Full Length Research Paper

Concomitant occurrences of tuberculosis and hyperglycemia in HIV/AIDS patients in Nigeria

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The present study was aimed at establishing the prevalence of concomitant occurrences of tuberculosis and hyperglycemia in HIV/AIDS patients in Nigeria. Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome, Tuberculosis and Diabetes mellitus are individually one of the top ten causes of mortality all over the world. Two hundred HIV/AIDS patients were selected randomly from the HIV clinic in University of Nigeria Teaching Hospital. Fasting blood glucose levels were determined using glucose oxidase method. Patients had their sputum samples screened for three consecutive times for the presence of tubercle bacilli using the Ziehl Nelson staining technique. Fifty non-HIV/AIDS subjects served as a matched control (25 males and 25 females). Of the 200 patients screened, 93 (46.5%) were males and 107 (53.5%) were females. Twelve (6%) patients had hyperglycemia, and 75 (37.5%) patients had tuberculosis. Amongst patients concomitantly affected by hyperglycemia and tuberculosis, persons between 41-50 years and 20-30 years had the highest and lowest prevalence respectively. Gender prevalence was not significantly different. Simultaneous occurrences of hyperglycemia and TB in the HIV/AIDS patients was not statistically significant (p>0.05). The duration of administration of antiretroviral had no significant effect on the fasting blood glucose levels of HIV/AIDS patients but had a significant effect on the prevalence of TB in these patients.

Key words: Diabetes, tuberculosis, HIV/AIDS patients, concomitant prevalence.

INTRODUCTION

Human Immunodeficiency Virus (HIV)/Acquired Immunodeficiency Syndrome (AIDS) infection is the strongest known risk factor for tuberculosis (TB). High HIV prevalence rates are significantly correlated with high TB incidence rates (WHO, 2009). HIV-associated TB contributes substantially to the burden of TB-associated morbidity and mortality. According to the World Health Organization report, there are about 8.8 million new TB cases and 1.45 million deaths owing to TB in the year of 2010 (WHO, 2011). Of the estimated 33.4 million people living with HIV in 2008, nearly 30 % were estimated to have latent or active TB infection (Getahun et al., 2010; UNAIDS, 2009). HIV/AIDS, TB and Diabetes mellitus (DM) were individually one of the top ten causes of mortality all over the world (WHO, 2011).

It has long been recognized that infective agents may predispose to, or trigger, some chronic non-communicable diseases with examples including infective contributions to cervical, liver and stomach cancers, and possible infective triggers for some types of diabetes (Hadley, 2006). Antiretroviral therapy for HIV may increase the risk of metabolic syndrome (the clustering of abdominal obesity, hyperglycemia, dyslipidaemia and hypertension) and thus predispose to Type 2 diabetes and cardiovascular disease (Grinspoon and Carr 2005; Pao et al., 2008; Aboud et al., 2007). The rising prevalence of DM is a potential threat to TB control, as

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Table 1. Age and sex distribution of HIV patients and control subjects.

Age Group	Patients				Control			
	M	F	Total		M	F	Total	
			n	(%)			n	(%)
20-30	28	41	69	34.5	6	9	15	30.0
31-40	31	30	61	30.5	7	4	11	22.0
41-50	21	26	47	23.5	6	6	12	24.0
51+	13	10	23	11.5	6	6	12	24.0
TOTAL	93 (46.5%)	107 (53.5%)	200	100	25 (50%)	25 (50%)	50	100

poorly controlled diabetes increases the risk of TB (Leung et al., 2008; Baker, 2012) and diabetes leads to poor TB treatment outcomes (Baker, 2011). Biologically, diabetes affects vulnerability to TB owing to the effects of DM on innate and adaptive immunity (Jeon et al., 2012).

According to research presented at the Diabetes Leadership Forum Africa 2010 in Johannesburg, people with diabetes are eight times more likely to contract TB; diabetes treatment interferes with TB management and TB treatment interferes with blood glucose management. Diabetes-related complications and mortality also increase in the presence of TB. Furthermore, for people with both diseases, their TB is more infective, which has major implications for the spread of TB (Motala and Kaushik, 2012). Recent systematic reviews of Stevenson et al. (2007) suggest that Type 2 diabetes mellitus (T2DM) increases individual risk of Mycobacterium tuberculosis disease.

With a high prevalence of diabetes in the population, it stands to reason that the same predisposing factors will operate in patients with HIV. HIV/AIDS patients, therefore, frequently present with diabetes and metabolic complaints. As treatment of HIV develops, and access to therapy improves, the incidence of HIV-associated diabetes is bound to grow. Apart from this, however, HIV patients present with other metabolic syndromes such as dyslipidemia and lipodystrophy (Aberg et al., 2005). Highly active antiretroviral therapy (HAART) however has also led to an increase in metabolic dysfunction, including insulin resistance, diabetes dyslipidemia and lipodystrophy (Capili et al., 2006). This constellation of abnormalities is also called antiretroviral-associated diabetes, and is consistent with the clinical picture of T2DM, rather than T1DM (Dagogo-Jack, 2008). The aim of this study was to know whether or not there was evidence(s) of concurrent occurrences of tuberculosis and diabetes in HIV/AIDS patients in Nigeria.

MATERIALS AND METHODS

A cross sectional research design was employed in this study. Two hundred HIV infected patients were randomly selected from the HIV clinic at University of Nigeria Teaching Hospital (UNTH) Ituku Ozalla, Enugu. Ethical certificate was obtained from UNTH Ethical Reviews Committee and the patients had a thorough explanation of the research protocol after which they gave their informed consent to participate in the study. Tuberculosis infections were screened for the presence of acid-fast bacilli. This was done by collecting three consecutive sputum samples using sterile universal containers and subsequently carrying out Ziehl Nelson staining technique on smears made on slides from the sputum samples. Two or more consecutive positive sputum samples indicated tuberculosis. Their fasting blood sugar levels were determined by glucose oxidase method using monoreagent enzyme glucose kit (Human Diagnostics, Wiesbaden Germany) and levels of ≥5.5 mmol/L was taken as being hyperglycemic.

The HIV test was carried out using the Immunochromatographic sandwich technique (Trinity Biotech Uni-gold, Trinity Biotech Plc, Bray, Ireland). Fifty subjects confirmed to be HIV negative by screening for the HIV virus 1 and 2 were used as a matched control population in terms of sex and age for this study. They were also selected from within Enugu metropolis. These subjects were screened to determine their fasting blood glucose levels and tuberculosis infections. Researchers' developed questionnaires were used to obtain information on demographic characteristics of the subjects. Data such as age, sex and length of time on antiretroviral use were collected from these subjects.

Data were analyzed using Statistical Package of Social Sciences (SPSS) version 15 and were presented in tables. A statistical correlation was done to see if there was any relationship between the simultaneous occurrence of tuberculosis and high fasting blood glucose levels (P>0.05).

RESULTS

Table 1 shows the age groups and sex distribution of the total number of patients and control subjects used for the study. A total of 93 males (46.5%) and 107 females (53.5%) made up the study group, and a total of 25 males (50%) and 25 females (50%) made up the control group.

Table 2. Prevalence rates of control subjects for hyperglycemia and tuberculosis according to age group distribution.

Age-Group	Hyperglycemia		Tuberculosis	
	n	Prevalence	n	Prevalence
20-30	0	0	0	0
31-40	0	0	0	0
41-50	0	0	0	0
51+	0	0	0	0
Total	0	0	0	0

Table 3. Prevalence of HIV/AIDS patients with hyperglycemia and tuberculosis according to age group distribution.

Age group No. of patients		Hyperglycemia		Tuberculosis infection	
		n	% Prevalence	n	% Prevalence
20-30	69	1	0.5	7	10.0
31-40	61	4	2.0	9	12.5
41-50	47	5	2.5	8	11.0
51+	23	2	1.0	3	4.0
Total	200	12	6	75	37.5

Table 4. Sex distribution of subjects with hyperglycemia and tuberculosis.

Gender	Hyperglycemia		Tuberculosis		Total	
	n	% Prevalence	n	% Prevalence	n	% Prevalence
Males	7	58.4	50	66.7	57	65.5
Females	5	41.6	25	33.3	30	34.5
Total	12	13.8	75	86.2	87	

The age groups used in the study were 20 - 30 years, 31 - 40 years, 41 - 50 years, and 51 years and above. The number of patients per age group and the corresponding percentages are shown.

Table 2 shows that no subject in the control group had tuberculosis or hyperglycemia. The control population was also selected from the same age groups as the study population.

Table 3 shows that out of the 200 HIV/AIDS patients that were screened, 12 subjects had high fasting blood glucose (6%). Seventy-five subjects (37.5%) were confirmed positive for tuberculosis. In subjects with high fasting blood glucose levels, persons within the age of 41-50 years and 20-30 years had the highest and lowest frequencies of occurrence (2.5% and 0.5% respectively). For subjects with tuberculosis, those in the 31-40 age group and 51+ age group had the highest and lowest frequencies respectively (12.5% and 4%). The percentage frequencies for both conditions did not vary with age.

Table 4 shows the percentage prevalence of patients having hyperglycemia and tuberculosis according to sex distribution. For hyperglycemia, the percentage frequency for both sexes was 5.3 and 41.6% for male and female respectively. For tuberculosis, the sex distributions were 66.6 and 33.3% for males and females respectively. The concomitant prevalence in males was 65.5% as against 34.5% in females (p> 0.05).

All the 12 patients who had hyperglycemia were also positive for tuberculosis. However, the regression coefficient shows that there was no relationship in the occurrences of tuberculosis and hyperglycemia (P>0.05).

DISCUSSION

The prevalence of hyperglycemia in this study (6%) was low compared to 14% obtained in a Multicenter AIDS Cohort study by Brown et al. (2004). The prevalence of metabolic syndrome was also high (14%) in an international cross sectional HIV patients study using

International Diabetes Federation (IDF) and U.S. National Cholesterol Education Program Adult Treatment Panel III (ATPIII) criteria, relative to body composition (whole-body dual-energy X-ray absorptiometry and abdominal computed tomography), lipids, glycemic parameters, insulin resistance, leptin, adiponectin, and C-reactive protein (CRP) (Wand et al., 2007). The type of diabetes associated with HIV may be classified as Type 2 diabetes (T2DM), rather than T1DM, in the vast majority of patients. In their study, incidence of tuberculosis was also high (56.7%) and ranked highest over other opportunistic infections.

The result of this study corresponds with that of a study carried out on impaired glucose metabolism and antiretroviral use among HIV infected women by Howard et al. (2005), where it was discovered that impaired glucose tolerance and diabetes mellitus were associated with traditional diabetes risk factors (advancing age, longer duration of HIV infection, low CD4 count, high viral burden, high body mass index, greater waist circumference or waist-to-hip ratio, lower socio economic class, and certain ethnic backgrounds or culture) (Dreher 2004), rather than HIV infection and the use of highly active antiretroviral therapy (HAART). This also explains why in this study, hyperglycemia was found more in the middle age group.

In the case of antiretroviral therapies, previous researchers have claimed that some of the protease inhibitors (PI) (which are a class of antiretroviral drugs that bind to the active site of the viral protease enzyme preventing the processing of viral proteins into functional forms) can be associated with insulin resistance (IR) and diabetes. This is because, protease inhibitors seem to affect the way insulin "shutters" sugars into the muscle and liver as glycogen for storage. In another study, patients on antiretroviral drugs containing protease inhibitors were switched to other antiretroviral drugs such as Nevirapine, Efavirenz or Abacavir and it was observed that their lipid and sugar metabolism improved (Fisac et al., 2005).

From this study, the duration of administration of antiretroviral had a significant effect on the percentage prevalence of tuberculosis. As the length of time of administration of antiretroviral increased, the percentage prevalence of tuberculosis decreased. This result corresponds with that of a study carried out by the Center for Disease Control (CDC, 2004) where 2,063 HIV infected adults and adolescents were enrolled in a clinical trial to ascertain the effect of HAART over a period of time on the incidence of opportunistic infections. A dramatic decline on the incidence of opportunistic infections was observed.

Conclusion

Even though the concomitant prevalence of these disease conditions according to this study is not significant, all HIV positive people are advised to go for screening for diabetes and active TB. However, knowing the prevalence of these concomitant diseases and merging the management of the diseases could improve the patient outcome.

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