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Retrospective Analysis of Bacterial Pathogens Isolated from Wound Infections at a Tertiary Hospital in Nguru, Yobe State Nigeria

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Abstract: Wound infections inflict clinical and societal consequences on the patients, but its bacteriological characteristic varies with different factors. Therefore, effective treatment and management of wound infections in hospital and community setting will require detailed epidemiological knowledge of the infecting bacterial pathogens and their antibiogram peculiar to the environment. Based on this information, we examined the prevalence and antibiogram of bacterial pathogens isolated from wound infection cases seen at the hospital over the study period. A total of 392 wound swabs/ and pus of different types of wound infections from different anatomical sites and associated clinical conditions were analyzed by standard bacteriological methods. Of the 392 clinical specimens analyzed, 301(76.8%) yielded at least one bacterial pathogen, 25(6.4%) polymicrobial, no anaerobes identified and 91(23.2%) yielded no bacterial growth, gender distribution, 204(67.8%) males and 97(32.2%) females, and majority of pathogens were recovered from septic wound infections. Overall, 7 different bacterial pathogens were identified 5(71.4%) gram-negative bacteria isolates and 2(28.6%) gram-positive bacterial isolates]. Staphylococcus aureus accounted for majority of the bacterial pathogens isolated, 162(53%) followed by coliforms 62(21%) and Pseudomonas aeroginosa 57(19%). The bacterial pathogens demonstrated high resistance to ampicillin(78%), amoxicillin(66%), and cotrimoxazole(78%), in contrast to high sensitivity pattern observed with fluoroquinolones (ofloxacin 83%,, norfloxacin 71%, ciprofloxacin 78%), erythromycin 72%, chloramphenicol 62%, gentamycin 58% and ceftazidime 60%. The relatively high number of wound infection cases seen within the study period is of public health concern, while the low number of bacterial pathogens isolated underscores the need for improvement in the laboratory diagnostic approach for effective treatment and management of wound infections.

Keywords: Wound Infections, Bacterial Pathogens, Antimicrobial Susceptibility Pattern, Nguru, Nigeria

1. Introduction

Wound infection occurs as a result of the disruption of skin membrane, and subsequent contamination/or colonization by microorganisms. It can be caused either by trauma (laceration, road traffic or burns) or surgical operational procedures or medical incision, that could result in open or closed wound

infections. The wound infection can progress from acute to chronic state depending on the interplay of different factors such as the age/ sex of the patients, immune status, associated clinical condition, and virulence factors of infecting bacterial pathogens [1, 2].

The consequential effect of the wound infection contaminated with bacterial pathogens translate to inhibition of the healing process that compound treatment and management approach, increased medical expenses, prolonged hospitalization, and in some cases responsible for high morbidity and mortality rate. In most cases, the source of contamination /or colonization of wound infection can either be due to endogenous source, that are the normal flora of the patient, while the exogenous contamination may originate from contaminated medical devices used in wound dressing, /or the environment, especially in the case of staphylococci and Pseudomonas spp [1,3]. In hospital setting, the level of adherence to basic standard infection control practices especially in wound dressing, level of hospital cleanliness, provision of portable water and washing solution and antibiotic stewardship may contribute significantly to the prevalence of wound infections cases seen (4).

Wide ranges of microorganisms are known to be associated with wound infections, ranging from aerobe and anaerobes bacteria, fungi and parasites [1]. The bacterial isolation rate varies with type of wound infections and associated clinical condition, type of hospital, the level of hospital infection control practice and patient person hygiene quality of clinical specimen and laboratory methods employed. In most studies, high bacterial isolation rate (>70%) have been reported, S.aureus, Pseudomonas aeruginosa, Klebsiella spp, and E.coli as the leading bacterial pathogens [2, 5-8]. Apart from above mentioned factors, sampling procedure influenced the bacterial isolation rate as evidenced in the study by Kehinde et al, in which high isolation rate was reported with wound biopsy(90%) compared to 70% with wound swab.

In sub Saharan African communities, the extensive use of antimicrobial agents for wide range of disease condition in the community because of their affordability and accessibility had encouraged the emergence of resistant strain. Emerging trend had shown that these resistant strains have been isolated from wound infections [9-10]. Because of the consequential impact of these pathogens in wound infections, local epidemiological information serves as a template for effective treatment and management approach. Based on this observation, we retrospectively analyzed the bacteriological data of all wound infections seen and clinical specimens submitted to the laboratory over the study period.

2. Methodology

2.1. Study Site

The retrospective study was conducted at the medical microbiology laboratory unit of Federal Medical Centre, Nguru Yobe state of Nigeria between January to December 2013. The 250 bed hospital provides multi-medical specialty care to Nigerians and citizens of neighboring countries of Chad and Niger. Bacteriological data of wound infections from patients admitted into different surgical units, with different associated clinical conditions between January and December, 2013 were retrieved and analyzed. Repeat wound samples data were excluded. Other demographic information retrieved includes, age, sex and associated clinical conditions, type of bacterial pathogens and antibiogram. The clinical information of some patients were either not entered or provided on the laboratory forms. Based on the available clinical information provided the wound infections were classified into 6 different types, septic wound infections 189(48.2%), abscess 11(2.8%), diabetic foot ulcer 19(4.8 %), burns 35(8.9 %), gangrene 12(3.1 %), Surgical site infection (SSI) 18(4.6%), ulcers 44(11.2%) and other 46(11.7 %).

2.2. Bacteriological Analysis

The wound swab/pus specimens were inoculated on Blood gar and MacConkey plates, incubated at 37^0C for 24hours. For anaerobes, the specimens were inoculated on chocolate agar plates placed inside a slid candle jar container incubated at 37 for 24hours. Suspected bacterial colonies were identified by standard bacteriological methods (11). Antimicrobial susceptibility testing was carried out by disc diffusion method on Mueller-Hinton agar (12). The following antibiotic discs were tested, penicillin, ampicillin, amoxicillin, ampiclox ofloxacin, ciprofloxacin, erythromycin, augmentin, gentamycin, ceftazidime, cotrimoxazole, chloramphenicol. Demographic characteristic and bacteriological data were analyzed using SPSS version 16.0, values expressed in mean and percentages.

3. Result

Of the 392 wound specimens examined, 301(76.8%) yielded at least one bacterial pathogens, 25(8.3%) were polymicrobial (mainly S.aureus and P.aeruginosa), no anaerobes identified and 91(23.2%) cases with no bacterial pathogens isolated. The mean age of the patients was 25.3$\pm$10.7 years, gender distribution of 204 (67.8 %) males and 97 (32.2%) females. Table 1, depict the different types of wound infections versus the age-group of the patients, majority of the cases examined were classified as septic wound infections(n=189, 48.2%) and featured within all the age-groups, abscess(n=11, 2.8%) and burns(n=35, 8.9%) within the age-group 0-10 to 21-30 years, and diabetic foot ulcer within 31-40 to >60years. High proportion of wound infection were recovered from patients within the age-group 21-30years 84(21.4%), followed by <10 years 83(21.2%).

Overall, 7 different bacterial pathogens were isolated, 5 (71.4%) gram-negative bacterial and 2 (28.6%) gram-positive bacterial pathogen. Figure 1, depict the frequency of bacterial pathogens isolated, S.aureus accounted for 53% of the total pathogens isolated, followed by coliforms 22%, Pseudomonas aeruginosa, 20%, Escherichia coli 2%, and Klebsiella spp, Proteus spp and streptococcus spp accounted for 1% each respectively. The distribution of bacterial

pathogens isolated versus the types of wound infections examined (figure 2). Overall, S.aureus, Pseudomonas aeruginosa and coliforms were isolated in relatively all the wound infection cases examined, with high isolation rate in septic wound infection.

Antimicrobial susceptibility pattern of the bacterial pathogens as presented in table 2, showed high sensitivity to ofloxacin (82.7%), norfloxacin (70.7%), ciprofloxacin (78.3%), erythromycin (72.0%), moderate sensitivity pattern to augmentin (53.0%), streptomycin in (59.7%), chloramphenicol (62.0%), gentamycin(58.0%), ceftazidime (60%) and reduced sensitivity to ampicillin (22%), cotrimoxazole (22%), ampiclox (38%) and amoxicillin (44%). Similar susceptibility pattern was demonstrated by the bacterial pathogens in table 3; streptococcus spp exhibiting relatively high sensitivity pattern.

4. Discussion

In this study, the overall bacterial isolation rate of 76.8%, is comparable with the rate reported similar studies in Ethiopia [6] and Cameroon [4]. In contrary, higher isolation rate (>80%) were reported in other studies in Nigeria [2, 7] and elsewhere (>80%) [8, 13]. In Philippines, a lower rate of 7.8% was reported in aerobic surgical infections study [14]. Wound infections serve as favorable medium for proliferation of microorganisms that are potentially pathogenic [2]. In most wound infection studies, polymicrobial is a common phenomenon, in this study we reported a polymicrobial rate of 5.6 %, which is lower compared to 18.6% reported in a study in Ethiopia[6]. Similarly, relatively few numbers of bacterial pathogens were isolated. The reason for this few number recorded may be due to,(i) quality of clinical specimens collected, (ii)delay in the transportation of the clinical specimens from the clinic/wards to the laboratory, (iii)laboratory methods employed and (iv) possible pre-antimicrobial medication by the patients.

The frequency of bacterial isolation and gender pattern recorded in this study showed that gram-negative bacteria accounted for 71% as against 30% of gram positive bacteria, while high proportion of patients with wound infections were males(67.3%) compared to 32.2% reported among female, this pattern are in agreement with other studies[6-8]. The predominance of male gender highlights the predisposing risk factor of occupational hazard, social activities and associated clinical conditions that result in wound infections. Furthermore, we observed that the demographic presentation of the type of wound infections as classified in the study and the age-group of the patients were consistent with the reports in other studies, with particular reference to cases of diabetic ulcer, burns, SSTI [14-17]

In the breakdown of bacterial pathogens isolated, S.aureus isolates predominates, followed by coliforms, P. aeruginosa and E.coli, which is similar to the pattern reported in some studies but varies with the frequency of isolation [3,6, 16, 18,19]. While other studies have reported pathogens like Pseudomonas aeruginosa, Klebsiella spp and E.coli as leading pathogens in different wound infections and geographical locations [15, 17, 19]. As observed in the this study, the high co-isolation rate of S.aureus and Pseudomonas aeruginosa, thus raises the possibility of exo- and endogenous contamination, that may be attributable to overcrowding of hospital wards/clinics and lack of basic facilities for standard hygienic condition, a common feature in most hospital in sub-Saharan African countries[4] . Nasal carriage of S.aureus by patients and health care worker could be another potential source of infection [20].

Table 1. *Distribution of Wound infections versus age-group of the patients*

Wound infections	0-10	11-20	21-30	31-40	41-50	51-60	>60	Total
Abscess	2	5	2				2	11(2.8)
Burns	16	10	49	2			3	35(8.9)
DFU	1			5	5	5	3	19(4.8)
Gangrene	4	2	1		1	1	3	12(3.1)
Osteomyelitis	9	1	2	2	2		2	18(4.6)
SSI	4	4	3	2	3		1	18(4.6)
Septic infections	35	26	47	20	17	10	34	189(48.2)
Ulcers	6	7	16	4	6	2	3	44(11.2)
Others	6	10	9	5	3	4	9	46(11.7)
Total	83(21.2)	65(16.6)	84(21.4)	40(10.2)	37(9.4)	22(5.6)	61(15.6)	392(100)

Table 2. *Overall Antimicrobial susceptibility pattern of bacterial pathogens isolated*

Antimicrobial agents tested	Sensitivity (%)	Resistance (%)
Ofloxacin	82.7	37.3
Norfloxacin	70.7	39.1
Ciprofloxacin	78.3	31.7
Erythromycin	72.0	28.0
Augmentin	53.0	47.0
Streptomycin	59.7	40.3
Chloramphenicol	62.0	38.0
Gentamycin	58.0	42.0
Ampicillin	22.0	78.0
Amoxicillin	44.0	66.0
Co-trimoxazole	22.0	78.0
Ceftazidime	60.0	40.0

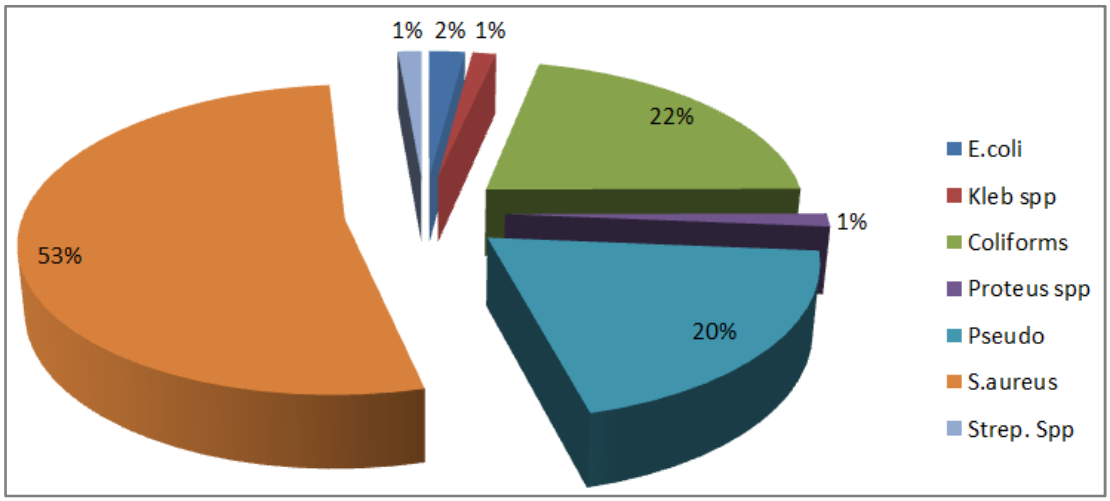

Figure 1. *Frequency of isolation of bacterial pathogens*

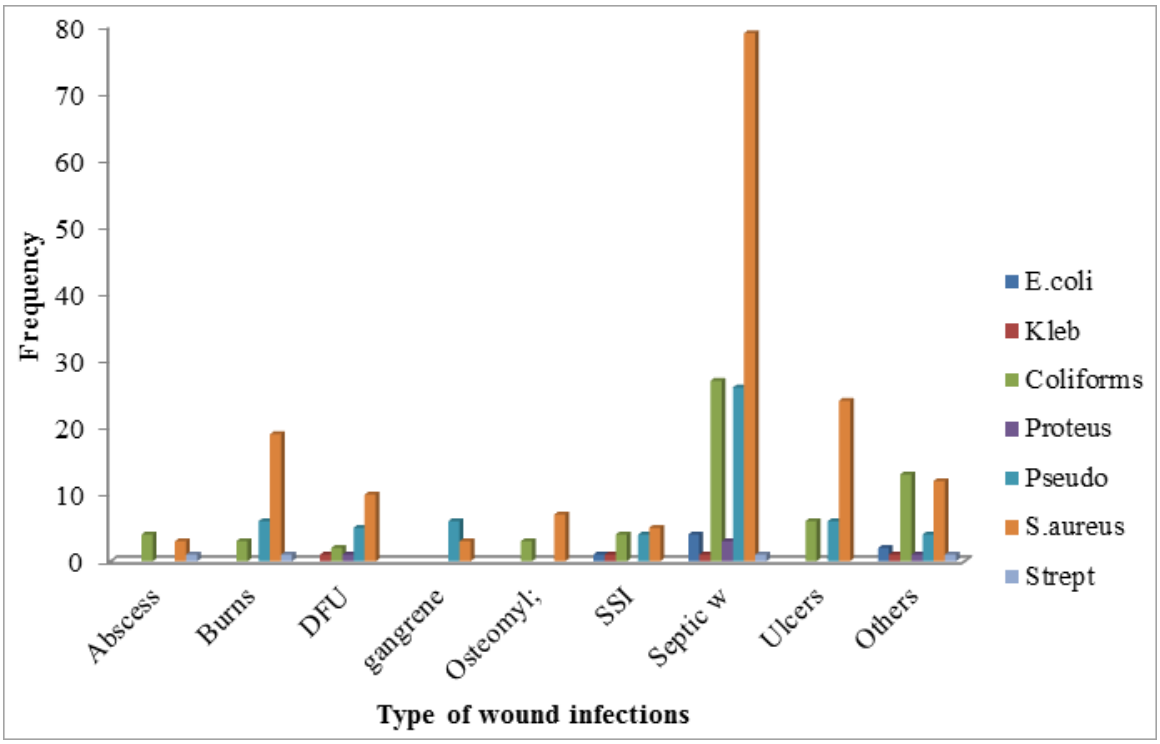

Figure 2. *Frequency of bacterial pathogens versus the wound infections.*

Table 3. *Antimicrobial resistance pattern of bacterial pathogens*

	Pseudo	E.coli	Kleb	Proteus	Coliforms	S.aureus	Strep. Spp
OFX	44	41	25	40	46	30	25
NOR	9	14	25	30	3	47	20
CIP	42	40	50	40	30	29	21
S	44	71	25	80	41	61	30
AUG	14	71	70	20	33	9	23
GEN	46	43	40	40	43	56	35
ERY	12	51	25	47	16	58	50
CHL	40	53	45	53	40	33	30
AMP	70	68	68	50	51	60	50
AMX	89	71	75	100	90	60	55
SXT	65	70	65	50	56	70	50
CAZ	16	40	30	40	34	45	20

OFX-ofloxacin, NOR- norfloxacin, CIP-ciprofloxacin, S-streptomycin, AUG- augmentin, Gen-gentamycin, CHL-chloramphenicol, AMP-ampicillin, AMX-Amoxicillin, APX-Ampiclox, SXT-co-trimoxazole, CAZ-ceftazidime.

Overall, we observed high antimicrobial resistance pattern of the bacterial isolates to ampicillin, amoxicillin, ampicillin-clavulanic acid, cotrimoxazole, a common pattern in most studies conducted in sub-Saharan African countries [6, 7]. Reasons for such pattern are not far-fetched, as these agents are readily affordable and accessible and are readily administered for wide range of infections in the community. The high sensitivity pattern of fluoroquinolones, aminoglycosides and macrolides is an indication that these agents are alternate option for effective treatment and management of wound infections. The high sensitivity of Pseudomonas aeruginosa isolates to the fluoroquinolones tested, erythromycin, aminoglycosides and ceftazidime, which showed a wide range of agents of choice for treatment. While Proteus spp demonstrated high resistance to amoxicillin, streptomycin, and moderate to low resistance to other agents tested. The high sensitivity pattern of Streptococcus spp to all agents tested may be due to possible exogenous contamination. The E.coli and Klebsiella spp isolates resistance pattern to most of the drugs tested, may not be surprising as these bacterial pathogens are known ESBL producing and exhibit multidrug resistant pattern [21].

The major finding of the study is the high prevalence of wound infections (diabetic ulcer, gangrene, osteomyelitis and surgical infections) that are associated with high morbidity and mortality rate. Apart from the number of bacterial pathogens isolated, the non-detection of multidrug resistant bacterial pathogens of clinical significance such as methicillin resistant S.aureus (MRSA) and ESBL-producing gram-negative bacteria by a simple disc diffusion tests, possibility of errors in documentation and confirmation of clinical diagnosis as documented in laboratory request form are some of the limitations in this study.

In conclusion, the high number of wound infections cases recorded within the study period is of public health concern considering clinical and societal implication. While the relatively small number of bacterial pathogens further underscores the needs for improvement in laboratory diagnosis and sampling procedures. However, periodic studies are also needed as evaluation measure of the level of infection control practices in the hospital.

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