Trop J Nat Prod Res, September 2020; 4(9):612-620

ISSN 2616-0684 (Print)
ISSN 2616-0692 (Electronic)

Tropical Journal of Natural Product Research

Available online at https://www.tjnpr.org

Original Research Article

CD4+ T- Lymphocyte Values, Bloodstream Bacterial Isolates and their Antibiotic Susceptibility Profiles among Human Immunodeficiency Virus Infected Patients in Uyo, Nigeria

Olajide J. Akinjogunla[1]*, Agantem E. Ekuma[2], Idongesit U. Etukudo[3], Godwin O. Oshosanya[2], David E. Inyang[1]

[1]*Department of Microbiology, Faculty of Science, University of Uyo, P.M.B. 1017, Uyo, Akwa Ibom State, Nigeria*
[2]*Department of Medical Microbiology and Parasitology, Faculty of Basic Clinical Sciences, University of Uyo, Akwa Ibom State, Nigeria*
[3]*Department of Microbiology, Faculty of Biological Sciences, Abia State University, Uturu, Abia State, Nigeria*

ARTICLE INFO

Article history:
Received 13 August 2020
Revised 07 September 2020
Accepted 29 September 2020
Published online 03 October 2020

ABSTRACT

Studies on HIV infections have been widely reported in Nigeria, yet there are paucity of data regarding CD4+ values and bacteremia among HIV infected patients. This study determined CD4+ T-lymphocyte values and provided information on antibiotic susceptibility of bacteria from blood of HIV infected patients. Socio-demographic characteristics of subjects were obtained via questionnaires. CD4+ values of subjects were obtained using Pima ™ Analyzer. Bacteriological analysis of blood was carried out using Oxoid Signal blood culture bottles system and bacteriological agar. The antibiotic susceptibility profiles of isolates were determined by disc diffusion techniques. The HIV infection was highest and lowest among subjects aged 31–40 yrs and ≤ 20 yrs**,** respectively**.** There was a significant difference in HIV prevalence among subjects based on educational and marital status at $p < 0.005$. The CD4+ T-lymphocyte values ranged from ≤ 100 to ≥ 800 cells /uL. Thirty-three samples had positive bacterial growth and bacterial genera obtained were *Staphylococcus, Acinetobacter, Streptococcus, Pseudomonas, Bacillus, Proteus, Salmonella* and *Escherichia. Streptococcus pneumoniae* and coagulase negative *Staphylococcus* spp exhibited ≥71.4% sensitivity to Doxycycline and Azithromycin, ≤ 42.8% *S. pneumoniae* were Penicillin resistant, between 80 and 100% *S. aureus, Bacillus* spp, *E. coli* and *Acinetobacter* spp showed sensitivity to Tobramycin, while *P. aeruginosa* were highly resistant to Ceftriaxone. This study showed that blood stream infections among HIV infected patients with CD4+ T-lymphocyte values ranging from ≤ 100 and ≥ 800 cells/µL were caused by antibiotic-resistant bacteria, predominantly *S. aureus* and CoN *Staphylococcus* spp.

Keywords: CD4+, lymphocyte, HIV, Antibiotics, Bacteremia, Susceptibility.

Introduction

Human Immunodeficiency Virus (HIV), belonging to the genus Lentivirus in the family Retroviridae and subfamily Orthoretrovirinae, is the causative agent of Acquired Immunodeficiency Syndrome (AIDS).[1,2] The HIV/AIDS epidemic has continued to be the world's utmost public health challenge, most especially in the developing countries.[3] Nigeria accounted for 9% of global HIV infection, with 3.2 million people living with HIV; 220,000 newly infected and 210,000 AIDS-related deaths.[4] The sexual networking practices, unprotected sex, poverty and blood transfusion have vastly contributed to the spread of HIV-1 and HIV-2.[3,5] Inadequate information regarding HIV among young adolescents coupled with socio-cultural factors have contributed immensely to stigmatizing tendencies towards those infected with HIV.[3]

The cluster of differentiation 4 (CD4+) value is a reliable and common predictive marker used for evaluation of disease progression in HIV-infected patients.[6,7]

*Corresponding author. E mail: papajyde2000@yahoo.com
Tel: +2348064069404

Citation: Akinjogunla OJ, Ekuma AE, Etukudo IU, Oshosanya, GO, Inyang, DE. CD4+ T- Lymphocyte Values, Bloodstream Bacterial Isolates and their Antibiotic Susceptibility Profiles among Human Immunodeficiency Virus Infected Patients in Uyo, Nigeria. Trop J Nat Prod Res. 2020; 4(9):612-620. doi.org/10.26538/tjnpr/v4i9.20

Official Journal of Natural Product Research Group, Faculty of Pharmacy, University of Benin, Benin City, Nigeria.

The HIV invades immune cells such as macrophages, dendritic cells and CD4+ T cells.[6] The innate ability of the virus to invade and destroy CD4 lymphocytes leads to decline in CD4+ T cell numbers below a critical level as the HIV viral loads increase and makes the host to become progressively more vulnerable to opportunistic infections.[6] Bacteraemia, bacterial bloodstream infection, is one of the most substantial causes of morbidity and mortality among HIV-infected patients[8,9] with case-fatality ratios >50 %.[10] In Africa, bacteraemia contributes to between 10 and 38% of all hospitalizations of febrile and HIV-infected patients.[11] Severe neutrophil reduction, abnormalities in cell-mediated immunity and low CD4+ T-cell counts often predispose HIV-infected patients to bacteraemia.[12] *Klebsiella pneumoniae*, *Staphylococcus aureus Acinetobacter* spp., *Pseudomonas aeruginosa*, *Escherichia coli* and alpha-hemolytic streptococci are pathogenic bacteria associated with bloodstream infections.[13]

Prompt detection and identification of pathogenic microorganisms in blood cultures[14] and rapid administration of appropriate antibiotics to the patients aids in the reduction of morbidity and mortality associated with blood stream infections.[15] However, the high resistance profile of bacteria, attributable to an indiscriminate use of antibiotics has posed a serious challenge to the clinicians in the management/treatment of bacterial infections.[16] Studies on HIV infections have been widely reported in Nigeria, yet there are paucity of data regarding CD4+ values and bacteremia among HIV infected patients. Thus, this study was undertaken to determine the CD4+ lymphocyte values and prevalence of blood stream bacteria and their antibiotic susceptibility profiles among Human Immunodeficiency Virus (HIV) patients in Uyo, Nigeria.

ISSN 2616-0684 (Print)
ISSN 2616-0692 (Electronic)

Materials and Methods

Collection of samples

Venous blood samples were aseptically collected using sterile disposable syringes from confirmed HIV infected patients (aged ≤ 20 yrs and ≥ 51 yrs) attending different hospitals in Uyo, Akwa Ibom State. The approval from the management of the hospitals (UA/H07 2018) and verbal informed consents of participants (44 males and 51 females) were obtained prior to samples collection. The samples were transported in a cold box within 1–4 hrs of collection to laboratories for analysis. Questionnaires were administered to the subjects to obtain their socio-demographic characteristics (gender, age, occupation, marital status and educational level).

Inclusion criteria

The HIV infected patients, either on antiretroviral drugs or not, who agreed and gave verbal consent to participate were recruited in the study.

Exclusion criteria

The HIV negative patients and HIV infected patients who were on antibiotics within one week prior to enrolment and/or those that declined to participate in the study.

Determination of Cluster of Differentiation 4 *(CD4+) T- lymphocyte counts*

The cluster of differentiation 4 (CD4+) T- lymphocyte counts (cells /µL) of HIV positive patients were determined using Pima ™ Analyzer (Waltham, Maryland, USA). The blood samples were run only after the normal and low value control cartridges gave acceptable values. Each blood sample collected in EDTA tube was loaded in a Pima ™ disposable cartridge containing anti-human CD4-dye monoclonal antibodies using a disposable transfer pipette. Thereafter, the collector was removed and cartridge was immediately placed in the PIMA analyzer for 20 mins and results were obtained.

Bacteriological analysis of samples

The blood samples (10 mL) from HIV infected patients (n = 95) were aseptically inoculated into Oxoid Signal blood culture bottles system (BC0100), mixed with the medium and incubated for 2-10 days. Thereafter, 10 µL of aliquot from each of the bottles (positive vials) was subcultured onto plates of MacConkey, blood and chocolate agar (Thermo Fisher Scientific Oxoid Ltd). The plates were aerobically incubated at 37°C for 18-24 hrs and bacterial isolates obtained were identified using their cultural, morphological, biochemical and sugar fermentation tests according to the published protocols.[17]

Antibiotic sensitivity testing of bacterial isolates

Antibiotic susceptibility testing was performed using the Kirby–Bauer disc diffusion technique.[18] Ten microliters (10 µL) of each bacterial suspension, prepared directly from an overnight agar plate, adjusted to 0.5 McFarland Turbidimetric Standard of approximately 1.5 x 10^8 CFU/mL, was inoculated using sterile pipette onto each plate containing Mueller-Hinton Agar (MHA). The antibiotic discs used for Gram negative bacteria were: Gentamycin (GEN), Streptomycin (STR), Tobramycin (TOB), Ciprofloxacin (CIP), Ofloxacin (OFL), Levofloxacin (LEV), Aztreonam (ATM), Tigemonam (TIG), Ampicillin (AMP), Piperacillin (PPC), Ceftriaxone (CEF), Ceftazidime (CFT), Cefoperazone (CFP), Meropenem (MER), Imipenem (IMI) and Ertapenem (ERT). The antibiotic discs used for Gram positive bacteria were: Gentamycin (GEN), Streptomycin (STR), Tobramycin (TOB), Ciprofloxacin (CIP), Ofloxacin (OFL), Levofloxacin (LEV), Ampicillin (AMP), Piperacillin (PPC), Tetracycline (TET), Doxycycline (DOX), Erythromycin (ERY) and Azithromycin (AZI). The antibiotic discs were aseptically placed on the surfaces of the culture plates using sterile forceps. The plates were aerobically incubated at 37°C for 18 hr and inhibition zones after incubation were observed, measured in millimeters (mm) using a ruler and interpreted as sensitive (S), intermediate sensitive (I) resistant (R) according to the CLSI criteria.[18]

Statistical Analysis

The data obtained were analyzed using Statistical Package for Social Sciences (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). The chi-square ($\chi 2$) test was used to determine the statistically significant difference in the socio-demographic characteristics of HIV infected patients at $p \leq 0.05$. Descriptive data were presented as charts and percentages.

Results and Discussion

The socio-demographic characteristics of HIV-infected patients recruited in this study are presented in Table 1. Of the 95 participants, 44 were males and 51 were females, giving a gender ratio of 1: 1.6. The HIV prevalence was highest among subjects within ages 31–40 yrs and lowest among subjects aged ≤ 20 yrs**.** There was a statistically significant difference in occurrence of HIV infection among the subjects based on ages ($\chi^2 = 16.31$, df = 4, p = 0.003). Fourteen (14.7%) of the subjects had primary school education, 30.5% had secondary education, 42.1% had tertiary education, while 12.6% of subjects had no formal education. The HIV prevalence was highest among the married (43.5%, 41/95), followed by the single (29.5%, 28/95), widowed (16.8%, 16/95) and divorced (10.5%, 10/95). The prevalence of HIV infections based on the occupations of subjects in decreasing order was: self-employed (28.4%) > students (22.1%) > traders (16.8%) > unemployed /retired (14.7%) > civil servants (10.5%) > teachers (7.4%). More than half (62.1%) of the subjects were on antiretroviral drugs, while 37.9% were non-users. There was a statistically significant difference at $p < 0.005$ in prevalence of HIV infections among subjects based on educational level and marital status (Table 1).

The CD4+ T- lymphocyte counts of HIV-infected patients ranged from ≤ 100 to ≥ 800 cells/µL. Twenty-two (23.2%) subjects had CD4+ counts of ≤ 299 cells/µL; 62.1% subjects had CD4+ counts between 300 and 599 cells/µL, 6.3% had CD4+ counts ranging from 600 to 699 cells/µL, while 2.1% subjects had CD4+ counts of ≥ 800 cells/µL (Table 2). Of the 95 blood samples from the subjects, sixty-two (62) samples did not yield any bacterial growth, while 33 samples had positive bacterial growth, giving a prevalence of 34.7% for bacteremia. The blood samples of subjects with bacterial growth was highest in the age group 31-40 yrs (14/33; 42.4%), followed by age group 41-50 yrs (8/21; 38.1%), 21-30 yrs (5/17; 29.4%) and ≥ 51 yrs (4/14; 28.6%), while age group ≤ 20 yrs had the lowest (2/10; 20.0%). Of the 51 blood samples from female subjects, (39.2%) had bacterial growth, while 29.5% samples from male subjects (n = 44) had bacterial growth (Table 3).

Fifty-three bacterial isolates, belonging to the genera *Staphylococcus*, *Acinetobacter*, *Salmonella*, *Proteus*, *Pseudomonas*, *Bacillus*, *Streptococcus* and *Escherichia* were obtained from the samples. Of the 53 isolates obtained, 39.6% isolates were from male subjects, while 60.4% isolates were obtained from female subjects. The percentage occurrence of isolates in decreasing order was *S. aureus* (18.9%) > *S. typhi* (17.0%) > CoN *Staphylococcus* spp/*S. pneumoniae* (13.2%) > *E. coli* (11.3%) > *P. mirabilis* (9.3%) > *P. aeruginosa* (7.5%) > *Acinetobacter* spp (5.7%) > *Bacillus* spp (3.8%) (Table 4). The distributions of bacterial isolates based on CD4+ values of subjects are presented in Table 5. The subjects with CD4+ values ranging from 300 to 399 cells/µL had the highest number of bacterial isolates (n = 16), followed by subjects with CD4+ values of 200 to 299 cells/µL (10 bacterial isolates), while *S. typhi* was the only isolate from subjects with CD4+ values of ≥ 800 cells/µL. Three (3) bacterial isolates each were obtained from subjects with CD4+ values of ≤ 100 cells/µL, 500 to 599 cells/µL and 600 to 699 cells/µL. *S. aureus* and *P aeruginosa* were the only isolates from subjects with CD4+ values of 700 to 799 cells/µL (Table 5).

Salmonella typhi were highly sensitive to Tobramycin, Ceftriaxone (100 %) and Meropenem (88.9%), and showed moderately high resistance to Tigemonam and Ampicillin (44.4%). More than 80.0% *P. mirabilis* and *E. coli* were Meropenem, Aztreonam and Ceftriaxone sensitive. *Acinetobacter* spp were 100% sensitive to Ampicillin and Aztreonam, but were highly resistant to Ofloxacin (66.7%). *P.*

ISSN 2616-0684 (Print)
ISSN 2616-0692 (Electronic)

aeruginosa showed high sensitivity (100%) to Piperacillin, Cefoperazone and Ertapenem and showed ≤ 50.0% resistance to Ciprofloxacin and Imipenem (Tables 6 and 7). *Streptococcus pneumoniae* and CoN *Staphylococcus* spp exhibited between 71.4 and 85.7% sensitivity to Levofloxacin, Doxycycline, Piperacillin and Azithromycin, while ≤ 42.8% *S. pneumoniae* were Penicillin resistant (Table 8). The percentage intermediate susceptibility of *S. aureus* to Gentamycin, Streptomycin and Levofloxacin was 10.0%, while between 80 and 100% *S. aureus and Bacillus* spp showed Tobramycin and Doxycycline sensitive (Table 9). Of the 15 different antibiotics tested against GNB, Ciprofloxacin resistance prevalence was highest (37.0 %), followed by Imipenem (32.3%), Tigemonam (29.6%), Ampicillin (29.6%), Ofloxacin (29.6%), Piperacillin (25.9%) and Streptomycin (25.9%). The GNB showed the highest sensitivity to Meropenem (92.6%), Tobramycin (85.2%), Ceftriazone (81.5%) and Aztreonam (77.8%). The percentage intermediate susceptibility of GNB to Gentamycin, Ofloxacin, Levofloxacin and Ertapenem was 14.8%, 14.8%, 3.7% and 11.1%, respectively (Figure 1). Overall, between 73.1 and 84.6% GPB isolates recovered from the blood samples of subjects were sensitive to Tobramycin, Levofloxacin, Doxycycline, Piperacillin, Erythromycin and Azithromycin. Of the 12 different antibiotics tested against GPB, Ampicillin resistance prevalence was highest (46.2%), followed by Tetracycline (34.6%), while Ciprofloxacin, Ofloxacin and Streptomycin was 30.8% each. The percentage intermediate susceptibility of GNP to Gentamycin, Levofloxacin and Azithromycin was ≤ 11.5% (Figure 2).

The prevalence of HIV has drastically increased in recent years and approximately 5.6% of people living with HIV infection in Nigeria hail from Akwa Ibom State.[19] The socio-demographic characteristics of HIV infected patients recruited in this study showed that the highest and lowest prevalence of HIV was among subjects within ages 31–40 yrs and ≤ 20 yrs, respectively. The lowest prevalence of HIV infection among subjects aged ≤ 20 yrs may be attributed to their less likely engagement in high-risk sexual behaviour when they reside with their parents. In our findings the prevalence of HIV infection was highest among the married, followed by the single, widowed and was lowest among the divorced. The highest prevalence of HIV infection among the married in this study was in conformity with the findings of Khan and Sharma[20] and Kemei *et al*.[21] in which ≥ 46% of the married had HIV infection in Kenya. The high prevalence of HIV infection among the married might be attributed to non-use of a condom during sexual intercourse, believing that their partners were faithful and did not engage in extramarital affairs. Although, education has been shown as a factor associated with HIV awareness, but in this study, the prevalence of HIV infection was more among subjects with formal education than those without any formal schooling and this conformed to the study of Taylor *et al.*[22] in Kumasi, Ghana.

In this study, HIV prevalence was higher among females than males and this corroborated the findings of Taylor *et al.*[22] in Ghana. Several reports have shown higher vulnerability to HIV infection among females than males owing to the increased surface areas of their genital parts compared to that of males;[23] higher concentrations of HIV in semen than in vaginal secretions;[23] damage of delicate tissues of the female genital tract during intercourse leading to increased abrasions, vaginal bleeding and tearing[22] and the warmth and moistness of the vaginal muscles that aids easy entrance of HIV into the body.

Table 1: Socio-demographic Characteristics of HIV Infected Patients

Socio-demographic Characteristics		HIV Positive Patients		$\chi 2$	p-value
		No	%		
Gender	Male	44	46.3	0.52	0.473
	Female	51	53.7		
Age	≤ 20	10	10.5	16.31	0.003*
	21-30	17	17.9		
	31-40	33	34.7		
	41-50	21	22.1		
	≥ 51	14	14.7		
Educational Level	Primary	14	14.7	22.09	0.001*
	Secondary	29	30.5		
	Tertiary	40	42.1		
	None	12	12.6		
Marital Status	Single	28	29.5	23.78	0.001*
	Married	41	43.5		
	Divorced	10	10.5		
	Widowed	16	16.8		
Occupation	Teacher	7	7.4	16.85	0.005
	Trader	16	16.8		
	Civil Servants	10	10.5		
	Students	21	22.1		
	Self -Employed	27	28.4		
	Unemployed / Retired	14	14.7		
Antiretroviral drug (ARV)	Users	59	62.1	5.57	0.018
	Non-users	36	37.9		

ISSN 2616-0684 (Print)
ISSN 2616-0692 (Electronic)

The CD4+ T-cell count is a surrogate marker of HIV progression[24] and as well a suitable means of assessing clinical prognosis of HIV infected patients, monitoring the risk of opportunistic infections and treatment failure.[25] In our study, the CD4+ T-cell counts of HIV infected patients varied between ≤ 100 and ≥ 800 cells/µL. Studies have revealed that CD4+ T-cell counts of HIV infected patients could decline from a normal level of 800-900 to ≤ 100 cells/µL. [26] and this study confirmed that as 2.1% subjects had CD4+ T-cell counts of ≤ 100 cells/µL. The detection of a low CD4+ T-cell counts ≤ 200 cells/µL among subjects in this study corroborated the previous report of Mboto *et al.*[27] The occurrence of 7.4% subjects with CD4+ T-cell counts of ≤ 200 cells/µL in this study was lower than the value reported by Adeleye *et al.*[28] in which 67% HIV infected patients attending Lagos Teaching Hospital had CD4+ T-cell counts of ≤ 200 cells/µL. The CD4+ T-cell count of ≤ 200 cells/µL has been reported as a significant threshold at which the HIV infected patients become vastly susceptible to opportunistic infections,[29] thus, necessitates the administration of anti-retroviral therapy.

Bacteremia, one of the features of HIV/AIDS from the onset of the epidemic,[30] constitutes a significant public-health problem and causes of morbidity and mortality in HIV/AIDS patients.[31] *S. aureus, S. typhi,* CoN *Staphylococcus* spp, *S. pneumoniae, E. coli, P. mirabilis, P. aeruginosa, Acinetobacter* spp and *Bacillus* spp were isolated from blood samples of subjects. The isolation of *E. coli* and *S. pneumonia*e from blood samples of subjects corresponded to the findings of Kiertburanakul *et al*.[32] who obtained *E. coli* and *S. pneumoniae* from blood samples of HIV infected patients in Thailand. Our study substantiated the findings of Verma and McCarthy[33] that *E. coli, S. aureus, S. pneumoniae* and *P. aeruginosa* were bacteria associated with bloodstream infections in HIV infected individuals. Studies have also shown that apart from the higher burden of bacteraemia among HIV infected patients in sub-Saharan Africa, the spectrum of aetiologic agents differed from those in developed world.[34] *S. aureus* was predominant bacterial isolate and this agreed with the reports of Imade *et al.*[35] in Benin, but contradicted the findings of Bonadio *et al*.[36] and Choi *et al.*[37] who reported CoN Staphylococci as the commonest bacterial isolate in bloodstream of HIV infected patients.

This study showed varied percentages of antibiotic susceptibility among the Gram positive and Gram negative bacteria isolated from blood streams of the subjects. *P. aeruginosa, S. typhi* and *Acinetobacter* spp were vastly sensitive to Tobramycin, Levofloxacin, Ceftazidime and Aztreonam. The high sensitivity of *P. aeruginosa* to Ceftazidime observed in this study differs from the result of Ojo *et al.*[38] who obtained high Ceftazidime resistant *P. aeruginosa* in Ado-Ekiti. Our study showed that 85.7% *S. pneumoniae* were sensitive to Ciprofloxacin and this value was higher than 57.1% Ciprofloxacin sensitive *S. pneumoniae* obtained by Nielsen *et al*.[39] *E. coli* showed high sensitivity to Aztreonam, Ceftriazone, Tobramycin and Piperacillin. Although, the high sensitivity of *E. coli* and *P. mirabilis* to Tobramycin and Ceftriazone in this study agreed with Kassam *et al*.[40] but there was discrepancy regarding the sensitivity of *E. coli* to Piperacillin. *S. aureus* and *B. substilis* showed ≥ 70% sensitivity to Tobramycin, Levofloxacin and Ciprofloxacin. Our results on high sensitivity of *S. aureus* to Tobramycin (aminoglycoside) and Ciprofloxacin (fluroquinolone) substantiated the findings of Etok *et al.*[41] on fluroquinolones and aminoglycosides sensitive *S. aureus*. Consequently, early identification of bacterial pathogens and administration of appropriate antibiotics will possibly reduce morbidity and mortality associated with blood stream infections among HIV-infected patients with low CD4+ T-cell counts.

Table 2: Cluster of Differentiation 4+ T-Lymphocyte Counts of HIV Infected Patients

CD4+ Counts (cells/µL)	Age (yrs)					Total No (%)
	≤ 20	21-30	31-40	41-50	≥ 51	
≤ 100	0	0	1	1	0	2 (2.1)
100-199	0	0	2	1	2	5 (5.3)
200-299	0	3	5	5	2	15 (15.8)
300-399	3	4	13	5	4	29 (30.5)
400-499	4	4	6	2	3	19 (20.0)
500-599	2	2	2	3	2	11 (11.6)
600-699	1	2	2	1	0	6 (6.3)
700-799	0	1	2	2	1	6 (6.3)
≥800	0	1	0	1	0	2 (2.1)
Total	10	17	33	21	14	95 (100)

Table 3: Prevalence of Bacteremia Based on Age and Gender of HIV Infected Patients

Age (yrs)	No. of Samples Collected		No. (%) of Samples with Bacteria		Total No (%)
	Male	Female	Male	Female	
≤ 20	4	6	0 (0.0)	2 (33.3)	2 (20.0)
21-30	7	10	2 (28.6)	3 (30.0)	5 (29.4)
31-40	15	18	6 (40.0)	8 (44.4)	14 (42.4)
41-50	11	10	4 (36.4)	4 (40.0)	8 (38.1)
≥ 51	7	7	1 (14.3)	3 (42.9)	4 (28.6)
Total	44	51	13 (29.5)	20 (39.2)	33 (34.7)

ISSN 2616-0684 (Print)
ISSN 2616-0692 (Electronic)

Table 4: Age and Gender-Wise Distribution of Bacterial Isolates in Blood Cultures of HIV Infected Patients

	Gender		Age (yrs)					
	Male	Female	≤ 20	21-20	31-30	41-40	≥ 51	Total
Bacterial Isolates	**No (%)**	**No (%)**	**No (%)**	**No (%)**	**No (%)**	**No (%)**	**No (%)**	**No (%)**
CoN *Staphylococcus* spp	3 (42.9)	4 (57.1)	0 (0.0)	0 (0.0)	3 (42.9)	2 (28.6)	2 (28.6)	7 (13.2)
S. aureus	3 (30.0)	7 (70.0)	1 (10.0)	2 (20.0)	5 (50.0)	1 (10.0)	1 (10.0)	10 (18.9)
Acinetobacter spp	1 (33.3)	2 (66.7)	0 (0.0)	0 (0.0)	1 (33.3)	2 (66.7)	0 (0.0)	3 (5.7)
S. typhi	6 (66.7)	3 (33.3)	2 (66.7)	2 (22.2)	2 (22.2)	0 (0.0)	3 (33.3)	9 (17.0)
P. mirabilis	1 (20.0)	4 (80.0)	1 (20.0)	0 (0.0)	1 (20.0)	0 (0.0)	3 (60.0)	5 (9.3)
S. pneumoniae	2 (28.6)	5 (71.4)	0 (0.0)	1 (14.3)	0 (0.0)	4 (57.1)	2 (28.6)	7 (13.2)
P. aeruginosa	1 (25.0)	3 (75.0)	0 (0.0)	1 (25.0)	3 (75.0)	0 (0.0)	0 (0.0)	4 (7.5)
Bacillus spp	0 (0.0)	2 (100)	0 (0.0)	0 (0.0)	1 (50.0)	1 (50.0)	0 (0.0)	2 (3.8)
E. coli	4 (66.7)	2 (33.3)	1 (16.7)	2 (33.3)	2 (33.3)	0 (0.0)	1 (16.7)	6 (11.3)
Total	21(39.6)	32(60.4)	5 (9.4)	8 (15.1)	18 (34.0)	10 (18.9)	12 (22.6)	53 (100)

Values in parentheses express the percentage (%) of bacteria isolated

Table 5: Distribution of Bacterial Isolates Based on CD4+ Counts of HIV Infected Patients

	No / CD4+ Counts (cells/µL) of Subjects									
	(n=2)	(n=5)	(n=15)	(n=28)	(n=19)	(n=10)	(n=6)	(n=6)	(n=4)	Total
Bacterial Isolates	**≤ 100**	**100-199**	**200-299**	**300-399**	**400-499**	**500-599**	**600-699**	**700-799**	**≥ 800**	
CoN *Staphylococcus* spp	-	-	-	4 (14.3)	2 (10.5)	-	1 (16.7)	-	-	7
S. aureus	1 (50.0)	1 (20.0)	3 (20.0)	2 (7.1)	-	2 (20.0)	-	1 (16.7)	-	10
Acinetobacter spp	-	1 (20.0)	-	1 (3.6)	1 (5.3)	-	-	-	-	3
S. typhi	-	1 (20.0)	3 (20.0)	3 (10.7)	1 (5.3)	-	-	-	1 (25.0)	9
P. mirabilis	1 (50.0)	-	2 (13.3)	-	1 (5.3)	-	1 (16.7)	-	-	5
S. pneumoniae	-	2 (40.0)	-	2 (7.1)	3 (15.8)	-	-	-	-	7
P. aeruginosa	-	-	1 (6.7)	2 (7.1)	-	-	-	1 (16.7)	-	4
Bacillus spp	-	-	1 (6.7)	-	-	1 (10.0)	-	-	-	2
E. coli	1 (50.0)	2 (40.0)	-	2 (7.1)	-	-	1 (16.7)	-	-	6

Table 6: Antibiotic Susceptibility Profiles of *S. typhi* and *P mirabilis* from HIV Infected Blood Samples

		Groups of Antibiotics															
		Aminoglycosides			Fluoroquinolones			Monobactams		Penicillins		Cephalosporins			Carbapenems		
Bacterial Isolates	**Codes**	**GEN**	**STR**	**TOB**	**CIP**	**OFL**	**LEV**	**ATM**	**TIG**	**AMP**	**PPC**	**CEF**	**CFT**	**CFP**	**MER**	**IMI**	**ERT**
S. typhi	ST01	S	S	S	R	S	S	R	S	R	R	S	S	S	S	S	S
	ST04	S	R	S	S	R	S	I	R	S	S	S	R	R	S	S	S
	ST08	S	S	S	S	S	S	R	S	S	S	S	S	S	S	S	S
	ST14	R	S	S	R	I	S	S	R	R	S	S	I	S	R	S	S
	ST20	I	S	S	S	S	I	S	S	R	R	S	S	I	S	R	I
	ST26	S	S	S	R	R	S	S	R	R	S	S	S	S	S	S	S
	ST31	R	I	S	S	I	S	R	R	S	S	S	I	S	S	R	S
	ST56	S	S	S	S	S	R	S	S	S	S	S	S	R	S	I	R
	ST90	I	R	S	I	R	S	I	S	S	R	S	R	S	S	S	S
P. mirabilis	PM19	S	S	R	S	S	R	S	S	S	R	S	S	R	S	R	R
	PM21	S	S	S	R	S	S	S	S	S	S	R	S	S	S	S	S
	PM32	I	R	R	S	I	S	R	R	S	S	S	S	S	S	S	S
	PM33	S	S	S	R	S	R	S	S	S	S	S	S	R	R	I	I
	PM75	R	R	S	S	R	S	S	S			S	R	S	S	R	S

Key: GEN: Gentamycin; STR: Streptomycin; TOB: Tobramycin; CIP: Ciprofloxacin, LEV: Levofloxacin; OFL: Ofloxacin; ATM: Aztreonam; TIG: Tigemonam; AMP: Ampicillin; PPC: Piperacillin; CEF; Ceftriazone; CFT: Ceftazidime; CFP: Cefoperazone; IMI: Imipenem; MER: Meropenem; ERT: Ertapenem; R: Resistant; I: Intermediate; S: Sensitive

ISSN 2616-0684 (Print)
ISSN 2616-0692 (Electronic)

Table 7: Antibiotic Susceptibility Profiles of *E coli*, *Acinetobacter* spp. and *P. aeruginosa* from HIV Infected Blood Samples

Bacterial Isolates	Codes	Group of Antibiotics														
		Aminoglycosides			Fluroquinolones			Monobactams		Penicillins		Cephalosporins			Carbapenems		
		GEN	STR	TOB	CIP	OFL	LEV	ATM	TIG	AMP	PPC	CEF	CFT	CFP	MER	IMI	ERT
E coli	EC02	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
	EC09	I	S	S	S	S	S	S	S	S	S	S	I	R	S	S	S
	EC14	R	R	R	S	S	R	S	S	R	R	S	S	R	S	R	R
	EC69	S	S	S	R	R	S	R	I	I	S	R	S	S	S	S	S
	EC77	S	R	S	S	I	S	S	R	S	S	S	R	S	S	R	S
	EC83	S	S	S	R	S	R	S	S	R	S	S	S	R	S	S	R
Acinetobacter	ST35	S	S	S	R	S	S	S	S	S	S	I	S	S	S	S	S
spp	ST77	R	I	I	S	R	S	S	R	S	R	S	S	S	S	R	S
	ST90	S	S	S	S	R	R	S	S	S	S	S	S	R	S	S	I
P. aeruginosa	PM08	S	S	S	S	S	S	S	R	R	S	R	S	S	S	S	S
	PM26	S	R	S	S	R	S	R	S	S	S	S	R	S	S	R	S
	PM72	R	S	S	R	S	R	S	S	R	S	S	S	S	S	S	S
	PM93	S	S	S	R	S	S	S	S	S	S	R	S	S	S	R	S

Key: GEN: Gentamycin; STR: Streptomycin; TOB: Tobramycin; CIP: Ciprofloxacin, LEV: Levofloxacin; OFL: Ofloxacin; ATM: Aztreonam; TIG: Tigemonam; AMP: Ampicillin; PPC: Piperacillin; CEF; Ceftriazone; CFT: Ceftazidime; CFP: Cefoperazone; IMI: Imipenem; MER: Meropenem; ERT: Ertapenem; R: Resistant; I: Intermediate; S: Sensitive

Table 8: Antibiotic Susceptibility Profiles of CoN *Staphylococcus* spp. and *S. pneumoniae* from HIV Infected Blood Samples

Bacterial Isolates	Codes	Groups of Antibiotics											
		Aminoglycosides			Fluoroquinolones			Tetracyclines		Penicillins		Macrolides	
		GEN	STR	TOB	CIP	OFL	LEV	TET	DOX	AMP	PPC	ERY	AZI
CoN	CS03	S	R	R	R	S	S	S	S	R	S	S	S
Staphylococcus spp	CS10	S	R	S	S	S	S	S	R	S	S	S	S
	CS03	S	S	S	R	S	S	R	S	R	R	S	S
	CS70	R	S	S	S	I	R	R	R	S	S	S	I
	CS19	R	S	S	S	S	I	S	S	R	R	S	S
	CS36	S	S	S	R	R	S	S	S	R	S	R	S
	CS07	S	S	S	S	I	S	R	S	S	S	R	I
S. pneumoniae	SS08	S	S	S	S	S	S	S	S	S	S	S	S
	SS14	S	R	R	S	S	S	R	R	S	R	S	R
	SS26	R	S	S	S	S	R	S	S	R	S	S	S
	SS41	S	S	S	R	S	S	S	S	R	S	S	S
	SS69	I	I	S	S	R	S	R	S	S	S	S	S
	SS80	S	S	R	S	S	S	S	S	S	S	S	S
	SS83	R	R	S	S	R	S	S	S	R	R	S	S

Key: GEN: Gentamycin; STR: Streptomycin; TOB: Tobramycin; CIP: Ciprofloxacin, LEV: Levofloxacin; OFL: Ofloxacin; TET: Tetracycline; DOX: Doxycycline; AMP: Ampicillin; PPC: Piperacillin; ERY: Erythromycin; AZI: Azithromycin: R: Resistant; I: Intermediate; S: Sensitive; CoN: Coagulase negative.

ISSN 2616-0684 (Print)
ISSN 2616-0692 (Electronic)

Table 9: Antibiotic Susceptibility Profiles of *S. aureus* and *Bacillus* spp. from HIV Infected Blood Samples

		Groups of Antibiotics											
		Aminoglycosides			Fluoroquinolones			Tetracyclines		Penicillins		Macrolides	
Bacterial Isolates	Codes	GEN	STR	TOB	CIP	OFL	LEV	TET	DOX	AMP	PPC	ERY	AZI
S. aureus	SA01	S	R	S	S	R	S	R	S	R	S	S	S
	SA02	S	R	S	S	S	S	R	R	S	S	S	R
	SA03	S	S	S	S	S	S	R	S	S	S	S	S
	SA04	R	S	S	R	R	S	S	S	R	S	S	R
	SA50	R	S	S	S	S	I	S	S	R	R	S	S
	SA52	S	S	S	R	R	S	S	R	S	S	R	R
	SA57	S	I	S	S	S	S	R	S	S	S	R	R
	SA64	S	S	S	S	S	R	S	S	S	S	S	S
	SA69	I	R	S	R	R	S	S	S	S	S	S	S
	SA95	R	R	R	S	S	R	S	S	R	R	S	S
Bacillus spp	BS12	S	S	S	S	S	S	S	S	R	R	R	S
	BS45	I	S	S	R	R	S	S	S	S	S	S	S

Key: GEN: Gentamycin; STR: Streptomycin; TOB: Tobramycin; CIP: Ciprofloxacin, LEV: Levofloxacin; OFL: Ofloxacin; TET: Tetracycline; DOX: Doxycycline; AMP: Ampicillin; PPC: Piperacillin; ERY: Erythromycin; AZI: Azithromycin: R: Resistant; I: Intermediate; S: Sensitive

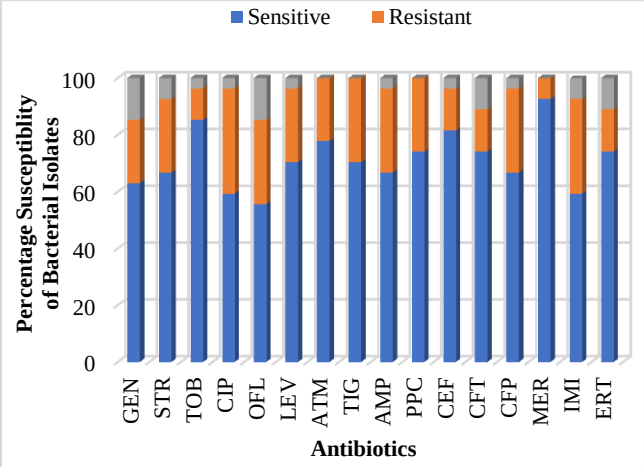

Figure I: Percentages Susceptiblity of Isolates (Gram Negative Bacteria) vs Antibiotics
Key: GEN: Gentamycin; STR: Streptomycin; TOB: Tobramycin; CIP: Ciprofloxacin; LEV: Levofloxacin; OFL: Ofloxacin; ATM: Aztreonam; TIG: Tigemonam; AMP: Ampicillin; PPC: Piperacillin; CEF; Ceftriazone; CFT: Ceftazidime; CFP: Cefoperazone; IMI: Imipenem; MER: Meropenem; ERT: Ertapenem.

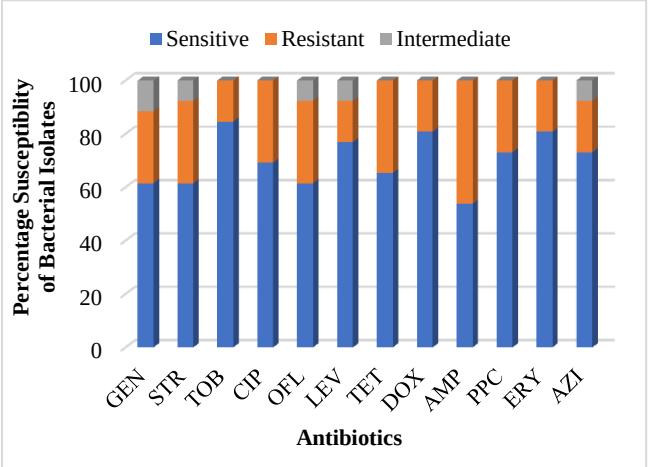

Figure 2: Percentages Susceptiblity of Isolates (Gram Positive Bacteria) Vs Antibiotics
Key: GEN: Gentamycin; STR: Streptomycin; TOB: Tobramycin; CIP: Ciprofloxacin; LEV: Levofloxacin; OFL: Ofloxacin;
TET: Tetracycline; DOX: Doxycycline; AMP: Ampicillin; PPC: Piperacillin; ERY: Erythromycin; AZI: Azithromycin.

Conclusion

This study has shown that blood stream infections among HIV infected patients with CD4+ T-cell counts ranging from ≤ 100 and ≥ 800 cells/µL were caused by spectrum of bacteria, predominantly *S. aureus* and CoN *Staphylococcus* spp. In addition, the varied antibiotic susceptibility profiles of bacterial isolates associated with blood stream infections among the subjects were revealed.

Conflict of interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

Acknowledgements

The authors would like to thank all support staff and students, especially Miss Onuh, Peace Kelechi and the patients who participated in this study.

References

1. Luciw PA. Human immunodeficiency viruses and their replication. In: Fields BN (Hrsg) Virology, 3. Aufl. Lippincott-Raven, Philadelphia, 1996. S 1881–1952 p.
2. Douek DC, Roederer M, Koup RA. Emerging Concepts in the Immunopathogenesis of AIDS. Annu Rev Med. 2009; 60:471–484.
3. Akinjogunla OJ and Adegoke AA. Sero-prevalence of human immunodeficiency virus (HIV) 1 and 2 infections in Uyo metropolis, Akwa Ibom State. Sci Res Essays 2009; 4(11):1381-1384.
4. UNAIDS. HIV and AIDS estimates in 2014, Geneva, Switzerland.Availableat http://www.unaids.org/en/regionscountries/countries/nigeria, 2014.
5. Pennap GRI, Makut MD, Gyar SD, Owuna G. Sero-prevalence of HIV/AIDS in Keffi and Environs. Nig J Microbiol. 2006; 20(3):1114 - 1146.
6. Walkers BR and Colledge NR. Davidson's principle and practice of medicine. Elsevier Health Science, 2013. 987 p.
7. Shaukat SN, Khan S, Raza A, Khanani R, Ghayaz, A, Kazmu SU. Prognostic markers in HIV mono-and co-infected individuals: A study from Karachi–Pakistan. J Infect Pub Health 2018; 11(2):250-255.
8. Diekema DJ, Beekmann SE, Chapin KC, Morel KA, Munson E, Doer GV. Epidemiology and outcome of nosocomial and community-onset bloodstream infection. J Clin Microbiol. 2003; 41(8):3655–3660.
9. Muyanja SZ, Larke N, Rutebarika D, Kaddu I, Nakubulwa S. Decreasing trends of bacteraemia among HIV-infected Ugandan adults: incidence, aetiology, clinical outcomes and effect of antiretroviral therapy in a semi-urban setting (2000–2008). Trop Med Int Health 2011; 16:756–765.
10. Ali J and Kebede Y. Frequency of isolation and antimicrobial susceptibility pattern of bacterial isolates from blood culture, Gondar University Teaching Hospital, Northwest Ethiopia. Ethiop Med J. 2008; 46:155–161.
11. Reddy EA, Shaw AV, Crump JA. Community-acquired bloodstream infections in Africa, a systematic review and meta-analysis. Lancet Infect Dis. 2010; 10:417–432.
12. Brettle RP. Bacterial infections in HIV: the extent and nature of the problem. Int. J. STD AIDS 1997; 8:5-15.
13. Cervera C, VanDelden C, Gavalda J, Welte T, Akova M. Multidrug-resistant bacteria in solid organ transplant recipients. Clin Microbiol Infect. 2014; 20(Suppl. 7):49–73.
14. Mehta M, Dutta P, Gupta V. Antimicrobial susceptibility pattern of blood isolates from a teaching hospital in North India, Jpn J Infect Dis. 2005; 58(3):174–176.
15. Singh AK, Venkatesh V, Singh RP, Singh M. Bacterial and antimicrobial resistance profile of bloodstream infections: A hospital-based study, Chrismed J Health Res. 2014; 1(3):140-144.
16. Akinjogunla OJ, Eghafona NO, Enabulele IO. Aetiologic agents of acute otitis media (AOM): prevalence, antibiotic susceptibility, β-lactamase (βL) and extended spectrum β-lactamase (ESBL) production. J Microbiol Biotechnol Food Sci. 2012; (3):333-353.
17. Cheesbrough M. District laboratory practice in tropical countries, part II. Cambridge University, 2006. 80-81 p.
18. Clinical Laboratory Standard Institute (CLSI). Performance standard for antimicrobial disk susceptibility test. Fifteenth informational supplement, CLSI document M100-S15, Wayne PA, USA, 2015.
19. National Agency for the Control of AIDS (NACA). Revised national HIV/AIDS strategic framework, 2019.
20. Khan M and Sharma S. Socio-demographic and clinical profile of people living with HIV/ AIDS. Asian J Med Sci. 2012; 3(2):1-10.
21. Kemei T. HIV infections highest among married couples young adult men. J Urban Health 2013; 83(4):575-585.
22. Taylor J, Ossei PPS, Agyeman-Duah E, Baah E, Fenteng EA, Ayibor W. Socio-demographic characteristics of people living with HIV/AIDS at the Komfo Anokye Teaching Hospital, Ghana: A five-year retrospective study. ASMS 2018; 2(6):42-47.
23. WHO. Policy Brief: consolidated guidelines on HIV prevention, diagnosis, treatment and care for key population, NY, Geneva, 2013.
24. Ford N, Meintjes G, Marco V, Greene G, Chiller T. The evolving role of CD4 cell counts in HIV Care. Curr Opin HIV/AIDS 2017; 12(2):123-128.
25. Levine BL, Bernstein WB, Aronson NE, Schlienger K, Cotte J, Perfetto S. Adoptive transfer of costimulated CD4+ T Cells induces expansion of peripheral T cells and decreased CCR5 expression in HIV infection**.** Nat Med 2002; 8(1):47-53.
26. Chan RK. Early clinical manifestations of HIV infection. S Med J. 1990; 31:477–479.
27. Mboto CI, Davies-Russell A, Fielder M, Jewell AP. CD4+ lymphocyte values and trends in individuals infected with Human Immunodeficiency Virus and/or co-infected with Hepatitis C Virus in The Gambia. Afr Health Sci. 2009; 9(3):130-136.
28. Adeleye IA, Alani AS, Solomon BB, Obosi AC, Inem AV. Bacterial bloodstream infections in HIV-infected adults attending a Lagos Teaching Hospital. J Health Popul Nutr. 2010; 28(4):318-326.
29. Egger M, May M, Chêne G, Phillips AN, Ledergerber B, Dabis F. et al. Prognosis of HIV-1- infected patients starting highly active antiretroviral therapy: A collaborative analysis of prospective studies. Lancet 2002; 360(9327):119–129.
30. Bekele A, Bethany G, Berry K. Bacterial pneumonia in hospitalized patients with HIV infection. The pulmonary complications, ICU support, and prognostic factors of hospitalized patients with HIV (PIP) study. Am Rev Respirat Dis. 2003; 148:1523-1552.
31. Adeleye IA, Akanmu S, Bamiro S, Smith S, Inem V, Sobande O. Chromosomally mediated antibiotic resistance in non-thyphoidal Salmonellae isolates from HIV patients in Lagos. W Ind Med J. 2008; 57:548-549.
32. Kieriburanakul S, Watcharatipagron S, Chongtrakool P, Santanirand P. Epidemiology of bloodstream infections and predictive factors of mortality among HIV infected adult patient in Thailand in the era of HAART. J Infect Dis. 2012; 65(1):28-32.
33. Verma JK and McCarthy KD. Bloodstream infections among HIV infected outpatients, Southeast Asia. Emerg Infect Dis. 2010; 16(10):1569-1575.
34. Ward JL and Zangwill KM. Haemophilus influenzae. In: Feigin RD, Cherry JD, editors. Textbook of Pediatric Infectious Diseases. 4th edition. Philadelphia, PA:WB Saunders; 1998. 1464-1482 p.
35. Imade PE and Eghafona NO. Incidence of bacteraemia in antiretroviral-naive HIV-positive children less than five years of age in Benin -city, Nigeria. Libyan J Med. 2010; 5:10-12.
36. Bonadio M, Gigli C, Maccantio O, Longo B, Smorfa A. Bloodstream infection in HIV- positive patients: a review of sixty-eight episodes. J Chemother. 1998; 10:243-247.
37. Choi G, Van den Borne MPJ, Visser CE, Kersten MJ, Kater AP. Invasive infections with a coagulase-negative staphylococcus in an immunocompromised patient: case report and review of the literature. Ann Hematol 2008; 87:771-772.
38. Ojo BA, Adebolu TT, Odinayo MS. Assessment of blood CD4 count and antibiogram profile of bacteria isolated from HIV Patients, HIV Curr Res. 2016; 1(1):1-8.
39. Nielsen MV, ' Sarpong N, Krumkamp R, Dekker D, Loag W, Amemasor S, Incidence and characteristics of

ISSN 2616-0684 (Print)
ISSN 2616-0692 (Electronic)

bacteremia among children in rural Ghana, PLoS ONE 2012; 7(9): e44063.

40. Kassam NA, Damian DJ, Kajeguka D, Nyombi B, Kibiki GS. Spectrum and antibiogram of bacteria isolated from patients presenting with infected wounds in a tertiary hospital, northern Tanzania. BMC Res Notes. 2017; 10:757.

41. Etok CA, Edem EN, Ochang E. Aetiology and antimicrobial studies of surgical wound infections in University of Uyo Teaching Hospital (UUTH) Uyo, Akwa Ibom State, Nigeria. Niger Open Access Sci Rep. 2012; 1:1–5.