Journal of
AIDS & Clinical Research
ISSN: 2155-6113

Belay et al., J AIDS Clin Res 2014, 5:8
DOI: 10.4172/2155-6113.1000328

Research Article Open Access

Lipid Profile Derangements among Human Immunodeficiency Virus Infected Adults Receiving First Line Anti-Retroviral Therapy in Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia: Comparative Cross-Sectional Study

Ezra Belay[1], **Daniel Seifu**[2], **Wondwossen Amogne**[3] **and Kelemu Tilahun Kibret**[4*]

[1]*Department of Biochemistry, College of Medical and Health Science and Ayder Referral hospital, Mekele University, Mekele, Ethiopia*

[2]*Department of Biochemistry, College of Medical and Health Science, Addis Ababa, University, Addis Ababa, Ethiopia*

[3]*Department of Internal medicine, College of Medical and Health Science, Addis Ababa, University, Addis Ababa, Ethiopia*

[4]*Departments of Public Health, College of Medical and Health Science, Wollega, University, Nekemte, Ethiopia*

[*]**Corresponding author:** Kelemu Tilahun Kibret, Departments of Public Health, College of Medical and Health Science, Wollega, University, Nekemte, Ethiopia, Tel: 0910020153; E-mail: ktwu27@gmail.com

Received date: June 09, 2014; **Accepted date**: Jul 29, 2014; **Published date**: August 05, 2014

Abstract

Introduction: Dyslipidemia is becoming one of the common problems in human immunodeficiency virus infected patients receiving antiretroviral therapy. Data on lipid profile derangements induced by antiretroviral treatment in Ethiopia is scarce. The aim of this study was to assess the prevalence and patterns of lipid profile abnormalities among patients taking first line antiretroviral therapy in Tikur Anbesa hospital, Addis Ababa, Ethiopia.

Methods: comparative cross sectional study was conducted between August and December 2012 in Tikur Anbesa Specialized Hospital in Addis Ababa. The study population consisted of 70 HIV positive individuals who had been receiving first line ART regimen for at least 6 months (treatment group) and 71 individuals with diagnosed HIV infection and who were not yet receiving antiretroviral therapy. An interviewer administered structured questionnaire was used to collect information. Lipid profile was determined after overnight fasting and dyslipidemia was diagnosed according to the United State National Cholesterol Education Program III criteria. Data comparison used chi-square test, Student t-test and logistic regressions.

Result: The prevalence of dyslipidemia was higher in antiretroviral treatment group (80%) as compared to antiretroviral treatment naïve groups (57.7%). Total cholesterol >200 mg/dL was 45.7% in Antiretroviral Therapy groups and 21.1% in Antiretroviral Therapy naïve groups. Similarly low density lipoprotein cholesterol > 130 mg/dL was 40% vs 29.6%, triglyceride >150 mg/dL; 40% vs 32.4%, and high density lipoprotein cholesterol <40; 22.9% vs 16.9% in Antiretroviral Therapy and Antiretroviral Therapy naïve groups respectively, showing more lipid alteration in ART group. Use of ART was also significantly associated with high total cholesterol (>200 mg/dL) ($p<0.002$), total cholesterol / high density lipoprotein cholesterol ratio >5($P<0.026$), an established risk indicator of coronary artery disease and triglyceride / high density lipoprotein cholesterol ratio > 2.4($p<0.036$).

Conclusion: Higher prevalence of dyslipidemia was observed among Antiretroviral Therapy treated groups as compared to ART naïve groups. Therefore lipid profiles should be screened in Antiretroviral Therapy treated populations periodically to monitor any changes in lipid profile.

Keywords: Ethiopia; Antiretroviral treatment; Dyslipidemia; Cardiovascular disease

Introduction

The introduction of antiretroviral treatment (ART) in the mid-1990s led to a marked reduction in morbidity and mortality from human immunodeficiency virus (HIV) infection [1]. In addition to improving quality of life and reducing acquired immune deficiency syndrome (AIDS) related deaths [2,3], ART treatment has been recognized to prevent HIV transmission by reducing viral load [4].

However, over time ART has been associated with an increasing number of metabolic abnormalities such as the development of dyslipidemia, insulin resistance, and human immunodeficiency virus lipodystrophy syndrome (HIV-LS). These metabolic change are known to contribute for the development of cardiovascular disease (CVD) and diabetes mellitus (DM), representing a challenge in the treatment of HIV infection [5-9]. Moreover, lipodystrophic body changes can jeopardize the quality of life of these patients, leading to low adherence to ART and subsequent virologic and clinical failure [7].

During the last decade, an increasing frequency of dyslipidemia has been observed among ART treated HIV-positive patients [5]. The prevalence lays somewhere in between 20% and 80% including hypertriglyceridemia (40-80%) and high total cholesterol (10-50%), with at least one physical abnormality in approximately 50% of patients depending on the type of drug regimen used [6,10]. It is

reported that as high as 82.3% of first line ART and 76.9% pre-ART patients had at least one lipid profile abnormality (dyslipidemia) [11].

The mechanisms responsible for lipid profile changes in HIV/AIDS infected patients are proven to be complex and to date are not fully understood but are probably multifactorial. It is suggested that various conditions and complex interactions involving the direct and indirect effects of antiretroviral medications and HIV infection itself have played a role in development of dyslipidemia [5,9,12].

Lipid profile alterations in pre ART patients are associated to the host's response to systemic inflammation and persistent viral infection mediated by various cytokines including tumor necrosis factor (TNF), interleukins, and the interferons secreted by active immune cells in the adipose tissue [6]. Increased production of these cytokines and inflammatory responses enhance β-adrenergic stimulation of adipose tissue and thus advance adipose tissue lipolysis which in turn results in a secondary elevation in hepatic fatty acid levels, providing a stimulus for triglyceride synthesis and secretion as very-low-density lipoprotein (VLDL) particles [5].

Following the initiation of ART, more pronounced atherogenic changes in the lipid profile has been increasingly observed [13]. Initially it was associated with exposure to protease inhibitors (PI) but subsequently exposure to nucleoside reverse transcriptase inhibitors(NRTIs) particularly stavudine (d4T) and zidovudine (AZT) were recognized as being central to the development of this syndrome, even though it has been less well studied [1,14].

HIV patients exposed to NRTIs demonstrate mitochondrial dysfunction, manifested by depletion of Mitochondrial Deoxy Ribonucleic Acid (mtDNA) and reduced mitochondrial Ribonucleic Acid (mtRNA) expression. This is due to the ability of NRTIs to inhibit DNA polymerase-☒, the enzyme responsible for replication of mtDNA. These molecular effects resulted in impaired β-oxidation-conversion of fatty acids to triglycerides that accumulate in myocyte and hepatocyte cytosol, causing hyperlipidemia, inhibition of pre-adipocyte differentiation, increased adipocyte apoptosis, and abnormally functioning subcutaneous adipose tissue with reduced storage capacity for circulating lipids. Finally it resulted in increased circulating free fatty acids, reduced adiponectin secretion, and lipid accumulation in non-adipose tissues such as liver (hepatic steatosis) and hepatic triglyceride accumulation [1]. Mitochondrial toxicity are also believed to disrupt metabolic pathways through changes in sterol-regulatory binding proteins leading to insulin resistance and dyslipidemia [5].

Emerging evidences also indicate an association between Non-Nucleoside Reverse Transcriptase Inhibitors (NNRTIs) containing regimens and dyslipidemia and other metabolic changes [9,15], even though the mechanisms they induced dyslipidemia is unclear and still unexplained [16].

Different ART classes and even individual agents within each drug class can have disparate effects on lipid profile alteration which may determine selection of ART regimens for initiations of treatment. However, most of the previous studies explored vigorously on the effect of old ART regimens like stavudine (d4T) in lipid metabolism, which are now almost excluded from the combination therapy. Still the effect of recently approved ART regimens like TenofovirDisoproxilFumarate (TDF) on lipid metabolism remains fully unexplained particularly in sub Saharan African where most of HIV patients live. In this region, where 8 to 71% of patients initiating ART die within the first year of treatment, apart from baseline CD4 count, viral load, and stage of the disease, dyslipidemia is thought to be one of the contributing variables to high AIDS-related mortality [17]. In addition, patients in developing nation initiating ART may experience different rates and types of lipid abnormalities than patients in developed countries because of differences in genetic background, dietary intake, and lifestyle factors [18]. A better understanding of the prevalence and patterns of lipid metabolic derangements at early stage in both HIV infected patients and those initiated ART could be important to identify potential interventions as well as additional clinical measurements that can be used to improve the care of HIV patients.

Therefore the aim of this study was to determine and compare the prevalence and pattern of dyslipidemia in resource poor setting, where data are scarce.

Methods and Materials

Study setting and period

This study was done at Tikur Anbesa Specialized Referral hospital. This is the largest referral hospital in the country, which is located at the center of the capital city. The ART clinic hosted approximately 5015 clients, of which 2414 were on 1st line ART and the rest 133 and 2468 were on 2nd line ART and pre-ART respectively.

Study design

A comparative cross sectional study design (comparison between ART naïve and ART treated groups) was used to assess the prevalence and paterns of lipid profile derangements among HIV patients receiving first line ART with respect to treatment naive groups at TikurAnbesa specialized Referral Hospital, Addis Ababa Ethiopia, from August to December 2012.

Study populations

All adult HIV positive patients (≥18 years of age) visited TikurAnbesa specialized Referral Hospital ART clinic from August to December 2012 were our source population for cases and controls.

Cases were defined as adult HIV positive (≥18 years old) who had been on first line ART treatment continuously for at least six months duration and controls were HIV positive adults who were not yet receiving ART prior to time of data collection.

Those who had started/changed first line ART treatment within less than six months' time and those on 2nd line ART treatment (for cases), with known diabetics and cardiovascular disease, those using lipid lowering drugs, Pregnant/ breast feeding womens, were excluded from the study.

First-line ART regimens

As defined by the WHO, regimens that included nucleoside reverse transcriptase inhibitors (NRTIs): 3TC, AZT, or d4T, TDF, and non-nucleoside reverse transcriptase inhibitors (NNRTIs): NVP or EFV and or do not include PIs.

Sample size determination

The sample size was determined by using double proportion formula and taking the prevalence of Low Density Lipoprotein-

Cholesterol(LDL-c) from previous cameroon study with similar context and proximate study settings [19]. LDL-cholestrol >130 was found in 46.4% of ART treated and 21% of ART neive gruop. By taking significance level (α) = 0.05, 95% confidence level, 80% power with a case to control ratio of 1:1. Adding 10% contingency, the calculated sample size was 141(61 for treatment groups and 61 for the ART naieve groups).

Sampling method

By using convenient sampling method, all consecutive treatment and treatment naïve individuals fulfilling the inclusion criteria and attending TikurAnbesa specialized hospital ART clinic during the study period were included until the required sample size was achieved.

Data collection procedure

Clinical and demographic data collection: Information on sex, age, specific ART type in use , ART start date, duration of treatment, duration of HIV infection, BMI, relevant signs and symptoms, CD4 count, co-infection/opportunistic infection, other chronic diseases and medications if any were collected by trained nurses using structured questionnaires and patients medical record.

Blood Sample Collection, Transport and Processing: Following a standard and safety collection procedure, about 5 mL fasting venous blood was taken from both the patients and the control groups by clinical nurses and senior laboratory technologist with SST TM test tube. Sera were separated after centrifugation at 3700 rotation per minute for 10 minutes, stored at -20°C with nunck tubes and thawed just before analysis.

Laboratory investigations: Fasting serum samples were analyzed for total cholesterol (TC), triglyceride (TG), High Density Lipoprotein-Cholesterol(HDL-c),glucose, alanine aminotransferase (ALT), aspartate aminotransferase (AST) and creatinine according to their measurement principle/guideline (standard operating procedures (SOP) and manufacturer's guideline by using Hitachi 902 Auto analyzer (Roche Diagnostics, Germany). Low density lipoprotein cholesterol (LDL) was determined by Friedewald Equation ((TC-HDL)-TG/5)).The lipid ratios (TC/HDL-c and TG/HDL-c) were also computed. Recent CD4 counts were also taken from patient's medical record.

Dyslipidemia was defined according to the US National Cholesterol Education Program III guidelines. These include TC level >200 mg/dL, LDL-c level>130 mg/dL, TG level >150 mg/dL, and HDL-c level < 40 mg/dL.

Statistical data analysis

Data were entered using EPIInfo version 3.5 software and analyzed using SPSS software version 20.0. Differences in mean values and proportions of altered lipid profiles between the two groups were assessed using Student t-test and X^2 test. Bivariate logistic regression models with odds ratios (ORs) and their 95% confidence interval (CIs) were used to estimate the association of independent variables to altered lipid profiles in both groups. Internal Comparisons among groups of various variables was also performed. *P* values < 0.05 were considered statistically significant.

Ethical considerations

The study was approved by Ethics and Research Committee of the department of biochemistry (protocol no. 0016/DERC, 2012) and department of internal medicine, School of Medicine, Addis Ababa University. Then written informed consent was obtained from each study participants after stating and introducing the purpose and procedures of the study to them clearly in understandable local language. Confidentiality was assured for all the information gathered from the participants by restricting the persons who access the data and personal identifiers were not also included in data collection questionnaire.

Result

General characteristics of the study population

Of 141 participants selected, 141 study subjects responded, 70 (50%) participants who were on first line ART cases and 71(50%) participants who were ART naïve controls) with over all response rates of 100 %. The sex distribution in each group was almost equivalent (P = 0.9) (Table 1).

Characteristics	ART treated groups (n=70)	ART naïve group (n=71)	p-values
Sex: Female n (%)	51(72.9)	51(72.8)	0.9
Age (in years): mean (SD)	38.5(8.7)	36.2(8.9)	0.1
Residence n (%) Town	67(100)	66(94.3)	0.9
Rural	0	4(5.7)	
Time after HIV diagnosis mean (SD)	76.6 (78)	49.2 (29)	0.001
Last CD4 counts (cells/mL), median (IQR)	369(263)	267(302)	NA
CD4 < 200 (cells/mL), n (%)	9(12.9)	23(32.4)	0 .009
Active Smokers	1(1.4)	6(8.5)	
Frequent alcoholic habit, n (%)	0	1(1.4)	NA
BMI (kg/m^2): mean (SD)	22.2(3.3)	22.4 (3.6)	0.7
<18 (underweight)	4(6.1)	4(6.0)	NA
18-25 (normal weight)	53(80.3)	50(74.6)	
>25 (overweight)	9(13.6)	13(19.4)	0.4
Medication other than ART, n (%)	1(1.4)	2(2.9)	
Opportunistic infection, n (%)	0	3(4.2)	NA
History of hypertension, n (%)	0	0	NA
*NA= not applicable, CI=confidence interval, SD=standard deviation, BMI= body mass index IQR= Interquartile range, ART= antiretroviral therapy			

Table 1: General characteristics of study participants at TikurAnbesa specialized referral hospital, Addis Ababa, Ethiopia, 2012/13.

First line antiretroviral drugs used in ART groups

The first line ART used in our study participants was a combination of 2NRTIs and 1NNRTIs. Half, 50% of participants in the treatment group were using TDF containing NRTIs while more proportion of groups, 58.6% was on EFV based regimes. All the combinations were included 3TC in common (Table 2).

Variables	Frequency (%)
Duration of ART(months); mean(SD)	42.9(26.9)
6-12	8(12.5)
>12	56(87.5)
d4Tcontaining regimens	9(12.9)
AZT containing regimens	26(37.2)
TDF containing regimens	35(50.0)
EFV based regimens	41(58.6)
NVP based regimens	29(41.4)
d4T switch to AZT or TDF: Yes	14(20)
No	56(80)
ART = Antiretroviral treatment SD = Standard deviation, d4T = Stavudine, AZT = zidovudine; TDF=Tenofovir Disoproxil Fumarate; EFV = Efavirenze; NVP = Neverepin	

Table 2: First line antiretroviral drugs used in ART groups at TikurAnbesa specialized Referral hospital, Addis Ababa Ethiopia, 2013.

Characteristics of lipid profile abnormalities

Lipid profile tests (TC, TG, HDL-c, LDL-c) were performed for a total of 141 (71 ART naïve & 70 ART treated) participants. High dyslipidemia was found in ART groups 56(80%) and 41 (57.7%) in ART naïve groups (X2=8.13, P=0.004, OR =2.9, 95%CI= 1.33-6.66).

Single abnormal lipid profile occurred in 20(28.2%) of the ART naïve group and in 22 (31.4%) of the ART group (X2=0.18, P=0.67 OR =1.2 95%CI= 0.53-2.56). Number of participants with mixed (two or more) lipid profiles abnormalities was 21(29.6%) in pre-ART group and 34(48.6%) in ART group, showing significant difference between the two groups (X2=5.34, P=0.02, OR =2.56, 95%CI=1.06-4.78) (Table3).

There was statistically significant difference between the two groups forTC> 200, TC/HDL-c ratio and TG/HDL –c ratio. The TC/HDL ratio was > 5 in 6 (8.5%) of ART naïve subjects and 19(27.1%) of ART participants ((P=0.026) with participants on ART being 4 times more likely to have higher TC/HDL-c ratio ≥5 (OR=4.0; 95%CI= 1.5-10.8).

A high triglyceride to HDL-C ratio (≥2.4), a strong indicator of the insulin resistance syndrome, was detected in 42.3% of ART naïve participants and 60% of ART participants (p=0.04). There was no significant difference between the two groups on HDL-C<40 and LDL-C >130 (Table 3).

In this study, CD4 count shows positive correlation with TC (correlation coefficient, r = 0.22, p=0.0078), TG(r=0.04, p=0.886), and LDL-c(r=0.18, p=0.036) but negative correlation with ALT (r =-0.12, p=0.15), AST (r =-0.16, p=0.053), and HDL-c (r=-0.049, p=057).

Lipid profiles	ART naïve(n=71)	ART (n=70)	P –value	OR (95%CI)
TC mean (SD)	162.4(46.1)	195.3(48.1)	0.001*	17.2-48.6
TC>200 mg/dL, n (%)*	15(21.1)	32(45.7)	0.002*	3.1 (1.5- 6.6)
TG mean (SD)	124.7 (60.9)	147.7(70.3)	0.049*	0.07- 43.6
TG > 150 mg/dL, n (%)*	23(32.4)	28(40.0)	0.4	1.4 (0.7- 2.8)
LDL-c, mean (SD)	107.3(45.3)	113.4(39.4)	0.4	-6.6-20.8
LDL-c> 130 mg/dL, n (%)*	21(29.6)	28(40.0)	0.2	1.6 (0.8-3.2)
HDL-c, mean (SD)	55.2(24.3)	51.54(17)	0.3	-2.9-10.7
HDL-c <40 mg/dL, n (%)*	12(16.9)	16(22.9)	0.4	1.5; 0.6-3.4
TC/HDL-c ratio ≥ 5, n (%)*	6(8.5)	19(27.1)	0.006*	4.0 (1.5-10.8)
TG/HDL-c ratio ≥ 2.4, n (%)*	30(42.3)	42(60.0)	0.036*	2.05(1.05-4.0)
n (%)*= number of case (percentages), ART= antiretroviral therapy, SD=standard deviation, OR = odds ratio, *statistically significant difference, TC=Total Cholesterol, HDL-c= High Density Lipoprotein -Cholesterol, LDL-c= Low Density Lipoprotein-Cholesterol, TG = Triglyceride				

Table 3: Prevalence of lipid profile derangements and their association with use of ART at TikurAnbesa hospital, Addis Ababa-Ethiopia, 2013.

Changes in Lipid profile in different ART Regimen

Nucleoside Reverse Transcriptase Inhibitors (NRTIs): There were no statistically significant differences among groups taking d4T, AZT and TDF regimens against raised TC, LDL-c, TG values and low HDL-c value (p>0.05). However, AZT and TDF groups were 5.8 and 6.7 times more likely to develop TG >150 as compared with d4T groups; 1.3 and 1.5 times for LDL-c >130, and 1.7 and 1.9 times more likely to develop TC>200 than d4T groups, respectively (Table 4).

Non- Nucleoside Reverse Transcriptase Inhibitors (NNRTIs)

Nearly 50% of participants taking NVP based NNRTIs combination have TC>200 and TG >150. Also the prevalence of LDL-c >130 and TC/HDL-C ratio was higher in these groups. However the differences between the two regimens was not statistically significant for all lipid profiles (Table 5).

Lipid profiles (in mg/dL)	*d4T		AZT			TDF		
	N (%)	COR	N (%)	p-value	OR (95% CI)	N (%)	p-value	OR (95 CI)
TC>200	3(33.3)	1.00	12(46.2)	0.5	1.7(0.4-8.4	17(48.6)	0.4	1.9(0.4-8.8)
HDL-c<40	2(22.2)	1.00	6(23.1)	0.95	1.05(0.2-6.5)	8(22.8)	1.0	1.0(0.2-6.0)
LDL-c >130	3(33.3)	1.00	10(38.5)	0.6	1.3(0.3-6.2)	15(42.9)	0.4	1.5(0.3-7.0)
TG>150	1(11.1)	1.00	11(42.3)	0.1	5.8 (0.6-54.0)	16(45.7)	0.1	6.7(0.8-59.8)
TC/ HDL-C >5	1(11.1)	1.00	7(26.9)	0.4	2.95(0.3-8.3)	11(31.4)	0.3	3.7(0.4-33.0)

Table 4: Changes in lipid profile of ART participants by NRTIs regimens at TikurAnbesa hospital, Addis Ababa-Ethiopia, 2013.

Lipid profiles(mg/dL)	*NVP		EFV		
	N (%)	OR	N (%)	p-value	OR(95%CI)
TC>200	14(48.3)	1.00	18(43.9)	0.7	0.8(0.3 -2.2)
HDL-c<40	6(20.7)	1.00	10(24.4)	0 .7	1.2(0.4-3.9)
LDL-c >130	12(41.4)	1.00	16(39)	0.8	0.9(0.3-2.4)
TG>150	13(44.8)	1.00	15(36.6)	0.5	0.7(0.3-1.9)
TC/HDL-C ratio > 5	7(24.1)	1.00	12(29.3)	0.6	1.3(0.4-3.9)

* Reference category, OR= odd ratio, TC= Total Cholesterol, HDL-c= High Density Lipoprotein -Cholesterol, LDL-c= Low Density Lipoprotein-Cholesterol, TG= Triglyceride, NVP= Neverapin, EFV= Efanvirenz

Table 5: Changes in lipid profile of ART participants by NNRTIs regimens at TikurAnbesa hospital, Addis Ababa-Ethiopia, 2013.

Discussion

This comparative cross sectional study assessed the prevalence and characteristics of lipid profile derangement in HIV infected adults receiving first line ART in resource limited setting, where data are scarce.

The prevalence of dyslipidemia was 80% in ART treated group and 57.7% in ART naïve group. For ART groups, it was comparable with other findings from Uganda (81.6%) and southern Ethiopia (79.6%) [11,20].

The difference between the two group may be due to changes in lipid metabolism induced by medium to long term exposures to ART [1]. The direct effects of ART on lipid metabolism, endothelial and adipocyte cell function, and mitochondria have been suggested for altered lipid profiles in these subjects [21,22]. Both decreased TG clearance and increased Very-low-density lipoprotein (VLDL) overproduction found in these patients could be also the reason for the increased serum TG and then consequent elevated cholesterol level observed [13,23]. High prevalence of these lipid abnormalities in pre ART HIV infected people might be associated with high levels of oxidative stress and lipid per oxidation associated with HIV/AIDS [21]. It may be also associated to the host's response to infection mediated by various cytokines including tumor necrosis factor (TNF), interleukins, and the interferons that increase serum triglyceride levels and decrease HDL-cholesterol [6].

An association between dyslipidemia and myocardial infarction (MI) and cardiovascular disease (CVD) has been recognized. The association between high serum cholesterol levels, especially high LDL-C, and CVD is causal and independent of other risk factors while increasing clinical evidence suggested that elevated triglycerides may be an independent risk factor for CVD. Low HDL-C can also act synergistically with other lipid to increase CVD [24].

Generally the present study observed a high prevalence of dyslipidemia and noted differences in the type and extent of dyslipidemia between ART and ART naïve groups. Accordingly we found statistically significant differences in the prevalence of TC>200, TC/HDL-c ratio>5 and triglyceride /HDL-c ratio >2.4 between ART treated group and pre ART group ($p<0.05$). Even though it is not statistically significant, the prevalence and the chances to have LDL-c>130, TG> 150 and LDL-C <40 was still higher in ART participants.

Significant difference in TC>200 between the two groups was also described by different authors [11,14,19-21] However, all these studies did not include patients taking TDF containing regimens.

TC/HDL-c ratio ≥ 5 is an established sensitive marker of cardiac risk. Participants in ART group were four times more likely to have TC/HDL ratio ≥ 5 than participants in ART naïve group (p= 0.006, OR=4.0, 95%CI (1.5-10.8)). This was also in line with other studies from Cameroon and Ethiopia [11,19]. According to US National Institutes of Health report [25], Einhorn et al. [26], McLaughlin et al. [27], a high TG / HDL-C ratio ≥2.4 is a strong indicator of the insulin resistance syndrome. In contrast to the current study other studies reported significance difference between the two groups for LDL-c ≥ 130 [11,14,19] and TG>150 [11].

Higher proportion participants taking TDF and AZT containing regimens was diagnosed with lipid profile derangements as compared to those taking d4T containing regimens, in spite of small number of participants. Pefura Yone et al. [19] also found higher prevalence of raised value of TC, LDL-c, TG, and TC/HDL-c ratio > 5 in participants taking AZT compared to those taking D4T, while the prevalence of HDL<40 was similar in both regimens. However Tadewos et al. [11] reported no differences in the prevalence of these lipid abnormalities in AZT and d4T based. In contrast to this previous studies reported that smaller increases in TC, LDL, and triglyceride levels among patients taking TDF than other NRTIs (d4T and AZT [5,18,28-30]. On the other hand d4T was more involved in the occurrence of lipid derangements as compared with other NRTIs [7,20,31,32].

For NNRTIs based regimens, we did not find significant difference in all lipid profile alterations between patients taking NVP and EFV

based regimens. This was in agreement with other studies reports by Pefura Yone et al. [19] Tadewos et al. [11] and Padma priyadarsini et al. [14]. Divergence to the current finding, it has been stated that EFV has a deleterious effect on lipids when compared to, NVP based regimens [5,18]. These variations may be due to patient characteristics such as gender and race/ethnicity, mitochonderial haplotype and drug metabolism polymorphism which affects variations in lipid profile between populations taking the same antiretroviral drug. Also variations in the study settings and treatment duration may contribute to these differences.

Conclusion

The prevalence of dyslipidemia is high in HIV positive populations receiving first line ART as compared to ART naive. There is major difference in atherogenic lipid profile changes between ART and pre ART groups. Considering that these altered lipid profiles can be an independent risk factors for coronary artery diseases and myocardial infarction, treatment with first-line ART may actually have potential risks for cardiovascular health of HIV positive people receiving ART. The major limitation of this study was the absence of HIV negative control groups.

Recommendation

The present study illustrated high occurrence of altered lipid profiles in HIV infected patients receiving first line ART compared to treatment naïve individuals. However we need another study with large sample size and prospective cohort in nature is to explain fully the causal relationship between each class of ART and dyslipidemia.

We recommend that lipid profile measurements at baseline, which are not currently part of routine care in our countries. It could become an important parameter to increase survival and improve treatment outcome. Therefore lipid profiles should be screened before and after start of antiretroviral therapy; then periodically through treatment follow-up to monitor any rising trends.

Acknowledgments

The authors would like to thank all the staffs of Tikur Anbesa Hospital, especially in ART clinic, and data collectors and study participants involved in the study.

References

1. Feeney ER, Mallon PW (2011) HIV and HAART-Associated Dyslipidemia. Open Cardiovasc Med J 5: 49-63.
2. Tsegaye E, Worku A (2011) Assessment of antiretroviral treatment outcome public hospitals, South Nations Nationalities and Peoples Region, Ethiopia. Ethiop J Health Dev 25: 102-109.
3. USAID, Healthy policy initiative equity and access to ART in Ethiopia (2010) UNAIDS, the Joint United Nations Programme on HIV/AIDS.
4. World AIDS Day Report (2011) Zero new HIV infection, zero discrimination, zero AIDS related deaths. UNAIDS, the Joint United Nations Programme on HIV.
5. Erdembileg A, Alison S, Lars B (2009) Human Immunodeficiency Virus and Highly Active Antiretroviral Therapy-Associated Metabolic Disorders and Risk Factors for Cardiovascular Disease. Metab Syndr Relat Disord 7: 401-410.
6. Silva EF, Bassichetto KC, Lewi DS (2009) Lipid profile, cardiovascular risk factors and metabolic syndrome in a group of AIDS patients. Arq Bras Cardiol 93: 113-118.
7. Ceccato MG, Bonolo PF, Souza Neto AI, Araújo FS, Freitas MI (2011) Antiretroviral therapy-associated dyslipidemia in patients from a reference center in Brazil. Braz J Med Biol Res 44: 1177-1183.
8. Kotler DP (2008) HIV and antiretroviral therapy: lipid abnormalities and associated cardiovascular risk in HIV-infected patients. J Acquir Immune Defic Syndr 49 Suppl 2: S79-85.
9. Almeida SE, Borges M, Fiegenbaum M, Nunes CC, Rossetti ML (2009) Metabolic changes associated with antiretroviral therapy in HIV-positive patients. Rev Saude Publica 43: 283-290.
10. Troll JG (2011) Approach to dyslipidemia, lipodystrophy, and cardiovascular risk in patients with HIV infection. Curr Atheroscler Rep 13: 51-56.
11. Tadewos A, Addis Z, Ambachew H, Banerjee S (2012) Prevalence of dyslipidemia among HIV infected patients using first-line highly active antiretroviral therapy in Southern Ethiopia: a cross-sectional comparative group study. AIDS Research and Therapy 9: 31.
12. Domingos H, Cunha RV, Paniago AM, Martins DM, Elkhoury EB, et al. (2009) Metabolic effects associated to the highly active antiretroviral therapy (HAART) in AIDS patients. Braz J Infect Dis 13: 130-136.
13. Van Wijk JPH, Cabezas MC (2012) Hypertriglyceridemia, Metabolic Syndrome, and Cardiovascular Disease in HIV-Infected Patients: Effects of Antiretroviral Therapy and Adipose Tissue Distribution. Int J of Vascular Med.
14. Padmapriyadarsini C, Ramesh KS, Terrin N, Narendran G, Menon PA, et al. (2011) Dyslipidemia among HIV-infected Patients with tuberculosis taking once-daily Nonnucleoside Reverse Transcriptase Inhibitor Based Antiretroviral Therapy in India. Clin Infect Dis 52: 540-546.
15. Friis-Møller N, Sabin CA, Weber R, d'Arminio Monforte A, El-Sadr WM, et al. (2003) Combination antiretroviral therapy and the risk of myocardial infarction. N Engl J Med 349: 1993-2003.
16. Sankatsing RR, Franssen R, Hassink E (2007) Nevirapine increases high density lipoprotein Cholesterol by stimulation of apoprotein A1 synthesis. Antiviral Ther 12: 5.
17. Ngu JN, Heimburger DC, Arnett DK, Nyirenda CK, Potter D, et al. (2010) Fasting Triglyceride Concentrations are Associated with Early Mortality Following Antiretroviral Therapy in Zambia. N Am J Med Sci (Boston) 3: 79-88.
18. Tungsiripat M, Aberg JA (2005) Dyslipidemia in HIV patients. Cleve Clin J Med 72: 1113-1120.
19. Pefura Yone EW, Betyoumin AF, Kengne AP, Kaze Folefack FJ, Ngogang J (2011) First-line antiretroviral therapy and dyslipidemia in people living with HIV-1 in Cameroon: a cross-sectional study. AIDS Res Ther 8: 33.
20. Omech B, Sempa J, Castelnuovo B, Opio K, Otim M, et al. (2012) Prevalence of HIV-Associated Metabolic Abnormalities among Patients Taking First-Line Antiretroviral Therapy in Uganda. ISRN AIDS 2012: 960178.
21. Awah FM, Agughasi O (2011) Effect of highly active anti-retroviral therapy (HAART) on lipid profile in a human immunodeficiency virus (HIV) infected Nigerian Population. Afr J Biochem Res 5: 282-286.
22. Barbaro G (2006) Metabolic and cardiovascular complications of highly active antiretroviral therapy for HIV infection. Curr HIV Res 4: 79-85.
23. Grunfeld C, Pang M, Doerrler W, Shigenaga JK, Jensen P, et al. (1992) Lipids, lipoproteins, triglyceride clearance, and cytokines in human immunodeficiency virusinfection and the acquired immunodeficiency syndrome. J Clin Endocrinol Metab 74: 1045-1052.
24. Jellinger PS, Smit DA, Mehta AM, Ganda OM, HandelsmanY, et al. (2012) American Association of Clinical Endocrinologists' Guidelines for Management of Dyslipidemia and Prevention of Atherosclerosis: executive summary. Endocr Pract 18: 269-293.
25. National Institutes of Health; National Cholesterol Education Program (2002) Third report of the National Cholesterol Education Program (NCEP) Expert Panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III): Final Report. Circulation 106: 3143-3421.

26. Einhorn D, Reaven GM, Cobin RH, Ford E, Ganda OP, et al. (2003) American College of Endocrinology position statement on the insulin resistance syndrome. Endocr Pract 9: 237-252.
27. McLaughlin T, Abbasi F, Cheal K, Chu J, Lamendola C, et al. (2003) Use of metabolic markers to identify overweight individuals who are insulin resistant. Ann Intern Med 139: 802-809.
28. Dube MP, Stein JH, Aberg JA, Fichtenbaum CJ, Gerber JG, et al. (2003) Guidelines for the Evaluation and Management of Dyslipidemia in Human Immunodeficiency Virus (HIV)-InfectedAdults Receiving Antiretroviral Therapy: Recommendations of the HIV Medicine Association of the Infectious Disease Society of America and the Adult AIDS Clinical Trials Group. Clin Infect Dis 37: 613-627.
29. Crane HM, Grunfeld C, Willig JH, Mugavero MJ, Van Rompaey S, et al. (2011) Impact of NRTIs on lipid levels among a large HIV-infected cohort initiating antiretroviral therapy in clinical care. AIDS 25: 185-195.
30. Tungsiripat M, Kitch D, Glesby MJ, Gupta SK, Mellors JW, et al. (2010) A pilot study to determine the impact on dyslipidemia of adding tenofovir to stable background antiretroviral therapy: ACTG 5206. AIDS 24: 1781-1784.
31. Galli M, Kitch D, Adorni F, Gervasoni C, Ravasio L, et al. (2002) Body habitus changes and metabolic alterations in protease inhibitor-naive HIV-1-infected patients treated with two nucleoside reverse transcriptase inhibitors. J Acquir Immune Defic Syndr 29: 21-31.
32. Gallant JE, Staszewski S, Pozniak AL, DeJesus E, Suleiman JM, et al. (2004) Efficacy and safety of tenofovir DF vs stavudine in combination therapy in antiretroviral-naive patients: a 3-year randomized trial. JAMA 292: 191-201.