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RESEARCH ARTICLE

EFFECT OF MOST COMMON ANTIBIOTICS AGAINST BACTERIA ISOLATED FROM SURGICAL WOUNDS IN ADEN GOVERNORATE HOSPITALS, YEMEN

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Abstract

Objective: The increased antibiotics resistance of pathogenic bacteria isolated from surgical wound is the major health threats challenge the patients especially in developing countries like Yemen. This work was aimed to determine and identify the bacteria associated with surgical wound infections and their resistance to commonly used antibiotics.
Methods: One hundred and twenty swabs were sampled from surgical wound patients at Aden City, Yemen. The pathogenic bacteria were isolated and identified according to standard microbiological methods. Also, antibiotic susceptibility tests were determining by using Kirby-Bauer disc diffusion technique.
Results: The results showed that out of 120 samples, 68 (56.67%) showed bacterial growth. It was found that the most isolated bacteria was *Sylococcus aureus* 27 (39.70%) followed by *Escherichia coli* 19(27.94%), *Pseudomonas aeruginosa* 13 (19.12%), and *Proteus mirabilis* 9 (13.24%). All isolated bacteria were recorded to be extremely resistant to the most tested antibiotics. *S. aureus* was reported to be susceptible to cefotaxime, vancomycin, and ciprofloxacin and highly resistant to ceftazidime, nalidixic acid, erythromycin, and tetracycline. The *E. coli* isolates showed resistance (100%) to vancomycin and tetracycline and moderately sensitive to ceftazidime and gentamycin. *P. aeruginosa* showed from high to moderate resistance to most tested antibiotics except gentamycin and cefotaxime. Most of *P. mirabilis* isolates were sensitive to ceftazidime, cefotaxime, ciprofloxacin, and gentamycin and highly resistant to amoxicillin, erythromycin, and vancomycin.
Conclusion: The current study findings that the reduced sensitivity of isolated bacteria to commonly used antibiotics is an alarming and threat upsurge of infections caused by antibiotic-resistant bacteria.
Keywords: Antibiotics, pathogenic bacteria, resistant, wounds infection.

INTRODUCTION

The wound infections consider to be one of the most common nosocomial infections and are a significant cause of morbidity and account for 70-80% mortality[1,2]. Wound infections were caused by several pathogenic microorganisms that are bacteria, fungi, and parasites as well as virus[3]. *Enterococci*, *Escherichia*, *Pseudomonas*, *Klebsiella*, *Enterobacter*, *Proteus* and *Acinetobacter* were recorded the most common infecting wounds[4,5]. Advances in infections control of wound have become more challenging resulting from prevalent of microorganism's resistance to antibiotics, and to a more occurrence of infections caused by methicillin- resistance *S. aureus* and polymicrobial flora[6]. The problem of antimicrobial resistance is challenging in low-income countries resulting from high occurrence of infections, misuses of antimicrobials, over the counter availability of drugs and lack of diagnostic laboratories for susceptibility testing of antibiotics[7]. Also, the antibacterial resistance can increase problems and expenses associated with digenesis and treatment[8]. However, very limited information is available on the type of isolated bacteria and their antibacterial resistance associated with infected wound in Aden Hospitals, Yemen. So, the present investigation was carried out to isolate and identify the pathogenic bacteria from surgical wound infections and determine their sensitivity to common antibiotics.

MATERIALS AND METHODS

Samples Collection

One hundred and twenty (120) samples were collected from wound patients that undergo a surgical operation in three general hospitals, Algomhori, Khalifa, and Alsadaka, in Aden City of Yemen. By using a sterile cotton swab, the wound samples were swabbed gently from the superficial, medium or deep of the infected area and the samples were immediately transported to the laboratory. Each sample was inoculated on McConkey agar, Nutrient agar and Blood agar (Himedia, India) and then incubated for 24 hrs at 37°C.

Identification of isolated bacteria

Isolated bacteria were subjected to standard microbiological identification tests based on morphological characteristics for colony, micro-scopically, and biochemical tests to confirm their identity/purity[9].

Antibacterial susceptibility testing

The antibacterial sensitivity testing was performed by using disk diffusion methods on Mueller–Hinton agar based on Kirby–Bauer method[10]. Ten types of antimicrobial agents tested were: amoxicillin (30 µg), ceftazidime (30 µg), ciprofloxacin (5 µg), vancomycin (30 µg), ceftriaxone (30 µg), nitrofurantoin (30 µg), tetracycline (30 µg), erythromycin (15 µg), nalidixic acid, (30 µg), gentamicin (10 µg) (Himedia, India). The plates were incubated for 18-24 hrs at 37°C. The obtained of inhibition zones were determined in millimeters.

RESULTS

In the current results, 120 samples were collected from both sexes (males and females) with surgical wound infection. Total 88 samples (73.33%) from males and 32 samples (26.67%) from females as shown in Figure 1.

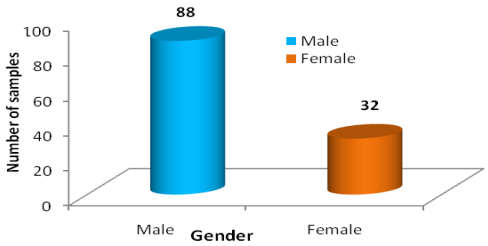

Figure 1: The number of samples distribution between genders.

From the results, there were only 68 samples (56.67%) reported as positive bacterial growth and 52 samples (43.33%) were negative for bacterial growth reported in culture media (Figure 2). The Figure 3 showed that the *S. aureus* at 27 (39.70%) was the most isolate followed by *E. coli* at 19(27.94%), *P. aeruginosa* at 13(19.12%), and *P. mirabilis* at 9 (13.24%). The results of antibacterial susceptibility reported that the *S. aureus* isolates showed high resistance against ceftazidime (100%) followed by nalidixic acid (88.9%), tetracycline (85.19%), and erythromycin (74.1%).

Table 1: Resistance and sensitivity pattern of isolated *S. aureus.*

Antibiotics	Resistant (%)	Sensitive (%)	Total
Amoxicillin	14(51.9)	13 (48.1)	27
Cefotaxime	0	27(100)	27
Ceftazidime	27(100)	0	27
Ciprofloxacin	4(14.9)	23(85.1)	27
Erythromycin	20(74.1)	7(25.9)	27
Gentamycin	10(37)	17(63.)	27
Nalidixic acid	24(88.9)	3(11.1)	27
Nitrofurantoin	12(48.1)	15(51.9)	27
Tetracyclin	23(85.19)	4(14.81)	27
Vancomycin	1(3.7)	26(96.3)	27

The medium-resistant of *S. aureus* was recorded to amoxicillin at 51.9% and nitrofurantoin at 48.1%. *S. aureus* showed very high sensitivity to cefotaxime (100%) followed by vancomycin (96.3%) and ciprofloxacin (85.1%) as shown in Table 1.

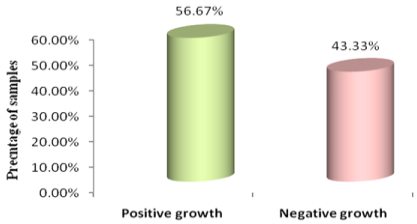

Figure 2: The percentage of bacterial growth in media.

The isolated *E. coli* from wounds indicated 100% resistant to vancomycin and tetracycline. Also, *E. coli* showed high resistance nalidixic acid (73.7%), erythromycin and amoxicillin (68.4%), nitrofurantoin and cefotaxime (63.2%). It was moderately resistant to gentamycin at 36.8% as listed in Table 2.

Table 2: Resistance and sensitivity pattern of isolated *E. coli.*

Antibiotics	Resistant (%)	Sensitive (%)	Total
Amoxicillin	13(68.4)	6(31.6)	19
Cefotaxime	12(63.2)	7(36.8)	19
Ceftazidime	10(52.6)	9(47.4)	19
Ciprofloxacin	7(36.9)	12(63.1)	19
Erythromycin	13(68.4)	6(31.6)	19
Gentamycin	7(36.8)	12(63.2)	19
Nalidixic acid	14(73.7)	5(26.3)	19
Nitrofurantoin	12(63.2)	7(36.8)	19
Tetracycline	19(100)	0	19
Vancomycin	19(100)	0	19

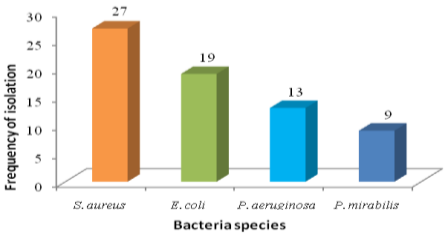

Figure 3: The type of isolated bacteria and their frequency.

The *P. mirabilis* isolates showed sensitive to ceftazidime at 88.9% followed by cefotaxime ciprofloxacin, and gentamycin at 77.8% for each. *P. aeruginosa* showed high resistance to amoxicillin and vancomycin at 100%, followed by tetracycline at 92.3%, erythromycin at 84.6%, nalidixic acid and nitrofurantoin at 76.9%, ciprofloxacin at 69.2%. *P. aeruginosa* was sensitive to gentamycin (76.9) and cefotaxime (69.2) as shown in Table 3.

DISCUSSION

The infection of wounds by different bacteria resulting from nosocomial infection and treatment of wound infections remains an important concern for surgeons. The type and cell number of bacteria play an significant role in developing of wound infection[11]. In the present study, it was revealed that the 88 samples (73.33%) were collected from males and 32 samples (26.67%) from females. This result is similar to the findings by Anthony *et al*.,[12] who recorded that the up of 40 samples were collected from males and 24 from females. Of 120 samples processed, 68 samples (56.67%) were recorded as positive growth and 52 samples (43.33%) were observed as negative growth. In a study by Farrag *et al*.,[11] revealed that the 41 samples (82%) collected from wound infections were reported as positive growth for bacteria and only 9 samples were showed no growth for bacteria.

Table 3: Resistance and sensitivity pattern of isolated *P. aeruginosa.*

Antibiotics	Resistant (%)	Sensitive (%)	Total
Amoxicillin	13(100)	0	13
Cefotaxime	4(30.8)	9(69.2)	13
Ceftazidime	6(46.2)	7(53.8)	13
Ciprofloxacin	9(69.2)	4(30.8)	13
Erythromycin	11(84.6)	2(15.4)	13
Gentamycin	3(23.1)	10(76.9)	13
Nalidixic acid	10(76.9)	3(23.1)	13
Nitrofurantoin	10(76.9)	3(23.1)	13
Tetracycline	12(92.3)	1(7.7)	13
Vancomycin	13(100)	0	13

These pathogenic bacteria are *S. aureus*, *E. coli*, *P. aeruginosa*, and *P. mirabilis.* The results showed that *S. aureus* was the predominant (39.70%) followed by *E. coli* (27.94%), *P. aeruginosa* (19.12%), and *P. mirabilis* (13.24%). In a similar investigation by Tayfour *et al.*,4 observed that the *S. aureus* was the most bacteria isolated from King Fahd Hospital patients with 33.5% percentage. A study by Anthony *et al*.,[12] revealed that the *S. aureus* was the predominant bacteria (25%), followed by *P. aeruginosa* (20%), *E. coli* (15%), and *P. mirabilis* (10%). *S. aureus* exists naturally on the skin surface by 40-60% of healthy people as well as present in the hospital environment[13]. Poor wound management allows the bacteria to invade the inner tissue and bring about chronic systemic infection[14]. The *P. aeruginosa* bacteria are common in hospitals and the presence of diseases associated with hospital-acquired infections that are transmitted saluting this type of bacteria, mainly from non-living sources to the body's tissues by disinfectants and surgical instruments used[15]. Most of contaminated wounds with hospital-acquired infections such as bacteria are known due to poor hospital hygiene[16].

Table 4: Resistance and sensitivity pattern of isolated *P. mirabilis.*

Antibiotics	Resistant (%)	Sensitive (%)	Total
Amoxicillin	9(100)	0	9
Cefotaxime	2(22.2)	7(77.8)	9
Ceftazidime	1(11.1)	8(88.9)	9
Ciprofloxacin	2(22.2)	7(77.8)	9
Erythromycin	9(100)	0	9
Gentamycin	2(22.2)	7(77.8)	9
Nalidixic acid	6(66.7)	3(33.3)	9
Nitrofurantoin	8(88.9)	1(11.1)	9
Tetracycline	4(44.4)	5(55.6)	9
Vancomycin	9(100)	0	9

The *P. mirabilis* bacteria was found in hospitals and it has an active role in bringing about infections of wounds and burns[15]. Most of the bacteria that exhibited higher rates of antibacterial resistance are human normal flora and biofilm-forming pathogens such as *S. aureus, P. aeruginosa*, and *E. coli*[17]. In this study, the *S. aureus* showed high resistance against many antibiotics that used to treat the *S. aureus* infection. These findings are in consistent with the study of Adcock *et al*.,[18] and Sani *et al*.,[19] who recorded that pathogenic *Staphylococci* are resistant to several antibiotics. Therefore, it should not be used these group of antibiotics singly for the treatment of chronic infection. The resistance of tetracycline and erythromycin antibiotics were determined by plasmids that can be transmitted between *Staphylococci* species by transduction and maybe by conjugation[20]. Also, *E. coli* exhibited high resistance to nalidixic acid (73.7%), erythromycin and amoxicillin (68.4%), nitrofurantoin and cefotaxime (63.2%). This finding is in agreement with the work of Adwan *et al*.,[21] who documented that the *E. coli* recorded resistance to many of antibiotics used to treat its infection. Similar results was reported by Giacometti *et al*.,[13] found that the *E. coli* was resistant to gentamycin at 50% and ciprofloxacin at 36.7%. Giacometti *et al*., reported that *E. coli* was resistant to gentamycin at 50% and ciprofloxacin at 36.7%[13]. In the present study *P. aeruginosa* was observed to reduce sensitivity to most used antibiotics especially for ciprofloxacin (69%), ceftazidime (83.3%) and ciprofloxacin (69.2%). The reducing resistance of *P. aeruginosa* to ciprofloxacin was documented in India by Raja and Singh[22]. On the other hand, *P. aeruginosa* showed resistance to gentamicin (87.5%) and to tetracycline (57%)[23]. The *Pseudomonas* species are naturally resistant to a wide variety of antibiotics due to mechanisms such as efflux pumps[17]. The existence of such biofilm greatly contributes to persistent bacterial infections in surgical sites[24]. Most of the *P. mirabilis* were highly resistant to amoxicillin, erythromycin, and vancomycin at 100% and followed by nitrofurantoin at 88.9%. These results agree with the

results reported by Mordi and Momoh[25] and Manikandan and Amsath[26].

CONCLUSIONS

In conclusion, the increase of isolated bacteria resistance to used antibiotics due to unrestrained, mismanagement, extensive incorrect, and misuse of antimicrobial agents in hospitals and whole of country. Also, this is promoted by the absence of polices for National antibiotics and over-the-counter antibiotic obtain ability in Yemen. Hence, it is essential to establish the national antibiotic policies that regulate the operation for giving the patients antibiotics before performance the antibiotics sensitivity test.

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AUTHOR'S CONTRIBUTION

ALhlale MF: writing original draft, methodology. **Humaid A:** formal analysis, data curation. **Saleh AH:** writing, review. **Alsweedi KS:** methodology, formal analysis. **Edrees WH:** supervision, conceptualization.

DATA AVAILABILITY

Data will be made available on request.

CONFLICT OF INTEREST

No conflict of interest associated with this work.

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