MICROBACTERIAL PROFILE OF SURGICAL SITE INFECTION AND THEIR PATTERN OF SENSITIVITY IN TERTIARY HOSPITAL IN NORTH CENTRAL HOSPITAL, NIGERIA

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ABSTRACT

Background: **Surgical site infections (SSI) remain a problem in surgical practice despite the improvement in advanced technology and the use of antibiotics. Also, there is also a growing menace of antibiotic resistance which poses a great challenge in treating SSI. The study aimed to find out the most common bacterial pathogens responsible for surgical site infection and their antibiotic sensitivity profile.**

Material and Methods: **It was a descriptive study carried out in Federal Medical Centre, Bida. 500 surgical procedures were carried out and samples were obtained from 73 patients that showed clinical evidence of SSI for culture and susceptibility test. Samples were collected from each patient using a swab stick. Bacteriological culture examination and identification were done following standard microbiological techniques. Susceptibility testing was performed by Kirby-Bauer technique according to Clinical and Laboratory Standards institute 26th edition. Data were analysed using SPSS 26.**

Results: **Out of the 73 samples taken, 83 isolates were obtained while five samples yielded no growth. Gram-negative bacteria (GNB) were predominant in 73(88.1%) with the dominant being E. Coli species (38.6%). From the strains that were isolated, there were 9(10.8%) Staph aureus was the only Gram-positive organism. Concerning antibiotic susceptibility, the results demonstrated remarkably high multidrug resistance. However, the meropenems and amikacin demonstrated good activities against all gram-negative isolates. The resistance pattern of enterobacteriaceae to tested antibiotics were to ciprofloxacin (90.2%) levofloxacin (82.2%) augmentin (88.5%) ceftriaxone (85.2%) ceftazidime (80.3%), gentamicin (80.3%) meropenems (14.8%) amikacin (16.4%.).**

Conclusions: **The study demonstrated a high alarming rate of multidrug resistance following SSI and this should call for concerns and surveillance among surgeons.**

Keywords: Antibiotics, Antibiotic resistance, Bacteria

INTRODUCTION

The Centers for Disease Control and Prevention defines Surgical site infections as those infections which are confined to the incisions and involving structures adjacent to the wounds that were exposed during operation within one month after a surgical operation or one year after implant surgery.[1] According to WHO, surgical site infection (SSI) is the most common healthcare-associated infection in low and middle-income countries and can affect up to one-third of surgical patients.[2] The overall incidence of SSI is 14.8% in sub-Saharan Africa.[3] From a meta-analysis the cumulative incidence of SSI in Nigeria was 14.5%.[4] In a single centre study from a tertiary hospital in Nigeria, health care associated infection was 2.7% and SSI accounted for 30.4% of it.[5] Once a surgical wound is infected, it is usually associated with prolonged postoperative hospital stays, additional surgical interventions, and higher mortality.[6] The most common organism commonly isolated from SSI are S. aureus, Klebsiella species, E. coli, Proteus species, Streptococcus species, Enterobacter species, and Pseudomonas species.[7] Antimicrobial resistance (AMR) is now considered a major threat to global health.[8] Antibiotic resistance can occur naturally but there are many reasons behind the emergence and acceleration process of AMR which may be due to misuse (under-dosing and overuse) and over-prescription of antimicrobials.[9] Resistance to antibiotics has made infections difficult to treat and may impinge on the quality of care given to a surgical patient through its associated morbidity, mortality, and significant economic consequences.[10]

This study was aimed to determine the spectrum of bacterial pathogens isolated from infected surgical sites and their antimicrobial susceptibility profile in the Federal Medical Centre, Bida, with the view of providing guidelines to the surgeons for making rational decisions over the choice of antibiotics in the management of SSIs.

SUBJECTS AND METHODS

This was a prospective study conducted at Federal Medical Centre (FMC), Bida for 6 months from 1st May 2019 to 30th November 2019. FMC, Bida is a tertiary hospital in Niger State, North-Central Nigeria with a bed capacity of 200. All patients one month above who had undergone surgical procedures and developed SSI as diagnosed clinically by physicians within 30 days were recruited after surgery. A patient was considered to have surgical site infection, if there was pus or seropurulent discharge from the surgical wound with signs of sepsis. Patients who developed an infection from episiotomy and circumcision were excluded. A pre-tested proforma was used to obtain patients' demographics, clinical diagnosis, date of admission, personal history, and date of surgical procedure and prophylactic antibiotics.

All samples were collected from infected surgical site early in the morning before dressing the wounds using sterile cotton swabs. The swab was firmly applied, and slowly rotated thoroughly covering the surface of the wound. The swab specimens were transported to the microbiology laboratory of the hospital within one hour of collection. The samples were processed by the standard laboratory procedure. These included direct gram stain, culture, identification of organism and antibiotic susceptibility testing on the organism. Culture of specimen: The swabs were inoculated on blood agar and MacConkey agar for culturing and isolation of organisms. The culture plates were incubated at 35°C - 37°C aerobically for 18-24 hours. The culture positive isolates were identified by their colony morphology, gram stain reaction, and also motility testing according to standard methods. Pure colonies were characterized biochemically for species identification. Antibiotic susceptibility testing was performed by Kirby-Bauer technique according to the Clinical and Laboratory Standards Institute 26th edition by disc diffusion method.[11] From a pure culture, 3-5 pure colonies of bacteria were taken and transferred into a tube containing 5 ml sterile nutrient broth (Oxoid) and mixed gently until the turbidity of the suspension become adjusted to a McFarland 0.5 standard. Using a sterile cotton swab, the bacteria were seeded evenly over the entire surface of Mueller-Hinton agar (pH 7.2-7.4) (Oxoid). The plates were left at room temperature to dry for 3-5 minutes and a set of antibiotic discs (Oxoid) with the recommended concentrations was placed on the surface of the inoculated Muller-Hinton plate. Finally, the plates were incubated at 35ºC-37ºC for 18-24 hours. Diameters of growth inhibition around the discs were measured and interpreted as sensitive, intermediate, or resistant as stated by CLSI 26th edition.[11]

RESULTS

A total of 500 surgical procedures in 490 patients were performed in the hospital during the study period. There were 74(14.8%) wounds that showed clinical signs of SSI but samples were obtained from 73 patients. Their age ranged from with 1 year to 80 years with median age of 28.0 years. There were 39(53.4%) female and 34 (46.6%) male. Majority of the operation that gave rise to SSI were emergency 50(68.5%) and mostly superficial SSI 54(74.0%) (Table 1). The bacteriological culture yielded eighty-three isolates and 15(20.5%) samples showed mixed bacterial growth

Table 1: Sociodemographic and clinical variables of patients with surgical site infections

Variables	Frequency (73)	Percentage (100%)
Age		
1-20	21	28.8
21-40	35	49.9
41-60	9	12.3
60-80	8	11.0
Gender		
Female	39	53.4
Male	34	46.6
Department		
Surgery	55	75.3
Obstetrics and Gynaecology	18	24.7
Class of Wound		
Clean	36	49.3
Clean contaminated	4	5.5
Contaminated	9	12.3
Dirty	24	32.9
Type of Operation		
Elective	23	31.5
Emergency	50	68.5
Class of SSI		
SUPERFICIAL	54	74.0
Deep	17	23.3
Organ space	2	2.7

Table 2: Frequency table of the isolated organisms from surgical site infections

Organisms	Frequency (83)	Percentage (100%)
Escherichia coli	34	41.0
Klebsiella pneumonia	19	23.0
Staphylococcus aureus	9	10.8
Acinetobacter baumannii	6	7.2
Proteus vulgaris	4	4.8
Pseudomonas aeruginosa	4	4.8
Proteus mirabilis	3	3.6
Enterobacter cloacae	2	2.4
Enterococcus spp	1	1.2
Candida albican	1	1.2

NB: 5 samples yielded no growth

of two bacterial each and 53(72.6 %) yield single isolate. Out of the 73 wound samples sent, 5(6.9%) yielded no growth.

Gram-negative organisms accounted for the majority of the isolates 73(88.1%). Most of the gram-negative organisms were Escherichia coli 34(41.0%) isolates followed by Klebsiella 19(23.0%). From the strains that were isolated, there were 9(10.8%) Gram-positive organisms which were only Staph aureus. Also, one infection was caused by the Candida albican as it accounted for 1.2% of the pathogen (Table 2). Concerning antibiotic susceptibility, the results demonstrated remarkably high resistance rates to all antibiotics, except the meropenems and amikacin which showed good activities against all gram-negative isolates. For enterobacteriaceae the resistance was to ciprofloxacin (90.2%) levofloxacin (82.2%) augmentin (88.5%) ceftriaxone (85.2%) ceftazidime (80.3%), gentamicin (80.3%) meropenems (14.8%) amikacin (16.4%) (Figure 1). Escherichia coli was resistant to augmentin (85.3%), ceftazidime (79.4%), ceftriaxone (85.3%), ciprofloxacin (88.2%) and levofloxacin (73.5%) but more susceptible to amikacin (73.4%) and meropenem (88.2%) (Table 3). Staphylococcus aureus was resistant to all antibiotics used for sensitivity testing: cefoxitin (60.0%), gentamicin (77.0%), ciprofloxacin (80.0%), levofloxacin (90.0%), and clindamycin (50.0%) (Figure 2)

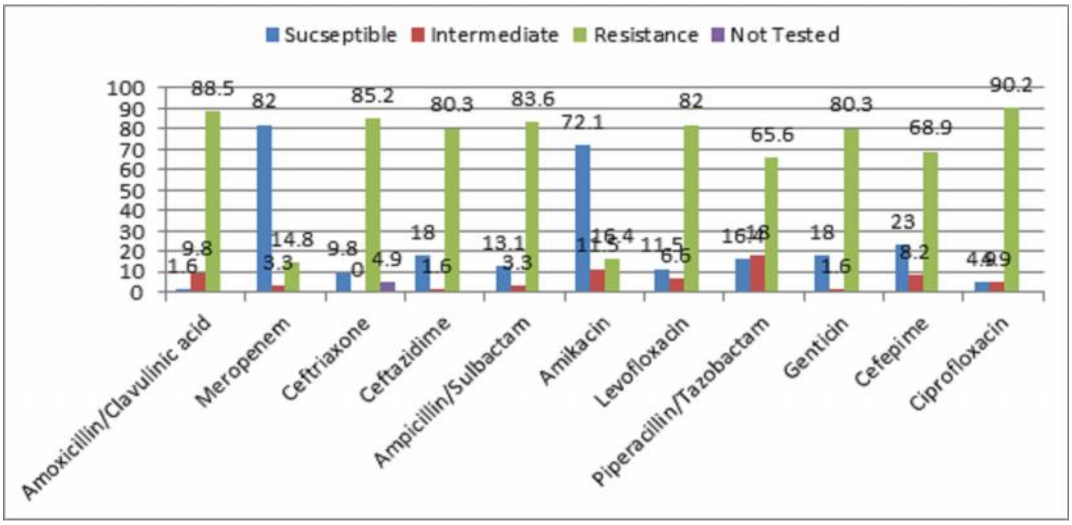

Figure 1: Percentage susceptibility pattern of the isolated gram negative organisms to the Tested antibiotic

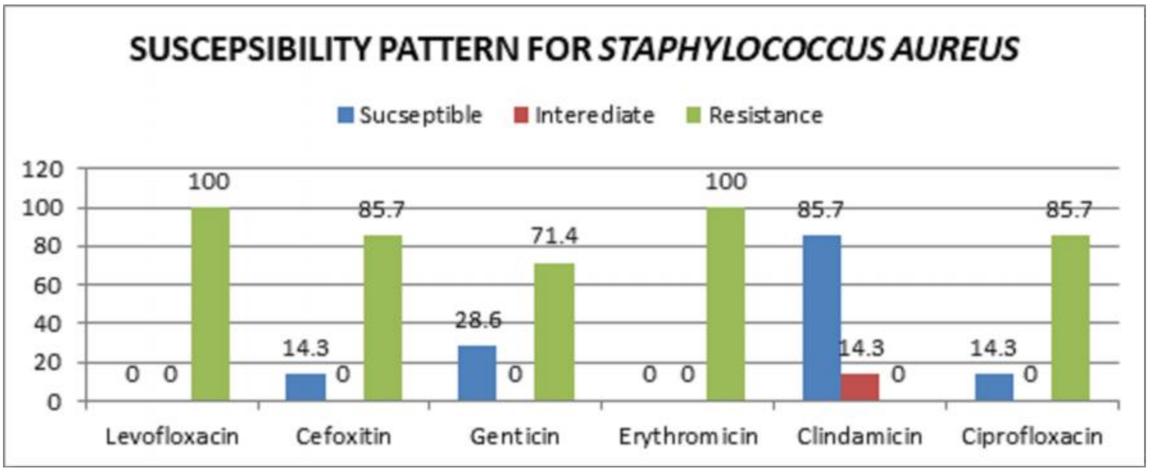

Figure 2: Percentage susceptibility pattern of the isolated staphylococcus aureus to the tested antibiotic

Table 3: Percentage susceptibility of the each isolates to tested antibiotics

		AUG	PTZ	SAM	CAZ	CRO	FEP	MER	LEV	CIP	AK	CN	E*	DA*	FOX*
Klebsiella pneumoniea	**S**		5.3%	100.0%	15.8%	10.5%	21.1%	89.5%	15.8%	5.3%	68.4%	26.3%	NT	NT	NT
	I	10.5%	36.8%	-	6.7%	-	10.5%	5.3%	-	10.5%	15.8%	-	NT	NT	NT
	R	89.5%	57.9%	-	78.9%	89.5%	68.4%	5.3%	84.2%	84.2%	15.8%	73.7%	NT	NT	NT
Escherichia coli	**S**	2.9%	20.6%	14,7%	17.6%	14,7%	32.4%	88.2%	20.6%	8.8%	73.5%	17.6%	NT	NT	NT
	I	11.8%	14.7%	5,9%	2,9%	-	8.8%	2.9%	73.5%	2.9%	11.8%	2.9%	NT	NT	NT
	R	85.3%	64.7%	79.4%	79,4%	85.3%	58.8.1%	8.8%	73.5%	88.2%	14.7%	79.4%	NT	NT	NT
****Staphylococcus aureus***	**S**	NT	NT	NT	NT	NT	NT	NT	-	-	NT	30.0%	-	50.0%	25%
	I	NT	NT	NT	NT	NT	NT	NT	10.0%	20.0%	NT	-	-	10.0%	-
	R	NT	NT	NT	NT	NT	NT	NT	90.0%	80.0%	NT	70.0%	60.0%	-	75%
Acinetobacter baumannii	**S**	-	16.7%	50.0%	16,7%	-	16.7%	50.0%	-	-	66.7%	16.7%	NT	NT	NT
	I	16.7%	16.7%	-	-	-	66,6%	-	33,3%	-	16.7%	-	NT	NT	NT
	R	83.3%	83,3%	50,0%	83.3%	100.0%	16,7%	50,0%	66.7%	100.0%	16.7%	83.3%	NT	NT	NT
Pseudomona auregenosa	**S**	20%	60%	20%	60%	NT	-	80%	-	-	60%	-	NT	NT	NT
	I	-	20%	-	-	NT	-	-	20%	-	-	20%	NT	NT	NT
	R	80%	20%	80%	40%	NT	100%	20%	80%	100%	40%	80%	NT	NT	NT
Proteus mirabilis	**S**	25.0%	25,0%	25.0%	-	-	25.0%	100.0%	25.0%	-	50.0%	25,0%	NT	NT	NT
	I	-	25.0%	-	-	-	-	-	-	25.0%	-	-	NT	NT	NT
	R	75.0%	50.0%	75.0%	100.0%	100.0%	75.0%		75.0%	75.0%	50.0%	75.0%	NT	NT	NT
Enterobacter cloecae	**S**	-	-	-	-	-	-	50.0%	-	-	100.0%	-	NT	NT	NT
	I	-	-	-	-	-	-	-	-	-	-	-	NT	NT	NT
	R	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	50.0%	100.0%	100.0%	-	100.0%	NT	NT	NT
Enmterococcus spp.	**S**	NT	NT	NT	NT	NT	NT	NT	-	NT	NT	-	-	-	--
	I	NT	NT	NT	NT	NT	NT	NT	-	NT	NT	-	-	-	
	R	NT	NT	NT	NT	NT	NT	NT	100.0%	NT	NT	100.0%	100.0%	100.0%	100.0%

* "*Susceptibility or resistance to a wide array of beta lactam antimicrobials agents may be deduce from testing only penicillin and either cefoxitin or oxacilin. testing of other beta agents except ceftraroline it not advised" —CLSI*

DISCUSSION

The microorganisms causing healthcare infections have changed in medical practice over the years.[12] The gram-positive organisms were initially predominantly involved in surgical infections but now gram-negative organisms are being isolated at an increasing rate.[13] This change in pattern was observed in our study which recorded a higher proportion of gram-negative organisms. The commonest pathogen isolated from SSI was E. coli (38.6%). This was followed by Klebsiella and staph aureus. E. coli has also been reported as the commonest isolate from SSI in previous studies.[14-16] In other studies where staph aureus was the commonest isolate, E.coli was found to be the most common gram-negative organism implicated in surgical infection.[17-19] The reason why infection from E. coli accounted for the highest isolate from the study may be because it was mostly from an endogenous source as it is part of normal intestinal flora.

Also, this also might explain the finding of this pathogen in most of the operations related to peritonitis.[16] Antibiotics played an important role in reducing the burden of surgical site infection in clinical practice globally. The menace of antibiotic resistance and its rapid spread is negating the impact of the usefulness of antibiotics. The major factors that promote resistance are inappropriate and irrational use of antibiotics.[8] The antibiotic sensitivity test showed that the isolates react differently to various antibiotics. In this study there was a high rate of multi-drug resistance among the bacteria isolates. Considering the commonest isolates in this study, the resistance was very high to most of the antibiotics except meropenen and amikacin. This was also similar to what has previously been documented in other studies.[18,20] Quinolones are commonly prescribed antibiotics in the study centre but the resistance to these drugs was very high in this study. This was not a novel finding as previous studies have shown high resistance also.[21,22] The isolated E. coli in the study were sensitive to meropenem and amikacin. This was similar to the report from previous studies.[16,23] The high susceptibility may be as a result of the scarcity of amikacin while meropenem is expensive and is usually reserved for serious infection in the centre. Staphylococcus aureus was the most common gram-positive organism and the third commonest isolate in the study.

The study showed reduced sensitivity of staph aureus to most of the antibiotics with 100% resistance to levofloxacin. The growing pattern of the resistance to antibiotics from other studies was similar to ours.[24-26] This high resistance pattern observed might be because of abuse in form of overuse and which forms the breeding ground for resistance. The reduced susceptibility of bacteria to antibiotics encountered in this study was not a surprise issue in surgical practice but it calls for concern to surgeons, particularly in low and middle-income countries where lack of funds for medical care is a big issue. The limitation of this study was anaerobic bacteria were not isolated, which could have increased the number of bacterial isolates reported as negative cultures.

CONCLUSIONS

The antibiotic resistance following SSI is alarming, and this calls for concerns among surgeons. A judicious and rational use of antibiotic use, as well as strict adherence to aseptic practice during surgery will help to reduce the need for antibiotics. There is a need for collaboration among surgeons, microbiologists and infection control units to develop an action plan in order to prevent and control surgical site infection. Also, there is a need to promote antibiotic stewardship among clinicians which will help in curbing the menace of antibiotic resistance.

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