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Original Research Article

Association of CD4 count with anthropometric parameters and metabolic alterations in treatment naive human immunodeficiency virus infected patients

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ABSTRACT

Background: Body fat abnormalities and metabolic derangements are well known to occur in human immunodeficiency virus (HIV) infection. The objective of present study was to evaluate the anthropometric parameters, fasting lipid profile and fasting blood sugar in treatment naïve HIV patients and to assess any relation with CD4 count.
Methods: Anthropometric measurements, latest CD4 count were recorded from HIV patients. Blood was collected from patients for lipid profile and sugar measurements.
Results: Anthropometric parameters showed a gradual increase in waist circumference (WC), increase in waist hip ratio (WHR) and decrease in body mass index (BMI) as CD4 count declined. Fasting lipid profile showed a gradual decrease in total cholesterol, low density lipoprotein cholesterol (LDL-C) and high density lipoprotein cholesterol (HDL-C) and increase in triglycerides (TG) and very low density lipoprotein cholesterol (VLDL-C) as CD4 count declined which were statistically highly significant (P<0.001). Compared to higher CD4 group (350-500/ mm3), the lower CD4 group (<50/mm3) showed a decrease in mean total cholesterol by 60 mg/dL, LDL-C by 76 mg/dL and HDL-C by 13 mg/dL. The increase in mean TG and VLDL-C were 154 mg/dL and 30 mg/dL respectively. Comparison of fating blood sugar (FBS) between CD4 groups showed a gradual rise in FBS as CD4 count declined.
Conclusions: As CD4 count declines, metabolic alterations occur in treatment-naïve HIV patients with substantial decrease in serum total cholesterol, HDL-C, LDL-C and an increase in TG and VLDL-C and increased incidence of impaired FBS. Morphological alteration in advanced HIV is evidenced by increased WC, WHR and decreased BMI.

Keywords: Anthropometry, CD4 count, Fasting lipid profile, Human immunodeficiency virus

INTRODUCTION

Body fat abnormalities and metabolic derangements are well known to occur in the course of human immunodeficiency virus (HIV) infection, both due to a direct effect of the infection and as a complication of treatment.[1,2] Various studies have addressed on the occurrence of lipodystrophy as a consequence of highly active antiretroviral therapy (HAART) especially with the use of protease inhibitors characterized by hyperlipidemia, insulin resistance and fat redistribution with central obesity and peripheral wasting.[3-6] Dyslipidemia in HIV infection can be a direct effect of HIV or due to the effect of drugs. Abnormalities in lipid metabolism in HIV infected patients are described before the advent of HAART.[7,8] Increased serum triglycerides (TG) and decreased total cholesterol (TC) were associated with advanced HIV. Patients with AIDS have lower high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C), decreased

TG clearance and a predominance of small dense LDL (low density lipoprotein) particles compared with controls.[9] Most of the derangements are probably due to the elaboration of cytokines.[10,11]

Early detection of lipid abnormalities in HIV infected will be helpful in initiating treatment strategies since dyslipidemia is a well-known cardiovascular risk factor. This assumes special importance in the present context of increased life span of HIV patients after the advent of HAART so that mortality due to cardiovascular events can be decreased. The present study aims to evaluate the anthropometric parameters, fasting lipid profile and fasting blood sugar in HIV patients who are not on antiretroviral drugs and to assess any relation with CD4 count.

METHOD

The study population included HIV positive patients (including freshly diagnosed cases) attending Internal Medicine department in a tertiary care hospital in South India and was conducted over a period of two years. Patients attending the medical outpatient and those admitted in wards were selected at random. Patients in age group 20-40 years with HIV positivity confirmed by triple ELISA testing were included in the study. HIV positive patients initiated on antiretrovirals, patients with overt thyroid dysfunction, familial hyperlipidemia, nephrotic range proteinuria, diabetes, patients on drugs: antihyperlipidemic agents, beta blockers, thiazides, steroids were excluded. Age group between 20 to 40 years was selected because by 20-21 years a person attains adult anthropometric proportions and remains more or less static until around 40-45 years after which age related changes occur especially in the form of increased waist circumference and waist-hip ratio.[12] This selection prevented age related changes as a confounding factor while assessing anthropometric parameters. Triple ELISA (rapid test) according to national AIDS control organization (NACO) guidelines was used for diagnosis. Triple ELISA testing involves the use of three different methods of ELISA of which the first ELISA is highly sensitive and second and third highly specific.

Data

A proforma was filled up for each patient which included age, history of smoking and alcoholism, hypertension, vascular diseases like coronary artery disease, cerebrovascular accident, peripheral occlusive vascular disease. A detailed physical examination was done including anthropometric measurements. The height (meters) was measured barefoot and weight (kilogram) in normal indoor clothing. Waist circumference was measured as the narrowest measurement between the ribcage and iliac crest. Hip circumference was measured as the largest measurement of the hip over the buttocks. Waist-hip-ratio was calculated. Blood pressure was recorded with a standard sphygmomanometer. Latest CD4 count (within the past one month) was also recorded. Blood was collected from patients after an overnight (12hours) fasting for lipid profile and blood sugar measurements. Approval for the study was obtained from institutional ethics committee.

Statistical analysis

Cases were grouped into four according to CD4 count: 350-499, 200-349, 50-199 and <50/mm^3. This classification was based on revised classification system for HIV Infection and expanded AIDS surveillance case definition for adolescents and adults with modifications which included addition of two more classes. The category with CD4 count >500/mm^3 which is considered as the early stage of HIV infection was not included because all cases in this study had CD4 count <500/mm^3. The intermediate stage with CD4count 200-499/mm^3 was further subdivided into two groups for better statistical analysis: 350-499/mm^3 and 200-349/mm^3. The category with CD4 count <200/mm^3 was subdivided further into two groups: 50-199/mm^3 ((late stage) and <50/mm^3 (advanced stage) according to NACO guidelines. Data were analyzed using statistical package for social sciences (SPSS) version 16. Quantitative or parametric data were expressed as mean ± standard deviation (SD) while qualitative or non-parametric data were expressed in its frequency and percentage. To compare different parameters, analysis of variance, one-way ANOVA was employed as parametric test. Duncan's multiple range test was used to assess significance between groups. For all statistical evaluations, a two-tailed probability value <0.05 was considered significant.

RESULTS

This study was conducted in forty HIV positive patients. It was planned to include both males and females in the study. Most of the female patients came without bystander and were not willing for anthropometric assessment. Some did not turn up a second time in fasting state for blood collection. At the end of study only four female patients were evaluated completely, and the data was insufficient for statistical significance. Hence the study was completed with forty male patients. Of the 40 patients, 7.5% were in the age group 25-29 years, 35% in 30-34 years, 57.5% in 35-40 years.

Among patients, 15% had a CD4 count between 350-500, 25% between 200-349, 37.5% between 50-199 and 22.5% less than 50/mm3. None had a count more than 500/mm.^{3} Majority of patients (60%) were severely immunosuppressed as indicated by CD4 counts <200/mm.^{3} Of the forty patients, none had hypertension or clinical evidence of coronary artery disease.

Analysis of anthropometric parameters (Table 1) showed a mean waist circumference (WC) of 81 cm in patients. There was a gradual increase in WC as CD4 count declined. By applying one-way ANOVA (analysis of

variance) comparing WC with CD4 groups and using Duncan's multiple range test showed highly significant (P<0.001) differences in WC between patients in higher and lower CD4 groups.

Table 1: Anthropometric parameters in CD4 groups.

CD4 count (/mm^3)	Mean waist circumference	±SD	P value
350-500	73.33	4.719	<0.001
200-349	80.40	6.168	
50-199	82.33	4.169	
<50	84.00	5.049	
CD4 count (/mm^3)	**Mean waist-hip-ratio**	**±SD**	**p value**
350-500	0.832	0.029	<0.001
200-349	0.850	0.021	
50-199	0.873	0.110	
<50	0.878	0.019	
CD4 count (/mm^3)	**Mean BMI**	**±SD**	**p value**
350-500	22.705	2.188	<0.001
200-349	21.493	1.427	
50-199	20.270	1.369	
<50	19.258	1.200	

Waist-hip-ratio (WHR) was between 0.8-0.9 in 92.5% patients, less than 0.8 in none of the patients, more than 0.9 in 7.5 % patients. Applying ANOVA with Duncan's test showed highly significant (P<0.001) differences between higher and lower CD4 groups with lower CD4 groups having an increase in WHR. Analysis of body mass index (BMI) showed a BMI between 18.5 - 24.9kg/m^2 in 36% patients, less than 18.5 in 7.5% and BMI more than 25kg/m^2 in 2.5% patients. It was observed that patients in lower CD4 groups had a significantly lower BMI than that of higher CD4 groups.

Considering the anthropometric parameters -WC, WHR and BMI, it was observed that anthropometric and morphological abnormalities appear in advanced stages of HIV infection. There was a decline in mean BMI with increase in WC and WHR as CD4 count decreased. The low BMI reflects the weight loss seen in advanced HIV and the increase in WC and WHR may reflect a redistribution of body fat with peripheral lipoatrophy and central lipohypertrophy.

Analysis of fasting lipid profile and applying ANOVA and Duncan's test to compare CD4 groups showed a gradual decrease in total, LDL and HDL cholesterol and increase in TG and VLDL-C as CD4 count declined. All the differences were statistically highly significant. (P<0.001). Compared to higher CD4 group (350-500/mm^3), the lower CD4 group (<50/mm^3) showed a decrease in mean total cholesterol by 60 mg/dL, LDL-C by 76mg/dL and HDL-C by 13mg/dL. The increase in mean TG and VLDL were 154mg/dL and 30mg/dL respectively. The changes were maximum when the CD4 count fell below 50/mm^3.

Comparison of fasting blood sugar (FBS) between CD4 groups showed a gradual rise in FBS as CD4 count declined and by applying ANOVA and Duncan's test, the change in mean FBS was statistically highly significant (P<0.001) (Table 2).

Table 2: Lipid profile and FBS in CD4 groups.

CD4 count (/mm^3)	Mean total cholesterol	±SD	p value
350-500	203.667	24.744	<0.001
200-349	165.500	7.678	
50-199	149.067	5.133	
<50	144.22	15.818	
CD4 count (/mm^3)	**Mean triglycerides**	**±SD**	**p value**
350-500	131.667	20.656	<0.001
200-349	202.400	5.147	
50-199	234.733	39.786	
<50	285.444	79.868	
CD4 count (/mm^3)	**Mean LDL-C**	**±SD**	**p value**
350-500	129.333	23.847	<0.001
200-349	86.100	9.689	
50-199	64.733	8.688	
<50	53.000	11.920	
CD4 count (/mm^3)	**Mean HDL-C**	**±SD**	**p value**
350-500	48.000	5.329	<0.001
200-349	38.800	2.251	
50-199	37.400	4.289	
<50	35.555	5.810	
CD4 count (/mm^3)	**Mean VLDL-C**	**±SD**	**p value**
350-500	26.333	4.131	<0.001
200-349	40.500	0.972	
50-199	46.933	7.951	
<50	55.666	8.131	
CD4 count (/mm^3)	**Mean FBS**	**±SD**	**p value**
350-500	84.833	7.859	<0.001
200-349	90.800	4.104	
50-199	91.800	8.055	
<50	98.222	8.496	

Of the total patients, 10% had an FBS more than 100mg/dL and all of them had a lower CD4 count. This shows that impaired fasting glucose may be seen in advanced HIV.

In this study, there were no statistically significant changes between different age groups with regard to lipid profile, FBS, WC, WHR and BMI. Also, no significant

differences were observed in metabolic parameters among alcoholics and non-alcoholics. The absence of significant difference between age groups is probably due to the narrow and specific age group (20-40 years) included in this study. This has helped by avoiding the interference of age as a confounding factor especially in assessing anthropometry.

DISCUSSION

Studies have shown significant morphologic and metabolic alterations in patients infected with HIV, independent of those caused as a consequence of HAART. Morphologic alteration in the form of body fat abnormalities were reported in advanced stage of HIV infection independent of HAART in the form of lipodystrophy - fat redistribution with central obesity and peripheral wasting and worsening metabolic abnormalities. Fat redistribution was assessed clinically by measuring waist-hip ratio (WHR) which was found to be increased in advanced HIV. Metabolic abnormalities are predominantly in the form of alteration in lipid profile and occurrence of insulin resistance. Since metabolic and body fat abnormalities are more common in patients on HAART than in treatment-naïve patients, most studies were done in patients on HAART. Only a few studies were done in treatment-naïve patients.

In this study-association of CD4 count with anthropometric parameters and metabolic alterations in treatment naïve Human Immunodeficiency Virus infected patients-most of the patients were severely immunocompromised with 60% having CD4 count below 200/mm^3. There were significant anthropometric and morphological abnormalities in the form of decrease in BMI with increase in WC and WHR as CD4 count declined. The differences were more significant in advanced HIV with CD4 count less than 200/mm3. The morphological abnormalities are probably due to decrease in total body mass as reflected by decrease in BMI and fat redistribution with peripheral lipoatrophy and central lipohypertrophy as reflected by increase in WC and WHR.

There were also significant metabolic abnormalities in the form of progressive decreases in total cholesterol, LDL-C, HDL-C and increases in TG and VLDL-C as CD4 count declined. Compared to higher CD4 group (350-500/mm^3), the lower CD4 group (<50/mm^3) showed a decrease in mean total cholesterol by 60mg/dL, LDL-C by 76mg/dL and HDL-C by 13mg/dL. The increase in mean TG and VLDL were 154mg/dL and 30mg/dL respectively. A study by Riddler SA et al, in 50 treatment naïve HIV positive men found a mean decline in total cholesterol by 30mg/dL, LDL-C by 22 mg/dL and HDL-C by 12mg/dL from preseroconversion values.[9] This shows a declining trend in total cholesterol, LDL-C and HDL-C in treatment naïve HIV patients which is in concordance with present study even though present study focused on comparison of lipid fractions among CD4 groups. Study by Devanath A et al, showed significant decrease in HDL-C and increase in TG as CD4 count declined which is in tally with present study but had no significant correlation of total cholesterol and LDL-C with CD4 count which is in contrast to present study.[8] Zangerle R et al, in their study has reported a decrease in HDL-C in patients with CD4 count less than 500.[13] In present study, comparison of fasting blood sugar (FBS) between CD4 groups showed a gradual rise in FBS as CD4 count declined. Of the total patients, 10% had an FBS more than 100mg/dL and all of them had a lower CD4 count. This shows that impaired fasting glucose may be seen in advanced HIV. Study by El-sadr et al, showed that a higher CD4 count was associated with less insulin resistance.[14] The central obesity, increased TG, decreased HDL-C and the possible insulin resistance (which was not measured in this study) associated with lipodystrophy may increase the patients' cardiovascular risk. A significant reduction in LDL-C was also observed which is a favorable alteration. The final impact of these metabolic and morphological abnormalities on the cardiovascular risk and any therapeutic intervention in this direction need further studies. Also, it is suggested that a baseline anthropometric and metabolic assessment including fasting lipid profile and FBS be included as part of initial evaluation of freshly diagnosed HIV seroconverters before starting treatment, to detect any abnormalities and for future reference. Further large-scale studies are needed to confirm the results of this study.

CONCLUSION

As CD4 count declines, significant metabolic and morphological alterations occur in HIV infected, treatment-naïve patients with substantial decrease in serum total cholesterol, high density lipoprotein cholesterol, low density lipoprotein cholesterol and an increase in triglycerides and very low-density lipoprotein cholesterol. Also, there is increased incidence of impaired fasting blood glucose in advanced HIV. Morphological alteration with possible fat redistribution causing central obesity and peripheral lipoatrophy in advanced HIV is evidenced by increased waist circumference and waist-hip ratio. All the metabolic and morphological alteration were more pronounced at lower CD4 counts-less than 200/mm^3. Further studies are needed to know the impact of these changes on cardiovascular risk and the role for therapeutic interventions.

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REFERENCES

1. Grinspoon S, Carr A. Cardiovascular risk and body-fat abnormalities in HIV-infected adults. New Eng J Med. 2005;352(1):48-62.

2. Krishnan S, Schouten JT, Atkinson B, Brown T, Wohl D, McComsey GA, et al. Metabolic syndrome before and after initiation of antiretroviral therapy in treatment-naive HIV-infected individuals. J Acqu Imm Defi Synd. 2012;61(3):381.
3. Wanke CA. Epidemiological and clinical aspects of the metabolic complications of HIV infection the fat redistribution syndrome. Aids. 1999;13(11):1287-93.
4. Safrin S, Grunfeld C. Fat distribution and metabolic changes in patients with HIV infection. Aids. 1999;13(18):2493-505.
5. Carr A. HIV lipodystrophy: risk factors, pathogenesis, diagnosis and management. Aids. 2003;17:S141-8.
6. Lichtenstein, Kenneth A, Ward DJ, Moorman AC, Delaney KM, Young B, et al. Clinical assessment of HIV-associated lipodystrophy in an ambulatory population. Aids. 2001;15(11):1389-8.
7. Reeds DN, Mittendorfer B, Patterson BW, Powderly WG, Yarasheski KE, Klein S. Alterations in lipid kinetics in men with HIV-dyslipidemia. Am J Physiol-Endocrinol Metabol. 2003;285(3):E490-7.
8. Devanath A, Ray S, Kumar R, Prarthana BS. A study to evaluate lipid profile in treatment naïve HIV positive patients. Indian J Clinic Biochem. 2014;29(1):45-0.
9. Riddler SA, Smit E, Cole SR, Li R, Chmiel JS, Dobs A, et al. Impact of HIV infection and HAART on serum lipids in men. JAMA. 2003;289(22):2978-82.
10. Grunfeld C, Kotler DP, Shigenaga JK, Doerrler W, Tierney A, Wang J, et.al. Circulating interpheron-alpha levels and hypertriglyceridemia in the acquired immunodeficiency syndrome. J Clin Endocrinol Metab. 1992;74:1045-8.
11. Grunfeld C, Pang MI, Doerrler W, Shigenaga JK, Jensen P, Feingold KR. Lipids, lipoproteins, triglyceride clearance, and cytokines in human immunodeficiency virus infection and the acquired immunodeficiency syndrome. J Clinic Endocrinol Metabol. 1992;74(5):1045-2.
12. Caan B, Armstrong MA, Selby JV, Sadler M, Folsom AR, Jacobs D, et al. Changes in measurements of body fat distribution accompanying weight change. Int J Obes Relat Metab Disord. 1994, 18:397-404.
13. Zangerle R, Sarcletti M, Gallati H, Reibnegger G, Wachter H, Fuchs D. Decreased plasma concentrations of HDL cholesterol in HIV-infected individuals are associated with immune activation. J Acqu Imm Defi Synd. 1994;7(11):1149-56.
14. El-Sadr WM, Mullin CM, Carr A, Gibert C, Rappoport C, Visnegarwala F, et al. Effects of HIV disease on lipid, glucose and insulin levels: results from a large antiretroviral-naive cohort. HIV Med. 2005;6(2):114-21.

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