33.6%) had counts more than 500. 79(71.8%) of participants have been on treatment for less than 5 years while 31(28.2) have been on treatment for more than 5 years. Minority, 2(1.8%) of the study participants were alcoholics and 108(98.2%) were non alcoholics. Only 1(0.9%) participant was a smoker and 109(99.1%) non-smokers. Majority, 56(50.9%) of participants were on Tenofovir/Lamivudine. 82(74.5%) participants had BMI less than 25 while 28(25.5%) had BMI more than 25.

Conclusion: The results of this study suggested the need to promote blood sugar screening in patients when diagnosed of HIV and regular screening within the course of treatment.

Keywords: Hyperglycemia; Combined Antiretroviral Therapy (cART); HIV/AIDS; Bali; Cameroon

ABBREVIATIONS

3TC: Lamivudine; AIDS: Acquired Immunodeficiency Syndrome; ARV(T): Anti-RetroViral(Therapy); AZT: Zidovudine; BMI: Body Mass Index; BDH: Bali District Hospital; CD4: Cluster of Differentiation 4; DM: Diabetes Mellitus; EFV: Efavirenz; FBS: Fasting Blood Sugar; HAART: Highly Active AntiRetroviral Therapy; HIV: Human Immunodeficiency Virus; NRTI:

Nucleoside Reverse Transcriptase Inhibitor; NVP: Nevirapine, PIs: Protease Inhibitors; TDF: Tenofovi

INTRODUCTION

Hyperglycemia is an increase in the blood glucose level above normal (above 110 mg/dL for fasting and 200 mg/dL for post prandial). It may occur in a variety of diseases most notably in diabetes mellitus, due to insufficient insulin in the blood and excessive intake of carbohydrate. Blood glucose is regulated by the homeostatic mechanism of the hormone insulin, failure of this regulation leads to clinical implication especially diabetes mellitus [1]. The introduction of Antiretroviral Therapy has resulted in the emergence of some metabolic complications including hyperglycemia and diabetes mellitus among HIV positive patient.

The development of hyperglycemia is a possible complication of pancreatitis. Pancreatitis damages the cells that produce insulin and glucagon, which are the hormones that control blood sugar levels. This leads to an increase in blood sugar levels leading to diabetes. About 45% of people with chronic pancreatitis develop diabetes [2]. Alcohol abuse is the most frequent cause of chronic pancreatitis, but autoimmune diseases, cystic fibrosis, can also cause it.

For the past 20 years or more, researchers have reported changes in glucose metabolism in patients with HIV/AIDS. Protease Inhibitors (PIs) have shown to increase insulin resistance and reduce insulin secretion thereby increasing the risk factor for development of diabetes in PI therapy [3].

For patients with diabetes, the additional diagnosis of HIV increases the challenge of self-care management. However, in patients with HIV who develop hyperglycemia, the added responsibilities are overwhelming as both HIV and diabetes are chronic diseases that significantly affect lifestyle. When they intersect, the treatment regimens required for both diseases can be overwhelming for patients. Therefore, early identification of hyperglycemia in HIV patients may lead to a review of the anti-retroviral therapy and management, as the mechanism of metabolic dysregulation varies in them.

Hyperglycemia is a known complication of ART being associated with exposure to some ARV drugs due to abnormal glucose metabolism during the course of treatment [4]. Patients with HIV will certainly have the same rates of diabetes as seen in the background population. Because of their younger age, HIV patients may have lower incidence of preexisting diabetes when they get infected. However, as they grow older, they may develop diabetes in the normal course of events. Certain metabolic factors related to HIV, and to HIV therapy, may increase the incidence and prevalence of diabetes amongst them [5].

MATERIALS AND METHODS

Study area

The study was conducted at the state-owned Bali District Hospital in the North West Region of Cameroon. Bali District Hospital is found in Bali Sub Division of Mezam Division in the North West Region of Cameroon.

Bali has a population of about 37,103 inhabitants [6], which is made up of mostly indigenous people, with a considerable proportion of non-indigenes. The most predominant activity of the people of Bali

is farming.

Study design and population

The study was a cross sectional study for a period of seven months. The study involved HIV patients aged above 21 years attending the BDH treatment center. Only patients who gave their consent and were followed till the end were considered for this study.

The sample size was calculated using the CDC-Epi Info™ 7.2.3.1 StatCalc software with the following characteristics: an estimated population size for Bali Health area of 37,103 inhabitants [6], expected frequency of persons living with HIV on ART in Bali of 50%, accepted error margin of 5%, design effect of 1.0 and one cluster. Thus, the CDC-Epi Info™ 7.2.3.1 StatCalc estimated minimum sample size was 380.A final sample of 110 participants were enrolled into the study. This was due to the socio-political issues as many inhabitants fled for the bushes for safety.

Data collection tool and data collection

The instruments used for the collection of data were, a well-organized laboratory form and patients files.

Data collected for analysis was defined as; socio-demographic information (age, gender and marital/educational status) and Fasting Blood Sugar (FBS) levels. The fasting blood sugar levels were obtained from measurements from glucometer.

Specimen collection and analysis

Capillary blood was obtained by means of finger prick, sample applied on a glucometer following manufacturer's instructions (Sensolite Nova, India).

Laboratory analysis: Blood sugar measurements were done at the Bali District Hospital Laboratory.

Hyperglycemia was defined as fasting blood sugar greater than 130 mg/Dl.

RESULTS

Socio-demographic characteristics of study participants

The ages of the study population ranged from 22 to 71 years with a greater number (38.2%) in the age group 41-50 years and the least number of participants in the age group 71-80 years (0.9%). 14 males (12.7%) and 96 females (87.3%) took part in the study. Majority of the participants were self-employed (74.5%), followed by those who were unemployed (16.4%), and salary earners (9.1%). 54.5% of the participants went to primary school, 24.5% went to secondary school, 10.9% did not go to school at all, 6.5% to high school and 3.6% went to the university (Table 1).

Table 1: Socio demographic characteristics of study participants.

Variable	Frequency	Percentage
Age		
21-30	21	19.1
31-40	23	20.9
41-50	42	38.2
51-60	16	14.5
61-70	07	6.4
71-80	01	0.9
Gender		
Male	14	12.7

Female	96	87.3
Occupation		
Salary employed	10	9.1
Self employed	82	74.5
Unemployed	18	16.4
Level of education		
None	12	10.9
Primary	60	54.5
Secondary	34	31
University	4	3.6

Clinical characteristics of participants

82 participants had normal weight (BMI<25 kg/m²), 23 were over weighed (BMI between 25 and 30 kg/m²), and 5 participants with BMI>30 kg/m². The CD4 count of the participants ranged from 23-805 cells/mm³. The CD4 counts were grouped into two; 500 cells/mm³ and below and those above 500 cells/mm³ was chosen because it was the baseline for initiation of ART. 73 participants (66.4%) had CD4 count at and below 500 while 37 participants (33.6%) had CD4 count>500 cells/mm³ (Table 2).

Table 2: Clinical characteristics of participants.

Parameter	Frequency	Percentage
BMI(Kg/m²)		
Normal (<25)	82	74.5
Over weight (25-30)	23	21
Obese (>30)	05	4.5
CD4 Count		
<500	73	66.4
>500	33	33.6

ARV combination of participants

The majority of study participants were on Tenolam (50.9%), followed by Tenolam/Efavirenz (14.6%), Zidolam/Nevirapin(12.7%), Zidolam/Efavirenz(11.8%) and Tenolam/Nevirapin (10%) (Figure 1).

Prevalence of hyperglycaemia and associated risk factors

Hyperglycaemia: The prevalence of hyperglycaemia in the study was 30.9% (Table 3).

Table 3: Prevalence of hyperglycaemia in the study participants.

Glycemic Status	Frequency	Percentage
Hyperglycaemia	34	30.9
Normal glycaemia	75	68.2
Hypoglycaemia	01	0.9
Total	110	100

Associated risk factors of hyperglycaemia

Low BMI (p-value 0.008) was significantly associated with hyperglycemia. Male gender (OR 1.7) and those with CD4 counts of less than 500 cells/mm³ (OR 2.1) are more likely to develop hyperglycemia than the female gender and those with CD4 greater than 500 cells/mm³ respectively. Alcohol, smoking and treatment regiment had no association with hyperglycemia in this study (Table 4).
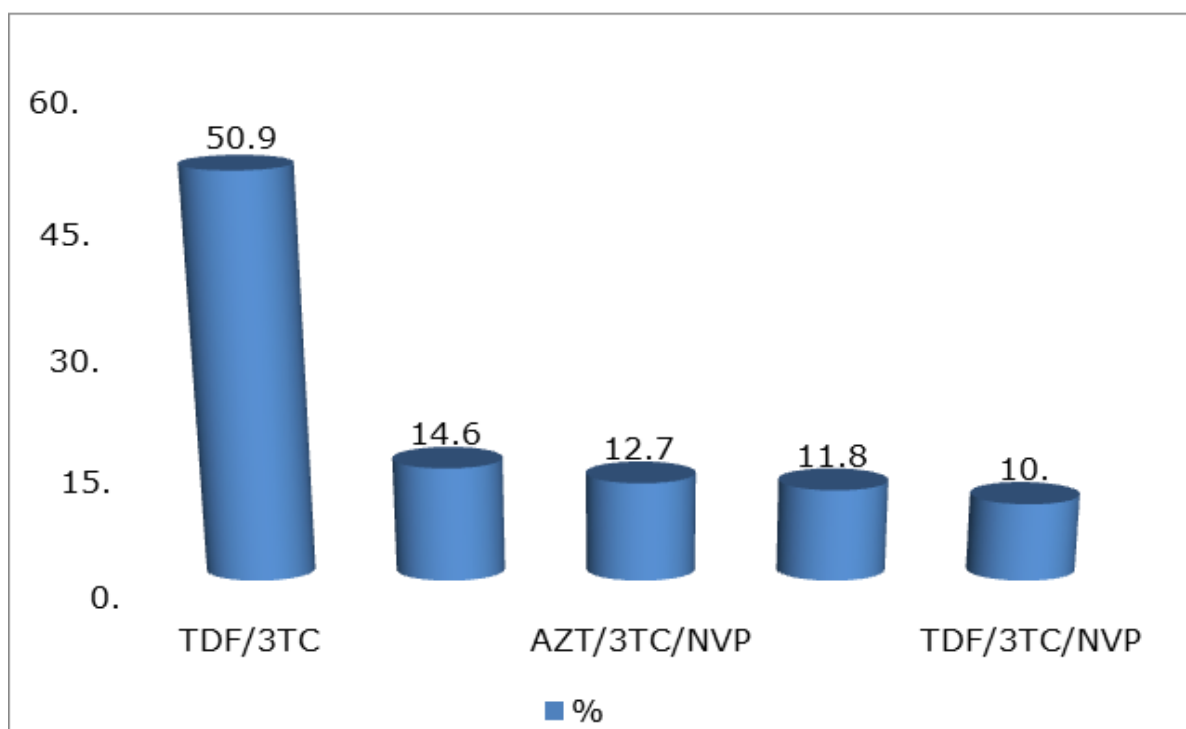

Figure 1: ARV combination of participants. **Abbreviations:** TDF: Tenofovir; AZT: Zidovudine; EFV: Efavirenz; 3TC: Lamivudine; NVP: Nevirapine.

Table 4: Risk factors of hyperglycemia in the study.

	Variable	Total	Abnormal‡ (%)	Normal (%)	χ^2	p-value	O.R (96% C.I)
			Blood sugar level				
Gender	Male	14 (12.7)	6 (17.1)	8 (10.7)	0.412	0.520	1.7 (0.6-5.4)
	Female	96(87.3)	29 (82.9)	67 (89.3)			1.0
BMI (Kg/m^2)	<25	82 (74.5)	20 (57.1)	62 (82.7)	6.903	0.008	0.3 (0.1-0.7)
	>25	28 (25.5)	15 (42.9)	13 (17.3)			1.0
ART duration	<5 years	79 (71.8)	21 (60.0)	58 (77.3)	2.737	0.098	0.4 (0.2-1.0)
	>5 years	31 (28.2)	14 (40.0)	17 (26.7)			1.0
CD4+ Count	<500 cells/mm^3	73(66.4)	27 (77.1)	46 (61.3)	2.011	0.156	2.1 (0.8-5.3)
	>500 cells/mm^3	37 (33.6)	8 (22.9)	29 (38.7)			1.0
Alcoholic	Yes	2 (1.8)	0 (0.0)	2 (2.7)	0.043	0.834	N/A
	No	108 (98.2)	35 (100.0)	73 (97.3)			
Smoking	Yes	1 (0.9)	0 (0.0)	1 (1.3)	0.000	1.000	N/A
	No	109 (99.1)	35 (100.0)	74 (98,7)			
ARV regimen	TDF/3TC	56	18	38	2.338	0.674	N/A
	TDF/3TC/NVP	11	5	6			
	TDF/3TC/EFV	16	6	10			
	AZT/3TC/NVP	14	3	11			
	AZT/3TC/EFV	13	3	10			
	Total	110	35	75			
‡ Hyper and hypoglycaemia	33	33	33	33	33	33	33

DISCUSSION

Socio-demographic characteristics

The study was aimed at determining the predisposing and risk factors of hyperglycemia in HIV/AIDS patients attending Bali District Hospital treatment center. 110 participants took part in the study, 87.3% of whom were females and 12.7% males. The age of participants ranged from 22 to 71 years. Most of the participants were above 40 years with a mean age of 42.9 years. The prevalence of hyperglycemia in this study was 30.9% which was higher than that estimated in a cross-sectional survey on HIV/AIDS patients (10.5%) in China [7], and 6.8% prevalence in patients on PIs in Brazil [8]. This could probably be due to the small sample size in our study, in part, or the fact that our study had most of the participants greater than 40 years of age and the occurrence of type 2 DM increases with increase age.

The frequency of hyperglycemia was more likely to be higher in males (OR 1.7) than in females. This was in accordance with a higher prevalence in males (21.54%) than in females (15.16%) in China [7] and also disagrees with the study in Brazil [8] which had no relationship between hyperglycemia and distribution of participants according to gender, this could be due to the fact that our study population was not evenly distributed among gender.

Clinical characteristics

Higher frequency of hyperglycemia was found to be significantly associated with lower BMI (p-value 0.008), and ART duration had no significance with frequency of hyperglycemia This was different from a study in Senegal [9] which identified higher BMI and long term ART as risk factors. There was a likelihood

of frequent occurrence of hyperglycemia in participants with CD4 less than 500 (p-value 2.1). Treatment regimen was not significantly associated with hyperglycemia. Alcohol and smoking were not identified as risk factors of hyperglycemia in the study population. This could be due to the fact that the participants were well educated on the adverse effect of alcohol and smoking on the ART, as a few acknowledged they stopped drinking and or smoking upon initiation of treatment [10].

CONCLUSION

This study showed the prevalence of hyperglycemia in HIV patients attending Bali District Hospital to be 30.9%, indicating a high prevalence of hyperglycemia in Cameroonian HIV patients. Hyperglycemia was seen to be associated with low BMI, likelihood to be more frequent with low CD4 count (<500 cells/mm^3) and male gender. Duration of treatment and treatment regimen had no significant association with hyperglycemia.

DECLARATIONS

Ethical consideration

The study was approved by the Regional Delegate of Public Health for the North West Region and the Training School for Medical Laboratory Technicians Bamenda and was conducted in accordance with the Helsinki declaration.

Participation in the study was voluntary. Participants were free to withdraw from the study at anytime without fear of any bias. Sample collection was done in a manner that provided maximum protection to the participants. Confidentiality was strictly maintained. All records were kept confidential, accessible only to

key research personnel. The questionnaires were coded to ensure anonymity.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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