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The Evaluation of Lipid Profile in HIV/AIDS Patients on Antiretroviral Therapy in University of Abuja Teaching Hospital, Nigeria

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Abstract **Original Research Article**

***Background*:** Abnormal lipids have being associated with the adverse effect of antiretroviral therapy (ART). Information in these areas is needed, to enhance the proper and adequate management of patients on antiretroviral therapies. This study was carried out to determine the levels of lipid profile in HIV/AIDS patients on antiretroviral therapy (ART), and as well ascertain the degree of metabolic and cardiovascular complications. ***Method*:** A hospital base case-control study was carried out in October, 2020 to October, 2021, and a total of 153 subjects were involved in the study, and they were divided into three groups: the control group (which consist of apparently healthy subjects), the study group 1 (consist HIV positive subject not on ART) and study group 2 (consist of HIV/Aids patients on ART). The lipid profile was analyzed using enzyme linked spectrophotometric methods. ***Result*:** In the study, increase in Triglyceride (TG) and very low density Lipoprotein (VLDL-C) were observed with P<0.001in the study group 2 compared with the control group (apparently healthy subject); there was no significant difference observed in the study group 1 when compared with the control group P>0.05, for HDL-C, TC and LDC-C; The mean values of the control group for Total Cholesterol (TC), Triglyceride (TG), HDL-C and VLDL-C are: 3.97± 0.69, 1.02± 0.31, 2.88± 0.29, 0.75± 0.51 and 0.26mmol/L respectively. The mean values of the study group 1 for Total Cholesterol, Triglyceride, HDL-C, LDL-C and VLDL-C are 3.02± 0.79, 2.67± 0.93, 1.98± 0.26, 0.85± 0.72 and 0.58± 0.07mmol/L respectively. The values for study group 2 are Total Cholesterol 2.54± 1.30mmol/L. Triglyceride is 3.86± 0.74mmol, HDL-C is 1.24± 0.34mmol/L, and LDL-C is 1.10±1.08mmol/L and 0.17± 0.12mmol/L for VLDL-C. ***Conclusion*:** The findings in this study shows elevation of some lipids in HIV/AIDS Patients on Antiretroviral Therapy, which suggests that it could be due to the adverse effects of Anti-Retroviral Therapy (ART).

Keywords: Lipid profile, HIV, AIDS, Anti-Retroviral Therapy.

INTRODUCTION

Acquired Immunodeficiency Syndrome (AIDS), is a fatal illness caused by a retrovirus known as human immunodeficiency virus (HIV) which breaks down the immune system, leaving the patient vulnerable to a host of life threatening opportunistic infections, neurological disorder and unusual malignancies [1]. More than a decade ago, more than 35.3 million people were living with HIV worldwide [2]. Globally, from 1996 to 2022, a total of above 6.6 million AIDS related deaths have been averted, including above 5.5 million deaths in low and middle income countries due to the increased access to antiretroviral therapy [2]. Sub Saharan Africa, a region with only 12% of the global population remains the region most highly affected by HIV, accounting for about 70% of the global burden of HIV [2]. The scaling up of antiretroviral therapy (ART) in low and middle income countries has transformed AIDS response and generated broad based health gain. However, long term use of ART has resulted in metabolic and cardiovascular complications [3, 4]. Infection can increase triglyceride (TG) levels by decreasing the clearance of circulating lipoproteins, a process considered to be the result of reduced lipoprotein lipase (LPL) or by stimulating hepatic lipid synthesis through increases in either hepatic fatty acid synthesis or re-esterification of fatty acid (FAA) derived from lipolysis [4].

Hypertriglyceridemia was the first dyslipidemias to be reported in HIV infected patients,

however, other lipid abnormalities such as hypocholesterolaemia or High Density Lipoprotein-cholesterolaemia have been reported [5]. It has been reported that Antiretroviral therapy (ART) can induce increase levels of Total Cholesterol (TC), low density lipoprotein- cholesterol (LP-c) and Triglycerides (TG), and variable effects on high density lipoprotein cholesterol (HDL-c) levels [5]. The treatment options available for the management of abnormal lipids in HIV- infection are similar to those in the general population with an additional option of changing to a different ART class with a tolerable lipid profile [4]. Routine monitoring of serum lipids in patients on ART is not usual practice in some healthcare facilities. However, following the recommendation of WHO 2010 guidelines, some health care facility have begun to determine the lipid profile of HIV/AIDS patients, but a lot more facilities are yet to comply with the guideline. In 2011 some ART like Stavudine (D4T) was phased out due to its metabolic toxicity amongst others [6].

One study in the country on ART associated dyslipidemias, had found that ART compounded the effects of HIV by increasing lipid oxidation [7]. While another show those patients on first line ART had high levels Total Cholesterol, LDL-c and high TC/HDL-c ratio compared with ART- naïve patients [8]. These studies were carried out in community health facilities and recommendations were suggested that lipid profile and cardiovascular risk factors should be monitored in patients on ART, such that adverse effects of treatment can be adequately managed and minimized [8].

Our anticipation is that the findings in this study would add a voice of emphasis to make the health care givers and partners aware of the associated adverse impact or toxicity of ART; and put in place measures to eliminate or reduced to its barest minimum the adverse effects of ART on HIV/AIDS patients.

MATERIAL AND METHOD

Subjects/ Samples

A hospital based case- control study was carried out between October, 2020 – October, 2021 and a total of one hundred and fifty three (153) subjects were involved in the study, which consist of fifty two HIV/AIDS patients receiving Anti-retroviral Therapy (ART), Fifty one HIV positive subjects who were not on (ART) and fifty apparently healthy subjects who serve as control group. Five milliliters of blood sample was drawn from each of the subject from the articular vein on their clinic visit days; the sample were allowed to clot, after which, it was spin at 3000rpm for 5 minutes; serum sample was then extracted from the clotted sample and then refrigerated at the temperature of 4-8 degree centigrade until analysis. The lipid profiles were then analyzed using enzyme linked spectrophotometric methods according to the supplier Darlez Nig Ltd. The statistical package for social science (SPSS) window version 20.0 was used for all calculation and data analysis, P value <0.05 and <0.001 were considered statistically significant.

Ethical Approval

Ethical approval was sought and obtained from the authorities of the University of Abuja Teaching Hospital Ethical Committee reference number FCT/UATH/GEN/1085/V.1/P.87.

Exclusion and Inclusion Criteria

Subject below 18 years and above 65years were excluded from the study however, those between the ages 18-65 years were included in the study. Those who are HIV/AIDS subjects on Antiretroviral therapy (ART) were included and served as study group 2, those who were HIV positive but not on ART, serves as study group 1 while those who are not on any drug and HIV negative were used as control group (apparently healthy).

RESULTS

The age distribution of participants in the control and study group is represented in Table 1. The sex distribution in control group and study group is represented in Table 2. The values of lipid profile in the control and HIV patients not on ART (study group 1), are represented in Table 3. The values of lipid profile in the control and patients on ART (study group 2) are represented in Table 4. The values of lipid profile in study group 1 and is group 2 is represented in Table 5.

To assess the possible role of Antiretroviral therapy on lipid concentration, we first compared triglycerides, total cholesterol, HDL-cholesterol, LDL-cholesterol and VLDL-cholesterol values between groups of the apparently healthy which serve as control, and the HIV/AIDS subjects who are on Antiretroviral Therapy (ART) study group 2.

It is observed that HIV/AIDS subjects who are on ART have lower total cholesterol, HDL cholesterol, LDL-cholesterol values; while there was significant increase in the value of triglyceride and VLDL cholesterols values.

Table 1 Age distribution off participants in the control and study group: In this study, a total of 153 subjects participated in the study, and they are within the Ages of 18- 60yrs. It was observes that 28.9% i.e. 15 participants in the study groups 1 who are HIV patients not on antiretroviral therapy (ART) fall within the age bracket (36-40yrs), it is then followed by ages (23-30yrs) which made up of 25% i.e. 13.

In study group 2, who are HIV/AIDS subjects on (ART), it is observed that 33% are within age (26-30yrs), 17 in number, followed by age (36-40yrs),

which is 23.5% and 12 in number. It is observed that age 26-40yrs is the highest hit with HIV diseases.

Table 1: Age Distribution of Participants in the Control and Study Group

Age groups (yrs)	Control group	Study group 1	Study group 2
20-25	2(4%)	4(8%)	5(10%)
26-30	12(24%)	13(25%)	17(33%)
31-35	5(10%)	7(13%)	10(20%)
36-40	13(26%)	15(28.9%)	12(23.5%)
41-45	4(8%)	9(17%)	4(8%)
46-50	5(10%)	3(6%)	1(2%)
51-55	3(6%)	1(2%)	1(2%)
56-60	6(12%)	0(0%)	1(2%)
>60	0(0%)	0(0%)	0(0%)
Total	50(100%)	51(100%)	52(100%)

% = Percentage, Yrs. = Years

Table 2 Sex distribution in control group and study groups. The study consists of male and female in both the control and the study groups, in the control groups 46% are made up of the male i.e. 23 in number, while 54% are made up of females-27 in number. In study group 1, those who are HIV positive but not on ART, 54.9% are male; there are 28 in number, while the female is made up of 46.2% that is 23 in number. In study group 2, 53.8% are males i.e. 28 in number, while 46.2% are female i.e. 24 in number.

Table 2: Sex Distribution in the Control and Study Groups

Sex	Control group	Study group 1	Study group 2
Male	23(46%)	28(54.9%)	28(53.8%)
Female	27(54%)	23(45.1%)	24(46.2%)
Total	50(100%)	51(100%)	52(100%)

% =Percentage.

Table 3 Show the values of the lipid profile in the control and study group1 (HIV subjects not on ART).

The result show that the values of Total Cholesterol in the control group is 3.99± 0.69mmol/L, while the Total Cholesterol of study group 1 (HIV subjects not on ART) is 2.02± 0.79mmol/L, when compared, showed significant difference, with P value of <0.05. The mean value of triglyceride of the control group is 1.02± 0.31mmol/L, while that of the study group 1 is 2.67± 0.93mmol/L, the comparison show significant differences with P value of < 0.001. The value of triglyceride in the study group 2 is 3.86± 0.74mmol/L, it shows significant difference when compared with control group, with P value of <0.001.

The mean value of HDL-cholesterol of the control group is 2.88± 0.29mmol/L, while that of the study group 1 is 1.98± 0.26mmol/L showed significant difference with P value of <0.001.

The mean value of LDL-cholesterol of the control group is 0.75± 0.5mmol/L, while that of the study group 1 is 0.85± 0.72mmol/L, with P value >0.001, there is no significant difference between the two groups.

The mean values of VLDL-cholesterol of the control group is 0.38± 0.26mmol/L, while that of the study group 1 is 0.54± 0.07, there is significant difference between the groups with P value of <0.05.

Table 3: Means of lipid profile in control group and study group 1 (HIV patients not on ART)

Parameters (mmol/L,)	Control group (n= 50)	Study group 1 (n= 51)	Z- score	P- value
T-cholesterol	3.97± 0.69	3.02± 0.79	0.34	0.73
Triglycerides	1.02± 0.31	2.67± 0.93	1.10	<0.001
HDL	2.88± 0.29	1.98± 0.26	1.52	0.13
LDL	0.75± 0.51	0.85± 0.72	0.86	>0.001
VLDL	0.38± 0.26	0.58± 0.07	0.57	>0.001

Table 4 show the values of lipid profile in the control group and the study group 2 (HIV/AIDS subjects on ART). There is a significant difference when the results of the study group 2 were compared with that of the control group. The mean value of Total Cholesterol of the study group 2 is 2.54 ± 1.30, when compared with that of the control group show a significant difference with P value of <0.001. The mean

value of Triglycerides of the study group 2 is 3.86±0.7mmol/L, when compared with that of the control group, it showed significant difference of P<0.05.

The mean value of HDL – Cholesterol of the study group 2 is 1.24±0.34mmol/L, when compared with that of control group, shows significant difference of P<0.006.The mean value of LDL- Cholesterol of the study group 2 is 1.10±1.08mmol/L, when compared with that of control group show significant difference P<0.001. The mean value of VLDL – Cholesterol of the study group 2 is 0.77±0.12mmol/L, when compared with that of the control group, shows significant difference P<0.05; as shown in Table 4.

Table 4: Means of lipid in the control and study group 2 (patients on ART)

Parameters (mmol/L,)	Control group (n= 50)	Study group 1 (n= 52)	Z- score	P- value
T-cholesterol	3.97±0.69	2.54±1.30	7.50	<0.001
Triglycerides	1.02±0.31	3.86±0.74	1.12	<0.05
HDL	2.88±0.29	1.24±0.34	2.78	<0.006
LDL	0.75±0.51	1.10±1.08	13.88	<0.001
VLDL	0.38±0.26	0.97±0.12	1.18	<0.05
HDL-C/TC	0.73±0.42	0.49±0.26		>0.001

Cardiovascular Risk Predictor

Positive Risk Factor <1.0mmol/L; Negative Risk Factor >1.6mmol/L

Table 5 show values of lipid profile in study group 1(HIV subjects not on ART) and study group 2 (HIV/AIDS subjects on ART). The results of the Total cholesterol in study group 1 was compared with that of study group 2, it show significant difference with P value of <0.001. Triglycerides value in the two groups shows significant difference with P value of <0.07. HDL-Cholesterol value show significant difference between the two groups with P value of <0.001.VLDL-Cholesterol values in the two groups show significant difference, with P value of <0.001. These are also represented in Figures 1 and 2 below.

Table 5: Means of lipid profile in study 1 (No ART) and study 2 (On ART)

Parameters (mmol/L,)	Control group (n= 51)	Study group 1 (n= 52)	Z- score	P- value
T-cholesterol	3.02±0.79	2.54±0.130	7.1	<0.001
Triglycerides	2.67±0.93	3.86±0.74	2.7	<0.001
HDL-c	1.98±0.26	1.24±0.34	7.8	<0.001
LDL-c	0.85±0.72	1.10±1.08	12.9	<0.001
VLDL-c	0.58±0.07	0.97±0.12	3.9	<0.001
HDL-C/TC	0.66±0.33	0.49±0.29		>0.001

Cardiovascular Risk Predictor

Positive Risk factor <1.0mmol/L; Negative Risk Factor >1.6mmol/L

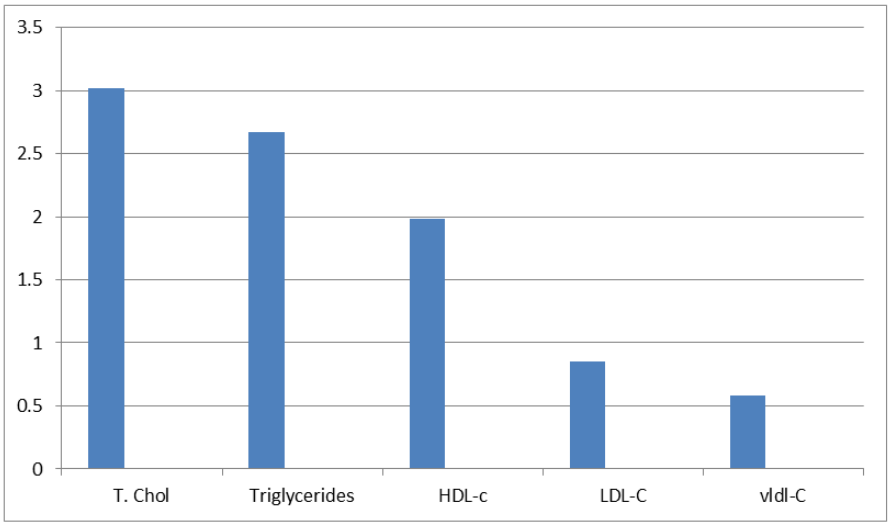

Figure 1: Study Group 1 HIV/AIDS, ART-Naïve Patients

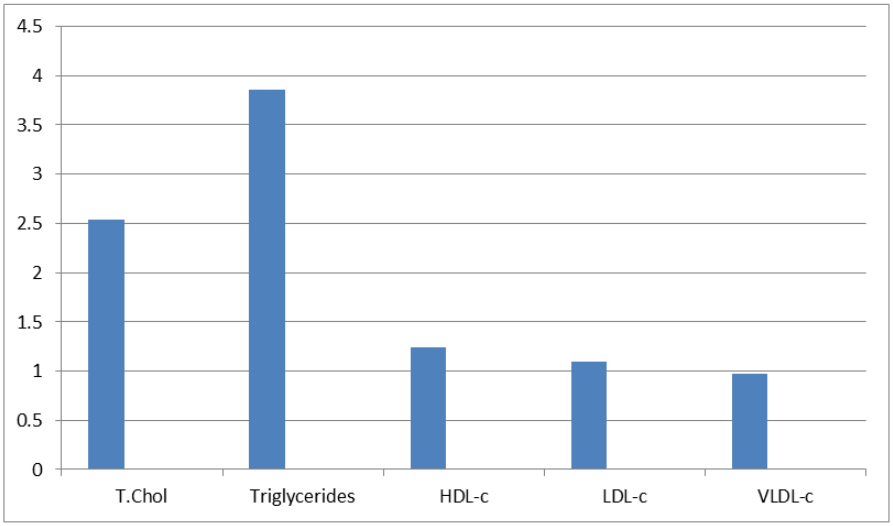

Figure 2: Study Group 2 HIV/AIDS Patients on ART

DISCUSSION

This study showed that lipid profiles were altered in HIV/AIDS subjects on antiretroviral therapy (ART) medication. The alteration in the serum lipid profile could have occurred when the patients or subjects were placed on antiretroviral therapy (ART). Previous studies have demonstrated that HIV/AIDS patients on ART exhibit highly abnormal total lipid concentration in plasma [9].

A few authors, who determine the levels of plasma triglycerides, Total cholesterol, HDL-Cholesterol, LDL- Cholesterol in HIV infected individuals also came to the same conclusion that with an increase of immunological deficiency and a clinical development of HIV infection (AIDS), lipid profile disorders, indicated by an increase in triglyceride level and decreased concentrations of HDL- Cholesterol intensified as well [9]. Consistent with earlier reports, this study also showed similar finding with elevated values of some lipids and however, the lipid profile showed decreased values of Total Cholesterol, HDL-Cholesterol and while LDL- Cholesterol; while VLDL-Cholesterol and triglyceride values were significantly different between the control groups and in study group 1 and study group 2. The finding in this report does agree with the reports of some of the earlier investigators which found the values of Triglyceride to be elevated in HI V/AIDS subjects [10, 11] reported similar findings in which they show significant low levels of Total Cholesterol, HDL -Cholesterol and high LDL- Cholesterol in HIV/AIDS patients when compared to sero negative controls ($P < 0.05$). This low level of Total Cholesterol, HDL -Cholesterol and high LDL - Cholesterol was reported to be associated with elevated levels of beta -2 microglobulin [11]. However, this report is quite different from [12] who reported high total cholesterol level in HIV/AIDS patients on antiretroviral therapy (ART) in Cameroon.

The high values of hypertriglyceridemia and high VLDL-c in this study were comparable to those observed in Southern Ethiopia [13]. However, in our study there was no significant difference between the control group and study group 1 (HIV not in ART) [14], stated that hypocholesterolaemia observed in HIV/AIDS infection is due to cytokine effects on different enzymes of lipid metabolism. [15], had reported that HIV/AIDS characterized by a high prevalence of hyper triglyceride and hypocholesterolaemia also had an elevated level of cytokines. They observed decreased cholesterol containing lipoprotein in both HIV/AIDS infection. This study does show increase in some of the lipids; therefore, could the abnormalities observed by other investigators be due to cytokines as well as ART? Since, ART preparations are made to inhibit some of the HIV transcription process. Predictable drug reaction may occur in anyone who accumulates a sufficient dose. However, it is little difficult to ascertain whether the prevalence and pattern of dyslipidemia in HIV infected population on ART in one community is different from that obtained in another community, say rural verses urban settings because abnormal lipids in HIV infected individuals is a complex condition, with multiple contributing factors including the HIV virus itself, individual genetic composition or characteristics and antiretroviral therapy induced metabolic changes [16].

This study is limited to the evaluation of lipids of HIV/AIDS patients on antiretroviral therapy; we did not estimate cytokines or CD4 count of the patients who were involved in the study. This serves as an opportunity for other researchers to explore.

CONCLUSION AND CONTRIBUTION TO KNOWLEDGE

We observed that Triglyceride and VLDL-Cholesterol were elevated in patients on ART; while

Total Cholesterol, HDL- Cholesterol, LDL-Cholesterol, in study group 2 were lower; therefore, we wish to suggest that a novel mechanism of ART administration be followed in order to avoid associated cardiovascular risk. ART should be administration with caution. The observations were as follows:

1. HIV/AIDS Patients on ART show elevated Triglycerides level.
2. HIV/AIDS Patients on ART show elevated VLDL-Cholesterol level.
3. HIV/AIDS Patients on ART show low Total Cholesterol, HDL-Cholesterol and LDL-Cholesterol levels.

Competing interests: Authors have declared that no competing interests exist.

THE ROLES OF AUTHORS

1. Abriba S. P. The principal investigator: responsible for research concept and selection of research title, for writing of research protocol and proposal; analysis and collation of the research data; documentation and interpretations of data.
2. Osadolor H. B. Involved in the selection of the research title, and supervision of the research work and the analysis of data.
3. Akande T. Involved in data collation and analysis.

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