Original Research Article

Study of Opportunistic Infections in HIV-AIDS Patients and their Co-Relation with CD4+Cell Count

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ABSTRACT

The aim of this study to determine the spectrum of opportunistic infections in adult AIDS patients and correlate different opportunistic infections (OI’s) with the CD4+ cell count. A total of 159 patients were tested for spectrum of opportunistic infections. All the specimens were processed as per standard procedures to detect bacterial, fungal, parasitic and viral infections. CD4+ counting of blood samples was done by Flow cytometry as per manufacturer's instructions (FACSCalibur, Becton- Dickinson, Immuncytometry system). Correlation of CD4 cell counts was done with the respective opportunistic infections. Male preponderance with male: female ratio i.e. 3.7:1 was seen. The young sexually active group (18-48 years) comprising of 93.7% of patients was affected. Among opportunistic infections, most common were bacterial (44.14%), fungal (32.43%), parasitic (16.21%) and viral infections (7.20%) of patients. Out of 222 events of OI’s 26% (58/222) were seen in CD4+ count <50(cells/µl), 37.2% (83/222) were seen within 50-99 CD4+ cells/ µl range followed by, 21.1% (47/222) in 100-149 CD4 cells/ µl while 15.2%(34/222) OI’s were observed in 150-199 CD4+ cells/ µl group and only 0.4% (1/222)OI’s were seen in <200-500 CD4+ cells/ µl group. Early diagnosis & prompt treatment of opportunistic infections is important before development of severe immunodeficiency to prevent serious and fatal outcome.

Keywords: Opportunistic infections, CD4 cell counts, HIV

Introduction

Opportunistic infections are the manifestations caused by the pathogens which are usually not invasive but invade the body when its immunity is hampered because of one or the other reasons. It occurs in conditions like AIDS, various malignancies, steroid therapy, radiotherapy and diabetes. With the changing scenario of AIDS epidemic, a host of opportunistic infections add to the present endemic state of some already existing infections like tuberculosis.
account for the majority of the mortality and the morbidity in AIDS. The type of pathogen responsible for morbidity and mortality vary from region to region. The identification of such pathogen is very important to manage such cases.1

A person infected with HIV develops into a case of full blown AIDS by appearance of a variety of infections, labeled as opportunistic infections and malignancies. Common opportunistic infections seen in America and Europe are Pneumocystis carinii pneumonia (PCP), Cryptococcal meningitis, Cytomegalovirus (CMV), and Toxoplasmosis. But in developing countries of Africa, South, and south-east Asia, Mycobacterium tuberculosis ranks as the most common infection seen in the reported AIDS cases.2

According to latest report by NACO(2007), 65% cases of Tuberculosis, 57.5% of Candidiasis, 36% of Cryptosporidiasis, 14% Herpes Zoster, 13% PCP, 9% bacterial pneumonia, 9% Cryptococcal meningitis, 3.8% Toxoplasmosis and Kaposi’s sarcoma 0.17% have been found in India.3

Most of the opportunistic infections broadly correlate with CD4 lymphocyte count in majority of the cases.4 HIV presently accounts for the highest number of deaths attributable to any single infective agent. India has an estimated 5.2million HIV-infected people. The threat to their life is not from virus alone. Opportunistic infections (OI’s) and associated complications account for a considerable proportion of such mortality. Appropriate management of OI’s is as important as antiretroviral therapy (ART) in preventing mortality and morbidity among HIV-infected persons. With this background, present study was undertaken to study the spectrum of opportunistic infections in adult AIDS patients & to study the correlation of different opportunistic infections (OI’s) with the CD4+ cell count.

Materials and Methods

The prospective study was conducted in the Department of Microbiology, Government Medical College & Hospital (GMCH), Nagpur from May 2006 to October 2007 after approval from ethical committee.159 HIV positive patients either hospitalized or coming to ART clinic were included in the study.

CD4/CD3 enumeration: The CD4/CD3 enumeration was done using the single BD FACS count machine Becton Dickinson and company, USA by strictly following the manufacturer’s instructions.

Depending on the patients clinical features various specimens were collected which included sputum, stool, CSF, oral swab, lymph node & skin scrapings.

Stool specimens were collected and examined microscopically using saline wet mounts. Lugol’s iodine was used for the detection of ova, larva, trophozoites and cyst of intestinal parasites. Smears were examined by Modified acid fast staining for Cryptosporidium parvum, Isospora belli and other. Also bacteriological culture of stool was done for identifying bacterial infections.

Candidiasis was diagnosed by taking oral swab specimens and was cultured on Sabouraud’s dextrose agar and suspected colony was identified by Germ tube test. Cryptococcal meningitis was diagnosed by using India ink preparation of CSF and culture on SDA.

Herpes infection was diagnosed by taking impression smears from vesicular lesions.
and by demonstrating multinucleated giant cells by Tzanck test using Giemsa stain or H&E.

**Results and Discussion**

In the present study, total 159 HIV positive AIDS patients were included. Out of these patients, 125 were males (78.6%) and 34 (21.4%) were females. Male to female ratio was found to be 3.7: 1. Most of the patients (93.7%) belonged to 18-48 (years) age group (Table No.1).

In this study total 222 opportunistic infections were found comprising of bacterial, fungal, parasitic & viral infections. Among different opportunistic infections, bacterial infections were seen in 44.14% patients, followed by fungal in 32.43%, parasitic in 16.21% & viral in 7.20% respectively. (Table No.2)

In the present study total 222 events of OI’s were found comprising of bacterial, fungal, parasitic and viral infections. Most of the OI’s ie 26 %( 58/222) were seen in CD4+ count <50(cells/µl), 37.2% (83/222) were seen within 50-99 CD4+ cells/ µl range followed by, 21.1% (47/222) in 100-149 CD4 cells/ µl while 15.2%(34/222) OI’s were observed in 150-199 CD4+ cells/ µl group and only 0.4% (1/222) OI’s were seen in <200-500 CD4+ cells/ µl group.

**OI’s association with CD4+ count <50 (cells/µl)**

In this group, 26 %( 58/222) of opportunistic infections were seen which comprised of 43.1% (25/58) bacterial infections, 39.7% (23/58) fungal infections, 6.9% ( 4/58) parasitic infections and 10.3% (6/58) of viral infections.

Among bacterial infections, pulmonary tuberculosis were seen with equal frequency i.e. 40% each (10/25), *Klebsiella pneumoniae* 12% (3/25), *Staphylococcus aureus* 4% (1/25) and *E. coli* 4 % (1/25).

In fungal infections, most common was *Candidiasis* 69.6 % (16/23) followed by *Cryptococcal meningitis* 21.7% (5/23), *Pneumocystis jiroveci* 4.3% (1/23) and *Trichophyton rubrum* 4.3 % (1/23).

Parasitic infections included *Cryptosporidium* 50% (2/4) followed by *Isospora* 25 % (1/4), *Strongyloides* 25% (1/4).

Viral infections included *Herpes zoster* 50% (3/6), *Molluscum contagiosum* 33% (2/6) and *Cytomegalovirus retinitis* in 16.7 % (1/6) patients.

**OI’s association with CD4+ count 50-99 (cells/µl)**

Most of the OI’s ie 37.2% (83/222) were seen within 99-50 CD4 cells/ µl range which comprised of 45.8% (38/83) bacterial infections, 31.3% (26/83) fungal infections, 16.7%(14/83) parasitic infections and 6.0%(5/83) of viral infections.

In this group, among bacterial infections most common was pulmonary tuberculosis 47.4% (18/38) followed by extra-pulmonary tuberculosis 44.7% (17/38), *Klebsiella pneumoniae* 7.9% (3/38) and *Staphylococcus aureus* 2.6% (1/38).

In fungal infections, most common was *Candidiasis* 76.9 % (20/26) followed by *Cryptococcal meningitis* 19.2% (5/26) and *Trichophyton rubrum* 3.8% (1/26).

Parasitic infections included *Cryptosporidium parvum* 64.3% (9/14) followed by *Isospora belli, Strongyloides stercoralis, Hymenolepis nana, Entamoeba.*
histolytica and Toxoplasma gondii each 7.1% (1/14).

Viral infections included Herpes Zoster in 60% (3/5) and genital herpes in 40% (2/5).

**OI’s association with CD4+ count 100-149 (cells/μl)**

In this group, 21.1% (47/222) of opportunistic infections were seen which comprised of 48.9% (23/47) bacterial infections, 31.9% (15/47) fungal infections, 17% (8/47) parasitic infections and 2.1% (1/47) of viral infections.

In this group, among bacterial infections most common was extra-pulmonary tuberculosis 47.8% (11/23) followed by pulmonary tuberculosis 26% (6/23), Klebsiella pneumoniae 8.7% (2/23) and Staphylococcus pneumoniae, Staphylococcus aureus, Escherichia coli and Nonfermenter 4.3% (1/23) each.

In fungal infections, most common was Candidiasis 86.7% (13/15) followed by Pneumocystis jiroveci 13.3% (2/15).

Parasitic infections included Cryptosporidium parvum 75% (6/8) followed by Strongyloides stercoralis, Isospora belli, Giardia lamblia and Entamoeba histolytica each 10% (1/10).

Viral infections included venereal warts only in one patient.

**OI’s association with CD4+ count 150-199 (cells/μl)**

In this group 15.2% (34/222) OI’s were observed which consisted of 35.3% (12/34) bacterial infections, 23.5% (8/34) fungal infections, 29.4% (10/34) parasitic infections and 11.8% (4/34) of viral infections.

In this group, among bacterial infections most common was pulmonary tuberculosis 50% (6/12) followed by extra-pulmonary tuberculosis 25% (3/12), Klebsiella pneumoniae, Salmonella typhi and Shigella dysenteriae each 8.3%(1/12)each.

In fungal infections, only member was Candidiasis 100% (8/8).

Parasitic infections included Cryptosporidium parvum 60% (6/10) followed by Strongyloides stercoralis, Isospora belli, Giardia lamblia and Entamoeba histolytica each 10% (1/10).

Viral infections included Herpes zoster 75% (3/4) and venereal warts 25% (1/4).

**OI’s association with CD4+ count 200-500 (cells/μl)**

Only 0.4% (1/222) OI’s were seen in 200-500 CD4+ cells/μl group. Only infection seen was of Candida species.

Acquired Immunodeficiency Syndrome (AIDS) is a pandemic of 21st century presenting with severe immunodeficiency in which patients present with symptoms of different opportunistic infections.

HIV presently accounts for the highest number of deaths attributable to any single infective agent. India has an estimated 5.2million HIV-infected people. The threat to their life is not from the virus alone. Opportunistic infections (OI’s) and associated complications account for a considerable proportion of such mortality.

Thus it is very important to identify and start appropriate management of the offending agent at an earliest so that OI’s can be managed appropriately to prevent mortality and morbidity among HIV-infected persons.
The present study of 159 HIV patients deals with wide spectrum of opportunistic infections and their correlation with CD4+ cell counts.

The age of the cases ranged from 20 to 65 years. Majority of the patients (93.7%) belonged to 18-48 years age group which is similar to what has been reported by Kumarasamy N et al\(^5\), Singh A et al\(^1\) and.

In the present study males (78.6%) outnumbered the females (21.4%). Male to female ratio was found to be 3.7:1 which is quite near to the ratio reported by Uzgare R et al\(^6\) and Singh A et al\(^1\).

In the study of opportunistic infections, we found bacterial infections as prominent opportunistic infection followed by fungal, parasitic and viral in decreasing order. Out of total 159 patients under study, 222 events of opportunistic infections were seen in the present study singly/ in mixed form.

Among bacterial infections, tuberculosis was found to be most common bacterial infection. It was seen in 50.9% of all the 159 patients out of which 49.4% were of pulmonary tuberculosis and 50.6% were of extrapulmonary tuberculosis. As far as tuberculosis is concerned we found almost equal distribution of pulmonary tuberculosis and extra-pulmonary tuberculosis in the study group with slightly more number of extra-pulmonary tuberculosis cases. Equal distribution of pulmonary tuberculosis and extra-pulmonary tuberculosis has also been observed by Ayyagariet al\(^7\) although in small number of cases.

Our findings are nearly similar to findings reported by Sunderam G. et al\(^8\), Kumarasamy N et al\(^5\), Misra SN et al\(^9\), Veeranoot et al\(^10\), M. Vajpayee et al\(^11\), Singh A et al\(^1\) and Sanjeev Sinha et al\(^12\).

In the present study, *Klebsiella pneumoniae* was found to be most common pneumonia causing bacterial pathogen (8.2%). However relatively higher incidence (18.7%) of pneumonia due to *Klebsiella pneumoniae* has been documented by Sanjeev Sinha et al\(^12\). Other organisms found to cause pneumonia in the present study were *Staphylococcus aureus, Escherichia coli* and *Streptococcus pneumoniae* which were also reported as common bacterial pathogens causing pneumonia by V V Shailaja et al\(^13\).

After bacterial pneumonia, other common bacterial infections found in present study are bacterial enteritis (3%) 1% each by *Salmonella typhi, Shigella dysenteriae* and Nonfermenter. However, slightly high incidence of Shigella (3.3%) and Salmonella enteritis (3%) has been reported by Kumar S Satheesh et al\(^14\).

Fungal infections were the second common infections (45.3%) in all the 159 patients after bacteria infections in the present study. Among all the fungal infections Candidiasis was found to be the most common fungal infection (79.2%) in present study group which is in accordance with the range (12-93%) as reported by Greenspan.\(^15\)

The high incidence of candidiasis in the present study can be explained by the fact that it is the second most common AIDS defining illness after tuberculosis in advanced stage of HIV infection in developing country like ours. Out of 57 cases of candidiasis, disseminated candidiasis was found in 6 patients 10.5% (6/57) which is in accordance with reports by other workers (Kumar S Satheesh et al\(^14\) and Sanjeev Sinha et al\(^16\)).

In the present study second common fungal infection after candida was found to be Cryptococcal meningitis (13.9%) among all
fungal infections which is within the range (6-13%) reported by Murakawa et al\textsuperscript{17}.

Third common fungal infection found in present study was \textit{Pneumocystis jiroveci} pneumonia (4.2%) among all fungal infections which is in the range (0.7-7%) as reported by Kumarasamy et al\textsuperscript{18} in a recent study.

Higher incidence (10-33%) of pneumocystis jiroveci has also been reported by Patel AK et al\textsuperscript{19}, Malin Adam S. et al\textsuperscript{20}, Myoung-don Oh et al\textsuperscript{21} and N. Usha Rani et al.\textsuperscript{22}

Lower incidence found in present study as compared to above-mentioned reports may be due to difference in types of samples processed. In the present study, induced sputum samples were processed for demonstration of \textit{Pneumocystis jiroveci} while other workers apart from processing sputum, have also used bronchoalveolar lavage, endobronchial brushings or even lung biopsy.

The disparity in the incidence of \textit{Pneumocystis jiroveci} in present study from the others mentioned earlier may also be due to the fact that majority of the patients in present study group belonged to later stage of HIV infection at which chemoprophylaxis is already initiated as per NACO guidelines.

Besides Candidiasis, Cryptococcal meningitis and Pneumocystis jiroveci infections, Cutaneous ringworm infection (2.8%) by \textit{Trichphyton rubrum} among all the fungal infections has been found in the present study group which is relatively less in comparison to the finding of Sivayathorn A et al\textsuperscript{23}.

After bacterial and fungal infections next common group of infections in the present study were found to be parasitic infections i.e. 22.6% of all the 159 patients. The most common parasitic infestation observed was \textit{Cryptosporidium parvum} (63.9%). Agarwal A et al\textsuperscript{24} has reported Cryptosporidium parvum in 81.8% of patients while 56.5% incidence of Cryptosporidium has been documented by Javid S S d r a e i et al\textsuperscript{25} which is in accordance with findings of present study.

Next common parasite after Cryptosporidium in present study was \textit{Strongyloides stercoralis}. Larvas of Strongyloides were seen in 11.1% of 36 cases of parasitic infestations. Lanjewar et al\textsuperscript{26} has reported \textit{Strongyloides stercoralis} in 9.1% as isolated and mixed infection. The findings in the present study are in accordance with Lanjewar et al\textsuperscript{26} & Ghorpade et al\textsuperscript{27}.

Like other studies we also found Strongyloides stercoralis infection mixed with Cryptosporidium parvum and Isospora belli (Ghorpade et al\textsuperscript{27}, Lanjewar et al\textsuperscript{26} and Joshi M et al\textsuperscript{28}).

After Cryptosporidium parvum and \textit{Strongyloides stercoralis} next common parasitic infection in present study was Isospora belli (8.3%) among all the parasitic infections. The infections were also seen as mixed infection with Cryptosporidium parvum and \textit{Strongyloides stercoralis}. The findings in present study are almost similar to 7.5% incidence reported by Gulick SM et al.\textsuperscript{29}

Esfandiari A et al\textsuperscript{30} has reported 10% prevalence while 9.9% Isospora belli has been reported by Sauda F.C. et al\textsuperscript{31}. Findings in the present study are nearly similar to the observations of these two workers.

Next common parasitic infestation in present study was \textit{Hymenolepis nana} (5.6%) among all parasitic infections which was also seen
as mixed infection with Cryptosporidium, Isospora and Strongyloides stercoralis. Hymenolepis nana has been reported in 0.6% cases as mixed infection by Kumar S Satheesh et al\textsuperscript{14}.

Next common parasite infection in present study was Entamoeba histolytica (5.6%) among all parasitic infections. Findings in present study are nearly same to those reported by Esfandiari et al\textsuperscript{30}. However, there is wide range (1-14.9%) of Entamoeba histolytica infection as reported by Mohandas et al\textsuperscript{32} and Joshi M et al\textsuperscript{28}.

Though the Toxoplasma gondii has been described as one of the most common opportunistic infection in AIDS patients, in the present study we found only one case of cerebral toxoplasmosis (2.8%) which is in accordance with findings reported by Ponniah P et al\textsuperscript{33}, Sanjeev Sinha et al\textsuperscript{12} and SK Sharma et al\textsuperscript{34}.

In the present study, among all parasitic infections a single case of Giardia lamblia was found (2.8%) which is in accordance with percentages reported by Joshi M et al\textsuperscript{28} (4.3%) and Gulick SM et al\textsuperscript{29} (1.5%).

Among opportunistic infections, viral infections were seen in 10.1% of all 159 patients in this study. In this group of viral infections, Herpes virus infection especially zoster was found to be most common Herpes infection (56.3%).

In the present study, Herpes zoster infections were seen in 5.7% of total 159 patients. The incidence is slightly less than that reported by Kielbauchet al\textsuperscript{35} (8%) and Patel AK et al\textsuperscript{19} (9.6%). However higher incidence (11.2-20%) has been reported by Sivayathorn A et al\textsuperscript{23} from Thailand, Myoung-don Oh et al\textsuperscript{21} and Kumarasamy et al\textsuperscript{36}.

Of total 16 viral infections cases, 2 were found to be having genital herpes in present study (12.5%) which is in accordance with herpes genitalis in 7.7% patients as reported by Kumarasamy et al\textsuperscript{36} and 10.9% by Sivayathorn A et al\textsuperscript{23}.

The cases of Molluscum contagiosum and venereal warts each two in number (1.3% each) of total 159 patients were observed in present study. Biswas Jyotirmay et al\textsuperscript{37} reported Molluscum contagiosum in 1.4% patients. Kumarasamy et al (2000) reported Molluscum contagiosum in 1.3% of patients. Findings in present study group are similar to those reported by Biswas Jyotirmay et al\textsuperscript{37} and Kumarasamy et al\textsuperscript{36}.

Incidence of genital warts in present study (1.3%) is also in accordance with Kumarasamy et al\textsuperscript{36} observation (1.2%).

In the present study apart from Herpes simplex and Pox viruses, we found only one case of Cytomegalovirus retinitis (6.3%) among all viral infections though high range (15-20%) has been reported by foreign workers (Jacobson et al 1988b\textsuperscript{38} and Drew et al 1988\textsuperscript{39}).

Study by Veeranoot et al\textsuperscript{10} reported slightly lower incidence (2%) of Cytomegalovirus infection in AIDS patients.

Though Biswas Jyotirmay et al\textsuperscript{37} found Cytomegalovirus ocular lesions in 21.4% in HIV infected patients but his study group comprised of only ocular lesions in HIV positive patients.

Corelation of opportunistic infections with CD4\textsuperscript{+} cell count

As the immunodeficiency advances, HIV positive patient becomes susceptible to variety of opportunistic infections because of profound immunosuppression. There
have been many reports showing the correlation between CD4+ cell count and occurrence of opportunistic infections in HIV patients. We also tried to correlate the same in the present study.

To correlate the opportunistic infection with CD4+ cell count, for the convenience we divided the study cases into five groups based on CD4 cell count (cells/mm$^3$) i.e. <500-200, 199-150, 149-100, 99-50 and <50 cells/mm$^3$. It was observed in the present study that when CD4+ count starts falling below 500 cells/mm$^3$, first indication of immunodeficiency is seen in the form of oral thrush however other opportunistic infections are seen when the severity of immunodeficiency increases as CD4 cell count becomes less than 200 cells/mm$^3$. The only infection seen in the CD4 count range (200-500) was Candida infection 0.4%(1/223). No other opportunistic infections were seen in this group in the present study. Merle A et al, Chien-Ching Hung et al and NACO also reported the similar findings in their studies. Whereas Crowe et al, Giri TK et al and Merle A et al reported the pulmonary tuberculosis to be the commonest opportunistic infection in CD4+ cell count range (200-500). However we did not get a single case of tuberculosis in this range of CD4 cell count in the present study.

However when immunodeficiency further progresses and CD4+ cell count falls below 200 cells/mm$^3$ i.e. (199-150), the most common infections after Candidiasis were pulmonary tuberculosis 50%(6/12) followed by parasitic infection in 29.4% (10/34) cases. Parasitic infections were found in the form of Cryptosporidium parvum 60% (6/10) in this range of CD4 cell count. Reactivation of Herpes zoster was also observed in 75 % (3/4) cases.

Pulmonary tuberculosis has also been reported by M Korzeniewska-Kosela et al, Myoung-don Oh et al and Veeranoot et al.

M. Vajpayee et al also reported tuberculosis as most common opportunistic infection followed by parasitic diarrhea and oral candidiasis at this level of CD4+ cell count(<200 cells/mm$^3$).

However Merle A et al, Theur CP et al and M Whiteman et al found extra-pulmonary tuberculosis to be common when CD4 cell count declines below 200 cells/mm$^3$.

Cryptosporidium were also reported as common parasitic pathogens in this CD4 count range (190-150) by Crowe et al, Wittner et al and Javid Sadraei et al.

Reactivation of Herpes zoster at CD4 cell count below 200 cells/mm$^3$ was also noticed by Myoung-don Oh et al and Merle A et al.

When CD4+ cell count further drops to below 149 cells/ mm$^3$ i.e. in the group (149-100), the spectrum of opportunistic infections changes. At this level of CD4+ cell count there were more number of cases of opportunistic infections 21.1%(47/223) observed in the present study. These infections comprised in the order of frequency i.e. Candidiasis followed by Cryptosporidium, extra-pulmonary tuberculosis and pulmonary tuberculosis. At this level, Pneumocystis jiroveci 13.3 % (2/15) were also noted. In this range of CD4 cell count extra-pulmonary tuberculosis dominated with addition of Pneumocystis jiroveci and bacterial pneumonia.

Singh Y.N. et al also reported the Pneumocystis jiroveci whereas JanoffENet al found Pneumococcal Pneumonia to be
common bacterial infection at this level of CD4+ cell count.

Most of the reports by other workers did not classify the CD4+ cell count in the range 100-149 cells/mm$^3$ as they had taken into consideration the CD4+ cell count <200cells/mm$^3$ as a group in place of 149-100 cells/mm$^3$.

In the present study, with further increase in degree of immunodeficiency and simultaneous decrease in CD4+ cell count i.e. below 100cells/mm$^3$ or in the group (99-50), tuberculosis both pulmonary and extra-pulmonary dominated the spectrum of opportunistic infections which was followed by Candidiasis, Cryptosporidium and Herpes zoster. At this level of immunodeficiency, two new infections, Cryptococcal meningitis and cerebral toxoplasmosis were seen. Similar findings have also been reported by Crowe et al.$^{43}$ Toxoplasma and Cryptococcus infections have also been reported by Fauci$^{52}$ and NACO.$^{42}$

McCabe et al.$^{53}$ has also reported Toxoplasma infection whereas Giri TK et al.$^{44}$ has found Cryptococcal meningitis at this level of immunodeficiency i.e. (CD4+ cell count <100 cells/mm$^3$).

When severe immunodeficiency occurs i.e. CD4+ cell count <50 cells/mm$^3$ almost all opportunistic infections become manifest at this terminal stage of AIDS. In this scenario, the existing infections are seen with increasing frequency and in disseminated form.

**Table.1 Age & Sex wise distribution of the total patients (n=159)**

<table>
<thead>
<tr>
<th>Age group(years)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Percentage</th>
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<tbody>
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<td>18-28</td>
<td>15</td>
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<td>29-38</td>
<td>73</td>
<td>21</td>
<td>94</td>
<td>59.11%</td>
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<td>39-48</td>
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<td>35</td>
<td>22.01%</td>
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<tr>
<td>49-58</td>
<td>6</td>
<td>3</td>
<td>9</td>
<td>5.66%</td>
</tr>
<tr>
<td>59 &amp; above</td>
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<td>Total</td>
<td>125</td>
<td>34</td>
<td>159</td>
<td>100%</td>
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**Table.2 Distribution of opportunistic infections**

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<thead>
<tr>
<th>Infection</th>
<th>Number</th>
<th>Percentage</th>
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<tr>
<td>Bacterial</td>
<td>98</td>
<td>44.14%</td>
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<tr>
<td>Fungal</td>
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<td>32.43%</td>
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<tr>
<td>Parasitic</td>
<td>36</td>
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<tr>
<td>Viral</td>
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<td>7.20%</td>
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<tr>
<td>Total</td>
<td>222</td>
<td>100%</td>
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Table.3 Correlation of OIs with CD4 cell counts

<table>
<thead>
<tr>
<th>Type of OI's</th>
<th>CD4⁺ count (cells/µl) range</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>&lt;50</td>
</tr>
<tr>
<td></td>
<td>n=37</td>
</tr>
<tr>
<td>Opportunistic pathogens</td>
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<tr>
<td>M.tuberculosis</td>
<td>10</td>
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<tr>
<td>Extrapulmonary</td>
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</tr>
<tr>
<td>Klebsiella pneumoniae</td>
<td>3</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
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<td>Streptococcus pneumonia</td>
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<td>Salmonella typhi</td>
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</tr>
<tr>
<td>Shigella dysenteriae</td>
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<td>Nonfermenter</td>
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<td>Bacterial</td>
<td>10</td>
</tr>
<tr>
<td>Fungal</td>
<td>16</td>
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<tr>
<td>Candidiasis</td>
<td>5</td>
</tr>
<tr>
<td>Cryptococcus neoformans</td>
<td>1</td>
</tr>
<tr>
<td>Pneumocystis jiroveci</td>
<td>1</td>
</tr>
<tr>
<td>Trichophytonrubrum</td>
<td>1</td>
</tr>
<tr>
<td>Parasitic</td>
<td>2</td>
</tr>
<tr>
<td>Cryptosporidium parvum</td>
<td>1</td>
</tr>
<tr>
<td>Strongyloides stercoralis</td>
<td>1</td>
</tr>
<tr>
<td>Isospora belli</td>
<td>1</td>
</tr>
<tr>
<td>Hymenolepis nana</td>
<td>1</td>
</tr>
<tr>
<td>Entamoeba histolytica</td>
<td>1</td>
</tr>
<tr>
<td>Giardia lamblia</td>
<td></td>
</tr>
<tr>
<td>Toxoplasma gondii</td>
<td></td>
</tr>
<tr>
<td>Viral</td>
<td>3</td>
</tr>
<tr>
<td>Herpes zoster</td>
<td></td>
</tr>
<tr>
<td>Genital herpes</td>
<td>2</td>
</tr>
<tr>
<td>Molluscum contagiosum</td>
<td>2</td>
</tr>
<tr>
<td>Venereal warts</td>
<td></td>
</tr>
<tr>
<td>Cytomegalovirus retinitis</td>
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</tr>
</tbody>
</table>

In the present study with increasing bacterial infections along with both forms of tuberculosis, Candida and Cryptococcus, we also found Cytomegalovirus retinitis in 16.7% (1/6) cases, Molluscum contagiosum in 33.3% (2/6) and Pneumocystis jiroveci in 4.3% (1/23).

Cytomegalovirus infections have also been reported by Fauci\textsuperscript{52}, Crowe et al\textsuperscript{43} and NACO\textsuperscript{42} at this level of CD4⁺ cell count.

Merle A et al\textsuperscript{40} has also reported Molluscum contagiosum at CD4⁺ cell count < 50 cells/mm\textsuperscript{3}.
Pneumocystis jiroveci has also been found to occur at CD4+ cell count <50 cells/mm³ by Giri TK et al. NACO 42 and Ballal et al 54 have also reported Cryptococcal meningitis at CD4+ cell count < 50/mm³.

The male gender is the important factors in HIV-AIDS infection. Candidiasis as opportunistic infection is the first indication of immunodeficiency followed by tuberculosis and Cryptosporidium parvum infection. There exists definite CD4+ cell count correlation with the opportunistic infections in HIV-AIDS patients starting with Candidiasis, Pulmonary tuberculosis, Cryptosporidiosis, Herpes, Cryptococcal meningitis, Pneumocystis jiroveci pneumonia, Toxoplasma gondii and in terminal stage of immunodeficiency, bacterial pneumonia along with Molluscum contagiosum and Cytomegalovirus retinitis in the order of increasing immunodeficiency.

Early diagnosis and prompt treatment of opportunistic infections is important before development of severe immunodeficiency to prevent serious and fatal outcome.

References

12. SanjeevSinha and RandeepGuleria. Spectrum of Pulmonary Infections in


