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Antibiogram of Surgical Site Infection In a Tertiary Health Care Facility in Osogbo, South Western Nigeria

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Abstract **- Surgical site infection is one of the most frequent types of nosocomial infections in developing countries. A cross sectional study was conducted at the Ladoke Akintola University Teaching Hospital, Osogbo from January to March 2013 to isolate and identify bacterial agents from patients with postoperative surgical site infections and assess the antimicrobial susceptibility patterns of the isolates. Seventy surgical samples were collected using sterile cotton tipped swabs. The samples were analyzed using standard bacteriological media. All the bacterial isolates thus obtained were characterized and identified by standard microbiological and biochemical tests, and assessed for sensitivity to antibiotic of frequent use in the study area. A total of 70 bacterial pathogens were recovered from all specimens, 60 samples yielded bacterial growth (51 samples had pure growth and 9 had mixed growth) while 10 of the samples showed no bacterial growth. *Staphylococcus aureus* was the predominant bacteria 18(25.7%) followed by *Klebsiella aerogenes* 17(24.3%), *Escherichia coli* 11(15.7%), *Pseudomonas aeruginosa* 10(14.3%), coagulase negative staphylococci 9(12.9%), and *Proteus* species 5(7.14%). Gram negative rods were deemed highly resistant to most of the antibiotics tested. Of the isolates, 41 (95%), 38 (88.4%), 37 (86.1%), 36 (83.7%), 36 (83.7%), 35 (81.4%) 34 (79.1%), 34 (79.1%) and 31 (72.1%) were found to be resistant to augmentin, amoxycillin, streptomycin, chloranphenicol, pefloxacin, tarivid, gentamycin, septrin, sparfloxacin in their respective order. *S. aureus* demonstrated high level resistance to cotrimoxazole, ofloxacin, amoxicillin, pefloxacin, streptomycin, zinnacef and ceftriazone. However, ciprofloxacin, erythromycin, chloramphenicol and gentamycin were found to be effective against the *S. aureus* isolates.**

Keywords **- Agents of Surgical Infections in Nigeria.**

INTRODUCTION

A surgical site infection (SSI) according to Centre for Disease Control is infection within 30 days after the operation and only involves skin and subcutaneous tissue of the incision and at least one of the following signs or symptoms of infection: pain or tenderness, localised swelling, redness, or heat [1]. The infection follows interference with the skin barrier and is associated with the intensity of bacterial contamination of the wound at surgery or later in wards during wound care [2]. Postoperative surgical site infection was known to be a major source of illness and a less frequent cause of death in surgical patient [3]. More recent studies however, showed SSI to be among the most common sources of nosocomial morbidity for patients undergoing surgical procedures associated with increased hospital length of stay, increased risk of mortality, and decreased health-related quality of life. [4,5]. The likelihood of developing an SSI is influenced by a number of factors. These factors fall into four major groups, which are: patient factors, anaesthetic factors, wound status, and surgeon factors [6]. The hospital environment is a potential reservoir of bacterial pathogens since it houses both patients with diverse pathogenic microorganisms and a large number of susceptible/ immunocompromised individuals [7]. The increased frequency of bacterial pathogens in hospital environment is associated with a background rise in various types of nosocomial infections. SSI is one of the most frequent types of nosocomial infections in developing countries and the world at large [8, 9, 10]. It has been reported that almost 10% of hospitalization are complicated by nosocomial infection and about 75% of these are due to organisms resistant to first-line antimicrobial therapy [11, 12]. Extended Spectrum betalactamases (ESBL's) have been implicated in surgical site infections [13]. Infection due to ESBL's bacteria have been associated with significantly worse clinical outcomes, with mortality rates up to 4 times higher than infections caused by susceptible strains [14].

Nasal carriage of *Staphylococcus aureus* has been identified as a major risk factor for wound infections after both joint arthroplasty and cardiac surgery [15]. In the United States, a study between 2001and 2002 revealed that approximately 30 percent of apparently healthy population carries *S. aureus* in their nose [16]. Several reports have also implicated *Pseudomonas* sp in surgical wound infections [17]. Although several factors have been proposed to guide against surgical site infection but yet infection persist in most of our wards

[18]. The aim of this study was to isolate and identify bacterial agents from patients with postoperative surgical site infections and assess the antimicrobial susceptibility patterns of the isolates.

Materials And Methods

Study area and period

The study was carried out among all the patients who had undergone operation in Ladoke Akintola University of Technology Teaching Hospital Osogbo within a period of 6 months (Oct 2012- Mar 2013). Osogbo which is the capital city of Osun state, Nigeria lies on the geographical coordinates of 7° 46' 0'' N, 4° 34' 0'' E.

Sample collection

A total number of 70 surgical wound samples were collected from different patients in various wards in Lautech Teaching Hospitals using sterile cotton-tipped applicators after obtaining an informed consent. Swab samples were collected from the following locations: Male Surgical Ward (MSW), Female Surgical Ward (FSW), Female Medical Ward (FMW), Paediatrics ward (PAED), Orthopaedic ward (ORTHO), Surgical Out Patients (SOP), General Out-Patients Department (GOPD). A total of 46 swab samples were collected from males, while 24 swab samples were collected from females. The swab samples were collected aseptically before wound dressing while avoiding contamination with skin commensals. Specimens were transported to the microbiology laboratory within 30 minutes of collection. The samples were analyzed using standard bacteriological media including MacConkey agar and Chocolate agar. All the bacterial isolates thus obtained were characterized and identified by studying their cultural and morphological features as described by Cowan [19].

Antibiotic susceptibility test

Only the conventional antibiotics regularly available for frequent use in the study area were considered for our study. The antibiotic susceptibility testing was then performed using disc diffusion method according to the Clinical Laboratory Standards Institute guidelines on Muller Hilton agar [20]. The antibiotics (Oxoid, Ltd) used to determine the susceptibility pattern of the isolates include Erythromycin (5 µg), Amoxycillin (25 µg), Ofloxacin (5 µg), Streptomycin (10 µg), Chloranphenicol (30 µg), Ceftriazone (30 µg), Gentamyin, (10 µg), Pefloxacin (5 µg), Cotrimoxazole (25 µg), Ciprofloxacin (10 µg), cotrimoxazole(30 µg), Sparfloxacin (10 µg), Tarivid (10 µg). The isolates were considered sensitive and resistant based on the guidelines of CLSI.

Results

The patients were made up of 46 males and 24 females and their ages ranged from 21 to 60. The majority of the wound swabs, 60 (85.7%) had bacterial growth within 18-24 hours of incubation. Nine out of 60 (15%) had polymicrobial growth while 51 (85%) had monomicrobial growth. The rate of bacterial isolation among those patients who had clinically septic wound infections was 85.7%. Of the total bacterial isolate (Table 1), Forty-three (61.4%) of the isolates of postoperative surgical site infections were Gram-negative bacteria. *Klebsiella* species 17 (24.3 %) were the predominant isolates followed by *Escherichia coli* 11(15.7%), P*seudomonas aeruginosa* 10 (14.3%) and *Proteus mirabilis* 5 (7.14%) while 27 (38.6%) of the isolates were Gram-positive cocci. Of the Gram positive bacteria, *S. aureus* accounted for 18 (25.7%) and coagulase negative staphylococcus 9 (12.9%). Surgical wound infection was most prevalent in the age group of 21-30 and less prevalent in the age group of 41 and above (Data not shown). In relation to sex, surgical wound infection was more prevalent in males than in females. The antibiotic susceptibility pattern of the isolates revealed that the Gram-positive organisms were highly susceptible to ciprofloxacin, gentamycin, zinnacef, and erythromycin. Majority of the Gram-negative organisms were moderately sensitive to ciprofloxacin, chloranphenicol, sparfloxacin, pefloxacin, septrin, tarivid (Table 2). Multi drug resistant pattern of the bacterial isolates is shown in table 3.

Discussion

Postoperative surgical site infections remain one of the major types of nosocomial infections in countries where resources are limited [8, 9, 21]. The successful management of patients suffering from bacterial illnesses depends upon the identification of the types of organisms that cause the diseases and the selection of an effective antibiotic against the organism in question [9]. Our results show that *S. aureus* was the single most prevalent (25.7%) agent of surgical wound infection. In an earlier study by Oni and others, [10]., *S. aureus* constituted about 29% of the isolates from surgical wound site. This finding is again in agreement with a similar study where it constituted over 40% [22]. This may reflect the degree of carriage of *S. aureus* as a member of the skin flora of the patients, as well as nasal carriage by the Surgeons and other Health Workers. This calls for periodic screening of members of the surgical team for nasal carriage of *S. aureus* and their prompt treatment before any operative measures. Other common organisms included *K. aerogenes* 24.3%, *E. coli* 15.7%, *Ps. aeruginosa* 14.3%, coagulase negative staphylococci 12.9% and *Pr. mirabilis* 7.14%. [23]. Others reported that out of 44 patients with surgical wound examined microbiologically for surgical wound infection, 15.9% had Staphylococcal and *Klebsiella* surgical site wound infection while, 13.6% had *Proteus* infection. The result of our study showed that *S. aureus*, *K. aerogenes*, *E. coli, Ps. aeruginosa* and

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Pr. mirabilis were the major bacterial pathogens associated with surgical wound infections in our study area. This also agrees with the findings of [13,17,]. Furthermore from this study, when the observed infection rate was categorized with respect to age, it was discovered that deeply infected limb related surgery could be attributed to young people. This is attributable to the fact that the age range 21-30 years is termed as the leisurely active age group. Largest number of bacterial pathogens isolated from the same age range might also be due to their agility as observed (during sample collection) that many of them hardly stayed on their beds. This observation was peculiar to male patients and might explain the higher infection recorded among them compared to their female counterparts.

A study of *in vitro* antimicrobial susceptibility profile of the etiological agents of surgical site infection has revealed that there is a growing emergence of multi-drug resistant microbes [13,24]. The results of antimicrobial susceptibility testing showed various percentage of resistance among the bacterial isolated patients. More than 80% of Gram negative rods were resistant to streptomycin, cotrimoxazole, chloranphenicol, sparfloxacin, ciprofloxacillin, augmentin, amoxycillin, tarivid, gentamycin, pefloxacin. It was reported that, ciprofloxacin were effective for most than 90% of Gram negative isolates in Gondar [25]. However, in our study ciprofloxacin was found to be effective for more than 60% of the isolates. Among Gram negative isolates *Ps. aeruginosa*, *K.* species, *E. coli*, and *Proteus* species demonstrated high level of resistance to most of the antibiotics tested. Some of these Gram negative bacteria were found to be multi-resistance as seen in this study. However ciprofloxacin were relatively effective against most of the bacterial isolates. This result was also in agreement with the findings of other studies [25,26]. The relative effectiveness observed in ciprofloxacin may be due to less frequent usage of them as indicated in a study in Gondar [27]. Multiple antibiotics resistance was seen in 72.7% of the Gram positive and 90% of the Gram negative isolates. This is high when compared to previous studies [25, 26]. The high frequency of multiple antibiotic resistance might be a reflection of inappropriate use of antimicrobials, lack of laboratory diagnostic tests, non-availability of guideline for the selection of antibiotics, indiscriminate use of antibiotics for conditions that may not clinically indicate their use, some new drug formulations which may be of poor quality and dumping of banned products into the market where the people may get access to them hence antimicrobial resistant strains emerge readily and easily. This study has demonstrated vividly the urgent need for hospital management to encourage periodic review of the microbial flora of their environment and the antibiotic sensitivity pattern. Postoperative wounds should not be exposed for prolonged period unduly during the course of dressing. These findings demonstrated the widespread problem of antibiotic resistance among nosocomial pathogens. Continued surveillance is necessary to guide appropriate empirical therapy for postoperative surgical site infections. [28,29]. To keep resistance level to the barest minimum, it is imperative that all professionals should take an active role in infection control within their organization. More resources should be provided to encourage good antibiotic practice and good hygiene in the hospital.

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Table 1: Prevalence/occurrence of bacteria isolates in surgical wound infection

Bacteria	Number of isolates	Percentage of isolates (%)
Escherichia coli	11	15.7
Klebsiella aerogenes	17	24.3
Staphylococcus aureus	18	25.7
Coagulase-negative Staphylococcus	9	12.9
Pseudomonas aeruginosa	`0	14.3
Proteus mirabilis	5	7.14
Total	70	100

Table 2: Antimicrobial susceptibility pattern of bacterial pathogens isolated from SSIs

Bacteria isolate	pattern	STR %	SXT %	CH %	SP %	CPX%	AU %	AMX %	OFX %	CN%	PEF%	ERY%	CEF%	COT %	OFL%	Z%
Gram negative																
Klebsiella aerogenes	S	3(17.6)	4(23.5)	3(17.6)	6(35.3)	11(64.7)	0(0)	1(5.9)	3(17.6)	3(17.6)	2(11.8)	-	-	-	-	-
	R	14(82.4)	13(76.5)	14(82.4)	11(64.7)	6(35.3)	17(100)	16(94.1)	14(82.4)	14(82.4)	15(88.2)	-	-	-	-	-
Escherichia coli	S	1(9.1)	2(18.2)	2(18.2)	2(18.2)	8(72.7)	0(0)	1(9.1)	1(9.1)	1(9.1)	1(9.1)	-	-	-	-	-
	R	10(90.9)	9(81.8)	9(81.8)	9(81.8)	3(27.3)	11(100)	10(90.9)	10(90.9)	10(90.9)	10(90.9)	-	-	-	-	-
P. aeruginosa	S	0(0)	0(0)	0(0)	1(10)	4(40)	0(0)	0(0)	1(10)	1(10)	1(10)	-	-	-	-	-
	R	10(100)	10(100)	10(100)	9(90)	6(60)	10(100)	10(100)	9(90)	9(90)	9(90)	-	-	-	-	-
Proteus mirabilis	S	2(40)	3(60)	2(40)	3(60)	3(60)	2(40)	3(60)	3(60)	4(80)	3(60)	-	-	-	-	-
	R	3(60)	2(40)	3(60)	2(40)	2(40)	3(60)	2(40)	2(40)	1(20)	2(40)	-	-	-	-	-
Gram positive																
CONS	S	3(33.3)	-	4(44.4)	-	7(77.8)	-	1(11.1)	-	3(33.30	1(11.1)	6(66.7)	5(55.6)	1(11.1)	0(0)	2(22.2)
	R	6(66.7)	-	5(55.6)	-	2(22.2)	-	8(88.9)	-	6(66.7)	8(88.9)	3(33.3)	4(44.4)	8(88.9)	9(100)	7(77.8)
Staphylococcus aureus	S	6(33.3)	-	10(55.6)	-	12(66.7)	-	3(16.7)	-	10(55.6)	3(16.7)	11(61.1)	8(44.4)	2(11.1)	2(11.1)	6(33.3)
	R	12(66.7)	-	8(44.4)	-	6(33.3)	-	15(83.3)	-	8(44.4)	15(83.3)	7(38.9)	10(55.6)	16(88.9)	16(88.9)	12(66.7)

Table 3: Multi drug resistance pattern of bacterial isolates

		Antibiogram pattern					
Bacterial isolate	Total	R0	R1	R2	R3	R4	>R5
Gram negative	43(61.4%)	2(4.7%)	0(0%)	1(2.3%)	1(2.3%)	2(4.7%)	38(88.4%)
Klebsiella aerogenes	17(24.3%)	0(0%)	0(0%)	1(5.9%)	1(5.9%)	1(5.9%)	14(82.4%)
Escherichia coli	11(15.7%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	11(100%)
Pseudomonas aeruginosa	10(14.3%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	10(100%)
Proteus mirabilis	5(7.14%)	2(40%)	0(0%)	0(0%)	0(0%)	1(20%)	2(40%)
Gram positive	27(38.6%)	0(0%)	1(3.7%)	3(11.1%)	1(3.7%)	0(0%)	22(81.5%)
Staphylococcus aureus	18(25.7%)	0(0%)	1(5.6%)	3(16.7%)	1(5.6%)	0(0%)	5(27.8%)
CONS	9(12.9%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	9(100%)
Total	70(100%)	2(2.9%)	1(1.4%)	4(5.7%)	2(2.9%)	2(2.9)	60(85.7%)

Key: **R0**- No antibiotic resistance, **R1-** Resistance to one, R2-Resistance to two , **R3-**Resistance to three, **R4**- Resistance to four, **>R5-**resistance to five and more antibiotics. **CONS**: Coagulase negative *Staphylococcus*.