Research Article

A study of the effects of HIV infection and ART treatment on the serum lipid profile of HIV/AIDS patients attending the Nylon District Hospital, Douala, Cameroon

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Abstract

Background: Antiretroviral therapy (ART) has been shown to substantially reduce morbidity and mortality in human immunodeficiency virus (HIV) seropositive patients. However, long-term management of patients on ART may affect their lipid metabolism and predispose them to an increased risk of developing cardiovascular diseases.

Objective: This study was aimed at investigating the effects of HIV infection and ART treatment on the serum lipid profile of HIV/AIDS patients.

Materials and Methods: A cross-sectional study was conducted on an equal number of HIV positive ART-naïve patients, ART-initiated patients, and apparently healthy HIV negative control subjects (n = 100). Serum lipid parameters were determined using colorimetric techniques. Independent sample t-test statistical analyses were carried out on the laboratory results using SPSS.20. p-Value <0.05 was considered as statistically significant.

Result: The mean (standard error of the mean [SEM]) duration of treatment with ART was 20.77 ± 11.5 months. The mean serum high density lipoprotein cholesterol (HDL-C) of ART-naïve patients was significantly lower than the control group (p = 0.001). Similarly, the mean serum total cholesterol (TC) and low density lipoprotein cholesterol (LDL-C) of patients on ART were significantly higher (p = 0.001), whereas HDL-C was significantly lower compared with the control subjects (p = 0.021). The mean serum TC, HDL-C, and LDL-C of the ART-initiated group were significantly higher compared with the ART-naïve group (p = 0.001).

Conclusion: Infection with HIV is characterized by a decrease in the serum HDL-C levels. Furthermore, the treatment with ART significantly increases plasma concentration of TC, HDL-C, and LDL-C. HIV patients on ART in Cameroon should therefore be closely monitored for alterations in their lipid profile levels.

KEY WORDS: Antiretroviral therapy, human immunodeficiency virus, dyslipidemia, Cameroon

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Introduction

Human immunodeficiency virus (HIV) infection is a major public health problem worldwide, affecting 35 million people, among whom 24.5 million are in Africa[1] and 68% of these HIV-infected individuals live in sub-Saharan Africa.[1] The prevalence of HIV infection in Cameroon is estimated at 5.3%[2] with individuals aged between 15 and 49 years being the most commonly infected.[2] Introduced in 1996, highly active

antiretroviral therapy (HAART) has modified the natural history of HIV infection through reduction in risks of death associated with the condition and improvement of the quality of life of people living with the infection.[3] HAART suppresses viral replication, allows the infected individual's immune system to recover, and protects from the development of AIDS and AIDS-related deaths.[3] In recent years, provision of antiretroviral therapy (ART) to those in need has become an increasingly important and feasible global priority[4] with many international donors and organizations funding this move in most countries in sub-Saharan Africa including Cameroon. As in many other countries, HIV/AIDS treatment in Cameroon is based essentially on the administration of antiretroviral (ARV) drugs and the symptomatic treatment of opportunistic infections.[5,6] Abnormalities in lipid metabolism of the persons infected with HIV potentially induced by the disease itself and probably by ART were first reported in the early 1990s. Studies in HIV-infected ART-naïve individuals have shown a variety of lipid abnormalities with decreases early in the infection in both total cholesterol (TC) and high density lipoprotein cholesterol (HDL-C), and increases later in triglycerides (TGs).[7] HAART also leads to lipid changes with increases in both TC[8] and TGs.[9] Patients in resource-limited settings are more likely to have advanced HIV disease and lesser access to relatively lipid friendly ARV drugs. Furthermore, patients initiating ART in such settings may experience different types of lipid abnormalities[10–12] than their counterparts in developed countries because of differences in lifestyle factors and genetic makeup. In Cameroon, the evaluation of lipid parameters is not required during the follow-up of HIV/AIDS patients and the data regarding lipid abnormalities in treatment-naïve and ART-initiated HIV-infected patients are limited.[13] This study was designed to investigate the effects of HIV infection and ART on serum lipid profile levels so as to provide useful data for better management and monitoring of HIV patients who are placed on ART throughout life.

Materials and Methods

Study Design, Area, and Participants

A cross-sectional study of 300 eligible volunteer participants was conducted at the HIV Voluntary Counseling and Testing Centre of the Nylon District Hospital, Douala, Cameroon from March 2012 to August 2012. Of this number, 100 were HIV positive patients on ART whereas 100 were HIV positive ART-naïve individuals [Table 1].

Potential study participants were adequately sensitized on the objectives of the study to obtain consent. Only volunteers who signed the informed consent form were enrolled into the study. A structured questionnaire to document information on lifestyle, demography, and anthropometric measurements of participants was administered. Body weights in light clothes were measured on a calibrated weighing scale to the nearest 0.5 kg. Heights were measured to the nearest 1.0 cm using a stadiometer with subjects standing in an erect position with their shoes off. Body mass index (BMI) was then calculated for each participant as weight in kilogram (kg) divided by the height in meter squared (m^2) and expressed in kilograms per square meter (kg/m^2).

Ethical Consideration

All procedures were approved by the Cameroon National Ethical Committee through the Ministry of Public Health and the Regional Delegation of Public Health, Buea, South West Region, Cameroon. Administrative clearance was received from the district medical officer of the Nylon Health District, Douala, Cameroon.

Sample Collection

Venous blood (10 mL) was collected after an overnight fast and 5mL each was distributed into dry tubes and Ethylenediaminetetraacetic acid (EDTA) tubes. Serum was used to confirm HIV status by the enzyme-linked immunosorbent assay technique. Whole blood CD4+ T lymphocyte cell count was determined using a flow cytometer (Partec Gmbh, Germany, 2006) according to the procedure described by the manufacturer. Serum TC, HDL-C, low density lipoprotein cholesterol (LDL-C), and TG concentrations were determined using commercially available kit (S.r.l Hospitex Diagnostics, Italy) on an automated clinical chemistry autoanalyzer (Erba Diagnostics). Serum TC concentration was determined using colorimetric enzymatic techniques based on the successive action of cholesterol oxidase and peroxidase; HDL-C concentration in the serum supernatant was determined by the same process after the precipitation of very low density lipoproteins cholesterol (VLDL-C), LDL-C, and chylomicrons in the presence of phosphotungstic acid and $MgCl_2$.

Serum LDL-C values were calculated using the formulae of Friedewald et al.[14]

LDL-C (mg/dL) = TC (mg/dL) - [HDL-C (mg/dL) - TGs (mg/dL)/5].

Statistics

Data were entered and analyzed using the Statistical Package for the Social Sciences version 20 for windows (IBM Statistics, USA). Group means (SEM) and percentages were calculated. Independent sample *t*-test was used to compare group means. Statistical significance was designated as $p<0.05$.

Result

Of the 300 participants enrolled in the study, 68% were female participants. An equal number of ART-naïve patients, ART-initiated patients, and apparently healthy HIV negative control subjects (n = 100) were studied. Inclusion criteria included all newly diagnosed HIV positive ART-naïve patients and HIV/AIDS patients on ART attending the Nylon District Hospital for treatment follow-up. Participants, who tested positive for hepatitis B and C viruses or who were pregnant, obese, smokers, taking antihypertensive agents as well as those with a family history of coronary heart disease or any

Table 1: Demographic characteristics of study subjects

Parameter	Controls	ART naïve	ART initiated
Number of patients	100	100	100
Sex			
Female	65	69	71
Male	35	31	29
Marital status			
Married	55	41	36
Single	45	59	64
Mean age (SEM) (years)	36.51 ± 0.46	38.81 ± 0.76	38.18 ± 0.65

ART, antiretroviral therapy; SEM, standard error of mean.

Table 2: Comparison of anthropometric and biochemical measurements between ART-naïve and ART-initiated study participants

Parameter	ART naïve	ART initiated	*p* Value
Number of patients	100	100	
Weight (kg)	53.41 ± 7.76	71.11 ± 8.65	0.001
BMI (kg/m^2)	22.83 ± 3.41	26.70 ± 4.10	0.001
Waist circumference (cm)	69.44 ± 5.35	74.97 ± 5.15	0.001
Hip circumference (cm)	78.03 ± 8.15	83.04 ± 7.55	0.001
Waist/hip ratio	0.88 ± 0.05	0.90 ± 0.05	0.001
CD4 count (mL)	282.10 ± 83.5	395.5 ± 95.2	0.001
TG (mg/dL)	150.57 ± 2.16	151.10 ± 2.11	0.865
TC (mg/dL)	144.42 ± 3.63	185.00 ± 5.08	0.001
HDL-C (mg/dL)	43.44 ± 1.39	52.72 ± 1.31	0.001
LDL-C (mg/dL)	73.48 ± 3.16	103.64 ± 4.57	0.001
TC:HDL-C ratio	3.32	3.50	0.001

ART, antiretroviral therapy; BMI, body mass index; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; TC, total cholesterol; TG, triglyceride.

Table 3: Comparison of lipid profile levels between ART-naïve individuals and HIV negative control subjects

Parameter	ART naïve	Control subjects	*p* Value
Number of patients	100	100	
TG (mg/dL)	150.57 ± 2.16	147.11 ± 2.76	0.494
TC (mg/dL)	144.42 ± 3.63	149.56 ± 1.97	0.288
HDL-C (mg/dL)	43.44 ± 1.39	58.67 ± 1.70	0.001
LDL-C (mg/dL)	73.48 ± 3.16	60.13 ± 1.99	0.058

ART, antiretroviral therapy; BMI, body mass index; HDL-C, high density lipoprotein cholesterol; HIV, human immunodeficiency virus; LDL-C, low density lipoprotein cholesterol; TC, total cholesterol; TG, triglyceride.

chronic organ or systematic disease were excluded from the study. The main source of exposure to HIV in all the infected patients was heterosexual transmission. As shown in Table 1, 29% male patients and 71% female patients were currently receiving ART treatment whereas 31% male patients and 69% female patients were HIV seropositive ART-naïve individuals. The ratio of male to female participants was 30:70 in HIV-infected patients and 65:35 in controls. The mean (SEM) age of the study participants was 37.41 ± 0.69 years. The mean (SEM) age of the HIV/AIDS patients on ART was 38.18 ± 0.65 years whereas that of the ART-naïve participants was 38.81 ± 0.76 years. The mean (SEM) duration of treatment with ART was 20.77 ± 21.5 months. Of all the subjects, 12 (4.0%) had TB-HIV coinfection during the study period (9 [9.0%] of the ART and 3 [3.0%] non-ART groups).

Table 2 revealed that the mean CD4+ T lymphocyte cell count, weight, BMI, waist circumference, hip circumference, waist to hip ratio, mean serum LDL-C, HDL-C, and TC were

Table 4: Comparison of lipid profile levels between ART-initiated patients and HIV negative control subjects

Parameter	ART initiated	Control subjects	*p* Value
Number of patients	100	100	
TG (mg/dL)	151.10 ± 2.11	147.11 ± 2.76	0.353
TC (mg/dL)	185.00 ± 5.08	149.56 ± 1.97	0.001
HDL-C (mg/dL)	52.72 ± 1.31	58.67 ± 1.70	0.021
LDL-C (mg/dL)	103.64 ± 4.57	60.13 ± 1.99	0.001

ART, antiretroviral therapy; HDL-C, high density lipoprotein cholesterol; HIV, human immunodeficiency virus; LDL-C, low density lipoprotein cholesterol; TC, total cholesterol; TG, triglyceride.

significantly higher in the ART-initiated patients compared with the ART-naïve individuals.

As shown in Table 3, the mean serum HDL-C of ART-naïve patients was significantly lower than the control group ($p = 0.001$).

The mean serum TC and LDL-C of patients receiving ART were significantly higher compared with the control subjects ($p = 0.001$).

Discussion

This study reveals that the treatment with ART ameliorates the decrease in CD4+ T lymphocyte cell count caused by HIV infection. Also, serum HDL-C levels of ART-naïve HIV patients were significantly reduced compared with HIV seronegative control subjects. Furthermore, serum levels of TC, HDL-C, and LDL-C were higher in ART-initiated compared with ART-naïve HIV seropositive patients.

This study reports a higher prevalence of HIV infection in women than in men in Cameroon as observed earlier.[15–17] A number of studies have reported differences in lipid profiles between patients receiving ART and those who were ART naïve. Although an elevated TG level and a decreased HDL-C level have been reported as the most common profile in ART-naïve patients,[18] our study only revealed a decrease in HDL-C concentration in this group of patients. The findings of low serum levels of HDL-C in ART-naïve individuals were similar to the Nutrition for Healthy Living (NFHL) cohort in the United States[19] in which the HIV patients who are not yet on HAART had an adjusted Odds ratio (OR) of 2.7 for low HDL-C compared with general population, and another study conducted in Spain.[20] The striking decrease in HDL-C level with no change in TG levels observed in ART-naïve HIV positive patients in this study is comparable to similar findings in patients with CD4 counts >350 cells/μL who had not yet developed significant hypertriglyceridemia, suggesting that the disturbances in HDL-C metabolism precede the elevation in serum TG during HIV infection.[13] In contrast, one study with a limited sample size reported no significant difference in the mean serum HDL-C levels of the HIV-infected subjects on HAART compared with those without HAART and the seronegative in Nigeria.[21] Our observations are different from reported changes in which higher concentrations of TC and LDL-C were found in most protease inhibitors–based ART regimens without higher levels of HDL-C with ART treatment.[22–23] This difference in observation could be owing to the fact that only about 30% of HIV positive patients in Cameroon currently receive tritherapies consisting of (1) two Nucleotide reverse transcriptase inhibitors (NRTIs) + one Protease inhibitor (PI) and (2) two NRTIs + one Non-nucleotide reverse transcriptase inhibitor (NNRTI).[13] Several other studies in other countries have shown that HIV/AIDS patients on ART exhibit dyslipidemia characterized by an increase in TC, TG, and LDL-C and variable effects on HDL-C levels.[24–26] Furthermore, our results bear striking similarity with the results of the study done by Ngogang et al., who also reported a significant increase in serum TC and LDL-C levels during the use of ARV drugs in Cameroon and observed that the increase was progressive with the duration of ART administration. HDL-C also increased significantly but TG levels were not altered in the same study.[11]

Results of this study should be interpreted in light of some limitations. The cross-sectional design used does not permit to establish cause–effect relationships. Also, the selection of patients without lipid-lowering treatment may bias our study population. Furthermore, the study did not take into account the effects of different ART drugs on lipid profiles.

Conclusion

Results from this study suggest that infection with HIV is characterized by a decrease in the serum HDL-C levels. Treatment with ART significantly restores immune status and increases plasma concentration of TC, HDL-C, and LDL-C. HIV/AIDS patients on ART in Cameroon should therefore be closely monitored for alterations in lipid profile levels to prevent them from being victims of cardiovascular diseases.

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