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Original Research Article

$CD4^+$ T cells and Full blood count parameters in HIV infected subjects at a tertiary health institution at Nnewi, Anambra state

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Abstract

Human immunedeficiency virus (HIV) infection is a global pandemic of concern, with immunodeficiency and haematological abnormalities as major complications in infected individuals. This present study was designed to evaluate $CD4^+$ T cells and full blood count parameters in HIV positive subjects presenting at Nnamdi Azikiwe University between November 2022 and May 2023, with a view to identifying the pattern of $CD4^+$ T cells and hematological abnormalities in the study subjects. In this longitudinal study, a total of ninety (90) HIV seropositive subjects aged 18 – 60 were recruited by simple random sampling from Nnamdi Azikiwe University Teaching Hospital, Nnewi and followed-up 6-months post treatment. Ninety apparently (90) healthy HIV seronegative age matched subjects drawn from the same hospital community served as control. Informed consent and ethical approval were sought and obtained and blood samples were collected at baseline (before commencement of HAART) and at 3months, and 6 months post treatment. $CD4^+$ T cells were auto-counted using flow cytometric method. Full blood count were done using sysmex automated haemotology analyzer KY2 IN model. Data generated were analyzed using SPSS version 25. The result showed that $CD4^+$ T count, RBC count, haemoglobin concentration and PCV in pretreatment subjects were significantly lower when compared with HIV seronegative subjects, 3-months and 6-months post treatment subjects (F 324.764; $P<0.05$), (F 25.822; $P<0.05$), (F 16.683; $P<0.05$), (F 14.490; $P<0.05$) respectively. The WBC (T), neutrophil count, lymphocyte count and monocyte count in pretreatment subjects were significantly lower when compared with HIV seronegative subjects, 3-months and 6-months post treatment subjects (F 20.262; $P<0.05$), (F 27.663; $P<0.05$), (F 18.382; $P<0.05$) and (F 5.111; $P<0.05$) respectively. The Eosinophil and Basophil count in pretreatment subjects showed no significant difference when compared with HIV seronegative subjects, 3-months and 6-months post treatment subjects (F 0.054; $P>0.05$) and (F 2.593; $P>0.05$) respectively.

This study shows abnormalities in $CD4^+$ T cells and FBC parameters in HIV subjects which are corrected by ART. Delay in commencement of ART could result in immunosuppression and haematological abnormalities complications in the subjects. This study therefore reports reduced $CD4^+$ T cells and haematological abnormalities in treatment naïve HIV individuals.

Keywords: *$CD4^+$ T; HIV; ART; HAART, Full Blood count.*

1.0 Introduction

The Human Immunodeficiency Virus (HIV) is a member of the genus Lentivirus (a subgroup of retrovirus), part of the family Retroviridae that causes the acquired immunodeficiency syndrome (AIDS), a condition in humans in which progressive failure of the immune system allows life threatening opportunistic infections and cancers to thrive [1]. HIV infection is common in Nigeria with about 1.4% National HIV prevalence [2]. The widespread prevalence of sexually transmitted diseases, the practice of scarification, unsafe blood transfusion and mother-to child transmission all may be facilitating factors in the transmission of HIV-1[3]. Haematological abnormalities are among the most common complications of HIV infection and involves all blood cells lineages resulting in anaemia, leucopenia and thrombocytopenia [4]. Haematological abnormalities associated with human immunodeficiency virus infection seem to be dependent on the level of viral replication as these abnormalities are severe in late-stage AIDS patients with high viraemia and low $CD4^+$ T cell count [5]. The use of antiretroviral drugs could positively or negatively affect these disorders [6]. Anaemia is the most common haematological abnormality in HIV seropositive patients and its incidence is strongly associated with the progression of the disease. HIV infection leads to low levels of $CD4^+$ T cells and when $CD4^+$ T cell numbers decline below a critical level, cell mediated immunity is lost and the body becomes progressively more susceptible to opportunistic infections [7]. Thus, a specific diagnosis and a determination of $CD4^+$ T cell count and haematological parameters are required for initiating and monitoring early treatment to avert disease progression hence the need for this research work which will include estimation of haemoglobin concentration, PCV, RBC count, total WBC count, platelet count and $CD4^+$ T cell-count in HIV infected subjects.

2.0 Materials and method

2.1 Subjects

A total of ninety HIV seropositive (group B) subjects aged 18-60years were recruited for the study by simple random sampling and followed-up after 3-months (group C) and 6-months (group D) post treatment with tenofovir or abacavir for renal patients, lamivudine, and doutegranvir from the the ART clinic of Nnamdi Azikiwe University Teaching Hospital, Nnewi in Anambra State Nigeria between November 2022 to May 2023. Eighty (80) subjects each were in their 3 months and 6 month's post treatment stages respectively. Ninety (90) apparently healthy subjects (group A) who visit the hospital for medical check- up served as control. Ethical approval was obtained from the ethics committee of Nnamdi Aziikiwe University Teaching Hospital, Nnewi before embarking on the study. Informed consent was also obtained from the subjects.

2.3 Statistical method

Result generated in this study were tabulated using excel. Statistical analysis was done using statistical package for social sciences (SPSS) version 25. The variables were expressed in mean and standard deviation. Student's t-test and analysis of variance (ANOVA) were used for comparison between and among groups respectively. A p-value of less than 0.05 ($p<0.05$) was considered statistically significant.

3.0 Result

The result showed that the mean ± CD4 count; 1202.26 ± 180.16 (cells/cmm) for HIV negative control subjects group A, 396.67 ± 167.50(cells/cmm) for HIV pretreatment group B, 546.88 ± 159.47(cells/cmm) for 3-months post treatment group C, 580.96 ± 241.03(cells/cmm) for 6-months post treatment group D compared among the groups showed significant difference (F 324.764; $P<0.05$). The in between comparison showed that CD4 count in group B was significantly lower than the mean CD4 count in group A, C and D ($P<0.05$ in each case). The mean ± SD CD4 count in group A was significantly higher than the mean CD4 count in group C and D ($P<0.05$ in each case). However, the mean ± SD CD4 count in group C compared with the value in group D showed no significant difference ($P>0.05$). The Mean ± SD RBC count 4.21 ± 0.18 $x10^{12}$/l for HIV negative control subjects group A, 3.32 ± 0.61 $x10^{12}$/l for HIV pretreatment group B, 4.02 ± 0.88 $x10^{12}$/l for 3-months post treatment group C, 4.03 ± 1.19 $x10^{12}$/l for 6-months post treatment group D compared among the groups showed significant difference (F 25.822; $P<0.05$). The in between comparison showed that RBC count in group B was significantly lower than the mean RBC count in group A, C and D ($P<0.05$ in each case). The mean ± SD RBC count in group A showed no significant difference when compared with C and D ($P>0.05$). Furthermore, the mean ± SD RBC count in group C compared with the value in group D showed no significant difference ($P>0.05$). The Mean ± SD haemoglobin concentration 12.90 ± 0.55 g/dl for HIV negative control subjects group A, 10.19. ± 1.77 g/dl for HIV pretreatment, 12.33 ± 2.98 g/dl for 3-months post treatment, 12.36 ± 4.07 g/dl for 6-months post treatment compared among the groups showed significant difference (F 16.683; $P<0.05$). The in between comparison showed that Haemoglobin concentration in group B was significantly lower than the mean Haemoglobin concentration in group A, C and D ($P<0.05$ in each case). The mean ± SD Haemoglobin concentration in group A showed no significant difference when compared with C and D ($P>0.05$). Furthermore, the mean ± SD Haemoglobin concentration in group C compared with the value in group D showed no significant difference ($P>0.05$). The Mean ± SD PCV 38.94 ± 1.94 % for HIV negative control subjects group A, 31.29. ± 5.27 % for HIV pretreatment group B, 35.86 ± 8.98 % for 3-months post treatment group C, 33.86 ± 12.21 % for 6-months post treatment group D compared among the groups showed significant difference (F 14.490; $P<0.05$). The in between comparison showed that PCV in group B was

significantly lower than the mean PCV in group A, C and D (P<0.05 in each case). The mean ± SD PCV in group A showed no significant difference when compared with C and D (P>0.05). Furthermore, the mean ± SD PCV in group C compared with the value in group D showed no significant difference (P>0.05) (Table 1.0).

Table 1.0: Comparison of Red cell parameters and $CD4^+$ count among HIV negative control

Groups	HB (g/dl)	PCV (%)	RBC ($x10^{12}$/l)	CD4 (cells/cmm)
A. Control (n=90)	12.90 ± 0.55	38.94 ± 1.94	4.21 ± 0.18	1202.26 ± 180.16
B. Pretreatment(n=90)	10.19 ± 1.77	31.29 ±5.67	3.32 ± 0.61	396.67 ± 167.50
C.3-months Post-treatment (n=80)	12.33 ± 2.98	36.86 ± 8.98	4.02 ± 0.88	546.88 ± 159.47
D.3-months Post-treatment (n=80)	12.36 ± 4.07	37.08 ± 12.21	4.03 ± 1.19	580.96 ± 241.03
F(P) values	16.638 (0.001)	14.490 (0.001)	25.822 (0.001)	324.765(0.001)
A vs B P-value	0.001	0.001	0.001	0.001
A vs C P-value	0.121	0.101	0.131	0.001
A vs D P-value	0.111	0.121	0.141	0.001
B vs C P-value	0.001	0.001	0.001	0.001
B vs D P-value	0.001	0.001	0.001	0.001
C vs D P-value	0.112	0.134	0.128	0.196

Significant at P<0.05

$CD4^+$= Cluster of differentiation-4 HB = Haemoglobin
RBC = Red blood cell count PCV = Packed cell volume

Table 2.0 compares white blood cell parameters among HIV negative control subjects, HIV pretreatment, 3-months and 6-months post treatment subjects. The table presents both ANOVA and t-tests with corresponding P-value. The result showed that the mean ±SD WBC (T) 5.03 ± 0.75 x 10^9/l for HIV negative control subjects group A, 3.01 ± 0.87 x 10^9/l for HIV pretreatment group B, 4.46 ± 1.23 x 10^9/l for 3-months post treatment subjects group C, 4.37 ± 1.62 x 10^9/l for 6-months post treatment subjects group D compared among the groups showed significant difference (F 20.262; P<0.05). The in between comparison showed that WBC (T) in group B was significantly lower than the mean WBC (T) in group A, C and D (P<0.05 in each case). The mean ± SD WBC (T) in group A showed no significant difference when compared with C and D (P>0.05). Furthermore, the mean ± SD WBC (T) in group C compared with the value in group D showed no significant difference (P>0.05). The mean ±SD Neutrophil count 2.83 ± 0.52 x 10^9/l for HIV negative control subjects group A, 1.88 ± 0.63 x 10^9/l for HIV pretreatment, 2.51 ± 0.73 x 10^9/l for 3-months post treatment subjects, 2.43 ± 0.94 x 10^9/l for 6-months post treatment subjects compared among the groups showed significant difference (F 27.663; P<0.05). The in between comparison showed that Neutrophil count in group B was significantly lower than the mean Neutrophil count in group A, C and D (P<0.05 in each case). The mean ± SD Neutrophil count in group A showed no significant difference when compared with C and D (P>0.05). Furthermore, the mean ± SD Neutrophil count in group C compared with the value in group D showed no significant difference (P>0.05). The mean ±SD Lymphocyte count 2.07 ± 0.59 x 10^9/l for HIV negative control subjects group A, 1.90 ± 0.55 x 10^9/l for HIV pretreatment, 1.55 ± 0.57 x 10^9/l for 3-months post treatment subjects, 1.53 ± 0.65 x 10^9/l for 6-months post treatment subjects compared among the groups showed significant difference (F 18.382; P<0.05). The in between comparison showed that Lymphocyte count in group B was significantly lower than the mean Lymphocyte count in group A, C and D (P<0.05 in each case). The mean ± SD Lymphocyte count in group A showed no significant difference when compared with C and D (P>0.05). Furthermore, the mean ± SD Lymphocyte count in group C compared with the value in group D showed no significant difference (P>0.05). The mean ±SD Monocyte count 0.32 ± 0.09 x 10^9/l for HIV negative control subjects, 0.27 ± 0.05 x 10^9/l for HIV pretreatment, 0.29 ± 0.09 x 10^9/l for 3-months post treatment subjects, 0.27 ± 0.12 x 10^9/l for 6-months post treatment subjects compared among the groups showed significant difference (F 5.111; P<0.05). The in between comparison showed that Monocyte count in group B was significantly lower than the mean Lymphocyte count in group A, C and D (P<0.05 in each case). The mean ± SD Monocyte count in group A showed no significant difference when compared with C and D (P>0.05). Furthermore, the mean ± SD Monocyte count in group C compared with the value in group D showed no significant difference (P>0.05). The mean ±SD Eosinophil count 0.12 ± 0.02 x 10^9/l for HIV negative control subjects, 0.12 ± 0.01 x 10^9/l for HIV pretreatment, 0.12 ± 0.03 x 10^9/l for 3-months post treatment subjects group C, 0.12 ± 0.09 x 10^9/l for 6-months post treatment subjects compared among the groups showed no significant difference (F 0.054; P>0.05). The in between groups A, B, C, D comparisons also showed no significant difference (P>0.05 in each case). The mean ±SD Basophil count 0.02 ± 0.01 x 10^9/l for HIV negative control subjects, 0.02 ± 0.01 x 10^9/l for HIV pretreatment, 0.02 ± 0.01 x 10^9/l for 3-months post treatment subjects, 0.02 ± 0.01 x 10^9/l for 6-months post treatment subjects compared among the groups showed no significant difference (F 2.593; P>0.05). The in between groups A, B, C, D comparisons also showed no significant difference (P>0.05 in each case).

Table 2.0: Comparison of White blood cell parameters among HIV negative control subjects, HIV pretreatment, 3-months and 6-months post treatment subjects (Mean ± SD)

Groups	WBC (T) (x 10^9/l)	NEUT (x 10^9/l)	LYM (x 10^9/l)	MON (x 10^9/l)	EOS (x 10^9/l)	BASO (x 10^9/l)
A. Control (n=90)	5.03 ± 0.75	2.83 ± 0.52	2.67 ± 0.59	0.32 ± 0.09	0.12 ± 0.02	0.02 ± 0.01
B. Pretreatment (n=90)	3.01 ± 0.87	1.88 ± 0.63	1.55 ± 0.57	0.27 ± 0.05	0.12 ± 0.01	0.02 ± 0.01
C.3-months Post-treatment (n=80)	4.46 ± 1.23	2.51 ± 0.73	1.96 ± 0.55	0.29 ± 0.09	0.12 ± 0.03	0.02 ± 0.01
D.6-months Post-treatment (n=80)	4.38 ± 1.62	2.43 ± 0.94	1.98 ± 0.65	0.29 ± 0.12	0.12 ± 0.09	0.02 ± 0.01
F(P) values	20.262 (0.001)	27.663 (0.001)	18.382 (0.001)	5.111 (0.002)	0.054 (0.984)	2.593 (0.052)
A vsB P-value	0.001	0.001	0.001	0.004	1.000	0.456
A vsC P-value	0.081	0.065	0.074	0.096	1.000	0.068
A vsD P-value	0.091	0.071	0.091	0.086	1.000	0.710
Bvs C P-value	0.001	0.001	0.001	0.008	1.000	1.000
Bvs D P-value	0.001	0.001	0.001	0.009	1.000	1.000
Cvs D P-value	1.000	0.960	1.000	0.615	1.000	0.649

Significant at P<0.05

WBC = total white blood cell count
NEUT= Neutrophil count
LY = Lymphocyte count
EOS= Eosinophil count
BASO= Basophil count
MON= Monocyte count

4.0 Discussion

Table 1.0 presents key findings related to Red cell parameters and $CD4^+$ count among HIV negative control subjects, HIV pretreatment, 3-months and 6-months post treatment subjects. This study shows that there was a statistically significant difference reflecting lower levels of haemoglobin concentration, packed cell volume and RBC count in HIV pretreatment when compared with that of HIV negative control subjects, 3-months and 6-months post treatment subjects respectively. It was also seen that there was a statistically significant difference reflecting higher levels of haemoglobin concentration, packed cell volume and RBC count in 3-months and 6-months post treatment subjects when compared with that of HIV pretreatment.

Anaemia occurs when Hb and PCV of an individual falls below normal (11.0g/dl) and (0.33l/l) respectively. Anaemia occurs in different forms with anaemia due to chronic disease such as HIV infection [8] considered here. Anaemia, leucopenia and thrombocytopenia are the commonest haematological abnormalities from human Immunodeficiency virus infection [4]. The precise mechanism of anaemia in HIV infection is not clearly known, however, anaemia due to inflammation as well as that of iron deficiency has been implicated [6]. Factors such as decrease in red cell survival and reduced erythropoietin response by the bone marrow erythroid cells are also known to cause anaemia [4]. The use of antiretroviral drugs could positively or negatively affect these disorders [6]. In this present study, a significant reduction in anaemia was observed after 3 months of ART. The post-treatment haemoglobin levels and PCV values were significantly higher compared to the HIV pretreatment subjects.

The study shows that there was a significantly lower level of $CD4^+$ count in HIV pretreatment when compared with that of HIV negative control subjects, 3-months and 6-months post treatment subjects respectively. The findings are fully supported by previous reports that HIV infection leads to low levels of $CD4^+$ T cells because the virus infects vital cells in the human immune system such as helper T cells (specifically $CD4^+$ T cells), microphages and dendritic cells leading to their death and resulting in reduced $CD4^+$ T cells in HIV infection which occurs through a number of mechanisms, including apoptosis of uninfected bystander $CD4^+$ T cells, direct viral killing of infected $CD4^+$ T cells and killing of infected $CD4^+$ T cells by $CD8^+$ cytotoxic lymphocytes that recognize infected cells [5].

Table 2.0 presents key findings related to White blood cell parameters among HIV negative control subjects, HIV pretreatment, 3-months and 6-months post treatment subjects. The study shows that there was a significantly lower level of white blood cells, Neutrophils and lymphocytes counts in HIV pretreatment when compared with that of HIV

negative control subjects, 3-months and 6-months post treatment subjects respectively. These cells are components of the immune system involved in the inflammatory response and their reduced level may indicate depressed immunity inherent in HIV infection. This is supported by reports of leucopenia as the commonest haematological abnormalities from human immunodeficiency virus infection [1].

5.0 Conclusions

In conclusion, the present study showed that HIV pretreatment subjects exhibited lower level of haemoglobin concentration, Packed Cell Volume, Total White cell count and $CD4^+$ T cells. The study also indicates that these parameters progressively returned to normal as patients undergo treatment over 3 months and 6 months. Based on these findings it is recommended that base line levels of these haematological parameters are obtained prior to treatment in order to monitor the progress of treatment in HIV infected subjects. The present study highlights $CD4^+$ T cell count as a veritable prognostic tool in the treatment of HIV infected subjects.

Conflict of interests

Authors declared that no competing interests exist

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