International Blood Research & Reviews
2(2): 69-81, 2014, Article no. IBRR.2014.003

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Isolation and Antibiotic Susceptibility Pattern of Bacteria Associated with Blood Stream Infections

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Authors' contributions

Author OPO carried out the collection of isolates from University College Hospital and also participated in the experimental work. Author JJO was actively involved in the preparations of different media used. Authors BDA and CJ designed the methodology used in the research and was actively involved in the experiments, write ups and searches for materials online. All authors read and approved the final manuscript.

Original Research Article

Received 24th November 2013
Accepted 13th January 2014
Published 25th January 2014

ABSTRACT

Aim: To determine the pattern of bacterial agents responsible for blood stream infection and determine the antibiotic susceptibility pattern of the bacterial isolates.
Study Design: Experimental
Place and Duration of Study: blood samples were collected from general out patient clinic of the University College Hospital, Ibadan, Oyo-State, Nigeria between February 2013 July 2010.
Methodology: The study population was drawn from patients attending the General Out patient clinic of the University College Hospital, Ibadan, Oyo-State, Nigeria. Total blood samples of One hundred and fourty (140) were collected from adultsand children. Samples were immediately dispensed into blood culture bottles and incubated at 37ºC for six days. On the bottles were indicated Name, Age, Sex,and Time of collection. The samples were analysed, all the patientshad clinical evidence of varying degree of illness

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such as ferbrile illiness, sepsis, bilateral discharge, head injury, endocarditis, pyrexia, gastroenteritis, pneumonia, and poorly treated pnuemonia.Those patients who have been on antibiotics therapy were excluded from the study.

Results: from 140 samples collected, only 100 samples showed turbidityindicating an incidence rate of71.43%. When plated on blood agar, 60 showed microbial growth, 35 samples showed no growth and 5 were contaminated. The difference in prevalence among different sex groups was observed to be significant. The females ($^{77}/_{140}$, 55%) appeared to be more susceptible to blood stream infection than the males ($^{66}/_{140}$, 47.1%) in all the age groups. The commonest pathogenic bacteria in blood stream infection was seen to be *Staphylococcus aureus* having the highest frequency of 58.3%, while *Pseudomonas aeruginosa* was the least with the frequency of 1.7%. The bacteria harvested were subjected to *In-vitro* antibiotic susceptibility test using standardized disc agar diffusion methodand showed resistance to one or more of the ten (10) antibiotics used for the study.The lowest resistance of 40% and 60% (36 out of 60) sensitivity was observed in the organisms to Ofloxacin and amoxicillin. Conversely, the highest resistance of 85% (51 out of 60) and 15% (9 out of 60) was observed with Cefuroxime and Erythromycin. However some of the *S. aureus* (6) and *E.coli* (3) strains were multidrug resistance.

Conclusion: The study confirmed the diverse nature of bacteria causing blood stream infection and the increase in drug-resistant pathogens needs to be periodically reviewed for epidemiologically data and clinical prescription.

Keywords: Infective-endocarditis; infections; septiceamia; granulocytopenic; asymptomatic; bacteremia.

DEFINITIONS, ACRONYMS, ABBREVIATIONS:

CLSI : Clinical and laboratory Standards Institute;
DIC : Disseminated intravascular coagulation;
MDR : Multi-drug resistant;
IE : Infective endocarditis;
UTI : Urinary tract infection;
BSI : Blood stream infection;

1. INTRODUCTION

Blood stream infection is a systematic disease caused by micro-organisms or and their toxins in the blood. It has also been described as any bacterial infection documented by a positive blood culture [1]. Micro-organisms present in the circulating blood whether continuously or intermittently are a threat to every organ in the blood.Approximately 200,000 cases of septiceamia, bacteremia and fungimia occur annually with mortality rates ranging from 20-50%, therefore early diagnosis and appropriate treatment of the infections can make the difference between life and death. Blood stream infections are among the most important infections causing morbidity and mortality [2] and are among the most common healthcare associated infections [1,31]. Illnesses associated with blood stream infection ranges from self-limiting infections to life threatening sepsis that require rapid and aggressive antimicrobial treatment. The most commonly found micro-organism are Gram positive cocci [3] including *Stapylococcus* spp, *Enterococci* spp and the Gram negative bacilli which

include*Pseudomonas aeruginosa, E. coli, Klebsiella* spp*,* Fungi such as *Candida species* , and other yeast also grow in blood culture.

Illnesses associated with BSI ranges from self-limiting infections to life threatening sepsis that require rapid treatment [4,5]. A wide spectrum of organisms causing BSIs has been described and this spectrum is subject to geographical alteration. Patients who are granulocytopenic or inappropriately treated may have a mortality rate that approaches 100% [6]. Moreover, fatality among patients infected with Gram-negative bacilli is higher than those among patients who have Gram-positive cocci [7] as a causative agent of their bacteraemia. The prevalence of resistance in both out-patients and hospitalized patients with septicaemia is increasing, and it varies in accordance with regional locations. In almost all cases, antimicrobial therapy is initiated empirically before the results of blood culture are available. The presence of living microorganisms in the blood of apatient is usually indicative of a serious invasive infection [8] requiring urgent antimicrobial therapy. The mortality associated with blood stream infections may range from 20 to 50% depending on several factors, including the pathogen and host [2,9]. Many septic episodes are nosocomial and may be due to microorganisms with increased antimicrobial resistance.The clinical picture frequently present in septiceamia include septic shock which is recognised by a severe febrile episode with chills, fever, mailaise, tachycardia, mental confusion, hyperventilation and toxicity, hypotention and prostration which results when circulating bacteria multiply at a rate that exceeds thier removal by phagocytes [10]. Complications include disseminated intravascular coagulation (DIC) and acute renal failure. The infections caused by multi-drug resistant (MDR) organisms are most likely to prolong the hospital stay, increase the risk of death and require treatment with more expensive antibiotics [3]. The types and the frequency of those isolates may vary in different areas, age groups and among patients infected with Gram-positive cocci,causing bacteraemia and the mortality rates have been reported between 20% and 50%. Hence, blood culture is the single most important procedure to detect blood stream and systemic infections due to bacteria.

Blood is normally sterile in healthy individual, it is the main transport mechanism connecting all parts of the body, it serves as a transport medium for oxygen, food materials, waste products and others round the body, it can also carry microbes [11]. However blood has no normal flora and the presence of micro organism in it indicates failure of defence mechanisms to maintain its sterility. In many cases such a failure is transistory and of no clinical importance but in others, it may be serious and life threatening. Lymphoid tissue is an important part of the defence system acting as a filter to intercept potentially invasive pathogens. The involvement of blood lymphatic system and heart in many infections gives us the knowledgeof the presence of bacteria in the blood. Asymptomatic transient bacteraemia can occur during the course of many infections in the body.

Septicemia according to [29] is a clinical term used to describe severe life-threatening bacteraemia in which multiplying bacteria release toxins into the blood stream and trigger the production of cytokines, causing fever, chills, toxicity, tissue anoxia, reduced blood pressure, and collapse. Septic shock is usually a complication of septicaemia with Gram negative bacilli, and less frequently Gram positive organisms.

Staphylococcus aureus is one of the most common pathogens of bloodstream infections. In the United States, *S. aureus*is frequently isolated from all types of BSIs [12]. *S. aureus* BSIs are associated with a high frequency of life threatening complications, such as metastatic infections. This bacterium is the principal pathogen responsible for infective endocarditis (IE) in industrialized countries [13,14]. Patients with *S. aureus* IE are more clinically debilitated

and have a higher prevalence of severe sepsis, major neurological events, and multipleorgan failure, compared with patients with IE caused by other pathogens. As a result, *S. aureus* BSI shave a significant impact on mortality, with documented associated mortality rates of 20%–40% [15]. This relatively wide range of reported mortality rates may be reflective of the different characteristics of specific study populations and patients with prosthetic devices or long-term intravascular catheters may be particularly vulnerable.

S.aureus shows exceptional ability to appear in multiple-resistant form- especially in hospitals. Sensitivity testing is therefore essential in choice of an appropiate drug for therapy. Antibiotics active against *S. aureus* are; (i) Amikacin (broad spectrum antibiotic, active against both Gram positive and negative [16], (ii)Cephalosporins (iii) Penicillin (iv) Tetracyclines(many hospital strains resistant) (v) Fusidic acid.Penicillin resistance is due to production of ß-lactamase which breaks down the antibiotic,*B*- lactamase is plasmid- coded and transferred by bacterial conjugation, transformation and transductionvia bacteriophageorganism [17].

Proteus is a genus that belongs to a major group of Proteobacteria. *Proteus* spp are most commonly found in the human intestinal tract as part of normal human intestinal flora [16], along with *Escherichia coli* and *Klebsiella species*, of which *E. coli* is the predominant resident [18] *Proteus* is also found in many environmental habitats, including long-term care facilities and hospitals. In hospital settings, it is not unusual for Gram-negative bacilli to colonize both the skin and oral mucosa of both patients and hospital personnel. Infection primarily occurs from these reservoirs. However, *Proteusspecies* are not the most common cause of nosocomial infections. The most important member of this genus is considered to be *P. mirabilis*, a cause of wound and urinary tract infections [19]. Fortunately, most strains of *P. mirabilis* are sensitive to ampicillin and Cephalosporins. Unlike its relative, *P. vulgaris* is not sensitive to these antibiotics. However, this organism is isolated less often in the laboratory and usually only targets immunosuppressed individuals. *P. mirabilis* and *P. vulgaris* can be differentiated by indole test for which only *P. vulgaris* tests positive. *P. vulgaris* occurs naturally in the intestines of humans and a wide variety of animals. It occurs also in manure soil and polluted waters. More than 80% of human urinary tract infections (UTIs) are due to the bacterium '*Escherichia coli*' [20] but urinary infections due to *Proteus mirabilis* are also well documented. *P. mirabilis* once attached to urinary tract infects the kidney more commonly than *E. coli*. *P. mirabilis* belongs to *Enterobacteriaceae* and is a Gram-negative motile swarmer bacterium. It is often found as free living organisms in soil and water but they are also parasitic in the upper urinary tract of human beings.

Pseudomonas aeruginosa is an opportunistic nosocomial pathogen of immuno-compromised individuals, *P. aeruginosa* typically infects the pulmonary tract, urinary tract, burns, wounds, and also causes other blood infections. There is an increased risk of infection for people in hospitals and nursing homes. The mortality rate remains greater than 10%. An infected skin shows characteristic lesions (Ecthyma gangrenosum), which are haemorrhagic and necrotic, with surrounding erythema, and most often found in the axilla, groin or perianal area. *Pseudomonas* can in rare circumstances causes community-acquired pneumonias, as well as ventilator-associated pneumonias, being one of the most common agents isolated in several studies [21]. Pyocyanin is a virulence factor of the bacteria and has been known to cause death in *Caenorhabditis elegans* by oxidative stress [22]. However, research indicates that salicylic acid can inhibit pyocyanin production. One in ten hospital-acquired infections is from *Pseudomonas* spp [23]. Cystic fibrosis patients are also predisposed to *P. aeruginosa* infection of the lungs. *P. aeruginosa* may also be a common cause of "hot-tub rash" (dermatitis), caused by lack of proper and periodic attention to water quality.

This is a Gram-negative bacterium that causes pneumonia in humans, and the disease is termed *Klebsiella pneumonia*. Besides the lungs, infections in the intra-abdominal parts and urinary tract are also reported. In fact, it is the second most virulent pathogen, next to *E. coli*, which causes UTIs. It normally affects persons with low immune system such as hospital patients, diabetes patients and people with chronic lung disease [24]. Also, people who indulge in excessive alcohol consumption are more prone to *K. pneumoniae* infections than others. To be more precise, *Klebsiella pneumoniae* is either hospital-acquired or community-acquired. While it is difficult for *K. pneumoniae* strain to infect lungs of healthy persons, it produces a highly lethal pneumonia in patients who have been hospitalized, typically after two days of hospitalization.

Bloodstream infections can be identified by a blood test. A person suffering from bloodstream infections should maintain good personal hygiene during viral illness. This can help in reducing the risk of developing infections. Bacterial infections should be treated thoroughly and quickly minimizing the risk of spreading infection. Several kinds of bacteria live on the skin as well as the moist linings of the urinary tract, other internal surfaces and lower digestive tract. Most of the times the bacteria present in these areas are harmless and they are checked by the immune system and the natural barriers present inside the body. When the bacteria get introduced directly to the circulatory system the immune system may not be able to cope [25], developing the symptoms of bacteremia. It can leave them vulnerable to infection and antacid treatment undermines the body's defense, while antimicrobial therapy and recurrent blood transfusions have also been identified as risk factors of resistance.

This research is carried out to determine the pattern of bacterial agents responsible for blood stream and systemic infections and evaluation of antibiotic susceptibility pattern of these. This is important in determiningthe patients with blood stream infections and institute early and appropriate antimicrobial therapy.

2. MATERIALS AND METHODS

The study population was drawn from patients attending the General Out patient clinic of the University College Hospital,Ibadan, Oyo-State. Total blood samples of One hundred and fourty (14º) were collected from adultsand children. Samples were immediately dispensed into blood culture bottles and incubated at 37ºC for six days. The bottles were branded with name, age, sexand time of collection. The samples were analysedusing the methods of [26]. All the patientshad clinical evidence of varying degree of illness such as ferbrile illiness, sepsis,bilateral discharge, head injury, endocarditis, pyrexia, gastroenteritis, pneumonia, and poorly treated pnuemonia.Those patients who have been on antibiotics therapy were excluded from the study.

From 140 samples collected, only 100 samples showed turbidity in 30mls of brain heart infusion indicating an incidence rate of 71.43%. After 48 hours of inoculation and incubationon blood agar and MacConkey agar, only 60 from initial 100 samples showed microbial growth, 35 showed no growth and 5 were contaminated.The inoculums on the plates were streaked out for discrete colonies with a sterile wire loop following standard procedures [27,28]. All plates were then incubated at 37ºC aerobically for 48 hours.The plates were then examined macroscopically and microscopically (Gram stain technique). All the bacteria were isolated and identified using morphological, microscopy, and biochemical tests (Catalase test, Coagulase test, Indole test, motility test, citrate test, Urease test, Oxidase test) following standard procedures described by [28,29].

Antimicrobial sensitivity was carried out using agar disc diffusion technique as previously described by [30]. The 24 hour incubated broth of 0.5 Mcfarland standards was inoculated into the sterile nutrient agar plates.Different antibiotic disc were placed on the already inoculated plates. Interpretation of results was done using zones of inhibition ≥18mm as sensitve, 13-17mm as intermediate and <13mm as resistant. Isolates were classified as either resistant, intermediate or sensitive based on [31]. An isolate was considered multi-drug resistant if it was resistant to at least three of the antibiotics tested.

3. RESULTS AND DISCUSSION

On the overall, sixty-three (63) and seventy-seven (77) samples were obtained from male and female respectively as shown in Table1 below. The age range 41- 50 had the highest number of patients while11 – 20 had the lowest of 3 (2 male and 1 female).

Table 1. Age and sex of sampled population

Age Range	male	female	% of male in sampled population	% of Female in sampled population
1-10	3	4	2.14	2.86
11-20	2	1	1.43	0.71
21-30	16	21	11.43	15.00
31-40	11	17	7.86	12.14
41-50	15	23	10.71	16.43
51-60	16	11	11.43	7.86
Total	**63**	**77**	**45**	**55**

Fig. 1 below shows the frequency of diseases from which samples were collected. It was observed that febrile illness had the highest occurrence of diseases with 33% specimen.

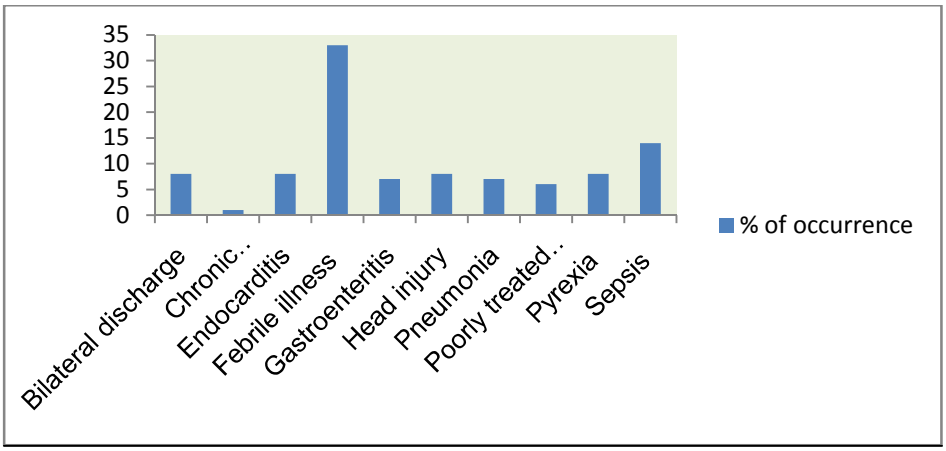

Fig. 1. Percentage occurence of various queried diseases among patients

One hundred and fourty (140) samples collected from patients were inoculated into 30mls of brain heart infusion medium. However, the hundred (100) samples that were positive by blood culture were then processed further by sub-culturing on blood agar, the frequency of bacteria isolation from each of the sample collected was shown in Fig. 2 below.

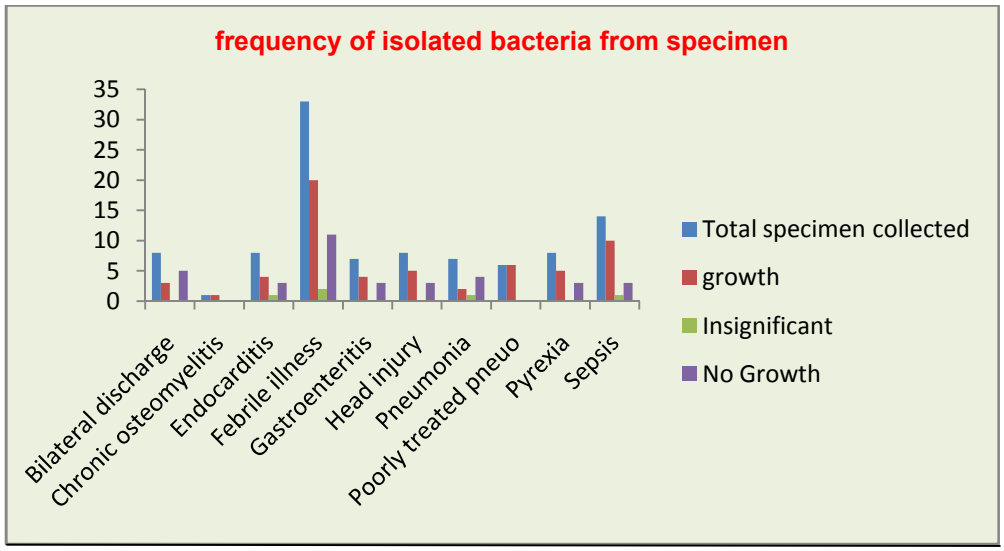

Fig. 2. Frequency of bacteria isolation from specimen

The sixty isolates recovered from the blood medium were identified using the appropiate Gram reaction and biochemical tests. The Gram staining reaction classified the isolates into Gram positive (66.6%) and Gram negative (33.3%). Following the performance of biochemical tests; catalase test, indole test, motility test, urease test and oxidase test, the isolatesobtained were shown in Table 2 after their identification. The antibiotic susceptibility pattern of Gram positive and Gram negative were shown in Table 3 and Table 4 respectively. The percentage antibiotic sensitivity pattern of sixty bacterial strains finally obtained was presented in Fig. 3.

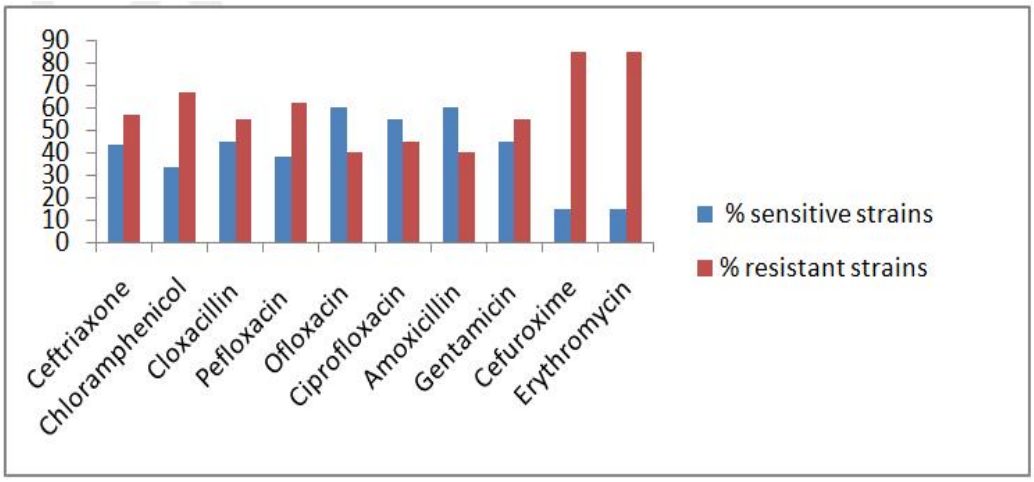

Fig. 3. Percentage antibiotic sensitivity pattern of sixty (60) bacterial strains

Table 2. Biochemical characteristics of isolates

No of isolates	Name of bacteria	Citrate	Urease	Oxidase	Catalase	Coagulase	Motility	Indole	% of abundance
15	*E. coli*	-	-	-	-	-	+	+	25.00
4	Kleb pneumonia	+	+	-	-	-	-	-	6.67
35	*S. aureus*	-	-	-	+	+	-	-	58.33
1	Pseudo aeruginosa	-	-	+	-	-	-	-	1.67
5	Staph saprophyticus	-	-	-	-	-	-	-	8.33

Table 3. Antibiotic susceptibility pattern of Gram positive of bacteria species

S/no	Bacteria species	Antibiotics used and Antibiogram									
		CRO 30µg	C 10µg	OB 5µg	PEF 5µg	OFX 10µg	CIP 5µg	AMX 30µg	CN 10µg	CXM 30µg	E 5µg
1	*S. aureus*	-	+	+	+	+	+	-	+	-	+
2	*S. aureus*	-	-	-	-	-	-	+	+	+	+
3	*S. aureus*	-	-	-	-	-	+	+	+	NA	NA
4	*S. aureus*	-	+	+	-	-	+	+	+	NA	NA
5	*S. aureus*	-	+	+	-	-	+	+	+	NA	NA
6	*S. aureus*	NA	NA	-	-	-	NA	+	+	NA	+
7	*S. aureus*	+	+	+	+	+	-	-	-	NA	NA
8	*S. aureus*	-	-	-	-	-	-	NA	NA	-	-
9	*S. aureus*	-	+	+	-	-	+	+	+	NA	NA
10	*S. aureus*	+	-	+	+	+	+	-	+	NA	NA
11	*S. aureus*	+	NA	+	+	NA	+	+	+	+	-
12	*S. aureus*	+	NA	+	+	-	-	+	-	NA	+
13	*S. aureus*	-	-	-	-	-	NA	NA	-	-	-
14	*S. aureus*	NA	NA	+	+	+	+	+	-	-	-
15	*S. aureus*	+	NA	+	+	+	+	NA	-	-	+
16	*S. aureus*	-	-	-	NA	-	-	-	-	NA	-
17	*S. aureus*	-	+	+	-	+	+	+	-	NA	NA
18	*S. aureus*	NA	NA	+	+	+	+	+	+	+	-
19	*S. aureus*	-	-	NA	-	+	+	+	+	NA	+
20	*S. aureus*	-	NA	-	-	-	-	NA	-	-	-

Table 3 Continued……

21	*S. aureus*	+	+	-	-	-	+	+	+	NA	-
22	*S. aureus*	NA	NA	+	+	-	+	+	-	-	+
23	*S. aureus*	+	+	+	+	+	-	+	+	-	-
24	*S. aureus*	+	-	+	+	+	+	+	NA	NA	NA
25	*S. aureus*	+	+	+	+	+	NA	-	-	-	+
26	*S. aureus*	+	-	+	+	+	+	+	-	NA	NA
27	*S. aureus*	NA	+	+	+	+	-	+	-	NA	NA
28	*S. aureus*	-	-	-	-	NA	NA	-	NA	-	NA
29	*S. aureus*	+	+	-	+	NA	NA	-	-	NA	NA
30	*S. aureus*	+	+	+	+	+	NA	-	+	NA	NA
31	*S. aureus*	-	NA	+	+	+	-	+	NA	NA	-
32	*S. aureus*	+	-	+	NA	+	+	NA	-	-	-
33	*S. aureus*	-	-	+	+	+	+	-	NA	NA	NA
34	*S. aureus*	-	-	-	NA	NA	-	-	-	-	-
35	*S. aureus*	-	NA	+	NA	-	+	+	-	NA	NA
36	*Staph sap*	+	+	+	+	-	+	+	NA	-	NA
37	*Staph sap*	-	-	+	+	+	-	+	+	NA	NA
38	*Staph sap*	+	+	-	+	+	-	NA	NA	NA	NA
39	*Staph sap*	-	-	+	+	+	+	+	NA	+	NA
40	*Staph sap*	+	-	+	+	-	-	+	+	NA	NA

Table 4. Antibiotic susceptibility pattern of Gram negative bacteria species

S/no	Bacteria species	Antibiotics used and Antibiogram									
		CRO 30µg	C 10µg	OB 5µg	PEF 5µg	OFX 10µg	CIP 5µg	AMX 30µg	CN 10µg	CXM 30µg	E 5µg
1	*E. coli*	NA	-	-	-	+	+	+	+	NA	NA
2	*E. coli*	-	-	-	-	+	NA	+	+	NA	-
3	*E. coli*	NA	-	-	-	+	+	+	+	+	NA
4	*E. coli*	+	+	-	-	+	+	+	-	NA	NA
5	*E. coli*	-	-	-	-	+	+	+	NA	NA	NA
6	*E. coli*	NA	-	NA	-	-	NA	-	-	-	-
7	*E. coli*	+	-	-	NA	+	+	+	+	-	-
8	*E. coli*	+	+	-	-	+	+	+	NA	+	NA
9	*E. coli*	NA	NA	-	-	-	-	-	-	-	-
10	*E. coli*	+	NA	-	-	+	NA	-	+	NA	+
11	*E. coli*	NA	NA	NA	-	+	+	+	+	+	+
12	*E. coli*	-	-	-	-	+	-	-	-	-	NA
13	*E. coli*	+	-	-	-	+	+	-	+	NA	NA
14	*E. coli*	-	+	-	-	+	+	+	+	NA	NA
15	*E. coli*	+	-	-	-	+	+	-	NA	NA	NA
16	*Kleb. spp*	+	-	-	-	+	-	+	NA	NA	NA
17	*Kleb. spp*	-	+	-	-	-	NA	+	+	NA	-
18	*Kleb. spp*	+	+	-	-	+	+	NA	NA	NA	NA
19	*Kleb. spp*	+	+	-	-	NA	NA	+	+	+	NA
20	*Pseu aeruginosa*	+	-	-	-	+	+	NA	+	NA	NA

KEY: NA= Not applicable,+= Positive,- = Negative,CRO = Ceftriaxone, C= Chloramphenicol, OB =Cloxacillin, PEF = Pefloxacin, OFX = Ofloxacin, CIP = Ciprofloxacin, AMX =Amoxicillin, CN =Gentamicin, CXM= Cefuroxime, E=Erythromycin

4. CONCLUSION

In this study, 140 patients were studied by collection of their blood and subsequent culturing of the blood samples in brain heart infusion to watch out for microbial growth. Of these 140 patients, 100 blood samples showed turbidity and when plated on blood agar, only 60 showed microbial growth, 35 showed no growth while 5 were discovered to be just contaminants. The remaining35 samples that did not grow after 48hrs of incubation which shows that there were no bacteria present in the blood sample tested.

About 63 (45%) of these patients were males, while 77 (55%) were females. Patients suffering from febrile illiness of varying degree form the highest population of the patients examined (33%) while patients suffering from chronic osteomylitis form the lowest (1%).Out of the 140. Patients examined, patients in the age range of 41-50 form the highest population among the female (16.4%) while patients in the age range 21-30yrs and 51-60yrs form the highest populatgion among the males. (22.85%). Patients in the age range 11-20yrs form the lowest population in males (1.4%) while patient in the 11-20yrs age range forms the lowest in female (0.7%). The findings that males had higher prevalence of infection than females agree with the earlier studies of [32]. The research finding shows that the prevalence of septicemia occurred in adult female than in children male, while febrile illiness conditions were more common. This may be due to the level of exposure of their bodies to the environment where they reside.

The order of prevalence of casual organisms in this study are as follow; *Staphylococcus aureus*, (58.35), *E.coli* (5%), *Klebsiella pneumoniae* (6.3%), *Staphylococcus saprophyticus* (8.3%), *Pseudomonas aeruginosa* (1.7%). The result however, agreed with [33] and [34] that any of these organisms may be the primary casual agent of the most of the blood stream infections.

All the strains examined showed resistance to one or more of the ten (10) antibiotics used for the study.The lowest resistance of 40%and 60% (36 out of 60) sensitivity was observed in the organisms to Ofloxacinand amoxicillin. Conversely, the highest resistance of 85% (51 out of 60) and 15% (9 out of 60) was observed with Cefuroxime and Erythromycin. However some of the *S. aureus* (6) and *E.coli* (3) strains were multidrug resistance.

Amoxicillin was most effective in this study with highest zone of inhibition compared with other antibiotics that were used. Amoxicillin which is a broad spectrum antibiotics inhibit ribosomal initiation and also cause misreading of messenger RNA (mRNA). They are bactericidal compounds and they are potent against organisms isolated in the study. Other antibiotics such as Cefuroxime and Erythromycin were not as effective as Amoxicillin, this may be due to the fact that these antibiotics have been in use for a long period and must have been abused, thus the organisms must have developed mechanisms of circumventing their mode of action. Resistance may also be caused by prescription of antibiotics without laboratory guidance as well as overcounter sales of antibiotics without prescription from the physician can also lead to the organisms building up resistance mechanisms antibiotics like Cefuroxime and Erythromycin

In conclusion, the study has shown that antibiotics sensitivity testing is necessary to obtain the correct antibiotics to kill or reduce microbial load under a given condition. However, the decision to use a particular antibiotic depends on its toxicity, cost and attainable level. There is every need to constantly monitor the daily activities, the susceptibility pattern of specific pathogens in different populations to commonly used antimicrobial agents. This will help the health professional and patients to manage the resistance strains.

CONSENT

Not applicable.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been carried out according to the regulations laid down by Nigeria Institute of Science Laboratory Technology examined and approved by Committee on Research and Publication of the Faculty of Pharmacy, Igbinedion University Okada, Benin City, Nigeria.

ACKNOWLEDGEMENTS

We really acknowledge the staff of General Out patient clinic of the University College Hospital, Ibadan, Oyo-State Nigeria for the support and assistance in getting the samples used for the research. We also appreciate the kindness received from the laboratory staff of Pharmaceutical Microbiology Departments of Igbinedion University Okada and University of Ibadan, Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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