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Haematological Indices of HIV-1 Infected Subjects on Antiretroviral Therapy from Selected Tertiary Hospitals in Port Harcourt, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Changes in haematological indices could result from so many underlining factors, one of which could be an autoimmune response, defect in hemopoiesis, infection, cancer, and so on. Cytopenia is a common illness observable in the blood of people infected with HIV.
Materials and Methods: This is a cross-sectional study involving two hundred patients. The blood samples of recruited subjects were collected aseptically before analysis for Haematology indices using Mindray BC-6800.
Results: Results showed that the lowest and highest count/L for haematological indices were; WBC 1.3-11.9 $x10^9$/L, Lymphocyte 0.3-6.4 $x10^9$/L, Monocyte 0.2-2.6 $x10^9$/L, Granulocyte 0.1-5.1 $x10^9$/L and Platelet 30-550 $x10^9$/L. White blood cell indices showed a significant difference in distribution of relative lymphocytes (Mean+SD 50.78+15.69) (P=0.000), Monocytes (Mean+SD 15.929+8.68) (P=0.000), Granulocytes (Neutrophils, Basophil and Eosinophil) (Mean+SD 33.287+18.05) (P=0.000), and absolute counts of lymphocytes (Mean+SD 2.742+1.14) (P=0.000), Monocytes (Mean+SD 0.838+0.48) (P=0.000), Granulocytes (Neutrophils, Basophil and Eosinophil) (Mean+SD 1.943+1.31) (P=0.000). Red blood cell indices showed a significant difference in their

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distribution across all ages in this study. Haemoglobin concentration (Mean+SD 10.491+2.30) (P=0.000), Haemoglobin crit (Mean+SD 40.52+6.98) (P=0.000), MCV (Mean+SD 92.03+6.68) (P=0.000), MCH (Mean+SD 23.43+2.32) (P=0.001), PLT x109/L (Mean+SD 223.10+84.52) (P=0.000), PDW (Mean+SD 13.04+5.23) (P=0.000). Similarly, age was a significant factor in the distribution of haematological parameters across all blood cell lines as it showed significant differences in white blood cell count, relative and absolute counts for Lymphocytes, monocytes, and granulocytes.

Conclusion: The study showed a substantial change in the WBC differential counts of study participants based on the duration of antiviral drug intake.

Keywords: Antiretroviral; lymphocytes; monocytes; granulocytes; platelets; HIV.

1. INTRODUCTION

Differences in haematological Indices are observable among people infected with HIV. It has been not too long after its actual discovery, with reports dated back to 1989 with work carried out by Mir et al. and Fan et al. [1,2]. Cytopenia could result from so many underlining factors, one of which could be an autoimmune response, defect in hemopoiesis, infection, cancer, and so on [3-7]. Consequently, this may happen with other systemic symptoms that mimic those of different types of cytopenia, for instance, fever, frequent infections, fatigue, bruising easily, bleeding, and weakness [3]. However, for HIV-infected individuals, cytopenia is a common illness observable in the blood of people infected with HIV. Its widespread occurrence could show varying manifestations of anaemia, neutropenia, and thrombocytopenia [1-2,7].

Earlier studies had revealed evidence of cytopenia at different occurrence ranges of 10%–85% [1-2] 1.3%–95% [8] and 7%–21% [9,10] nevertheless, there is this believe that HIV infection exerts some effect on the bone marrow that commonly leads to a reduction in red blood cell level and platelet count in peripheral blood [11]. And then, on a general note, the bone marrow, the site of blood formation, is the target of the combined effect of the HIV viral infection, the drugs used during the AIDS treatment, the inflammatory mediators released during infection, and the impact of likely opportunistic pathogens [3-7].

The direct and indirect effects of HIV infection on hematopoietic progenitor cells impair bone marrow homeostasis, affecting cell proliferation and differentiation during hematopoiesis [1-2,4,8-13]. The main consequences are altered cellularity, reduction of all haematological lineages, dysplastic changes in the erythroid and granulocytic series, megaloblastic abnormalities in the erythroid series, and reticulum endothelial iron block [1-3,14-18]. Therefore, this study intends to correlate the blood count indices with the commencement of HAART during HIV infection.

2. MATERIALS AND METHODS

2.1. Study Area

This research was done in Port Harcourt, a metropolitan city, Rivers State, Nigeria. It is the epicenter of oil and gas activities in the South-South region of the country, having residents in over five million people of diverse races and tribes [19].

2.2. Study Population

Two hundred (200) consenting individuals were recruited randomly into this study from two tertiary health facilities in the state with referrals from all parts of Rivers State. This study accommodated people from all works of life, races, tribes, and religion.

2.3. Study Design

This is a cross-sectional hospital-based study.

2.4. Inclusion and Exclusion Criteria

Only consented persons who are HIV positive and willing to provide all the required information for this study. Otherwise, excluded from this study.

2.5. Sampling Technique

All samples of confirmed HIV positive (n=200) patients have been collected aseptically via venous puncture into an EDTA bottle and sent to the laboratory for immediate analysis.

2.6. Haematological Analysis

Haematology indices were analyzed using Mindray BC-6800, an auto Haematology analyzer system, Mindray BC-6800 [20]. The principle was based on a combination of light scattering, electrical impedance, fluorescence, light absorption, and electrical conductivity methods to produce complete red blood cell, platelet, and leukocyte analyses. Sample mode for whole blood was selected, and EDTA tubes with sound mixed EDTA blood were placed under the entire blood aspirator tip (inserted at least 1 inch into the blood), and the whole blood button was then pressed. After 90 seconds, a complete analysis of the blood sample was done, and results were displayed on the auto Analyzer screen and then printed out within minutes.

2.7. Data Analysis

The results of the analysis are documented using five Tables. The data generated were collated in Microsoft excel and were analyzed using WHO criteria for cytopenias. Statistical analysis was done using the SPSS version 21.

3. RESULTS

Result from this study shows that the lowest and highest count/L for haematological indices were; WBC 1.3-11.9 $x10^9$/L, Lymphocyte 0.3-6.4 $x10^9$/L, Monocyte 0.2-2.6 $x10^9$/L, Granulocyte 0.1-5.1 $x10^9$/L and Platelet 30-550 $x10^9$/L (Table 1-5).

White blood cell indices showed that there was a significant difference in distribution of relative lymphocytes (Mean+SD 50.78+15.69) (P=0.000), Monocytes (Mean+SD 15.929+8.68) (P=0.000), Granulocytes (Neutrophils, Basophil and Eosinophil) (Mean+SD 33.287+18.05) (P=0.000), and absolute counts of lymphocytes (Mean+SD 2.742+1.14) (P=0.000), Monocytes (Mean+SD 0.838+0.48) (P=0.000), Granulocytes (Neutrophils, Basophil and Eosinophil) (Mean+SD 1.943+1.31) (P=0.000).

Table 1. Table showing comparison of means of haematological parameters based on year of first commencement of ART

Variable	Parameters	Mean±SD		F-value	P-value	Implications
White Cell Indices	WBC $x10^9$L	5.523±1.85	1.8521	1.475	0.120	Not Significant
	LYM	50.784±15.69	15.6940	4.768	0.000	Significant
	MON	15.929±8.68	8.6809	0.817	0.658	Not Significant
	GRAN	33.287±18.05	18.0468	4.496	0.000	Significant
	LYM $x10^9$ L	2.742±1.14	1.1443	1.752	0.046	Not Significant
	MONO $x10^9$ L	0.838±0.48	0.4818	0.965	0.494	Not Significant
	GRAN $x10^9$ L	1.943±1.39	1.3079	3.064	0.000	Significant
Red Cell Indices	RBC $x10^{12}$ L	4.42±0.75	0.751	1.209	0.270	Not Significant
	HB (g/dl)	10.491±2.30	2.3019	1.150	0.316	Not Significant
	HCT	40.52±6.99	6.989	1.204	0.274	Not Significant
	MCV (fL)	92.03±6.68	6.679	1.394	0.156	Not Significant
	MCH (pg)	23.428±2.32	2.3173	1.015	0.442	Not Significant
	MCHC (g/dL)	25.458±1.23	1.2310	0.831	0.642	Not Significant
	RDW-CV	14.269±1.38	1.3794	1.303	0.205	Not Significant
	RDW-SD (fL)	49.003±3.29	3.2855	2.371	0.004	Significant
	MPV (fL)	9.51±1.00	1.0048	2.391	0.004	Significant
Platelet Indices	PLT $x10^9$ L	223.10±84.52	84.5231	1.931	0.023	Significant
	PDW (fL)	13.04±5.23	5.2329	1.478	0.118	Not Significant
	PCT	0.46±2.40	2.39723	1.753	0.046	Not Significant
	PLCR	25.17±7.00	7.0051	2.344	0.005	Significant
	PLCC $x10^9$ L	52.51±17.07	17.0738	2.262	0.006	Significant

Key: SD= Standard Deviation of Mean; WBC=White Blood Cell; LYM=Lymphocytes; MON=Monocytes; RDW-SD: Red Cell Distribution Width–Standard Deviation; PLT: Platelets; MPV: Mean Platelet Volume; PDW: Platelet Distribution Width; PCT: Plateletcrit; P-LCC/L: Platelet large cell count. Within parameters and across interactive measures, means ± SD with different superscripts is significantly different at p<0.05

Table 2. Table showing statistical evaluation of red blood cell indices based on gender of study subjects

Variables	Mean±SD	F-value	P-value	Implication
RBCx10 ^{12} L	4.42±0.75	5.521	0.020	Significant
HBg/dl	10.49±2.30	2.689	0.103	Not Significant
HCT	40.52±6.99	0.658	0.418	Not Significant
MCV (fL)	92.03±6.68	14.405	0.000	Significant
MCH (pg)	23.42	6.292	0.013	Significant
MCHC (g/dL)	25.458	0.147	0.702	Not Significant
RDWCV	14.27±1.38	0.264	0.608	Not Significant
RDWSD (fL)	49.00±3.29	15.710	0.000	Significant
MPV (fL)	9.51±1.00	6.808	0.010	Significant

Key: SD= Standard Deviation of Mean; WBC=White Blood Cell; LYM=Lymphocytes; MON=Monocytes; RDW-SD: Red Cell Distribution Width–Standard Deviation; PLT: Platelets; MPV: Mean Platelet Volume; PDW: Platelet Distribution Width; PCT: Plateletcrit; P-LCC/L: Platelet large cell count. Within parameters and across interactive measures, means ± SD with different superscripts is significantly different at p<0.05

Table 3. Table showing statistical evaluation of platelet indices based on gender of the studied HIV population

Variable	Parameters	Mean±SD	F-value	P-value	Implication
Platelet Indices	PLT x10^{9}L	223.00±84.52	2.693	0.103	Not Significant
	PDW(fl)	13.04±5.23	11.313	0.001	Significant
	PCT	0.46±2.39	1.120	0.291	Not Significant
	PLCR	25.17±7.00	6.322	0.013	Significant
	PLCC x10^{9}L	52.51±17.07	0.050	0.824	Not Significant

Key: PLT: Platelets; MPV: Mean Platelet Volume; PDW: Platelet Distribution Width; PCT: Plateletcrit; P-LCC/L: Platelet large cell count. Within parameters and across interactive measures, means ± SD with different superscripts is significantly different at p<0.05. Significance Level: p<0.05; Not Significant (p>0.05). N=200

Table 4. Table showing the evaluation of white blood cell indices of the studied HIV population

Variable	Parameters	Mean±SD	F-value	P-value	Implication
WBC Indices	WBC x10^{9}L	5.523±1.85	1.378	0.242	Not Significant
	LYM	50.784±15.69	0.023	0.878	Not Significant
	MON	15.93±8.68	0.262	0.609	Not Significant
	GRAN	33.29±18.05	0.144	0.705	Not Significant
	LYM x10^{9}L	2.742±1.14	0.773	0.381	Not Significant
	MONO x10^{9}L	0.838±0.48	0.639	0.425	Not Significant
	GRAN x10^{9}L	1.943±1.31	1.409	0.237	Not Significant

Key: SD= Standard Deviation of Mean; WBC=White Blood Cell; LYM=Lymphocytes; MON=Monocytes; RDW-SD: Red Cell Distribution Width–Standard Deviation; PLT: Platelets; MPV: Mean Platelet Volume; PDW: Platelet Distribution Width; PCT: Plateletcrit; P-LCC/L: Platelet large cell count. Within parameters and across interactive measures, Mean ± SD with different superscripts is significantly different at p<0.05

Table 5. Correlation between age and haematological parameters among HIV infected individuals

Variables	Correlation	P-value	Implication
WBC x10^{9}L	0.034	0.647	Not Significant
LYM	-0.087	0.248	Not Significant
MON	-0.172	0.021	Significant
GRAN	0.158	0.034	Not Significant
LYM x10^{9}L	-0.036	0.627	Not Significant
MONO x10^{9}L	-0.127	0.089	Not Significant
GRAN x10^{9}L	0.128	0.088	Not Significant

Variables	Correlation	P-value	Implication
PLT x10^9L	-0.159	0.033	Significant
RBC x10^{12}L	0.022	0.769	Not Significant
HB(g/dl)	-0.025	0.744	Not Significant
HCT	0.033	0.665	Not Significant
MCV(fL)	0.042	0.579	Not Significant
MCH(pg)	0.004	0.962	Not Significant
MCHC(gdL)	-0.04	0.591	Not Significant
RDWCV	0.001	0.989	Not Significant
RDWSDfL	0.007	0.927	Not Significant
MPVfL	-0.053	0.477	Not Significant
PDWfL	-0.066	0.381	Not Significant
PCT	-0.051	0.498	Not Significant
PLCR	-0.041	0.582	Not Significant
PLCC X10^9L	-0.193	0.01	Significant

Key: SD= Standard Deviation of Mean; WBC=White Blood Cell; LYM=Lymphocytes; MON=Monocytes; RDW-SD: Red Cell Distribution Width–Standard Deviation; PLT: Platelets; MPV: Mean Platelet Volume; PDW: Platelet Distribution Width; PCT: Plateletcrit; P-LCC/L: Platelet large cell count. Within parameters and across interactive measures, means ± SD with different superscripts is significantly different at p<0.05

4. DISCUSSION

It has been a known fact that HIV infection causes a decline in the haematological indices of sufferers who have not experienced antiretroviral treatment. This study observed that absolute white blood cell mean count was 5.523 x 10^9/L with a breakdown of the differential count of leucocytes resulting in a mean of 50.8% lymphocytes, 15.9% monocytes, and 33.3% granulocytes (Neutrophils, Eosinophils and Basophil). However, there was a significant change in the differential counts of study participants based on their duration of antiviral drug intake for lymphocytes and granulocytes. In contrast, there was no significant difference in the differential count of monocytes irrespective of when antiretroviral therapy was initiated. Although the reason for haematological disorders in HIV infection remains inadequately understood, it could be attributed to dysfunctional hematopoiesis in bone marrow caused by several factors to include severe nutritional stress in advanced stages of HIV infection, suppression of the bone marrow by invading opportunistic infections, or neoplasm, chronic disease-associated changes, and toxic side effects of antiretroviral compounds [2,9,21].

The present study reflected a significant change in the platelet counts (223.1 x 10^9/L) (p=0.023) of studied subjects alongside their mean platelet volume (9.51±84.52) (p=0.004). These agreed with the report of Asemota *et al.* [12] who had a platelet count of 241.24 ± 83.24. This follows platelet activation during the infection, evidenced by the significant change in the platelet count and mean platelet volume of subjects in this study [22].

The substantial increase in mean platelet volume in this study, may be due to the activities of chemical compounds like nitric oxide, which down-regulate the production of platelets. This result is further confirmed by a change in the PCT value, which is used as a screening tool for detecting quantitative abnormalities. It is more accurate to assess patients with disorders rather than just the platelet count. Plateletcrit (PCT) is the volume occupied by platelets in the blood as a percentage, while mean platelet volume (MPV) is inversely related to platelet counts in line with Cheesbrough [23]. This present study showed a significant difference in the red cell indices and Platetelets of the studied HIV-infected subjects, a reflection of the effect of antiretroviral drug intake duration on the tendency for anaemia to occur among studied subjects as seen in Table1, 2, 3 and 5 of presented study results.

Similarly, age was a significant factor in the distribution of haematological parameters across all blood cell lines. It showed significant differences in white blood cell count, relative and absolute counts for Lymphocytes, monocytes, and granulocytes. This is relatively so because the relative significance of each haematological parameter varies based on an individuals' immunologic response differences [24], nutritional status or nutritional deficiencies [12,13,22,24-29] and genetic factors, geographic location, and season [12,13,22,24-30].

Consequently, it could be made worse with the resource-poor and tropical settings we find ourselves in; anaemia is mainly caused by underlying nutritional deficiencies and endemic parasitic infections, such as malaria and helminths, which lead to red blood cell destruction, decreased production, or loss. In sub-Saharan Africa, hemoglobinopathies such as sickle cell disease represent an additional cause of anaemia in HIV patients [12-22,24-29].

5. CONCLUSION

Based on the results of the present study, the authors came to these conclusions: HIV infection has been shown to affect haematological parameters. The study showed a significant difference in some red cell indices (the Absolute Red cell count, Red Cell Distribution Width–Standard Deviation and Red Cell Distribution Width-Cell Volume) and Platetelet indices (the absolute platelet count) of the studied HIV-infected subjects, a reflection of the effect of the duration of antiretroviral drug administration on the tendency for anaemia and thrombocytopenia to occur among studied HIV population. Also observed was a significant difference in the differential leucocyte count of study participants for lymphocytes and granulocytes. In contrast, there was no significant difference in the differential count of monocytes irrespective of when antiretroviral therapy was initiated. Furthermore, this study has made an important contribution to the knowledge about this disease with life-threatening complications of pancytopenia.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

This study was approved by the Research Ethics Committee of the University of Port Harcourt, Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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