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Research Article

Comparison of Peripheral Smear Finding with Bone Marrow Finding in HIV Patients

Dhurve Sharad A[1*], Dhurve Alka S[2]
[1]Associate Professor, Department of Medicine, LN Medical College, Bhopal, Madhya Pradesh
[2]Associate Professor, Department of Anatomy, RKDF Medical Institute, Bhopal, India

***Corresponding author**
Dr. Sharad A. Dhurve
Email: dr_dhurve2623@rediffmail.com

Abstract: Hematological abnormalities are a common complication of HIV infection. Present work was carried out to compare bone marrow abnormalities with peripheral hematological abnormalities in patients with HIV/AIDS. 160 patients of HIV +ve were included in the study. A complete blood count, relevant biochemical investigations, CD4 counts were done, besides a thorough history and clinical examination. HIV positive patients were classified as those having AIDS and those without AIDS according to NACO criteria. Bone marrow examination was performed for indication of anemia, leucopenia, pancytopenia and thrombocytopenia. As per CDC criteria 59.81% patients had AIDS in 107 patients. The most common hematological abnormality was anemia, seen in 93.12% patients. Bone marrow was normocellular in 79.06% of non-AIDS and 79.68% of AIDS, hypocellular in 13.95% of non-AIDS and 12.5% of AIDS, hypercellular in 06.97% of non-AIDS and 07.81 % of AIDS patients. For myelodysplasia in bone marrow in HIV patients we noted granulocytic dysplasia in 4.65% in Non –AIDS and 14.06% AIDS patients. Erythrocytic dysplasia in 9.30% in Non –AIDS, 12.5% in AIDS group. Thrombocytopenia was seen in4 cases of ART (4.93%) and 3 cases (4.68%) of AIDS group. Abnormal cells like plasma cell, histocyte and toxic granule were also found. In conclusion, Myelodysplasia was more common in AIDS than in non AIDS patients. Granulocytic series is most commonly associated with evidence of dysplasia. Anemia in HIV patients can be a good clinical indicator to predict and access the underlying immune status. Thus present study is imperative to methodically observe and follow clinical and laboratory aberration in such patients in order to improve our diagnostic and therapeutic skills pertinent to HIV/AIDS.
Keywords: Hematological abnormalities, HIV, leucopenia, pancytopenia, Bone marrow

INTRODUCTION

HIV infection is multisystem disease and hematological abnormalities are among the most common complications of HIV. Pathogenesis of these changes are multifactorial and include direct invasion of virus, sequalue of HIV related infection. Commonest changes occurs in peripheral smear are: a) Anemia - often reflecting reticuloendothelial iron block, b) Neutropenia- seen in patient with HIV disease might be decreased bone marrow production of granulocytes consequent on inhibition of granulocyte progenitors, c) Thrombocytopenia - occur in patients infected with HIV virus, d) Leucopenia – seems to correlate with severity of the disease e) Lymphopenia – one of the common finding on peripheral smear, cells of the T-helper phenotype being significantly depleted f) Left shift in the granulocytic series again the common finding which suggestive of chronic infection, g) Monocytopenia is one of the rare finding.

Bone marrow abnormalities are found at all stages of HIV disease. A number of characteristic but nonspecific, morphologic abnormalities of the bone marrow of AIDS patients have been reported. Bone marrow examination may be useful for the definitive assessment of iron stores which can assist in the differentiation of iron-deficiency anemia from anemia of chronic disease. a) Cellularity of the bone marrow on trephine biopsy is usually normal or increased, b) Dysplastic changes are common in erythroid and granulocytic lines, c) Megaloblastic changes in the red cell series are seen and that may reflect myelodysplastic changes, d) Plasma cell and histocytes – often observed is likely to be repeated infection, e) Reticuloendothelial iron block may seen in patients with AIDS is reflection of their clinical condition, with repeated episodes of infection. In Indian Study bone marrow, myelodysplasia was found to be 32.43% of HIV patients. Granulocytic series most commonly associated with evidence of dysplasia. This dysplasia was common in patients with anemia [1]. While in peripheral smear study anemia was 30.8% (Hb <10 gm%), normochromic normocytic in 61%, patients microcytic 33%, macrocytic 6% patients [2]. Here, we aimed at studying hematological

changes in HIV – positive patients and correlate those by doing bone marrow and peripheral smear blood examinations. Both patients on ART and Non ART were included in the present study who admitted to Government medical college and hospital and attending ART clinic.

MATERIALS AND METHODS

The study population included 160 HIV positive symptomatic or asymptomatic patients. Out of that 139 males and 21 were females. Commonest age group involved was 21 to 40 years. HIV was diagnosed by ELISA method as per NACO guidelines. The study was conducted in Department of Medicine and Department of Pathology, Government medical college and hospital, Nagpur, Maharashtra.

Inclusion criteria

Indoor patients from medicine wards and those attending ART clinic included in the study.

Exclusion criteria

Patients of malignancy not related to HIV disease and patients receiving chemotherapy were excluded.

Detailed history was taken which mainly included age, sex, place of residence, occupation, history of blood or blood product transfusions, high risk behavior, fever, weight loss, diarrhoea, oral or genital ulcerations, bleeding diasthesis or history suggestive of systemic involvement. All patients were subjected to thorough physical examination both, systemic and general with necessary investigation like USG abdomen and CSF examination. Patients were classified into two clinical groups according to NACO criteria, a) AIDS: (Those patients who fulfilled diagnostic criteria of AIDS according to NACO guidelines), b) Non AIDS: (Asymptomatic and symptomatic, who did not fulfill the NACO AIDS criteria).

Bone marrow study

Bone marrow examination was performed for indication of anemia, leucopenia, pancytopenia and thrombocytopenia. Posterior superior iliac spine was chosen as the site for bone marrow aspiration and biopsy because of large marrow space and least painful site. In obese and old patients, sternum was used for bone marrow aspiration. A smear was drawn and leishmans stained preparation was made. Bone marrow sample was examined for cellularity, morphologic data including myeloid cell, erythroblast, megakaryocyte, lymphocyte, plasma cell, histocyte, dysplastic changes, and fibrosis, granuloma and iron stores.

Other investigations performed were hemoglobin, total leucocyte count, differential leucocyte counts, absolute neutrophil, lymphocyte, monocyte, eosinophil and basophil counts, general blood picture, platelet count, reticulocyte count, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration and total red blood cell count. CD4 count was done in 107 patients. Anemia was defined as hemoglobin <13 g/dl (Men) and <12 g/dl (women). Leucopenia was defined as total WBC count less than 4000 cells/µl. Neutropenia was defined as absolute neutrophil count <1000 cells/µl. Lymphopenia was considered when absolute lymphocyte count <800 cells/µl. Thrombocytopenia was defined as total platelet count < 150 × 103/µl.The study was carried out after obtaining permission from the Institute's Ethics Committee. Also consent of patient or relative was taken.

RESULTS

Study title “comparison of peripheral smear finding with bone marrow finding in HIV patients” was conducted in Government Medical College and Hospital, Nagpur. Commonest age group involved, was 21 to 40 years (80%), similar findings were reported from other studies. There was a male preponderance with male to female ratio of 7:1; this may be because of more symptomatic male reporting to the hospital for testing HIV–positivity and treatment. Commonest population affected was that of drivers and laborers. Anemia (Hb % <10g/dl) was found in 93.12% cases, of this normocytic normochromic in 88.8% in Non-AIDS, 95.31%in AIDS group. In patients on ART bone marrow was hypercellular, hypocellular and normocellular in 15(18.51%), 15(18.51%), and 51(62.96%) respectively. In non-ART group bone marrow was hypercellular, hypocellular, and normocellular in 7(8.86%), 7(8.86%), 65(82.27%) respectively. The bone marrow found normocellular in majority cases of non-ART group as compared to ART (p=0.130). In ART group bone marrow showed megaloblastic 8 patients (9.87%) and micronormoblastic 5 patients (6.17%), where as in Non-ART group 5 patients (6.32%) had megaloblastic bone marrow. Thrombocytopenia was seen in 4 cases of ART (4.93%) group and 3 cases (4.68%) AIDS group, in spite of normal to increase megakaryocytes in bone marrow suggesting auto immune mechanism for thrombocytopenia. Patients having granulocytic dysplasia in the form of toxic granules or shift to left had infection like, gastroenteritis, pleural effusion and splenic abscess. Erythroid dysplasia was seen 12.5% in AIDS group was on HAART or Septran prophylacticaly. Plasmacytosis was seen in 13/79 Non-ART, while 5/81 in ART. Increase histocytes in bone marrow was seen in 2 cases Non-ART and ART group each. Regarding cellularity and morphology of bone marrow and peripheral smear there was good correlation and statistically significant.

OBSERVATION

The data were analyses using mean, standard deviation. A comparison between AIDS and Non-AIDS was done by chi-square test. A p value < 0.05 was taken as statistically significant.

Table 1: Age distribution

Age groups	No. of patients	%
12 to 20 yrs	3	1.8
21 to 30 yrs	60	37.6
31 to 40 yrs	69	43.12
41 to 50 yrs	22	13.75
51 to 60 yrs	4	4.5
61 and above	2	1.25

Table 2: Sex distribution

Sex	No. of patients	%
Male	139	86.87
Female	21	13.12

Table 3: Occupation of patient

Occupation	No. of patients	%
Drivers	54	33.75
Laborer	53	33.12
Businessmen	21	13.13
Govt. servant	13	8.13
House wife	13	8.13
Farmer	5	3.12
Student	1	0.62
Total	160	100

Table 4: Duration of illness

< 6 month	43
6 month to 1 year	62
>1 year to 2 year	23
> 2 year to 3 year	15
> 3 year	17
Total	160

Table 5: Hemoglobin %

HB%	No. of patients	%
5 to 8 gm%	43	26.87
Above 8 to 10 gm%	106	66.25
Above 10 to 14 gm%	11	6.87
Total	160	100

Table 6: CD4 counts

CD4 counts	No. of patients	%
< 200 (AIDS)	64	59.81
200 To 500 (OI)	42	39.25
> 5oo (Non AIDS)	1	0.93

Table 7: Values and standard deviations of bone marrow parameters

Hematological parameters	Non-AIDS Mean ± SD (n=43)	AIDS Mean ± SD (n=64)	P values
Hemoglobin%(g/dl)	8.51 ± 2.18	8.86 ±1.51	0.3377 NS
Red blood cell count (million/mm3)	3.38 ± 0.92	3.51 ±0.84	0.4232 NS
Mean corpuscular volume (MCV) (fl)	78.18 ± 0.75	86.89 ± 12.37	0.0001 HS
Mean corpuscular Hemoglobin(MCH)(pg)	23.56 ± 3.55	27.75 ± 6.81	0.0003 HS
Lymphocyte x 103	1.06 ± 0.91	1.74 ± 1.11	0.001 HS
Granulocyte x 103	3.82 ± 2.75	4.63 ± 1.98	0.0790 NS
Monocyte x 103	0.41 ± 0.42	0.49 ± 0.2	0.2720 NS
Lymphocyte (%)	21.14 ± 11.43	25.65 ± 9.22	0.0265 S
Granulocyte (%)	70.04 ± 11.08	64.75 ± 10.11	0.0058 HS
Moncyte (%)	7.91 ± 4.35	9.87 ± 5.28	0.0454 S
Platelet count (lac/mm3)	140.35 ± 67.01	189.01 ± 74.67	0.0008 HS
CD4 count/ ul	290.51 ± 79.90	117.64 ± 51.02	0.000 HS

(NS = Not significant, S= Significant, HS= Highly significant)

Table 8: Peripheral blood finding in AIDS/HIV

Parameters	Non-ADIS (n=43)	ADIS (n=64)
Anemia	38 (88.37%)	61 (95.31%)
Granulocytopenia	2 (4.65%)	3 (4.68%)
Thrombocytopenia	0	3 (4.68%)
Lymphopenia	6 (13.95%)	10 (15.62%)

Table 9: Bone marrow cellularity in HIV /AIDS patients

Bone marrow cellularity	Non-AIDS (n=43) (%)	AIDS (n=64) (%)	Total (n=107) (%)
Normocellular	34 (79.06)	51 (79.68)	85 (79.43)
Hypocellular	6 (13.95)	8 (12.5)	14 (13.22)
Hypercellular	3 (06.97)	5 (07.81)	08 (07.39)

Table 10: Myelodysplasia in bone marrow in HIV patients

Dysplasia	Non-AIDS (n=43) (%)	AIDS (n=64) (%)
No dysplasia	37 86.04	49 76.56
Granulocytic	02 4.65	09 14.06
Erythroid	04 9.30	08 12.50
Megakaryocytic	00 0.0	00 0.0
Total	43 100	64 100

Table 11: Morphological features of bone marrow and peripheral smear on ART

Sl. No.	Bone marrow	Peripheral smear	Total no. patients
1.	Normoblastic	Normocytic Normchromic	54
		Normocytic hypochromic	14
2.	Megaloblastic	Macrocytic	05
		Dimorphic	01
		Normocytic normochrmic	02
3.	Micronormoblastic	Microcytic hypchromic	03
		Normocytic hypochrmic	02

Table12: Morphologic feature of bone marrow and peripheral smear Non ART

Sl. No.	Bone marrow	Peripheral smear	Total no. patients
1.	Normoblastic	Normocytic normochromic	56
		Normocytic hypochromic	13
2.	Megaloblastic	Macrocytic	02
		Dimorphic	01
		Normocytic normochromic	02
3.	Micronormoblastic	Microcytic hypocromic	05

Table13: Comparison Between bone marrow and peripheral smear in ART and Non- ART group

ART				Non-ART		
P values	Bone marrow	Peripheral smear	Morphological features	Bone marrow	Peripheral smears	P values
1.000	68	68	Normoblastic	69	69	1.000
0.576	8	6	Megaloblastic	5	3	0.720
0.719	5	3	Micronormoblastic	5	5	1.000

Table 14: Bone marrow cellularity and peripheral smear finding (comparison) in patients on ART

Bone marrow	No. of patients	Peripheral smear	No. of patients
Normocellular	51	Normal count	46
		Lymphopenia	02
		Leucocytosis	03
Hypocellular	15	Normal count	11
		Lymphopenia	01
		Thrombocytopenia	01
		Leucocytosis	02
Hypercellular	15	Normal count	05
		Lymphopenia	05
		Leucopenia	02
		Thrombocytopenia	03
	81	Total	81

Table 15: Bone marrow cellularity and peripheral smear finding in Non-ART Patients

Bone marrow	No. of patients	Peripheral smear	No. of patients
Normocellular	65	Normal count	58
		Lymphopenia	05
		Leucocytosis	05
		Leucopenia	03
Hypocellular	07	Normal count	04
		Lymphpenia	01
		Leucocytosis	02
		Leucopenia	01
Hypercellular	07	Normal count	05
		Lymphopenia	01
		Leucopenia	01

Table 16: Abnormal finding in bone marrow

Abnormal cells	Bone marrow (no. of patients) ART	Non-ART	Total no. of patients
Plasma cell	5	13	18
Histocyte	2	2	4
Toxic granuls	1	2	3

Table 17: Abnormal finding in peripheral smear

Abnormal cells	Peripheral smear (no. of patients) ART	Non- ART	Total no. of patients
Shift to left	1	2	3
Toxic granuls	1	2	3

DISCUSSION

Total 160 (139 males and 21females) HIV positive patients were included. These patients were divided into two groups' on-ART and Non-ART with 81 and 79 patients respectively. CD4 count could be done in 107 out of 160 patients due to technical difficulty and financial problem. In that 64 patient's CD4 counts <200/ul considered as AIDS according to the CDC criteria and 43 patients CD4 counts >200/ul considered as Non- AIDS (Table 6). Study done by A.K Tripathi *et al*. [1], included 74 HIV- positive patients with male to female ratio was 4:1,and the commonest age group was 20-40 years with range of 20 to 68 years. Commonest age group in our study was 21 to 40 years, total 129(80.62%), range from12 years to 65 years (Table 1).We also categorized the patients according to occupation, most common population was of Drivers and Laborers, 54(33.75%) and 53(33.12%) respectively, Businessmen 13(8.13%), farmer 13(8.13%), government servant 5(3.12%), all 21(13.13%) females patients were house wives, and one 12 years student (Table 3). Patients were classified according to the duration of HIV positivity from history only and laboratory test reports (Table 4).In our study 40.00% of patients in AIDS (64patients), while 26.87% in non – AIDS (43 patients), as we were able to do CD4 count only in 107 patients out of 160 patients. Anemia was one of the most common finding in HIV positive patients. Patwardhan M.S. *et al*. [2] found anemia in peripheral blood was normocytic normochromic in 61% patients, microcytic in 33%, and macrocytic in 6% patients. Mir N, Costello C [3] found anemia 92%.neutropenia 85%, monocytopenia in 75%,and thrombocytopenia in 61% patients, , Khandekar M. M. *et al*. [4]studied combined finding of bone marrow and hematological parameter in 140 established HIV positive patients and showed anemia in 118 (84.28%) ,25 (17.86%) had leucopenia and 13 (9.28%) thrombocytopenia. Norac J Sun *et al*. [5] defined the following criteria in their study, anemia if hemoglobin concentration <10g/dl, leucopenia when white blood cell count < 4.0x109/L and thrombocytopenia was defined as platelet count < 50x109/l.In present study we defined with hemoglobin concentration <10g/dl for anemia and that for leucopenia white blood cell count<4.0x109/l, thrombocytopenia when platelet count < 100x103/ul.Out of 160 patients 149(93.12%) had hemoglobin % <10g/dl and 11(6.87%) patients whose hemoglobin % > 10 g/dl. Hematological parameters in non-AIDS and AIDS group showed hemoglobin % in Non-AIDS 8.51±2.18 and in AIDS 8.86±1.51 (P = 0.3377). There was no statistical significance. Red blood cell (mill/mm3) 3.18±0.92, 3.51±0.84(NS), Mean corpuscular volume (fl) 78.18± 0.75,86.89±12.37, Mean corpuscular hemoglobin (pg) 23.56± 3.55,27.75±6.81Lymphocyte counts 1.06 ± 0.91,1.74±1.11,Granulocyte % 70.04±1.08,64.75±10.11, Platelet counts (lac/mm3) 140.35± 67.01,189.01±74.67,CD4 counts /ul 290.51±79.90,117.64±51.02 (Table 7),all these values showed statistically significant. Rests of the parameter were not showed any statistical significance as

compared to previous. Peripheral smear finding showed normocytic normochromic anemia was found in 8.37% patients in Non-AIDS group and 95.31% in AIDS group, microcytic normochromic anemia 2(4.65%) patients with granulocytopenia/ leucopenia in Non-AIDS and 3 patients (4.68%) in AIDS group with lymphopenia. Lymphopenia13.95%, 15.62% in Non-AIDS and AIDS group respectively. Thrombocytopenia found 4.68% (3 out of 64 patients) only in AIDS. While comparing the marrow cellularity with peripheral smear, in ART group bone marrow normocellular in 51 patients and on peripheral smear 46 patients showed normal count, lymphopenia in 2 patients, granulocytosis in 3 patients. The difference between normocellular group found to be statistically significant (P=1.000). Hypocellular marrow in 15 patients which is due to patchy involvement mostly by fatty degeneration of bone marrow. These patients on peripheral blood finding showed normal count in 11 patients, lymphopenia in 1 patient, thrombocytopenia in 1 patient and leucocytosis in 2 patients. Hypercellular marrow in 15 patients because of erythroid hyperplasia in which normal count on peripheral smear in 4 patients, lymphopenia 5 patients, granulocytopenia 2 patients, thrombocytopenia in 3 patients, these thrombocytopenic 2 patients had pulmonary tuberculosis, 1 patients had gastroenteritis and 1with tubercular lymphadenopathy all these patients were on Navirapine . Whereas patients on Non- ART normocellular bone marrow in 65 patients in that peripheral smear finding showed normal count in 58 patients, lymphopenia 5, granulocytosis 5, granulocytopenia 3. Hypocellular marrow was found in 7 patients whose peripheral smear showed normal count in 4 patients, lymphopenia 1, granulocytosis 2 and granulocytopenia 1.Hypercellular in 7 patients in that normal count in 5 patients, lymphopenia 1 and granulocytopenia 1 on peripheral smear. The difference between the ART and Non-ART group found to be statistically significant in patients of normocellular bone marrow (P=0.000).Study by Donald S. *et al*. [6] showed marrow hyper cellularity 52% patients, hypocellularity in13% patients. Marrow cellularity was based on fat to cell ratio in relation to patients'age. However in HIV – infected patients, hypercellularity was only appeared when there is increase number of non-hemopoietic cell such as lymphocyte, plasma cells and histocytes. Tripathi A. K. *et al*. [1] studied on cellularity showed marrow in Non-AIDS normocellular 78.95% ,hypocellular in5.26%, hypercellular in 15.79% patients and in AIDS group normocellular in 74.5%, hypocellular in 7.27%, and hypercellular in 18.18% patients. Lionard I *et al*. [7] conducted similar study, showed in group A (seropositive with active infection and drug therapy), normocellular 15%, hypocellular 8%, hypercellular 77%, while in group B(seropositive with no active infection and no drug), normocellular 0%, hypocellular 52% , hypercellular 48%. Gonzles *et al*. [8] showed only hypocellular bone marrow in 65% HIV positive patients. Nora *et al*. [5] showed bone marrow in AIDS, hypercellular 50% in AIDS, 31% in ARC. Jeery L. *et al*. [9] showed normocellular in 33.33%, hypocellular 25%, hypercellular in 66% patients.In present study most of the marrow was normocellular 79.43% patients in AIDS and non-AIDS, hypercellular in 7.39%, hypocellular in 13.22% in both the groups, this hypocellularity of bone marrow due serous fatty degeneration. Majority of patients 65.62% were diagnosed to had HIV infection less than 1year, which was the cause for normocellular marrow as most of study showed hypercellular bone marrow.Bone marrow was normoblastic normocytic normochromic in 54 patients, normocytic hypochromic in 14 patients.Megaloblastic bone marrow showed macrocytic anemia in 5 patients, dimorphic in 1, normocytic normochromic in 2patients.Micronormoblastic marrow showed microcytic normochromic in 3 patients, normocytic hypochromic in 2 patients on peripheral smear. In Non-ART patients normoblastic marrow showed normocytic normochromic in 56 patients, normocytic hypochromic in 13 patients. Megaloblastic marrow showed macrocytosis in 3 patients,dimorphic in 1 patient, normocytic normochromic in 2 patients. Micronormoblastic bone marrow shows microcytic hypocromic in 5 patients. These finding were statistically significant in both groups (P=1.000).Thrombocytopenia associated with HIV infection has been described by Walsh *et al*. [10], Murphy *et al*. [11] suggests an autoimmune mechanism for the thrombocytopenia (30% AIDS) and neutropenia (20% AIDS), Lionard I. *et al*. [7] studied that majority of patients with thrombocytopenia adequate or increased megakaryocytes were evident in bone marrow. Jerry L. *et al*. [9] showed thrombocytopenia was initially in 3(25%) patient and subsequently developed in 2 others. Patwardhan M. S *et al*. [2] showed thrombocytopenia in 65 patients (13%) with average platelet count 0.92x10 (3)/ul. In our study thrombocytopenia on peripheral smear and marrow showed increased megakaryocyte due to increase peripheral destruction of platelet. In 4 patients of thrombocytopenia in ART, 2 patients had pulmonary tuberculosis and 2 had gastroenteritis. In these patients normoblastic bone marrow in 3, micronormoblastic in 1 patient. Donald S. *et al*. [6] noted the myelodysplastic changes involving at least one cell line in 69% of their specimens with erythrocytic, megakaryocytic, and granulocytic dysplasia in decreasing order (56%,31%and 18%respectively), Tripathi A. K. *et al*. [1] noted granulocytic ,erythrocytic and megakaryocytic dysplasia 20%,3%,1% respectively in Non-AIDS and AIDS groups, Lionard I. *et al*. [7] showed myelodysplasia in group –A and group –B,(mention previously) Dysplasia of any type in 8(62%) out of 13 group –A, 9(43%)out of 21in group B, erythroid 7 (54%) in group A,9((43%)in group B, myeloid dysplasia 5(38%) in group A and 5(24%)in group B. For myelodysplasia in bone marrow in HIV patients we noted granulocytic dysplasia in 4.65% in Non –AIDS, and 14.06% AIDS patients commonest

infection found either tuberculosis or diarrhea. Erythrocytic dysplasia in 9.30% in Non –AIDS, 12.5% in AIDS group (Table 9). Commonest infection was found to be pulmonary tuberculosis and diarrhea, these patients also on HAART (Navirapine, zidovidine), while megakaryocytic dysplasia was not observed in both groups.In AIDS granulocytic changes seen in 9 patients. Erythroid dysplasia was seen in 8 patients in AIDS group.Commonest infection was found to be tuberculosis and gastroenteritis which suggests that the myelodysplasia associated with infection probably was a direct result of the disease, which worsens with disease progression, and can be a side effect of therapy. We found abnormal cell in bone marrow a) Plasma cell: In both groups ART and Non ART total 18(11.25%) patients out of 160(5 patients ART, 13 patients Non –ART),infection in the patients of ART was pulmonary tuberculosis in1 , gastroenteritis 3 , bronchopneumonia 1 patients,whilein Non ART, pleural effusion(tubercular) 1, gastroenteritis 3,oral candidiasis 4, meningitis 3(Crypto 2 , TBM 1), splenic micro abscess and urinary tract infection in 1 each; b) Histocyte: found in 4 patients in both groups, 2 in each, Non –ART group 2 patients with tubercular pleural effusion, and ART group 2 patients with abdominal Koch's; c) Toxic granules: in 3 patients 1 on ART was pulmonary tuberculosis and 2 on Non-ART, in that pulmonary tuberculosis and gastroenteritis in 1 patient each. In peripheral smear shift to left in 1 patient in ART with pulmonary tuberculosis, 2 in Non-ART, gastroenteritis and pleural effusion (tubercular) 1 each. Toxic granules 1 in ART with pulmonary tuberculosis, while 2 in Non-ART splenic abscess and pleural effusion 1 each. All these finding suggested that patients with associated infection.

Limitation Of Study

- CD4 counts could not be done in all subjects due to technical problems.
- We could get symptomatic HIV patients, so as to study hematological profile in early stage of HIV infection.
- No follow up was done as to review the hematological changes on HAART with improvement in CD4 counts.

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