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Haematological Manifestations in HIV Infected Children.

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ABSTRACT

HIV infection in children ,has both medical and socio-economical implications such as social stigma and demise of parents. The children constitute 6% of global HIV disease burden. Majority proportion of morbidity and mortality, in HIV infected children , is due to Opportunistic infection. The major determinant of OI is the CD4 cell count and its suppression by the virus. institution of Anti-retroviral therapy, has changed the scenario , and so has the spectrum of disease. It was our endeavor to find out the impact of adequate therapy on Opportunistic infection and CD4 count. Hence this research was taken up in an urban ART center.

Keywords: HIV, Opportunistic infection, CD4 count, Hematological manifestation

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INTRODUCTION

HIV infection was first reported in 1982 in New York. Since then , it has crossed all boundaries to assume proportion of a pandemic(1). With more data becoming available and the gravity of the problem better understood ,HIV infection in children and adolescents is being recognized as a major issue(2). The most recent estimate of AIDS cases in India from NACO (2011) is 1,16,000(3). The highest HIV prevalence rates are found in Maharashtra in the West; Andhra Pradesh, Karnataka and Tamilnadu in the South; and Manipur and Nagaland in the North-East(4). Roughly 0.27% of India's population is living with HIV(3).Maharashtra - a diverse state of the western India - has a population of around 110 million. Average HIV prevalence at antenatal clinics has exceeded 1%. Prevalence of 0.55% was found in general population in 2000 – 2009(5).

HIV infection involves multiple systems. Hematological manifestation is one of most common abnormalities in HIV patients. Wide range of hematological abnormalities are seen, including altered haematopoiesis, immune mediated cytopenias and coagulopathies, particularly in the advanced stages of the disease(6,7).These hematological manifestations increase in severity and frequency with degree of immune suppression from asymptomatic stage to symptomatic stages of HIV(8).

HIV actually infects the hematopoietic stem cells or causes them to function abnormally(9).When hematopoietic stem cells, cannot produce adequate hematopoietic growth factors (the substances that stimulate the production of blood cells in the bone marrow), decreased production of blood cells occurs(10).Anemia is the most common hematological manifestation of human immunodeficiency virus (HIV) infection and acquired immunodeficiency syndrome, particularly in those with advanced HIV disease(11). Anemia has a significant impact on clinical outcomes and quality of life (QOL)(12).Anemia consistently has been shown to be a predictor of decreased survival, therefore early diagnosis and treatment plays an important role in improving patients survival and quality of life (e.g., fatigue and dementia)(13).

Neutropoenia is one of common hematological abnormality found in patients with HIV infection. Although it may be to the toxicity of therapies used for HIV infection or associated conditions, studies of untreated patients have also shown a high incidence of neutropoenia, particularly in patients with severe and advanced immunodeficiency. This may be an isolated event or may occur along with anaemia and thrombocytopenia(14).The pathogenesis of neutropoenia in children with HIV infection is multifactorial. An autoimmune mechanism involving anti-neutrophil antibodies(15) and impaired granulopoiesis has been postulated. Any infiltrative process involving the bone marrow (infection, malignancy) may also produce granulocytopenia. Drug toxicity due zidovudine and antimicrobial drugs like trimethoprim, sulphonamides can lead to neutropoenia. Hyposegmentation of neutrophil and a shift to left, with appearance of early myeloid precursors in the peripheral blood is common(16). Increase in both CD4 andCD8 T-lymphocyte cell death and impairment in function are the sine qua non of HIV infection.IL-2 partially corrects the impaired lymphocyte proliferation and cytotoxicity seen in HIV infection . It also can partially block the enhanced tendency of lymphocytes obtained from HIV-infected patients to undergo programmed cell death(17,18).

Total lymphocyte count as an age-dependent surrogate for CD4 lymphocyte count in HIV-infected children;
Total Current WHO guidelines suggest consideration of Total lymphocyte count (TLC) as a substitute for CD4 lymphocyte count in resource limited settings(19), lymphocyte count could be a relatively simple, inexpensive way to indicate when antiretroviral therapy (ART) should be started for HIV-infected children in developing countries.

In developed countries the decision about when to start ART in children with HIV is based on clinical symptoms, and assessment of the percentage of CD4 T-cells and HIV viral load. However, CD4 counting is too expensive to be made widely available in the countries most affected by the HIV/AIDS pandemic. Absolute lymphocyte count is a possible alternative. World Health Organization (WHO) 2003 guidelines recommend Total lymphocyte count thresholds for children at which ART can be started in the absence of CD4 cell counts.David Dunn (Medical Research Council, UK)(20) and colleagues combined data from 17 studies looking at Total lymphocyte count and disease progression, involving over 3900 children with HIV infection in Europe and USA. The researchers found that Total lymphocyte count could predict clinical progression almost as well as CD4 cell percentage.The association of thrombocytopenia with HIV infection was 1st established in 1982 and has since been observed in children as, either an initial manifestation of AIDS or during the course of the infection(21,22).

Thrombocytopenia occurs often in patients with HIV infection and is second most common haematogical abnormality found in children with HIV.Although there is no clear correlation between the severity of thrombocytopenia and the rate of progression of AIDS, the incidence of thrombocytopenia is higher in more advanced stages of HIV infection(23,24). In a paediatric patient population at the National Cancer Institute a platelet count of less than 50,000cells/mm3 was found in 19% of children suffering from HIV/AIDS(25).The main mechanism responsible for pancytopoenia in HIV patients are due to HIV infection of bone marrow CD34+ population, viral infection of stem cells by (EBV,parvo-B19,HHV8,HTLV) or due to myelosuppressive drugs. Other causes can be due to bone marrow involvement by lymphoma, Kaposi angiosarcoma and granulomatous disease.The haematological abnormalities adversely affect the treatment of primary viral infection and predispose the patient to opportunistic infections. This crossectional observational study was taken up to study the haematological changes in HIV infection.

AIMS AND OBJECTIVES

1. To study the prevalence of Anaemia, Leucopoenia, Lymphocytopoenia, Thrombocytopenia and Type of Anaemia in children living with HIV/AIDS (irrespective of ART status).
2. To correlate the finding with their corresponding CD4+ T lymphocyte count

MATERIALS AND METHODOLOGY

Type of Study:

A Crossectional observational study was done , of haematological manifestations in children in HIV /AIDS over the period of 2 years (July 2011 to July 2013) at a tertiary Care Hospital at Pimpri, Pune. Informed consent was taken from parents. Assent was taken wherever appropriate.

Inclusion Criteria:

Children diagnosed to have HIV AIDS in the age group upto 15 years irrespective of ART status. The confirmation of HIV status is done by ELISA/Western Blot.

Exclusion Criteria:

- HIV exposed but not proven cases
- Age more than 15 years
- Children with congenital haematological disorder
- Patients who did not give consent to be a part of the study.

Methodology:

- Detailed History was taken, clinical examination and relevant investigations were done.
- Clinical features symptoms, signs in children's with HIV AIDS were analysed.

Investigations:

- Complete Haemogram (Complete blood count)
- Peripheral Blood Smear
- CD4 + T Lymphocyle count by flow cytometry.

Statistical Analysis:

Data analysis was done using the SPSS (Statistical Package for the Social Science) Version 11 for window. The demographic variable, clinical features, complete blood count and level of immune suppression were calculated with no and percentage. The Chi-square test was used to find correlation between complete blood count with level of immune suppression. A probability value of 0.05 was accepted as the level of statistical significance.

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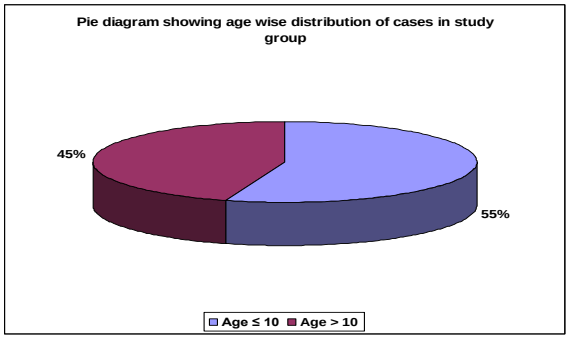
RESULT

Table 1 : Age wise distribution of cases in study group

Age (Yrs)	No of cases	Percentage
≤10	55	55
>10	45	45
Total	100	100

The above table shows Age wise distribution of 100 cases in study group. The majority i.e. 55 cases were in age group of ≤10 years and remaining 45 cases were in age group of > 10 years.



Sex wise distribution of 100 cases in study group showed that was equal distribution among males (N=50) and females (N=50).

ART status wise distribution of 100 cases in study group. Majority of cases i.e. 52 were on ART and remaining 48 cases were did not receive ART.

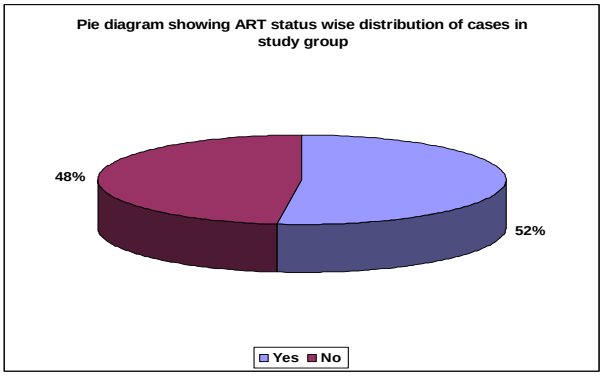


Table 2:Signs and Symptoms of the Patients in the study group

Clinical features	No of cases	Percentages (n=100)
Fever	47	47
Cough	41	41
Diarrhoea	14	14
Weight loss	62	62
Pallor	64	64
Clubbing	15	15
PGL	60	60
Oral thrush	32	32
CSOM	21	21
Wasted and Stunted	62	62
Scabies	21	21
Pruritis	18	18
Heptomegaly (HM)	80	80
Splenomegaly (SM)	61	61

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The above table shows clinical features wise distribution among 100 study subjects. The majorities i.e. 80 had hepatomegaly (HM), 64 had pallor, Weight loss and Stunting and wasting was seen in 62 cases. 61 cases had splenomegaly (SM). The rest of the clinical manifestation includes fever (47), Cough (41), oral thrush (32), Scabies and CSOM (21)

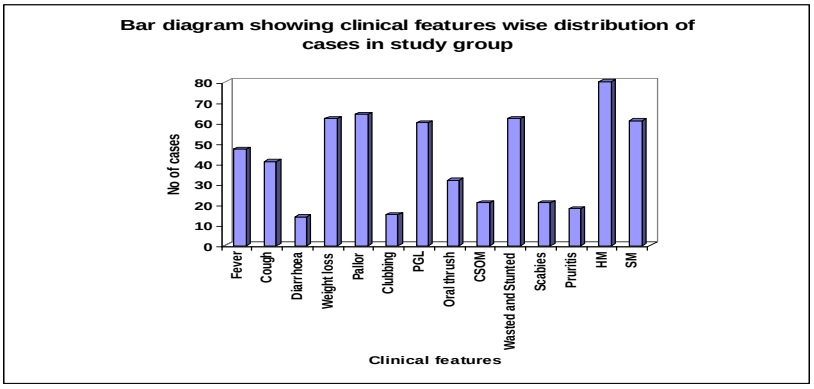

Table 3:Anaemia wise distribution of cases in study group

Hb. (gm%)	No of cases	Percentage
Anaemia	72	72
No anaemia	28	28
Total	100	100

The above table shows Anaemia wise distribution of 100 cases in study group. Majority of cases i.e. 72 had anaemia and remaining 28 cases were with normal hemoglobin levels.

Table 4: Peripheral blood smear (PBS) wise distribution of cases in study group

Peripheral Blood Smear	No of cases	Percentage
Microcytic Hypochromic Anaemia (MHA)	31	31
Normocytic Normochromic Anaemia (NCNC)	30	30
Normocytic Normochromic Blood Picture without Anaemia (NNBP)	30	30
Macrocytic Anaemia (MA)	8	8
Pancytopenia (PA)	1	1
Total	100	100

The above table shows Peripheral blood smear (PBS) wise distribution of 100 cases in study group. Majority of cases i.e. 31 had MHA followed by 30 cases had NCNC and NNBP respectively. 8 cases had MA and remaining 1 case had PA.

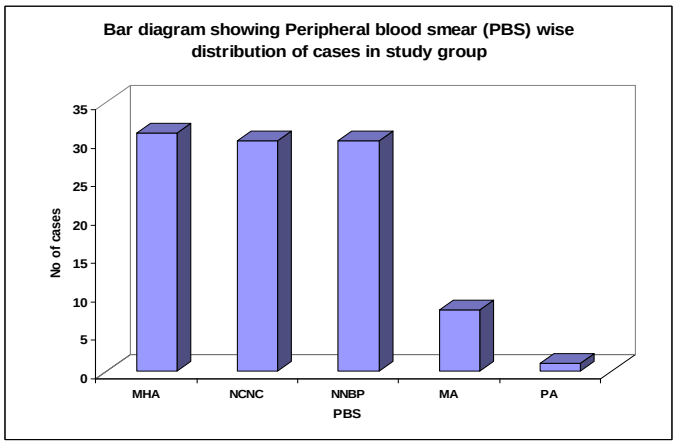

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Table 5: Total Leucocyte Count (TLC) wise distribution of cases in study group

Total Leucocyte Count (TLC)	No of cases	Percentage
Decreased	21	21
Normal	68	68
Increased	11	11
Total	100	100

The above table shows TLC (Total Leucocyte Count) wise distribution of 100 cases in study group. Majority of cases i.e. 68 had normal TLC, 21 cases had decreased and remaining 11 cases were with increased TLC.

Table 6 : Absolute Neutrophils Count (ANC) wise distribution of cases in study group

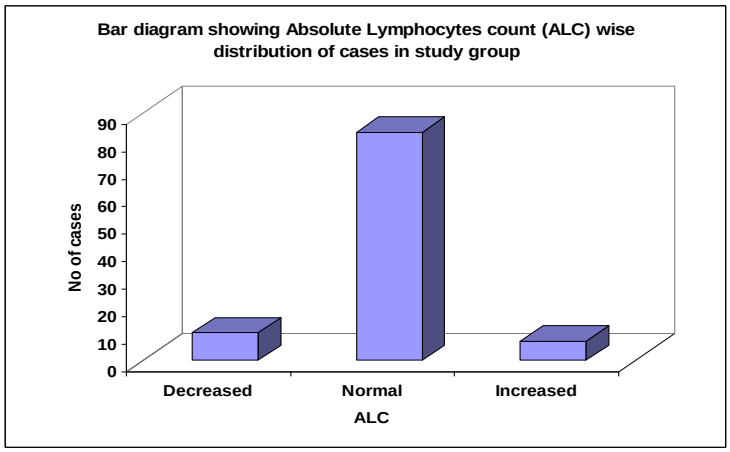
Absolute Neutrophil Count (ANC)	No of cases	Percentage
Decreased	10	10
Normal	83	83
Increased	7	7
Total	100	100

The above table shows Absolute Neutrophils Count (ANC) wise distribution of 100 cases in study group. Majority of cases i.e. 83 had normal absolute neutrophils count, 10 cases had decreased and remaining 7 cases were with increased Absolute Neutrophils Count.

Table 7: Absolute Lymphocytes Count (ALC) wise distribution of cases in study group

Absolute Lymphocytes Count (ALC)	No of cases	Percentage
Decreased	10	10
Normal	83	83
Increased	7	7
Total	100	100

Majority of cases i.e. 83 had normal absolute Lymphocytes count, 10 cases had decreased and remaining 7 cases were with increased Absolute Lymphocytes Count.



Absolute Eosinophils Count (AEC) wise distribution of 100 cases showed that majority of cases i.e. 94 had normal absolute Eosinophils count, 2 cases had decreased and remaining 4 cases were with increased Absolute Eosinophils Count.

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92 had normal platelet count (1.5-4.5) and remaining 8 cases were with decreased platelet Count. Results of the study of immune suppression showed that 38 had advanced immune suppression followed by 36 cases with No immune suppression. 22 cases had mild immune suppression and 4 cases had severe immune suppression.

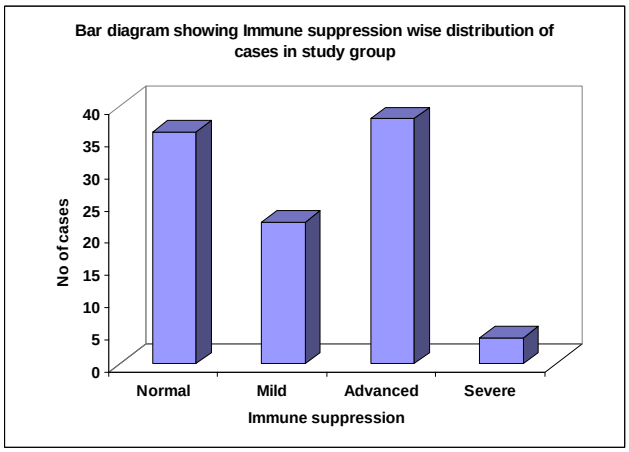

Table 8: Association between Anaemia and Immune suppression in study group

Hb. (gm %)	Immune suppression				Total
	Normal	Mild	Advanced	Severe	
Anaemia	18	14	36	4	72
No Anaemia	18	8	2	0	28
Total	36	22	38	4	100

Chi-square = 20.71, P<0.0001

Table 9: Association between TLC and Immune suppression in study group

Total Leucocyte Count (TLC)	Immune suppression				Total
	Normal	Mild	Advanced	Severe	
Decreased	3	3	12	3	21
Normal	28	17	22	1	68
Increased	5	2	4	0	11
Total	36	22	38	4	100

Chi-square = 14.13, P<0.05

Table 10: Association between ANC and Immune suppression in study group

ANC	Immune suppression				Total
	Normal	Mild	Advanced	Severe	
Decreased	3	0	5	2	10
Normal	29	22	30	2	83
Increased	4	0	3	0	7
Total	36	22	38	4	100

Chi-square = 13.20, P<0.05

Table 11: Association between ALC and Immune suppression in study group

Absolute Lymphocyte Count (ALC)	Immune suppression				Total
	Normal	Mild	Advanced	Severe	
Decreased	0	1	6	3	10
Normal	33	18	31	1	83
Increased	3	3	1	0	7
Total	36	22	38	4	100

Chi-square = 27.18, P<0.0001

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Table 12: Association between AEC and Immune suppression in study group

Absolute Eosinophil Count (AEC)	Immune suppression				Total
	Normal	Mild	Advanced	Severe	
Decreased	2	0	0	0	2
Normal	32	22	36	4	94
Increased	2	0	2	0	4
Total	36	22	38	4	100

Chi-square = 5.17, p>0.05

Table 13: Association between platelet count and Immune suppression in study group.

Platelet count	Immune suppression				Total
	Normal	Mild	Advanced	Severe	
<1.5	1	0	4	3	8
1.5 – 4.5	35	22	34	1	92
>4.5	0	0	0	0	0
Total	36	22	38	4	100

Chi-square = 27.97, P<0.0001

Table 14: Immune suppression wise distribution of cases in study group.

Correlation between CD4 count and	r Value	p Value
Hb.	0.43	<0.0001
TLC	0.16	>0.05
ANC	0.06	>0.05
ALC	0.32	<0.001
AEC	-0.07	>0.05
Platelet	0.09	>0.05
MCV	0.15	>0.05
MCH	0.14	>0.05
MCHC	0.06	>0.05

Pairs of quantitative variables as shown in this table were analyzed for correlation using Pearson's correlation coefficient(r). CD 4 count was correlated with all hematological parameters. Hemoglobin and absolute leukocyte count was significantly correlated with CD 4 count.

DISCUSSION

Haematological abnormalities are among the most common clinic pathological manifestations of HIV infection, adversely altering the patient's quality of life. Anemia occurs in 20-70% of HIV-infected children, more commonlyin children with AIDS. The pathogenesis of anemia may be due to chronic infection,poor nutrition, autoimmune factors, virus-associated conditions(hemophagocytic syndrome, parvovirus B19 red cell aplasia), or the adverse effect of drugs (zidovudine). In untreated HIV-infected children leucopenia is found in30% patients.Commonly neutropeniais also seen.To treat Opportunistic infections, drugs used may lead to decreased number of lymphocytes and neutrophils.Thrombocytopeniais seen in 10-20% of patients.The reason for hematological alteration is immunological (i.e., circulating immune complexes).(26)

The present study was carried out to study the prevalence of anaemia, leucopenia, lypmphocytopenia, Thrombocytopenia and type of anaemia in children living with HIV/AIDS (irrespective of ART status) and its correlation with immunosupression.

The CDC classifies all infected children younger than 13 years of age according to clinical stage of disease :-

Category N: Not Symptomatic

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Children who have no signs or symptoms considered to be the result of HIV infection or have only 1 of the conditions listed in Category A

Category A: Mildly Symptomatic

- Children with 2 or more of the conditions listed but none of the conditions listed in categories B and C
- Lymphadenopathy (≥0.5 cm at >2 sites; bilateral at 1 site)
- Hepatomegaly
- Splenomegaly
- Dermatitis
- Parotitis
- Recurrent or persistent upper respiratory tract infection, sinusitis, or otitis Media

Category B: Moderately Symptomatic

- Children who have symptomatic conditions other than those listed for category A or C that are attributed to HIV infection
- Anemia (hemoglobin <8 g/dL [<80 g/L]), neutropenia (white blood cellcount <1,000/µL [<1.0 x 109/L]), and/or thrombocytopenia (platelet count<100 x 103/µL [<100 x 109/L]) persisting for ≥30 days
- Bacterial meningitis, pneumonia, or sepsis (single episode)
- Candidiasis, oropharyngeal (thrush), persisting (>2 mo) in children >6 mo
- Cardiomyopathy
- Cytomegalovirus infection, with onset before1 mo of age
- Diarrhea, recurrent or chronic
- Hepatitis
- Herpes simplex virus (HSV) stomatitis, recurrent (>2 episodes within1 year)
- HSV bronchitis, pneumonitis, or esophagitis with onset before 1 mo.of age
- Herpes zoster (shingles) involving at least 2 distinct episodes or >1 dermatome
- Leiomyosarcoma
- Lymphoid interstitial pneumonia or pulmonary lymphoid hyperplasia complex
- Nephropathy
- Nocardiosis
- Persistent fever (lasting >1 mo)
- Toxoplasmosis, onset before 1 mo of age
- Varicella, disseminated (complicated chickenpox)

And immunologic status.(27)

Table : Revised Classification of Immune Suppression in Children (CD_4 Levels in relation to Severity of Immune Suppression)

Classification of HIV – Associated Immunodeficiency	Age Related CD_4 Values			
	<11 Months(%)	12-35 Months (%)	35-59 Months (%)	≥5 Years(Cells/mm^3)
Not Significant	>35	>30	>25	>500
Mild	30-35	25-30	20-25	350-499
Moderate	25-30	20-25	15-20	200-349
Severe	<25% or <1500 cells per mm^3	<20% or <750 cells per mm^3	<15% or <350 cells per mm^3	<15% or <200 cells per mm^3

This pediatric classification system emphasizes the importance of the CD4+ T-lymphocyte count and percentage as critical immunologic parameters and as markers of prognosis(28).

The age distribution among study subjects showed that maximum number of cases were in the within age group ≤10 years. 45 cases were in age group of more than 10 years. (Table no 1)

Sex wise distribution showed that both male and females were equally distributed in study group. ART status distribution showed maximum cases were on ART treatment. 48 cases did not receive ART treatment. Clinical features wise distribution showed that majority of them had HM, followed by weight loss, stunting(Table 2). Other clinical features included fever, cough, oral thrush, scabies and CSOM. Diarrhoea clubbing and pruritis was less likely clinical features among study group (Table no 9). In a study conducted by Sebhat Asnake, Solomon Amsalu (2005) who studied the clinical profile of HIV/AIDS in children(29). The main presenting complaint was cough and/or difficult breathing 52 (58.4%) and diarrhea 47 (52.8%). Chronic diarrhea was seen in 34.8% of the patients. Commonly seen physical findings on admission were hepatomegaly (53.9%), fever (50.0%), respiratory distress (47.2%), skin lesions (46.1%), generalized lymphadenopathy (41.6%) and splenomegaly (29.2%).

Similar finding was observed In a study conducted by Babatunde O Ogunbosi, Regina E Oladokun, Biobele J Brown and Kikelomo I Osinusi.(2011) studied Prevalence and clinical pattern of paediatric HIV infection(30).Features predictive of HIV infection were diarrhoea, cough, weight loss, ear discharge generalized lymphadenopathy, presence of skin lesions, parotid swelling and oral thrush. About 75% presented in advanced or severe clinical stages of the disease. Distribution of Presence of Anaemia showed maximum cases had anaemia (72%) and remaining 28% of subjects were with normal hemoglobin levels. (Table no3) Similar finding was observed in a study conducted by Shet A et al (2009) described anaemia burden and HIV disease correlates among 248 infected childrens aged 1 to 12 years attending three outpatient clinics in India(31).

Distribution of TLC (Total leucocyte count) showed maximum cases had normal TLC (68%) and 21% of subjects had decreased TLC and 11% cases had increased TLC (Table no 5). Distribution of ANC (Absolute Neutrophils Count) showed maximum cases had normal ANC (83%) and 10% of subjects were with decreased ANC and in remaining 7% cases ANC was increased. (Table no 6). Distribution of ALC (Absolute Lymphocytes Count) showed maximum cases had normal ALC (83%) and 10% of subjects were with decreased ALC and in 7% ALC was increased. (Table no 7) Similar finding was observed in a study conducted by Madeleine Bunders et al (2004) who followed data on 156 HIV-infected and 1533 uninfected children. Neutrophils counts were consistently and substantially lower in HIV-infected children(32).

Distribution of AEC (Absolute Eosinophils Count) showed maximum cases had normal AEC (94%) and remaining 2% of subjects were with decreased AEC and in 4% AEC was increased. Distribution of platelet count showed maximum cases (92%) had normal platelet count (1.5-4.5) and only 8% of cases had decreased platelet count. Similar finding was observed in a study conducted by Kumar P et al (2012) who studied clinical profile of HIV associated thrombocytopenia and its correlation with immune status among 173 childrens. 34 children (19.6%) out of 173 were found to have thrombocytopenia(33).

Immune suppression wise distribution among study subjects showed maximum cases had advanced immune suppression (38%), followed by 36% had normal immunity. 22 cases had mild immune suppression and 4 cases had severe immune suppression.

Association between Anaemia and Immune suppression among study group was analyzed. The mean hemoglobin was low with more advanced HIV disease. ($p<0.0001$(Table:8)

Presence of anaemia was significantly associated with immune suppression in study group. Advanced and severe immune suppression was significantly associated in cases with anaemia as compared with normal immune subjects. (Table no 8) Similar finding was observed in a study conducted by Eley et al (2002)(34).The prevalence of anaemia was 85% in childrens with severe immune suppression and 76% in advanced immune suppression as compared to anaemia in mild immune suppression and normal immunity. Mean hemoglobin was low in advanced immune suppression in the present study. Similar finding was observed in Adetifa et al (2006(35).

Association between PBS and immune suppression among study group was analyzed. Advanced immune suppression was significantly associated with microcytic hypochromic anaemia and normocytic normochromic anaemia. Severe immune suppression was significantly associated with microcytic hypochromic anaemia and pancytopenia.

Association between Total Leucocyte Count (TLC) and Immune suppression among study group was analyzed. Presence of abnormal TLC was significantly associated with immune suppression in study group. Advanced immune suppression was significantly associated in cases with decreased TLC as compared with normal immune subjects. (Table no 9) Adetifa IM, Temiye EO, Akinsulie AO, Ezeaka VC, Iroha EO. (2006) did cross-sectional study of baseline haematological parameters in 68 children with confirmed HIV infection. In all cases, a complete blood count was done and some had CD4+ counts and HIV RNA PCR. 6% had leucopenia, 17.5% had neutropoenia and 2.5% (one case) had thrombocytopenia; also, the four (6%) subjects with leucopenia were in clinical stages B and C. Neutropoenia, lymphocytopenia and thrombocytopenia were seen more in clinical stages B and C, though this relationship was not statistically significant(35).Association between Absolute Neutrophils Count and Immune suppression among study group was analyzed. Presence of decreased Absolute Neutrophils Count was significantly associated with advanced and severe immune suppression in study group (Table no 10). Similar finding was observed in a study conducted by Erhabor et al (2005) found prevalence of neutropoenia to be 24% among HIV positive children.

Association between Absolute Lymphocyte Count and Immune suppression among study group was analyzed. Presence of decreased Absolute lymphocyte Count was significantly associated with advanced and severe immune suppression in study group. Mild immune suppression and no immune suppression was significantly associated with increased Absolute lymphocyte Count (Table no 11).

Association between Absolute Eosinophil Count and Immune suppression among study group was analyzed. Presence of increased Absolute Eosinophil Count was significantly associated with advanced immune suppression in study group. Association between platelet count and Immune suppression among study group was analyzed. Presence of decreased platelet count was significantly associated immune suppression in study group. Advanced and severe immune suppression was significantly associated in cases with decreased platelet count as compared with normal immune subjects. (Table no 24) Kumar P et al (2012) who studied clinical profile of HIV associated thrombocytopenia and its correlation with immune status among 173 childrens.

CONCLUSIONS

- Hematological abnormalities are the most common manifestation in children with HIV/AIDS having significant impact on clinical outcomes and quality of life.
- Both the erythroid and other cell lines are affected HIV/AIDS ,resulting in anaemia , leucopenia, lymphocytopenia and thrombocytopenia.
- Anaemia is the most common haematological abnormality in children with HIV/AIDS increasing the morbidity and mortality.
- Anaemia is more prevalent among advanced and severe immune suppression
- Hence, it is prudent to investigate and find the cause of anaemia for appropriate treatment. Starting of highly effective anti-retroviral therapy(HAART) in cases of chronic disease and iron replacement therapy in cases with iron deficiency anaemia improves the quality of life.
- The severity of peripheral cytopenias is related to disease burden. Prevalence of leucopoenia, neutropoenia, lymphocytopoenia and thrombocytopenia is higher in advanced and severe immunosuppression.
- Lymphopoenia is a marker of disease progression. In resource limited setting, where CD 4 counts facility is not available, total lymphocyte count can be a surrogate immunological marker in children in HIV infection to indicate disease progression to start HAART.
- Hence, routine monitoring haematological parameters in children with HIV/AIDS is recommended, to detect abnormalities at earliest, found the etiology and treat appropriately. These measures will reduce the morbidity and mortality.

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