International Journal of Research Studies in Microbiology and Biotechnology (IJRSMB)
Volume 7, Issue 1, 2021, PP 1-8
ISSN No. (Online) 2454-9428
DOI: https://doi.org/10.20431/2454-9428.0701001
www.arcjournals.org

Antibiotic Resistance Profile of Bacteria Isolated from Patients with Wound Infection in Ekiti State

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Abstract: *The progression of a wound to an infected state is likely to involve a multitude of microbial or host factors. This study was carried out to determine the antibiotic resistance profile of bacteria isolated from wound infection of patients attending Federal Teaching Hospital, Ido-Ekiti. A total of 100 patients with open wound infections were recruited for this study between July, 2020 and December, 2020. Wound swabs were cultured on Chocolate and MacConkey agar and the colonies were identified using colonial description and biochemical characterization. Antibiotic susceptibility testing was carried out using Kirby-Bauer disk diffusion. Out of 100 wound samples analysed, 52(52.0%) yielded bacterial growth belonging to 5 different genera with Escherichia coli and Staphylococcus aureus having the highest isolation rate of 17(32.7%) each followed by Pseudomonas aeruginosa 7(13.5%), Klebsiella pneumoniae 7(13.5%) and Proteus mirabilis 4(7.7%). Female subjects had the highest isolation rate of 29(55.8%) compare to their male counterpart 23(44.2%). Age groups 31-46 year and 21-30 year had the highest isolation rates of 12(23.1%) and 10(19.2%) respectively. Antibiotic resistance pattern of the bacteria isolated ranged from 25.0% to 100.0%. Pseudomonas aeruginosa exhibited more than 42.9% resistance rate to all the antibiotics. However, fluroquilonoes (Levofloxacin) and folate pathway inhibitor (Cotrimoxazole) group of antibiotics with least resistance rate should be used for the treatment of bacteria associated wound infection.*

Keywords: *Antibiotic Resistance, Wound, Bacteria, Ekiti State, Nigeria*

1. Introduction

A breach in the skin and exposure of subcutaneous tissue following loss of skin integrity is often refers to as wound (Nitin et al., 2013). The exposed subcutaneous tissues provides a favourable substratum for a wide variety of microorganisms to contaminate and colonize, and if the involved tissue is devitalized and the host immune response is compromised, the conditions become optimal for microbial growth. This is because the host immune response plays a critical role in determining whether wound infection will arise (Esebelahie et al., 2013).

Wound can be classified as accidental, pathological or post-operative. Whatever the nature of the wound, infection is the attachment of microorganisms to host cells and they profilate, colonize, and become better placed to cause damage to the host tissues (Mordi and Momoh, 2009). Wounds can also be categorized as – having either an acute or chronic etiology. Acute wounds are caused by external damage to intact skin and include surgical wounds, bites, burns, minor cuts and abrasions, and more severe traumatic wounds such as Lacerations and those caused by endogenous mechanisms associated with a predisposing condition that ultimately compromises the integrity of dermal and epidermal tissue (Bowler et al., 2001).

Wound infections are the most expensive complications following surgery and moreover, it is thought to be second most common type of nosocomial infections are the infections acquired during hospital stay and are widespread. They are important contributors to morbidity and mortality. These infections concern 2 million cases usually worldwide i.e, 5-15 percent of hospitalized patient and up to 10 percent of patients acquired more than one of these infections (Anusha et al., 2010).

All wounds are contaminated by both pathogens and body commensals. But the progression of a wound to an infected state is likely to involve a multitude of microbial or host factors. These include: the microbial load, combined virulence expressed by the micro-organism involved, patient risk factors. Other related risk factors include: prolonged hospital stay before surgery, duration of the operation, tissue trauma, poor hemostasis and foreign material in the wound (Adegoke et al., 2010).

Wound can be infected by a variety of microorganisms ranging from bacteria to fungus and parasites. Both acute and chronic wounds are susceptible to contamination and colonization by a wide variety of aerobic and anaerobic microorganisms (Bowler et al., 2001). Isolates that have been incriminated in case of wound infections include: Staphylococcus aureus, Staphylococcus epidermidis, Streptococcus faecalis, Streptococcus pyogenes, Pseudomonas aeruginosa, Klebsiella spp, Escherichia coli, Acinetobacter and Enterobacter. Candida albicans and C. tropicalis have also been implicated as etiological agents (Egbe et al., 2011). The majority of wounds are characterized by a polymicrobial aerobic-anaerobic microflora, therefore, the careful use of broad spectrum antimicrobial agents is likely to be the most frequently and sometimes inappropriately prescribed or administered in wound treatments, which often leads to the selection of antibiotic resistant bacteria strains. Since wound colonization is most frequently polymicrobial involving numerous microorganisms that are potentially pathogenic, any wound is at some risk of becoming infected. In the event of infection, a wound fails to heal, the patient suffers increased trauma, treatment cost rise, and general wound management practice become more resource demanding. Infection continues to be a major complication of wounds with significant increase morbidity and potential mortality. Wound infection is one of the most challenging aspects of wound management and major contributor to health care cost globally (Germa et al., 2013). Antimicrobial resistance among pathogens of wound infections is on the increase. Antimicrobial drug resistance can be acquired as a result of mutation or acquisition of resistance genes, via horizontal gene transfer, or can be an innate features of an organism that is encoded chromosally (Adenike et al., 2012). Antimicrobial drugs overuse, overdosing, drugs, prescription with improper susceptibility test, self-medication and long duration of hospitalization was suggested to augment the problem of milti-drug resistant (MDR) in developing nations (Germa et al., 2013). Wound due to physical trauma, burn or surgical procedure predisposes the internal body tissue to microbial infections, especially bacterial ones. Wound infection impairs the healing process. In case of severe wound infection, healing becomes more difficult and sometimes convert into chronic wounds (Humpreys, 2009).

In most developing countries, it is a common practice that antibiotics can be purchased without prescription. This leads to misuse of antibiotics by the public thus contributing to the emergence and spread of anti-microbial resistance (Mulugeta and Bayeh, 2011). The current spread of Multi-Drug Resistant bacteria pathogens has added a new dimension to the problem of wound infection. A regular bacteriological review of infected wound is therefore a necessity if affected when blind treatment is a necessity, as in underdeveloped and developing nations.

Wound infections and antibiotics resistant bacteria become a real threat. Hence, monitory of local level antimicrobial resistance profile in indispensable to contain the spread of drug resistance. Therefore, this study aimed at determining bacterial and antibiotic resistant profile of infections from different sites of wound that occurred among patients.

2. Methodology

2.1 Study Location

The study location for this study was Federal Teaching Hospital (FETH) Ido Ekiti, Nigeria. FETH is located in Ido Ekiti, the principal town in Ido/Osi Local Government Area of Ekiti State with an estimated population of 107,000. It is geographically located in the northern part of Ekiti State which covers an estimated total area of 6353 km/ 2453 square mile and an estimated population of 2,737,186, where the routes from Kwara and Osun State converges. FETH, Ido Ekiti is serving five contiguous States (Ekiti, Osun, Ondo, Kogi and Kwara States).

2.2 Study Population

The study populations for this work were Adult and paediatric patients attending Federal Teaching Hospital presenting with various Wound Infections.

2.3 Ethical Consideration

The ethical clearance for this research was given by Federal Teaching Hospital ethical committee after due processes had been followed. Before the collection of the sample, information regarding the study was explained to the subjects. Oral and written consent for participation in the study were also obtained.

3. Questionnaire and Informed Consent

Questionnaire to obtain the demographic characteristics and other relevant information to the study as well as an informed consent were administered to the participants.

3.1 Sample Sizes

A total 100 wound swabs were collected from the adult and paediatric patients in both surgery and medical department of the above named hospital between July, 2020 and December, 2020. The samples were transported to the laboratory as soon as possible.

3.2 Collection of Samples

The method described by Egbe et al. (2011) was used for sample collection. The wound swab was collected on moistened cotton swab without contaminating with skin commensals and transported to the laboratory as soon as possible.

3.3 Cultivation of Wound Swab

The wound swab was cultured on MacConkey and Chocolate agar and incubated at 370C for 24hrs under aerobic and microaerophilic conditions respectively (Cheesbrough, 2000).

3.4 Identification of Colony

Colonial description on the MacConkey and Chocolate Agar was done based on some shape elevation, consistency and haemolysis on chocolate alone.

3.5 Gram Stain

The colony was Gram stained using method described by Cheesbrough (2000).

3.6 Biochemical Test

The following biochemical tests were used for the identification of the bacteria (Ochei and Kolhaktar, 2000). Gram-negative bacteria were tested for catalase, motility, indole, citrate and oxidase test, while Gram negative bacteria were tested for catalase and coagulase. The result of the biochemical tests were compared with standard identification chart.

4. Antimicrobial Susceptibility Testing

4.1 Disk Diffusion Testing

Antibiogram was performed for all bactreia isolates using the disk diffusion method and the results were interpreted using the criteria of the Clinical Laboratory Standard interpretation (CLSI, 2018).

The drugs for disk diffusion testing were obtained from reputable company. Their codes and concentration (in µg) were as follow: Aminoglycosides: Gentamycin (GEN) (10ug). Cephems: Cefepime(CEP) (30ug), Fluroquinolones: Levofloxacin (LEV) (5ug), Folate pathway inhibitor: Cotrimoxazole (COT) (1.25+23.75ug). Penicillin: Augumentin (AUG) (10ug).

5. Results

Table 1 shows the prevalence of bacteria isolated from wound infection in Federal Teaching Hospital, Ido-Ekiti. It showed that out of 100 wound samples processed 52(52.0%) yielded bacteria growth while 48(48.0%) yielded no bacteria growth with p value 0.0800 which is statistically not significant.

Table 2 shows the prevalence of bacteria associated with wound infection in relation of bacteria type. It revealed that *Staphylococcus aureus* and *Escherichia coli* were the highest isolated bacteria among the patient with wound infection with prevalence rate of 17(32.7%) each, followed by *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* with 7(13.5%) prevalence rate each, while 4(7.7%) prevalence rates were recorded for *Proteus mirabilis* respectively. This is statistically significant with P value 0.042.

Table 3 shows the rate of bacteria from wound infection in relation to sex. It revealed that female subjects had the highest prevalence 29(55.8%) compare to their male counterpart 23(44.2%). This is statistically not significant P value equal to 0.054

The isolation rate of bacteria from wound infection in relation to age is shown in table 4. It shows that Age groups 31-40yrs had the highest prevalence rate of 12(23.1%) followed by 21-30yrs with prevalence rate of 10(19.2%) while 8(15.9%), 8(15.9%), 5(9.6%), 5(9.6%), 2(3.9%) and 2(3.9%) prevalence rate for 1-10yrs, 11-20yrs, 41-50yrs, 51-60yrs, and 71-80yrs respectively with P value equal to 0.533 which is statistically not significant.

Table 5 shows the antibiotics pattern of bacteria isolated from wound infection. It revealed that *Staphylococcus aureus* was resistance to Levofloxacin, Cefepine, Gentamycin, Augmentin and Cotrimoxazole at resistant rate of 5(29.4%), 15(88.2%), 4(82.3%), 11(64.7%) and 3(17.7%) respectively. Six(35.5%), 14(82.3%), 15(88.2%), 10(58.8%) and 4(23.5%) *Escherichia coli* were resistant to Levofloxacin, Cefepine, Gentamycin, Augmentin and Cotrimoxazole respectively. Moreover, *Klebsiella pneumoniae* were resistant to Levofloxacin 2(28.6%), Cefepine 5 (83.3%), Gentamycin 5(83.3%), Augmentin 7(100%) and Cotrimoxazole 2(28.6%) respectively. Furthermore *Pseudomonas aeruginosa* were resistance to Levofloxacin 3(42.9%), Cefepine 7(100%), Gentamycin 7 (100%), Augmentin 5(77.4%) and Cotrimoxazole 3(42.9%) respectively. *Proteus mirabilis* was resistant to Levofloxacin, Cefepine, Gentamycin, Augmentin and Cotrimoxazole with resistant rate of 1(25%), 2(50%), 2(50.%), 3(75.0%) and 2(50.0%) respectively.

Wound Infection	**No examined (%)**	**p value**
Bacteria Growth	52 (52.0)	0.0800
No Bacteria Growth	48 (48.0)	
Total	100 (100.0)	

Table1. *Prevalence of bacteria isolated from wound infection in Federal Teaching Hospital, Ido-Ekiti.*

Bacteria	**No examined (%)**	**p value**
Staphylococcus aureus	17 (32.7)	0.042
Escherichia coli	17 (32.7)	
Klebsiella pneumoniae	7(13.5)	
Pseudomonas aeroginosa	7 (13.5)	
Proteus mirabilis	4 (7.7)	
Total	52 (100.0)	

Table2. *Prevalence of bacteria associated with wound infection in relation to bacteria type.*

Sex	**No examined (%)**	**p value**
Male	23 (44.2)	0.054
Female	29 (55.8)	
Total	52 (100.0)	

Table3. *Isolation rate of bacteria from wound infection in relation to sex*

Age (yrs)	**No examined (%)**	**p value**
1 – 10	8 (15.4)	0.533
11 – 20	8 (15.4)	
21 – 30	10 (19.2)	
31 – 40	12(23.1)	
41 – 50	5 (9.6)	
51 – 60	5 (9.6)	
61 – 70	2 (3.9)	
71 – 80	2 (3.9)	
Total	52 (100.0)	

Table4. *Isolation rate of bacteria from wound infection in relation to Age.*

Bacteria	**Antibiotics (%)**				
	LEV 55µg	**CEP 30µg**	**GEN 10µg**	**AUG 16µg**	**COT 1.25+23.75µg**
Staphylococcus aureus (n=17)	5(29.4)	15(88.2)	14(82.3)	11(64.7)	3(17.7)
Escherichia coli (n=17)	6(35.3)	14(82.3)	15(88.2)	10(58.8)	4(23.5)
Klebsiella pneumoniae (n=7)	2(28.6)	5(83.3)	5(83.3)	7(100)	2(28.6)
Pseudomonas aeruginosa (n=7)	3(42.9)	7(100)	7(100)	5(77.4)	3(42.9)
Proteus mirabilis (n=4)	1(25.0)	2(50.0)	2(50.0)	3(75.0)	2(50.0)

Table5. *Antibiotics resistant pattern of bacteria isolated from wound infection.*

Key n = Number of Resistant bacteria

LEV = Levofloxacin

CEP = Cefepine

GEN = Gentamycin

AUG = Augmentin

COT = Cotrimoxazole

6. Discussion

Wound Infection is the most frequently polymicrobial involving numerous of microorganism that are potential pathogen that can predispose the patients to various complications. In this study, the prevalence of bacteria isolated from wound infection in Federal Teaching Hospital, Ido-Ekiti is 52(52.0%). This prevalence rate appears to be very high because wound provides a favourable substratum for a wide variety of microorganism. This is supported by Esebelahie et al. (2013) who reported that bacterial contamination of wounds is a serious problem in the hospital, especially in surgical practice where the site of a sterile operation can become contaminated and subsequently infected

However, the bacteria profile from wound infection (table 2) showed that Staphyloccocus aureus and Escherichia coli had the highest prevalence rate 17(32.7%). This might be because the two bacteria are potential pathogen frequently isolated from environment. This is in agreement with Girma et al. (2013). Both acute and chronic wounds are susceptible to contamination and colonization by a wide variety of aerobic and anaerobic microorganisms (Bowler et al., 2001). Also, Sisay et al. (2019) reported that isolates that have been incriminated in case of wound infections include Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli Streptococcus faecalis, Streptococcus pyogenes and Pseudomonas aeruginosa, Klebsiella spp.

Table 3 showed the isolation rate of bacteria from wound infection in relation to sex. Female counterparts were more infected than their male counterpart. Although, the reason for high prevalence recorded among the female subjects was not known. This is because any individual can have wound infection irrespective of the sex. This is supported by Nitin et al. (2013).

The Age distribution of the bacteria from the wound infection should be that age group 21-30 and 31-40years had the highest prevalence rate compare to other studied age group. This is in agreement with Mulugeta et al.(2011) who reported that age group 21-50years are frequently down with various wound infection. Although Esebelahie et al. (2013) reported that host immune response plays a critical role in determine whether wound infection will arise or not. This suggested that the patients that are infected in this age group are likely to have a weaken immune system.

The antibiotic profile (table 5) showed that there is an increasing antibiotic resistance pattern amount the patients. Levofloxacin and Cotrimoxazole demonstrated least antibiotic resistance compared to other tested antibiotics. This is with the exception to Pseudomonas aeruginosa that exhibited resistance ranging from 42.9% in cotrimoxazole and 77.4% in Augmentin while 100.0% resistance in Cefepine and Gentamycin.

7. Conclusion

Wounds are contaminated by both pathogens and commensals. Therefore, adequate care should be put in place during the dressing of the wound. Above all, the need to improve the immune status of the patient is critical to the improvement to the treatment curses.

8. RECOMMENDATION

Wound infection remains a major problem, most especially among people with weakened immune system. Nevertheless antibiotics are helpful in this direction; therefore fluroquilonoes groups of antibiotics should be among the antibiotics of choice for the treatment of various wound infection.

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Citation: *Ojo B. O, et.al., Antibiotic Resistance Profile of Bacteria Isolated from Patients with Wound Infection in Ekiti State. International Journal of Research Studies in Microbiology and Biotechnology. 2021; 7(1): 1-8. DOI: https://doi.org/10.20431/2454-9428.0701001.*