

## A Prospective, Single Centric Study of Hematological Profile in HIV Infected Patients with Correlation to CD4 Count

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**Abstracts:** Background & objectives: A variety of haematological manifestations is seen at every stage of human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) and often pose a great challenge in the comprehensive management. These manifestations also reflect the underlying immune status if interpreted cautiously, especially if the patient is in regular follow-up. They may cause symptoms that are life-threatening and impair the quality of life of these patients. Methods: Blood samples collected in the ART centre send to the central pathology laboratory, Sir Takhtasinhji General Hospital, Bhavnagar. Haematological parameters were analysed by automated haematology analyser and peripheral smear examination. CD4 count was done by automated analyser. Descriptive statistics were applied. Association between two attributes was calculated by chi-square test, Kruskal-Wallis test, one way ANOVA test, unpaired t test and Mann Whitney test and P value less than 0.05 was considered statistically significant. Results: Comparison between CD4 count and haematological changes shows that p value is significant ( $P < 0.05$ ) in haemoglobin, total leucocyte count, differential leucocyte count except absolute eosinophil count, platelet, PCV and blood indices except in MCHC. Male: Female ratio is 2:1. 86 % was sexually transmitted, 1.6% by blood transfusion, 7.4% by vertical transmission, 5% by unknown reason. Maximum 44.4% patients have CD4 count between 200-499 cells/cumm. Anaemia is present in 47.4% patients. Leucopenia is present in 11.2% patients. Lymphopenia is present in 12.8% patients and eosinophilia is present in 6% patients. Thrombocytopenia is present in 8.6% patients. Interpretation & conclusion: Haematological changes are occurs along with changes in CD4 count and disease progression. Along with changes in CD4 count changes in haemoglobin, leucocytes and platelet occurs along with other haematological changes. Haematological parameters correlate with level of CD4 count. [Heema C NJIRM 2017; 8(2):169-176]

**Key Words:** CD4, HIV, Haematological changes.

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**Introduction:** Acquired Immunodeficiency Syndrome is the second leading cause of death in men between ages 25 and 44 and the third leading cause of death in women in this age group. Although initially recognized in the United States, AIDS is a global problem. It has now been reported from more than 190 countries around the world, and the pool of Human Immunodeficiency Virus infected persons in Africa and Asia is large and expanding. By the year 2011, HIV had infected 60 million people worldwide, and nearly 30 million adults and children have died of disease. There are about 34 million people living with HIV, of whom 70% are in Africa and more than 20% in Asia; the prevalence rate of infection in adults in Sub-Saharan Africa is more than 8%. It is estimated that 2.5 million people were newly infected with HIV in 2011 and 1.7 million deaths were caused by AIDS<sup>1</sup>.

A variety of haematological manifestations is seen at every stage of human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) and often pose a great challenge in the comprehensive management. These manifestations also reflect the underlying immune status if

interpreted cautiously, especially if the patient is in regular follow-up. They may cause symptoms that are life-threatening and impair the quality of life of these patients<sup>2</sup>.

The most important of them are cytopenia. Anaemia and neutropenia are generally caused by inadequate production (because of suppression of the bone marrow by the HIV infection through abnormal cytokine expression and alteration of bone marrow microenvironment)<sup>3</sup>.

Thrombocytopenia is caused by immune-mediated destruction of the platelets, in addition to inadequate platelet production. The incidence and severity of cytopenia are generally correlated to the stage of the disease. Other causes of cytopenia in these patients include treatment-related adverse events or secondary to the opportunistic infections or malignancies, or other pre-existing or coexisting medical problems. Optimal management of the underlying HIV infection is essential, and mild cytopenia in asymptomatic patients may need no specific management.<sup>3-5</sup>

This study was conducted since there is no information regarding the haematological manifestations and the probable interpretation of the same in population in Bhavnagar, using complete hemogram. Therefore, this study presents preliminary data regarding haematological manifestations. We also tried to evaluate the relationship between various haematological manifestations and CD4 cell counts in a hospital-based cohort of HIV-infected adults attending our ART centre.

**Methods:** The study was conducted in HIV positive patients, attending ART centre, Sir Takhtasinhji General Hospital, Bhavnagar according to following inclusion, exclusion criteria, after getting permission from Institutional Review Board.

**Inclusion Criteria:** All HIV positive patients attending ART centre, Sir T Hospital, Bhavnagar.

**Exclusion Criteria:** Pregnant females: HIV positive cases that have primary haematological disorders unrelated to HIV/AIDS. .e.g. Thalassemia, Sickle cell anemia

**Study Type:** Cross-sectional study.

**Sample Size:** 500 cases

After taking history blood samples were collected in the ART centre and sent to the central pathology laboratory of Sir Takhtasinhji General Hospital, Bhavnagar, for further tests.

**Tests to Be Done:**

1. Haemoglobin, Red cell count & indices, Packed cell volume, Total leukocyte count & differential counts, Platelets by automated haematology analyser.
2. Haemoglobin, Red cell count & indices, Packed cell volume, Total leukocyte count & differential

counts, Platelets are confirmed by peripheral smear examination.

3. CD4 count- Automated analyser.

**Statistical Analysis:** Different data collected & inserted in Microsoft Office Excel for comparing data of male and female by Chi-Square test, Kruskal-Wallis test, one way ANOVA test, unpaired t test and Mann Whitney test. P<0.05 is considered significant. All statistical analysis was done by using graphpad and SPSS trial version 22 software.

**Result:** Total 500 HIV positive patients were included in the study. Out of 500 studied cases, 166 (33.2%) were females and 334 (66.8%) were males. Maximum patients are between 13 to 40 year of age (67%). Out of 500, 222 (44.4%) patients have CD4 count between 200-499. (Table 1 and 2)

**Table 1: Age distribution with sex**

Age in years	Male	Female	Total
≤ 12	22 (4.4%)	7 (1.4%)	29
13-30	120 (24%)	59 (11.8%)	179
31-40	102 (20.4%)	54 (10.8%)	156
41-50	63 (12.6%)	34 (6.8%)	97
51-60	22 (4.4%)	9 (1.8%)	31
>60	5 (1%)	3 (0.6%)	8
Total	334	166	500

**Table 2: Distribution according to CD4 counts**

CD4 counts	Number
<200 cells/cumm	79 (15.8%)
200-499 cells/cumm	222 (44.4%)
>500 cells/cumm	199 (39.8%)

**Discussion:** Comparison of our study was done with other studies in following tables.

**Table 3: Comparison of Male: Female ratio among different studies**

	Our study (n= 500 )	Adediran IA <sup>6</sup> (n=49)	KothariK <sup>7</sup> (n= 30)	Sircar AR <sup>8</sup> (n= 74)	Dr.Keshva HK <sup>10</sup> (n= 50)
Male: Female ratio	2:1	1.8:1	5:1	3:1	4:1

Adediran IA et al in 2006 concluded that there were 32 (65%) males and 17 (35%) females. Kothari K et al<sup>7</sup> in 2001 did study on Clinical profile of AIDS and concluded that Twenty five were male and five were female patients (n=30).<sup>27</sup> Sircar AR et al did Clinical profile of AIDS: a study at a referral hospital in 1998 and concluded that male to female ratio was 3:1. Keshava H.K et al<sup>10</sup> did correlation between clinical profile, cd 4 count and total lymphocyte count in HIV infected persons in 2014 and had male: female ration 4:130. In our study out of 500 cases 334 were male and 166 were female so Male: Female ratio is 2:1.

**Table 4: Comparison of modes of transmission of HIV in different studies**

		<b>Our study (n= 500 )</b>	<b>KashiNath<sup>9</sup> (n=200)</b>	<b>Dr.Keshva HK<sup>10</sup> (n= 50)</b>
A	Sexual transmission			
1	Heterosexual	414(82.8%)	188(94%)	43(86%)
2	Homosexual	16(3.2%)	04(02%)	-
3	Spouse of HIV +	-	-	5(10%)
B	Blood transfusions	8(1.6%)	04(02%)	2(4%)
C	Vertical	37(7.4%)	04(02%)	-
D	Unknown	25(5%)	-	-

KashiNath B.Kamble et al<sup>9</sup> did A Descriptive study on clinical profile of patients with HIV in a Tertiary care hospital in 2014 and found that heterosexual 94%, homosexual 02%, blood transfusion 02%, vertical 02%<sup>29</sup>. Dr.Keshva et al concluded that 96% done by sexual transmission and 4% by blood transfusion<sup>30</sup>. In our study 86 % was sexually transmitted, 1.6% by blood transfusion, 7.4% by vertical transmission, 5% by unknown reason.

**Table 5: Comparison of distribution according to CD 4 counts in different studies**

<b>CD4 counts</b>	<b>Our study (n= 500 )</b>	<b>Obirikorang C<sup>11</sup> (n= 228)</b>	<b>Paul Nji Wankah<sup>12</sup> (n=81)</b>
<200 Cells/Cumm	79 (15.8%)	122 (53.5%)	26 (32.1%)
200-499 Cells/Cumm	222 (44.4%)	63 (27.6%)	39 (48.1%)
>500 Cells/Cumm	199 (39.8%)	43 (18.9%)	16 (19.8%)

Christian Obirikorang C et al did Blood haemoglobin measurement as a predictive indicator for the progression of HIV/AIDS in resource-limited setting and concluded that 53.5% patients had CD4 count below 200<sup>31</sup>. Paul NjiWankah et al did Profile of blood cell abnormalities among antiretroviral therapy naïve HIV patients attending the Yaounde University Teaching Hospital, Cameroon and concluded that 48.1% patients had CD4 count between 200-499<sup>32</sup>. In our study maximum patients 222(44.4%) patients had CD4 count between 200-499.

**Table 6: Comparison of Mean haemoglobin in present study with others**

	<b>Range</b>	<b>Mean</b>
SS Parinitha <sup>13</sup>	2.3g/dl to 19.3 gm/dl	10.2 gm/dl
Kaloutsi V <sup>14</sup>	3.8 to 17.3 gm/dl	10.8 gm/dl
Treacy M <sup>15</sup>	-	11.34 gm/dl
Our study	5.4 to 16.9 gm/dl	12.42 gm/dl

**Table 7: Comparison of number of anaemia cases in our study with others**

<b>Authors</b>	<b>No of anaemia cases</b>	<b>Total cases</b>
Karcher <sup>16</sup>	175 (89%)	197
Tripathi AK <sup>17</sup>	61 (82.4%)	74
Sitalakshmi S <sup>18</sup>	27 (64.2%)	42
Kaloutsi V <sup>14</sup>	34 (85%)	40
SS Parinitha <sup>13</sup>	210 (84%)	250
Our study	237 (47.4%)	500

SS Parinitha et al<sup>13</sup> did Haematological changes in HIV infection with correlation to CD4 cell count in 2012 and concluded that haemoglobin range from 2.3 to 19.3 and mean was 10.2<sup>33</sup>. Kaloutsi V et al<sup>14</sup> did comparison of bone marrow and hematologic findings in patients with human immunodeficiency virus infection and those with myelodysplastic syndromes and infectious diseases in 1994 and concluded that haemoglobin range from 3.8 to 17.3

and mean was 10.8<sup>34</sup>. Treacy M et al<sup>15</sup> did peripheral blood and bone marrow abnormalities in patients with HIV related disease in 1987 and concluded that mean haemoglobin was 11.34. In our study haemoglobin range from 5.4 to 16.9 and mean was 12.42. SS Parinitha<sup>13</sup> included the patients which were not taking the ART and in our study we have taken the patients which were on ART.

Karcher et al<sup>16</sup> did bone marrow in human immunodeficiency virus (HIV)-related disease morphology and clinical correlation in 1991 and concluded that 89% patients had anaemia. Tripathi AK et al<sup>17</sup> did Study of bone marrow abnormalities in patients with HIV disease in 2005 and concluded that 82.4% patients had anaemia. Sitalakshmi S et al<sup>18</sup> did hematologic changes in HIV infection in 2003 and concluded that 64.2% patients had anaemia. Kaloutsi V et al<sup>14</sup> did comparison of bone marrow and hematologic findings in patients with human immunodeficiency virus infection and those with myelodysplastic syndromes and infectious diseases in 1994 and concluded that 85% patients had anaemia. SS Parinitha et al<sup>13</sup> did Haematological changes in HIV infection with correlation to CD4 cell count in 2012 and concluded that 84% patients had anaemia. In our study 47.4% patients had anaemia. In our study we had taken patients taking ART and taking monthly follow up at ART centre so % of anaemia was less in comparison to other study.

**Table 8: Comparison of RBC Count, PCV & blood indices in our study with others**

Mean value of	SS Parinitha <sup>13</sup>	Tripathi AK <sup>17</sup>	Our study
RBC Count	3.66 mill/cumm	3.09 mill/cumm	4.08 mill/cumm
PCV	31.33%	27.36 %	36.84 %
MCV	87.3 fl	81.81 fl	91.23 fl
MCH	28.4 pg	27.59 pg	31.15 pg
MCHC	32.5 gm/dl	-	33.73 gm/dl
RDW-CV	15.7 %	-	15.6 %

In our study mean of RBC count, PCV and red cell indices are normal or slightly lower than normal limits in comparison to other study because patients were on ART and taking regular monthly follow up of ART centre.

**Table 9: Comparison of mean total leucocyte count & leucopenia in our study with others**

	SS Parinitha <sup>13</sup>	Kaloutsi V <sup>14</sup>	Our study
Mean total leucocyte count	5827.8 cells/mm <sup>3</sup>	5200 cells/mm <sup>3</sup>	6583 cells/mm <sup>3</sup>
Leucopenia	20.8%	-	11.2%

In our study mean total leucocyte count was within normal limit which is comparable to SS Parinitha<sup>13</sup> and Kaloutsi V study<sup>14</sup>. In our study leucopenia is 11.2% and in SS Parinitha study<sup>13</sup> it is 20.8%. In our study % of leucopenia is less in comparison to SS Parinitha<sup>13</sup> study because in our study patients were taking ART and SS Parinitha<sup>13</sup> had included the patients which were not taking ART.

**Table 10: Comparison of differential leucocyte count in our study with others**

	SS Parinitha <sup>13</sup>	Treacy M <sup>15</sup>	Tripathi AK <sup>17</sup>	Khandekar MM <sup>19</sup>	Our study
Lymphopenia	65.2%	70%	25.6%	-	12.8%
Eosinophilia	21.6%	-	-	11.43%	6%

In our study lymphopenia and eosinophilia is very less comparable to study mentioned in above table because patients in our study were on ART.

**Table 11: Comparison of thrombocytopenia in our study with others**

	SS Parinitha <sup>13</sup>	Karcher <sup>16</sup>	Our study
Thrombocytopenia	18%	45%	8.6%

Thrombocytopenia less striking in our study in comparison to other 2 study mentioned in above table.

**Table12: Comparison of total and differential leucocyte counts in patients with different CD4 counts**

Parameter	level	CD4- >500 cells/ mm <sup>3</sup> (n=199)	CD4-200 to 499 cells/ mm <sup>3</sup> (n=222)	CD4- <200 cells/ mm <sup>3</sup> (n=79)	Statistical test	Remarks (P value)
Total leucocyte count (mean±SD)	-	7300.5 ±2447.4	6256.80 ±2113.2	5692.66 ±2406.3	KW=41.897	P < 0.05
Total leucocyte count	<4000	04	20	13	χ <sup>2</sup> =18.73	P< 0.05
	≥4000	195	202	66		
Abs. neutrophil count (mean±SD)	-	3820.72 ±1696.8	3621.41 ±1734.4	3403.22 ±1743.8	KW=6.80	P< 0.05
Abs. neutrophil count	<7500	190	217	76	χ <sup>2</sup> = 1.692	P= 0.429
	≥ 7500	9	5	3		
Abs. lymphocyte count (mean±SD)	-	2909.03 ±1220.7	2142.46 ±705.53	1799.94 ±826.66	KW=91.01	P<0.05
Abs. lymphocyte count	<1500	9	31	30	χ <sup>2</sup> = 52.560	P< 0.05
	≥1500	190	191	49		
Abs. eosinophil count (mean±SD)	-	263.90 ±233.32	222.43 ±197.49	224.82 167.86	KW=2.503	P=0.286
Abs. eosinophil count	< 600	180	212	75	χ <sup>2</sup> = 4.68	P= 0.096
	≥ 600	19	10	4		
Abs. monocyte count (mean±SD)	-	297.13 ±155.88	262.51 ±136.75	260.55 ±153.39	KW=6.341	P < 0.05
Abs. monocyte count	<1000	79	221	199	χ <sup>2</sup> =1.255	P=0.534
	≥1000	00	01	00		

**Table 13: Comparison of platelet in patients with different CD4 counts**

Parameter	level	CD4- >500 cells/ mm <sup>3</sup> (n=199)(a)	CD4-200 to 499 cells/ mm <sup>3</sup> (n=222)(b)	CD4- <200 cells/ mm <sup>3</sup> (n=79)(c)	Statistical test	Remarks (P value)
Platelet Count (mean±SD)	-	2.81 ±0.81	2.61 ±0.82	2.296 ±0.92	KW=23.35	P<0.05
Platelet count	< 1.5	08	19	16	χ <sup>2</sup> = 18.959	P< 0.05
	≥ 1.5	191	203	63		

**Table 14: Comparison of haemoglobin, RBC and PCV in patients with different CD4 counts**

Parameter	Level	CD4- >500 cells/ mm <sup>3</sup> (n=199)	CD4-200 to 499 cells/ mm <sup>3</sup> (n=222)	CD4- <200 cells/ mm <sup>3</sup> (n=79)	Statistical test	Remarks (P value)
Haemoglobin (mean±SD)	-	12.47 ±1.867	12.67 ±1.802	11.77 ±1.919	KW=13.01	P< 0.05
Haemoglobin in Adult Male	< 13	33	61	42	χ <sup>2</sup> = 18.631	P< 0.05
	≥ 13	67	88	21		
Haemoglobin in Adult Female	<12	39	33	11	χ <sup>2</sup> =4.090	P=0.129
	≥12	39	34	3		
Haemoglobin in 6yr to 12yr	<11.5	0	0	1	χ <sup>2</sup> =6.00	P < 0.05
	≥ 11.5	3	2	0		
Haemoglobin in 6months-6yr	<11	10	2	1	χ <sup>2</sup> =0.845	P=0.655
	≥ 11	8	2	0		
RBC count (mean±SD)	-	4.05 ±0.64	4.12 ±0.71	4.07 ±0.73	F=0.616	P=0.541
RBC count in Male	<4.5	81	101	46	χ <sup>2</sup> =0.677	P=0.713
	≥4.5	35	52	19		

RBC count in Female	<3.8	36	27	4	$\chi^2 = 1.165$	P=0.559
	$\geq 3.8$	47	42	10		
PCV (mean $\pm$ SD)	-	36.73 $\pm 5.02$	37.49 $\pm 4.88$	35.29 $\pm 5.21$	F=5.75	P<0.05
PCV in Adult Male	<40	52	89	49	$\chi^2 = 10.948$	P< 0.05
	$\geq 40$	48	60	14		
PCV in Adult Female	<38	59	55	12	$\chi^2 = 1.302$	P=0.522
	$\geq 38$	19	12	02		
PCV in 6 year to 12 year child	<37	01	00	01	$\chi^2 = 3.0$	P=0.223
	$\geq 37$	02	02	00		
PCV in 6 month to 6 year child	<36	15	02	01	$\chi^2 = 0.297$	P=0.297
	$\geq 36$	03	02	00		

**Table 15: Comparison of Red cell indices in patients with different CD4 counts**

Parameter	Level	CD4- >500 cells/mm <sup>3</sup> (n=199)	CD4-200 to 499 cells/mm <sup>3</sup> (n=222)	CD4- <200 cells/mm <sup>3</sup> (n=79)	Statistical test	Remarks (P value)
MCV (mean $\pm$ SD)	-	92.09 $\pm 14.58$	92.04 $\pm 13.61$	86.81 $\pm 13.29$	KW=11.608	P<0.05
MCV	< 80	34	40	22	$\chi^2 = 27.41$	P < 0.05
	80-100	95	126	42		
	>100	70	56	15		
MCH (mean $\pm$ SD)	-	31.52 $\pm 5.94$	31.37 $\pm 5.52$	29.58 $\pm 5.89$	KW=10.255	P=<0.05
MCH	< 27	40	37	25	$\chi^2 = 8.069$	P< 0.05
	$\geq 27$	159	185	54		
MCHC (mean $\pm$ SD)	-	33.799 $\pm 1.83$	33.86 $\pm 2.04$	33.23 $\pm 2.47$	KW=6.350	P=0.418
MCHC	<32	27	26	15	$\chi^2 = 2.676$	P =0.2624
	$\geq 32$	172	196	64		
RDW (mean $\pm$ SD)	-	15.43 $\pm 2.45$	15.46 $\pm 2.27$	16.47 $\pm 3.40$	KW=9.208	P<0.05
RDW	$\leq 14.5$	22	95	88	$\chi^2 = 6.797$	P =0.2624
	>14.5	57	127	111		

In present study haemoglobin, PCV, MCV, MCH, RDW, total WBC count, absolute neutrophil count, absolute lymphocyte count, absolute monocyte count, platelet shows  $P < 0.05$  so there is a significant correlation between CD4 count and these haematological changes. RBC, MCHC, absolute eosinophil count had  $P$  value  $> 0.05$  by Kruskal-Wallis and one way ANOVA test. So haematological changes occurs in correlation to CD4 count.

Possible reasons for the differences of occurrence of these cytopenias in these different studies are the cut-off values used for anaemia and leucopenia, the local prevalence of parasitic infections such as malaria or hook-worms, variations in local nutritional patterns or

the number of female participants of the respective studies.

Keshava H.K et al<sup>10</sup> concluded that there was a highly significant correlation between CD 4 Count and Total Lymphocyte Count. TLC can be used as an effective laboratory tool to monitor disease progression in HIV infected persons where CD 4 is not available and in resource poor countries.  $P$  value of total leucocytes and lymphocytes count is  $< 0.05$  in Keshava study which is comparable to our study<sup>30</sup>.

Obirikorang C et al<sup>11</sup> concluded that there was a significant and positive correlation between the blood haemoglobin level and their CD4 counts. In their study mean blood haemoglobin concentrations in those

with CD4 counts <200 mm<sup>-3</sup>, 200-499 mm<sup>-3</sup> and ≥ 500 mm<sup>-3</sup> (8.83 ± 0.22 g/dl, 10.03 ± 0.31 g/dl and 11.3 ± 0.44 g/dl respectively). In our study it is (11.77±1.919 g/dl, 12.67± 1.802, 12.47±1.867). This difference may be due to difference in cut off value of parameters, racial disparity and status of ART of patients along with male:female ratio.

Wankah PN et al<sup>12</sup> concluded that in the HIV infection, peripheral blood cell abnormalities affect all cell lineages, with anaemia being the most frequent single blood cell abnormality. Blood cytopenias mainly occur in advanced immunosuppression and clinical stages. Anaemia was present in 62.9% cases. In our study

47.7% patients had anaemia. This difference may be due to racial disparity and difference in male:female ratio<sup>32</sup>.

SS Parinitha et al<sup>13</sup> concluded that anaemia was seen in 210 (84%) cases, Lymphopenia was seen in 163 (65.2%) cases, thrombocytopenia in 45 (18%) and majority of cases (70%) had CD4 cell counts below 200 cells/mm<sup>3</sup>. There is difference in % of haematological changes because our patients are taking ART and most of patients (44.4%) had CD4 count between 200-499 cell/mm<sup>3</sup>.

**Conclusion:** The aims and objectives of the study are met by assessing correlation of CD4+ T lymphocyte count with various hematological abnormalities. Various hematological changes are evaluated in correlation with CD4 count. Haematological changes in People Living with HIV/AIDS, if persistent, is associated with substantially decreased survival. From our analysis, there was a change in the haematological parameter as the HIV infection progressed and our findings are consistent with those of other studies. Comparison between CD4 count and haematological changes shows that p value is significant (P<0.05) in haemoglobin, total leucocyte count, differential leucocyte count except absolute eosinophil count, platelet, PCV and blood indices except in MCHC.

**Limitation of study:** Duration of HIV is not taken into consideration. This study can be done at Gujarat level. Patients were taking ART so pure effect of HIV can not be concluded in this study. Viral load is not included in the study.

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#### References:

1. Robbins & Cotran. Pathologic basis of disease. South asia edition. 2014;vol-1:243-246.
2. Volberding PA, Baker KR, Levine AM. Human immunodeficiency virus hematology. Hematology Am Soc Hematol Educ Program 2003;:294-313.
3. Coyle TE. Hematologic complications of human immunodeficiency virus infection and the acquired immunodeficiency syndrome. Med Clin North Am. 1997;81:449-70.
4. Salond E. Hematologic complications of HIV infection. AIDS Rev 2005;7:187-96.
5. Cosby CD. Hematologic disorders associated with human immunodeficiency virus and AIDS. J Infus Nurs. 2007;30:22-32.
6. Adediran IA, Durosinmi MA. Peripheral blood and bone marrow changes in patients with acquired immunodeficiency syndrome. Afr J Med Med Sci. 2006 Dec;35:85-91.
7. Kothari K, Goyal S. Clinical profile of AIDS. J Assoc Physicians India. 2001 Apr;49:435-8.
8. Sircar AR, Tripathi AK, Choudhary SK, Misra R. Clinical profile of AIDS: a study at a referral hospital. The Journal of the Association of Physicians of India. 1998; 46(9):775-778.
9. Kamble KB, Sneha K, Ramesh K. A Descriptive study on clinical profile of patients with HIV in a Tertiary care hospital. Int. J. Curr. Aca. Rev. 2014;2(10):137-143.
10. Keshava H.K, Manjunath R. Correlation between clinical profile, cd 4 count and total lymphocyte count in hiv infected persons. Journal of Evolution

- of Medical and Dental Sciences. 2014 Feb; 3(05): 1264-1275.
11. Obirikorang C, Yeboah FA. Blood haemoglobin measurement as a predictive indicator for the progression of HIV/AIDS in resource-limited setting. *J Biomed Sci.* 2009 Nov;16(1): 102.
  12. Wankah PN, Tagny CT, and Mbanya DNS. Profile of blood cell abnormalities among antiretroviral therapy naïve HIV patients attending the Yaounde University Teaching Hospital, Cameroon. *BMC Hematol.* 2014 Sep; 14: 15.
  13. Parinitha SS and Kulkarni MH. Haematological changes in HIV infection with correlation to CD4 cell count. *Australas Med J.* 2012; 5(3): 157–162.
  14. Kaloutsis V, Kohlmeyer U, Maschek H, Nafe R, Choritz H, Amor A, et al. Comparison of bone marrow and hematologic findings in patients with human immunodeficiency virus infection and those with myelodysplastic syndromes and infectious diseases. *Am J ClinPathol.* 1994 Feb;101(2):123–9.
  15. Treacy M, Lai L, Costello C, Clark A. Peripheral blood and bone marrow abnormalities in patients with HIV related disease. *Br J Haematol.* 1987;65:289–94.
  16. Karcher DS, Frost AR. Bone marrow in human immunodeficiency virus (HIV)-related disease morphology and clinical correlation. *Am J ClinPathol.* 1991 Jan;95(1):63–71.
  17. Tripathi AK, Kalra P, Misra R, Kumar A, Gupta N. Study of bone marrow abnormalities in patients with HIV disease. *JAPI.* 2005 Feb;53:105–10.
  18. Sitalakshmi S, Srikrishna A, Damodar P. Hematologic changes in HIV infection. *Indian J PatholMicrobiol.* 2003;46(2):180–3.
  19. Khandekar MM, Deshmukh SD, Holla VV, Rane SR, Kakrani AL, Sangale SA, et al. Profile of bone marrow examination in HIV/AIDS patients to detect opportunistic infections, especially tuberculosis. *Indian J PatholMicrobiol.* 2005;48(1):7–12.

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