Prevalence of Pathogenic Bacterial Isolates Infecting Wounds and their Antibiotic Sensitivity in Seiyun General Hospital Authority

Othman Mohamed Al-Amodi[1] , Hamzah Mohamed Al-Khadhra[1], Ammar Obaid Swedan[1] , Mohamed Othman Al-Amodi[2]

Abstract

The rapid development of pathogenic bacteria resistant to common antibiotics represents a major health problem for healthcare workers and the community. Therefore, the present study aimed to isolate and identify bacteria associated with surgical wound infection patients and determine the antibiotic susceptibility profiles of pathogenic bacteria isolated from wound patients attending Seiyun General Hospital Authority - Yemen. A cross-sectional study was conducted from February 2024 to December 2024 among patients with wound who hospitalized at Seiyun General Hospital Authority in Seiyun City. Forty-six (46) pus samples were collected from patients wound and transferred immediately to the microbiology laboratory at site of work for pathogenic bacteria isolation and identification by standard bacteriological procedures. Also, antibacterial susceptibility tests for isolated pathogenic bacteria were determined by using the Kirby-Bauer disc diffusion technique. The results showed that out of 46 samples, 32 (69.6%) showed bacterial growth; of which 23(71.8%) were Gram-positive and 9 (39.1%) were Gram-negative. Staphylococcus aureus (68.8%) was most common followed by Escherichia coli (12.5%), Pseudomonas aeruginosa (6.3%), Proteus mirabilis (6.3%), Klebsiella pneumoniae (3.1%) and Streptococcus pyogenes (3.1%). The most effective antibiotic for Gram-positive isolates was Gentamicin 10mcg (65.22%). For Gram-negative isolates, Piperacillin/tazobactam 20mcg. Most isolated bacteria were recorded to be extremely resistant to the most tested antibiotics. Staph. Aureus was reported to be susceptible to Gentamicin 10mcg and highly resistant to Ceftazidime 30mcg, Cefepime 30mcg, Ampicillin/sulbactam, Amoxicillin/clavulanic acid 30/20mcg, cefuroxime30mcg. The E. coli isolates showed resistance (100%) to Cefepime 30mcg, Ceftazidime 30mcg, Vancomycin30mcg, Ampicillin/sulbactam20mcg, Amoxicillin/clavulanic acid 30/20mcg and cefuroxime30mcg. The Ps. aeruginosa isolates showed resistance (100%) to all antibiotics except Ceftriaxone 30mcg (50%). The P. mirabilis isolates showed resistance (100%) to all antibiotics except Gentamicin10mcg (50%). Therefore, routine microbiological analysis of wound samples and antibiotic sensitivity testing are recommended so that the physician can treat the wound infection.

Keywords: Antibiotic, Bacterial isolates, wound infection

[1]College of Medicine and Health Sciences, Seiyun University

[2]College of Agriculture and Food, Seiyun University Faculty of Education

Introduction

Skin, the largest organ in the human body, plays a crucial role in the sustenance of life through regulation of water and electrolyte balance, thermoregulation, and by acting as a barrier to external noxious agents including microorganisms, however, when the epithelial integrity of skin is disrupted, a wound result (37). This may be characterized by the classic signs of redness, pain, swelling raised temperature and fever (30). 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 (21)

Wound can be infected by a variety of microorganisms. The common gram-positive organisms are *Staphylococcus aureus* and *Streptococcus pyogenes*. The gram-negative organisms are *Escherichia coli*, *Klebsiella* species, *Pseudomonas aeruginosa*, *Enterobacter* species, and *Proteus* species. The fungal organisms are Candida species and moulds such as *Aspergillus* species (27).

The commonest pathogenic bacteria isolated from infecting wounds are *Staphylococcus aureus*, *Escherichia* sp., *Pseudomonas* sp., *Klebsiella* sp., *Enterobacter* sp., *Enterococci* sp., *Proteus* sp., and *Acinetobacter* sp. (3; 15; 18, 20).

A study by (9;32), revealed that the *Staph. aureus* was the predominant bacteria (25%), followed by *Ps. aeruginosa* (20%), *E. coli* (15%), and *P. mirabilis* (10%). *Staph. aureus* exists naturally on the skin surface by 40-60% of healthy people as well as present in the hospital environment.

In a similar investigation by. (33), observed that the *Staph. aureus* was the most bacteria isolated from King Fahd Hospital patients with 33.5% percentage

However, most of the pathogenic bacteria existing in infecting wounds are nosocomial bacteria that responsible for causing morbidity and 70-80% of patient's mortality (22; 35).

Wound infections by *Staphylococcus* spp. are common in developing countries (5). Variations in antimicrobial susceptibility make it difficult to determine the infection patterns of *Staphylococcus* sp. in socioeconomically underdeveloped regions (13)

The control of wound infections has become more challenging due to widespread bacterial resistance to antibiotics and to a greater incidence of infections caused by methicillin-resistant *Staph. aureus* (MRSA) and polymicrobic flora (2). Although MRSA accounts for some wound infections, the majority are caused by methicillin-susceptible strains (25). The high prevalence of antimicrobial-resistance bacteria has become a major threat to reducing the effectiveness of antibiotics in low-income countries. The factors that contribute to antimicrobial-resistant bacteria maybe due to the over the-counter antibiotic availability, extensive incorrect and misuse of these agents in hospitals as well as in the country as a whole (16). The global number of Hospital-associated infection (HARIs) was estimated to be 136 million per year (12).

Yemen is one of the developing countries that lack an effective health system due to war since 2015 and so on. Therefore, most diseases are spreading during this period as a consequence of increased poverty level, inadequate personal hygiene, and availability of safe water (7, 4; 17).

The study of (6) recommended to need for a collaborative effort to improve antimicrobial stewards ship (AMS), infection prevention and control (IPC) preventive measures, and source control by appropriate surgical management, in order to combat the spread of Multidrug-Resistant (MDR) infections in conflict-affected areas

Problem statement:

Patients wound considers a favorite environment for the growth of pathogenic bacteria which acquired from hospital environment during hospitalizing. The nosocomial pathogenic bacteria are highly resistance to multi-antibiotics and are a major risk factor for morbidity and mortality. This leads to continues research to discover or develop new antibiotic that are highly effective and this takes long time. However, very limited information is available on the type of isolated bacteria and their antibacterial resistance associated with infected wound in Seiyun Hospital Authority, 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.

Significant of the study:

The results of this study will be used in building a database for researchers to know the types of bacteria that infect wounds in hospital patients and the effectiveness of antibiotic activity. In addition, informing workers in wounds places or department of the need to avoid the transmission of pathogenic bacteria especially antibiotic resistance, among patients with wounds, and establish a program to ensure the prevention and control of such pathogenic bacteria.

Aims of study

The present study was designed to:

1. Isolate and identify pathogenic bacteria isolated from infected wounds of patients in Seiyun General Hospital Authority in Seiyun city, Yemen.

2. Evaluate the antibiotic sensitivity profiles of pathogenic bacteria isolated from infected wounds.

MATERIALS AND METHODS:

Study area and period:

A cross-sectional descriptive analytical analysis was carried out in the Laboratory of Microbiology, at Seiyun General Hospital Authority in Seiyun City. Yemen.in order to isolate the causative organisms of wound infection patients along with their antibiotic susceptibility pattern, from February 2024 to December 2024.

Data collection:

A questionnaire designed to collect information about infected wound patients was applied and interviews were conducted with the laboratory technician of the National Center for Central Public Health Laboratories asking questions such as gender, age, information on how to take Specimens collections well as microbial and biochemical examination.

Samples Collection:

A total of forty-six (46) specimens were randomly collected from wound patients hospitalized at Seiyun General Hospital Authority in Seiyun City. Yemen. By using a sterile cotton swab and aspiration, the wound samples were swabbed gently from the superficial, medium or deep of the infected area and the samples were immediately transported to the National Center for Central Public Health Laboratories. Each sample was inoculated on McConkey agar, Nutrient agar and Blood agar (Himedia, India) and then incubated for 24 hrs. 37°C.

Microbiological examination:

Culture and identification:

Each sample was streaked independently on the surface of McConkey agar, Chocolate agar, nutrient agar**,** and Blood agar and then incubated for 24 hrs. 37°C. Identification of the isolated bacteria were preliminarily performed by macroscopic examination of the colony morphology on the pure cultures and other typical growth characteristics on non-selective, selective, and differential culture media and complemented with gram staining as well as motility test to confirm their identity/purity (26).

Antibacterial susceptibility testing:

Antimicrobial susceptibility testing of isolates was performed by the modified Kirby-Bauer disks diffusion method on Mueller-Hinton agar under the CLSI protocol (14). The using 10 antibiotic discs were used that include; Gentamycin (10 mcg), Cefepime (30 mcg), Ceftriaxone (30 mcg), Piperacillin/ Tazobactam (100/10 mcg), Cefuroxime30mcg, Cefotaxime30mcg, Amoxicillin /Clavulanic acid30/20mcg, Ampicillin/Sulbactam20 mcg, Ceftazidime and Vancomycin (30 mcg) discs (Hi Media Labs, India). The plates of Muller Hinton Agar were incubated overnight, and the zone of inhibition of bacterial growth was measured and interpreted according to the Clinical and Laboratory Standard Institute (14).

Statistical analysis:

The obtained data were performed for statistical purposes using the IBM SPSS Statistics software (version 20.0, 2011). The significance level of p<0.05 was used to indicate statistical significance.

Results and Discussion:

Results:

Out of 46 samples collected, 22 (47.83%) were aspirated pus and 24 (52.17%) were pus swab. 32 (69.57%) samples showed growth while 14 (30.43%) samples showed no growth. Aspirated pus 14 (63.6%) samples were growth positive. On the other hand, in case of pus swab, 18 (75%) samples were growth positive Table (1). A total of 32 bacterial isolates were obtained of which 23 (71.88%) were Gram positive and 9 (28.12%) were Gram negative bacteria (P> 0.05). Table1. Number and percentage of Gram-positive and Gram-negative bacteria

Table 1. Number and percentage of infection (infected and no infected with bacteria. (n=32)

S. N	**Sample type**	**Gram positive bacteria**		**Gram negative bacteria**		**Total**	**P- value**
		No	**%**	**No**	**%**	**No**	
1	Aspirated pus	11	78.57	3	21.43	14	**(P> 0.05)**
2	Pus swab	12	66.67	6	33.33	18	
Total		**23**	71.88	**9**	28.12	32	

Socio-demographic characteristics:

Table 2 illustrates the age and sex distribution of patients with wound infections. Out of 46 cases, the patients of age group ≤15and 16-25 had higher growth of organism, each with 100% and 50% respectively (P> 0.05) and out of 34 (73.91%) male patients and 12 (26.09%) female patients, the growth was found to be higher in male patients (76.47%) than in female patients (50%) (P> 0.05)

Table 2. Age and sex distribution of patents with wound infections (n=46)

Variables	Description	No. (%) of culture positive	P-value
Age groups (years)	≤15 (4)	4(100)	**(P> 0.05)**
	16-25 (6)	3(50)	
	26-35 (9)	3(33)	
	36-45 (7)	1 (14.28)	
	≥ 46 (20)	5(25)	
Gender type	Male (34)	26(76.47%)	**(P> 0.05)**
	Female (12)	6(50)	

A total of 32 bacterial isolates were obtained of which 23 (71.87%) were Gram positive and 9 (28.13%) were Gram negative bacteria (Table 3). Among Gram-positive bacteria, *Staph. Aureus* and among Gram-negative bacteria, *E. coli* were the predominant isolate in both samples (Table 3). The Table 3 showed that the *Staph. aureus* at 22 (68.75%) was the most isolate followed by *E. coli* at 4(12.50%), *Ps. aeruginosa* at 2(6.25%), *P. mirabilis* at 2(6.25%), and *strepto pyogenes* and *Klebsiella pneumoniae* each 1(3.13%).

Table 3. Frequency of bacteria isolates from wound infection:

S.N	Organism isolated	Frequency	Percentage
	Gram-positive		
	Staphylococcus aureus	22	68.7
	Streptococcus pyogenes	1	3.1
S.N	**Organism isolated**	**Frequency**	**Percentage**
	Gram negative		
	Escherichia coli	4	12.5
	pseudomonas aeruginosa	2	6.3
	Proteus mirabilis	2	6.3
	Klebsiella pneumoniae	1	3.1
	Total	**32**	**100**

The results of antibacterial susceptibility reported that the *Staph. aureus* isolates showed high resistance against ceftazidime30/20mcg (100%) followed by Cefepime 30mcg (95.45%), Ampicillin/ sulbactam 20 mcg (86.36%), and Amoxicillin/clavulanic acid 30/20mcg ((81.82%).

Staphylococcus aureus showed high sensitivity to Gentamicin 10mcg (63.64%) followed by Vancomycin 30mcg (40.91%) as shown in Table 4.

Table 4. Antibiotic susceptibility pattern of *Staphylococcus aureus* isolates

Antibiotics	Sensitive (%)	Intermediate (%)	Resistant (%)	Total
Gentamicin 10mcg	14(63.64%)	2(9.09%)	6(27.27%)	22
Ceftriaxone 30mcg	5(22.73%)	4(18.18%)	13(59.09%)	22
Cefepime 30mcg	1(4.55%)	0	21(95.45%)	22
Cefotaxime 30mcg	3(13.64%)	2(9.09%)	17(77.27%)	22
Ceftazidime 30mcg	0	0	22(100%)	22
Vancomycin 30mcg	9(40.91%)	0	13(59.09%)	22
Piperacillin/tazobactam 100/10mcg	8(36.36%)	4(18.19%)	10(45.45%)	22
Ampicillin/ sulbactam 20 mcg	3(13.64%)	0	19(86.36%)	22
Amoxicillin/clavulanic acid 30/20mcg	3(13.64%)	1(4.54%)	18(81.82%)	22
Cefuroxime 30 mcg	3(13.64%)	2(9.09%)	17(77.27%)	22

The isolated *E. coli* from wounds indicated (100%) resistant to Vancomycin 30mcg. Also, *E. coli* showed high resistance Cefepime 30mcg ((100%)), Ceftazidime 30mcg (100%), (100%), Ampicillin/ sulbactam 20 mcg (100%), Amoxicillin/clavulanic acid 30/20mcg (100%) and Cefuroxime 30 mcg (100%), *E. coli* showed sensitivity to Cefotaxime 30mcg Cefotaxime 30mcg (75%), and Piperacillin/tazobactam 100/10mcg (75%). It was moderately resistant to gentamycin at (50%) as listed in Table 5

Table 5. Antibiotic susceptibility pattern of *Escherichia coli* isolates

Antibiotics	Sensitive (%)	Intermediate (%)	Resistant (%)	Total
Gentamicin 10mcg	1(25%)	2(50%)	1(25%)	4
Ceftriaxone 30mcg	1(25%)	0	3(75%)	4
Cefepime 30mcg	0	0	4(100%)	4
Cefotaxime 30mcg	3(75%)	0	1(25%)	4
Ceftazidime 30mcg	0	0	4(100%)	4
Vancomycin 30mcg	0	0	4(100%)	4
Piperacillin/tazobactam 100/10mcg	3(75%)	1(25%)	0	4
Ampicillin/ sulbactam 20 mcg	0	0	4(100%)	4
Amoxicillin/clavulanic acid 30/20mcg	0	0	4(100%)	4
Cefuroxime 30 mcg	0	0	4(100%)	4

Pseudomonas aeruginosa showed high resistance to Amoxicillin/clavulanic acid 30/20mcg (100%) and Vancomycin 30mcg at (100%), followed by Cefepime 30mcg at (100%), Ceftazidime 30mcg at (100%), Ampicillin/ sulbactam 20 mcg (100%), Ceftazidime 30mcg (100%), and Cefuroxime 30 mcg at (100%), It was moderately resistant to Ceftriaxone 30mcg (50%). *P. aeruginosa* was sensitive to Gentamicin 10mcg (100%) and Piperacillin/tazobactam 100/10mcg (50%) as shown in Table 6.

Table 6. Antibiotic susceptibility pattern of *Pseudomonas aeruginosa* isolates.

Antibiotics	Sensitive (%)	Intermediate (%)	Resistant (%)	Total
Gentamicin 10mcg	2(100%)	0	0	2
Ceftriaxone 30mcg	0	1(50%)	1(50%)	2
Cefepime 30mcg	0	0	2(100%)	2
Cefotaxime 30mcg	0	0	2(100%)	2
Ceftazidime 30mcg	0	0	2(100%)	2
Vancomycin 30mcg	0	0	2(100%)	2
Piperacillin/tazobactam 100/10mcg	1(50%)	0	1(50%)	2
Ampicillin/ sulbactam 20 mcg	0	0	2(100%)	2
Amoxicillin/clavulanic acid 30/20mcg	0	0	2(100%)	2
Cefuroxime 30 mcg	0	0	2(100%)	2

The *Proteus mirabilis* isolates showed moderate sensitive to Gentamicin 10mcg at (50%) and Piperacillin/tazobactam 100/10mcg (50%). Most of the *P. mirabilis* were highly resistant to Ceftriaxone 30mcg, Cefepime 30mcg, Cefotaxime 30mcg, Ceftazidime 30mcg, Vancomycin 30mcg, Ampicillin/ sulbactam 20 mcg, Amoxicillin/clavulanic acid 30/20mcg, Amoxicillin/clavulanic acid 30/20mcg, and Cefuroxime 30 mcg each at 100% as listed in Table 7.

Table 7. Antibiotic susceptibility pattern of *Proteus mirabilis* isolates

Antibiotics	Sensitive (%)	Intermediate (%)	Resistant (%)	Total
Gentamicin 10mcg	0	1(50%)	1(50%)	2
Ceftriaxone 30mcg	0	0	2(100%)	2
Cefepime 30mcg	0	0	2(100%)	2
Cefotaxime 30mcg	0	0	2(100%)	2
Ceftazidime 30mcg	0	0	2(100%)	2
Vancomycin 30mcg	0	0	2(100%)	2
Piperacillin/tazobactam 100/10mcg	1(50%)	1(50%)	0	2
Ampicillin/ sulbactam 20 mcg	0	0	2(100%)	2
Amoxicillin/clavulanic acid 30/20mcg	0	0	2(100%)	2
Cefuroxime 30 mcg	0	0	2(100%)	2

Klebsiella pneumoniae were highly resistant to Ceftriaxone 30mcg, Cefepime 30mcg, Cefotaxime 30mcg, Ceftazidime 30mcg, Vancomycin 30mcg, Ampicillin/ sulbactam 20 mcg, Amoxicillin/clavulanic acid 30/20mcg, Amoxicillin/clavulanic acid 30/20mcg, Gentamicin 10mcg, Piperacillin/tazobactam 100/10mcg, and Cefuroxime 30 mcg each at 100% as listed in Table 8.

Table 8 Antibiotic susceptibility pattern *Klebsiella pneumoniae* isolates

Antibiotics	Sensitive (%)	Intermediate (%)	Resistant (%)	Total
Gentamicin 10mcg	0	0	1(100%)	1
Ceftriaxone 30mcg	0	0	1(100%)	1
Cefepime 30mcg	0	0	1(100%)	1
Cefotaxime 30mcg	0	0	1(100%)	1
Ceftazidime 30mcg	0	0	1(100%)	1
Vancomycin 30mcg	0	0	1(100%)	1
Piperacillin/tazobactam 100/10mcg	0	0	1(100%)	1
Ampicillin/ sulbactam 20 mcg	0	0	1(100%)	1
Amoxicillin/clavulanic acid 30/20mcg	0	0	1(100%)	1
Cefuroxime 30 mcg	0	0	1(100%)	1

The *Streptococcus pyogenes* isolates showed high resistance against Ceftriaxone 30mcg, Cefepime 30mcg, Cefotaxime 30mcg, Ceftazidime 30mcg, Piperacillin/tazobactam 100/10mcg, Ampicillin/ sulbactam 20 mcg, and Amoxicillin/clavulanic acid 30/20mcg each (100%). *Streptococcus pyogenes* showed high sensitivity to Gentamicin 10mcg (100%) followed by Vancomycin 30mcg (100%) as shown in Table 9.

Table 9. Antibiotic susceptibility pattern of Streptococcus pyogenes isolates

Antibiotics	Sensitive (%)	Intermediate (%)	Resistant (%)	Total
Gentamicin 10mcg	1(100%)	0	0	1
Ceftriaxone 30mcg	0	0	1(100%)	1
Cefepime 30mcg	0	0	1(100%)	1
Cefotaxime 30mcg	0	0	1(100%)	1
Ceftazidime 30mcg	0	0	1(100%)	1
Vancomycin 30mcg	1(100%)	0	0	1
Piperacillin/tazobactam 100/10mcg	0	0	1(100%)	1
Ampicillin/ sulbactam 20 mcg	0	0	1(100%)	1
Amoxicillin/clavulanic acid 30/20mcg	0	0	1(100%)	1
Cefuroxime 30 mcg	0	0	1(100%)	1

Discussion:

In our present study, 69.57% of pus samples showed bacterial growth. This isolation rate of pathogen is relatively lower (70.50%) than that previously observed in Ethiopia (10) but higher (55.50%, 60.20%) than that previously observed in Skopje (24, 32) respectively. According to our findings, there are significant difference was found in the wound infections among gender. However, the predominance of males in culture positive cases is probably due to more exposure to the environment and more chances of accidents while earning livelihood (34) and due to our social behavior where males are given superiority to the female and if get diseased are brought immediately to hospitals (37).

The highest percentage of positive culture was found in the age group ≤ 15 and 16-25 had higher growth of organism, each with 100%, 50% respectively, followed by the age group 26 – 35 (33%). This may be due to the weakening of the immune response as the age of the patient increases.

In this study, a total of 32 bacterial species were isolated and there is significant difference was found in infection rate among Gram-positive and Gram-negative isolates. Altogether, 6 different bacterial species were isolated with *Staph. aureus* (68.8%) being the most prominent one. *Staph. aureus* is the most important pathogen for wound infection and its nasal carriage is the main risk factor for the infection since carriers are two to nine times more likely to acquire Staph. aureus wound infection than noncarriers (11). The high incidence of Gram-negative organisms confirms the observation that most wound infections arising from abdominal procedures are presently acquired from the patient's own fecal flora (23).

Among Gram- positive isolates, the most effective antibiotic was Gentamicin 10mcg and the least effective antibiotic was Ceftazidime 30mcg Ceftazidime 30mcg. Similar result was observed in a study of Nigeria, where Gentamicin was the most effective antibiotic (1). However, (31) and (28) reported Cloxacillin being the most effective antibiotic and Amoxycillin being the most resistant antibiotic. Among Gram positive isolates, the most effective antibiotic was Gentamicin and the least effective antibiotic was Co-trimoxazole. Similar result was observed in a study of Nigeria, where Gentamicin was the most effective antibiotic (1). However, *Staph. aureus* was shown to have high level of resistance to tetracycline in a study carried out in North West Ethiopia (19) and to Oxacillin in a study carried out in Gujarat (20).

Gram-positive bacteria can develop resistance to antibiotics due to several mechanisms and structural features, Gram-positive bacteria have a thick peptidoglycan layer in their cell walls. While this layer is a target for antibiotics like beta-lactams, *Staph. aureus* can produce altered penicillin-binding proteins (PBPs), Gram-positive bacteria can produce enzymes like beta-lactamases that inactive antibiotics, many Gram-positive bacteria such as *Staph. aureus* form biofilms on surfaces and the biofilm provide a physical barrier to antibiotics and host immune responses, making treatment difficult. and Gram-positive bacteria can acquire resistance genes through conjugation, transformation, or transduction, these genes may encode resistance mechanisms like altered PBPs or antibiotic-degrading enzymes.

Among Gram-negative isolates the most effective antibiotic was Piperacillin/tazobactam 100/10mcg and the least effective antibiotics were Ceftazidime 30mcg, Vancomycin 30mcg, Ampicillin/ sulbactam 20 mcg, Amoxicillin/clavulanic acid 30/20mcg and Cefuroxime 30 mcg. Our result agrees with the study carried in Kathmandu (31), and in Sana'a (8). However, in a study carried out in Gujarat, the Gram-negative isolates were resistant to cefuroxime (21). For *Ps. aeruginosa*, the drug of choice was Amikacin, Ciprofloxacin, Gentamicin and Ofloxacin. The least effective antibiotic was Cefixime with 100.00% resistance. In a study carried out in Dhaka, *ps. aeruginosa* was more resistant to Azithromycin (100%) and the only drug found least resistant was Imipenem (29). Also, *Ps. aeruginosa* showed the highest resistance to Erythromycin in a study carried out in North East Ethiopia (10) and to Ceftriaxone in a study carried out in Kathmandu (31).

Gram-negative bacteria are particularly adept at resisting antibiotics to several key factories such as outer membranes barrier that acts as a barrier to many antibiotics, and these bacteria possess efflux pumps that actively expel antibiotics out of cell, reducing the concentration of the drug to ineffective levels and these bacteria produce enzymes like beta-lactamases that can deactivate antibiotics, rendering them ineffective, also these bacteria can form biofilms, which are protective layers that antibiotics have difficulty penetrating

The increased bacterial resistance is probably due to irrational and inappropriate use of antimicrobial agents, disregard to hospital infection control policies and showing negligible regard to culture susceptibility pattern while administering antimicrobial agents (34).

Conclusions:

1.The results observed that the Gram-positive bacteria had a higher rate among wound specimens than Gram-negative.

2.This study revealed that *Staph. aureus* and *C. coli* were the most common isolates in clinical specimens.

3.The high rate of bacterial isolates prevalent among patients wound in the present study and their resistance to commonly used antibacterial agents due to unrestrained, mismanagement, extensive incorrect, and misuse of antimicrobial agents in hospitals and whole of country.

Recommendations:

1.Infection control measures must be strictly adhered to reduce the spread of resistant bacteria among hospital patients.

2.Regular monitoring of antibiotic susceptibility testing and proper management of wound infections are essential to avoid the emergence and spread of drug-resistant bacterial strains.

3.Good hygiene and proper care of wound infections are therefore recommended, as well as the use of antimicrobial medications during treatment.

4.The antimicrobial susceptibility testing must be performed from all patients who suffering from microbial diseases to determine the effective antibiotics.

5.An effective antibiotic policy in all health facilities would reduce the incidence of postoperative wound infections.

Acknowledgements:

We are very thankful to the Director of National Center for Central Public Health Laboratories Dr. Nabil Mohamed Omer Ba-Abad for permission to carry out this study and all the laboratory staffs for their contributions during the study period.

References

1.Adegoke, A.A., T. Mvuyo, A.I. Okoh and J. Steve. (2010). Studies on multiple antibiotic resistant bacterial isolated from surgical site infection. Sci. Res. Essays. 5(24): 3876-3881.

2.Akinjogunla, O.J., A.A. Adegoke, C. Mboto, I.C. Chukwudebelu and I.P. Udokang. (2009). Bacteriology of automobile accident wounds infection. Int. J. Med. Med. Sci. 1(2): 23-27.

3.Alhlale FM, Saleh HA, Alsweedi SK, Edrees HW (2019). The inhibitory effect of Euphorbia hirta extracts against some wound bacteria isolated from Yemeni patients. COPS. 3(2): 780-786.

4.Al-Khawlany RS, Edrees WH, et al. (2021). Prevalence of methicillin-resistant Staphylococcus aureus and antibacterial susceptibility among patients with skin and soft tissue infection at Ibb City, Yemen. PSM Microbiol, 6(1): 1-11.

5.Allegranzi B, Nejad SB, et al. (2011). Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. Lancet. 377 (9761):228–241.

6.Almehdar, H., Yousef, N., Vanden Boogaard, W., Haider, A., Kanapathipillai, R., Al-Hodiani, E., Zelikova, E., Mohamed, W. G., Michel, J., and Malaeb, R. (2024) *Antibiotic susceptibility patterns at the Médecins Sans Frontières (MSF) acute trauma hospital in Aden, Yemen: a retrospective study from* January 2018 to June 2021. JAC. Antimicrobial Resistance, 6 (2) :P. dlae024.

7.Alshahethi MA, Edrees WH, Mogalli NM, Al-Halani AA (2020). Prevalence of Entamoeba histolytica among children attending healthcare centers at Amran governorate, Yemen. PSM Biol Res. 5(3): 98-105.

8. Al-Yosaffi E. A., Al-shmahy, H.A., Othman, R.M., Al-Haddad, A.M., and Al-Moyed, K.A. (2023). Antibiotic sensitivity of Bacterial bloodstream infection in the intensive care unit patients of University Hospitals in Sana'a city, Yemen, Universal Journal of Pharmaceutical Research; 8(5):22-29

9.Anthony A, Mvuyo T, Okoh, Anthony I, Steve J. (2010). Studies on multiple antibiotic resistant bacterial isolated from surgical site infection. Scient Res Essays 5(24): 3876-3881.

10.Azene, M.K. and B.A. Beyene. (2011). Bacteriology and antibiogram of pathogens from wound infections at Dessie Laboratory, North East Ethiopia. Tanzan. J. Health Res. 13(4): 1-10.

11.Barbos, M.P., B. Mognetti, S. Pecoraro, W. Picco and V. Veglio. (2010). Decolonization of orthopedic surgical team S. aureus carriers: impact on surgical-site infections. J. Orthopaed. Traumatol. 11: 47–49.

12. Balasubramanian, R., Van Boeckel, T. P., Carmeli, Y., Cosgrove, S., and Laxminarayan, R. (2023). *Global incidence in hospital-associated infections resistantto antibiotics: An analysis of point prevalence surveys from 99* countries. PLoS medicine, 20 (6): P. e 1004178**.**

13.Borgundvaag B, Ng W, Rowe B, Katz K (2013). Prevalence of methicillin-resistant Staphylococcus aureus in skin and soft tissue infections in patients presenting to Canadian emergency departments. CJEM. 15(3): 141–160.

14.Clinical and Laboratory Standards Institute (CLSI) (2016). Performance standards for antimicrobial disk susceptibility tests; Approved standard. 26th ed. 58-116.

15.Edrees HW, Alshwmi M, Al-Ofairi AB (2020). Prevalence and antifungal susceptibility of Candida species causing vaginitis among pregnant women in Hajjah Governorate, Yemen. Al-Razi Univ J Med Sci, 5(1): 1- 8.

16.Edrees HW, Anbar AA (2020). Prevalence and antibacterial susceptibility of bacterial uropathogens isolated from pregnant women in Sana'a, Yemen. PSM Biol Res. 5(4): 157-165.

17.Edrees WH, Mogalli NM, Alabdaly KW (2021). Assessment of some clinical and laboratory profiles among dengue fever patients in Hajjah Government, Yemen. UJPR 6(2):38-41.

18.Esebelahie NO, Esebelahie FO, Omoregie R (2013). Aerobic bacterial isolates from wound infection. Afr J Cln Exper Microbiol. 14: 155-159.

19.Fantahun, B., A. Bayeh, A. Atenaf and A. Belay. 2009. Bacterial isolates from wound infection and their antimicrobial susceptibility pattern in Felege Hiwot Referral Hospital, North West Ethiopia. Ethiop. J. Health Sci. 19(3):173-177.

20.Gautam R, Acharya A, Nepal HP, Shrestha S (2013). Antibiotic susceptibility pattern of bacterial isolates from wound infection in Chitwan Medical College Teaching Hospital, Chitwan, Nepal. JBAR. 248-252.

21.Goswami, N.N., H.R. Trivedi, A.P.P. Goswami, T.K. Patel and C.B. Tripathi. (2011). Antibiotic sensitivity profile of bacterial pathogens in postoperative wound infections at a tertiary care hospital in Gujarat, India. J Pharmacol Pharmacother. 2(3): 158–164.

22.Gottrup F, Melling A, Hollander AD (2005) An overview of surgical site infections: An etiology, incidence and risk factors. European Wound Managt Assoc J 5(2):11-15.

23.Isibor, J.O., A. Oseni, A. Eyaufe, R. Osagie and A. Turay. (2008). Incidence of aerobic bacteria and Candida albicans in post-operative wound infections. Afr. J. microbiol. Res. 2: 288-291.

24.Kaftandzieva, A., Z. Cekovska, I. Kaftandziev, M. Petrovska and N. Panovski. (2012). Bacteriology of Wound- Clinical Utility of Gram Stain Microscopy and the Correlation with Culture. Maced. J. Med. Sci. 5(1): 72-77.

25.Kernodle, D.S., D.C. Classen, C.W. Stratton and A.B. Kaiser. (1998). Association of Borderline Oxacillin Susceptible Strains of Staphylococcus aureus with Surgical Wound Infections. J. Clin. Microbiol. 36(1): 219.

26.Leboffe MJ, Pierce BE (2011). A photographic atlas for the microbiology laboratory. 4 th ed. Morton Publishing. Englewood, Colorado, United States of America. 25- 156.

27.Mordi, R.M. and M.I. Momoh. (2009). Incidence of Proteus species in wound infections and their sensitivity pattern in the University of Benin Teaching Hospital. Afr. J. Biotechnol. 8(5): 725-730.

28**.** Orubu, E.S.F., Al-Dheeb, N., Ching, C., BuJawdeh, S., Anderson, J., Sheikh, R., Hariri, F., Basaleem, H., and Zaman, M.H. (2021). *Assessing antimicrobial resistance, utilization, and stewardship in Yemen: an exploratory mixed-methods study*. The American Journal of Tropical Medicine and Hygiene 105 (5): P. 1404.

29.Rashid, A., A. Chowdhury, S.H.Z. Rahman, S.A. Begum and N. Muazzam. (2007). Infections by Pseudomonas aeruginosa and Antibiotic Resistance Pattern of the Isolates from Dhaka Medical College Hospital. Bangladesh. J. Med. Microbiol. 01(02): 48-51.

30.Sanjay, K.R., M.N.N. Prasad and G.S. Vijaykumar. (2010). A study on isolation and detection of drug resistance gram negative bacilli with special importance to postoperative wound infection. J. Microbiol. Antimicrob. 2(6): 68-75.

31.Shrestha, B. and R.B. Basnet. (2009). Wound Infection and Antibiotic sensitivity Pattern of Bacterial Isolates. Postgrad. Med. J. NAMS. 9(1): 1-6.

32.Shrestha, B. and V.K. Sharma. (2013). Bacteriological study of wound infection and antibiotic susceptibility pattern of the isolates. Nepal Journal of Science and Technology. 14(2): 143-150.

33.Tayfour MA, Tayfour MA, Al-Ghamdi SM, Al-Ghamdi AS. (2005). Surgical wound infections in King Fahad Hospital at AlBaha. Saudi Med J; 26: 1305-1307.

34.Verma, A.K., A.K. Kapoor and A. Bhargava. (2012). Antimicrobial susceptibility pattern of bacterial isolates from surgical wound infections in Tertiary Care Hospital in Allahabad, India. Internet J. Med. 7(1): 27-34.

35.Wilson AR, Gibbons C, Reeves BC, Hodgson B, Liu M, Plummer (2004). Surgical wound infections as a performance indicator: agreement of common definitions of wound infections in 4773 patients. BMJ. l(329): 720-722.

36.Zafar U, Taj M K, Nawaz I, Zafar A, Taj I (2007). Characterization of Proteus mirabilis isolated from patient wounds at Bolan Medical Complex Hospital, Quetta. Jundishapur J Microbiol.12(7):e87963.

37.Zafar, A., N. Anwar and H. Ejaz. (2008). Bacteriology of infected wounds- A study conducted at Children's Hospital Lahore. Biomedica. 24: 71-74.

انتشار العزلات البكتيرية المسببة للأمراض التي تصيب الجروح وحساسيتها للمضادات الحيوية في هيئة مستشفى سيئون العام

عثمان مُحَمَّد العمودي [1] ، حمزة مُحَمَّد الخضراء [1] ، عمار عبيد سويدان [1] و مُحَمَّد عثمان العمودي [2]

الملخص

يمثل التطور السريع للبكتيريا المسببة للأمراض المقاومة للمضادات الحيوية الشائعة أخطر مشكلة صحية للعاملين في مجال الرعاية الصحية والمجتمع. لذا، هدفت الدراسة الحالية إلى العزل والتعرف على البكتيريا المرتبطة بعدوى الجروح الجراحية وتحديد ملفات حساسية المضادات الحيوية للبكتيريا المسببة للأمراض المعزولة من مرضى الجروح الذين يرتادون هيئة مستشفى سيئون العام – اليمن.

أجريت دراسة مقطعية في الفترة من فبراير 2024 إلى ديسمبر 2024 للمرضى المصابين بجروح والذين دخلوا المستشفى في هيئة مستشفى سيئون العام في مدينة سيئون للعلاج. تم جمع ستة وأربعين (46) عينة صديد من جرح المرضى ونقلها على الفور إلى مختبر علم الأحياء الدقيقة في المستشفى لعزل البكتيريا المسببة للأمراض وتحديدها من خلال الإجراءات البكتريولوجية القياسية المتبعة. كما تم تحديد اختبارات حساسية المضادات الحيوية للبكتيريا المسببة للأمراض المعزولة باستخدام تقنية انتشار القرص كيربي باور.

أظهرت النتائج أنه من بين 46 عينة، أظهرت 32 (69.6٪) نموًا بكتيريًا؛ منها 23 (71.8٪) كانت إيجابية الجرام و9 (39.1٪) كانت سلبية الجرام. كانت المكورات العنقودية الذهبية (68.8%) هي الأكثر شيوعًا تليها الاشريكية القولونية (12.5%)، والزائفة الزنجارية (6.3%)، والبروتيس ميرابيليس (6.3%)، والكلبسيلة الرئوية (3.1%) والمكورات العنقودية القيحية (3.1%). وكان المضاد الحيوي الأكثر فعالية للعزلات إيجابية الجرام هو جنتاميسين 10 ميكروجرام (65.22%). أما بالنسبة للعزلات سلبية الجرام، فكان بايبيراسيلين/تازوباكتام 20 ميكروجرام.

كما اوضحت النتائج أن معظم البكتيريا المعزولة مقاومة لمعظم المضادات الحيوية التي تم اختبارها. حيث وجد أن البكتيريا العنقودية الذهبية حساسة لجرعة 10 ميكروجرام من جنتاميسين ومقاومة بدرجة عالية لكل من 30 ميكروجرام من سيفنازيديم و30 ميكروجرام من سيفيبيم و30 ميكروجرام من أمبيسلين/سولباكتام و20/30 ميكروجرام من أموكسيسيلين/حمض الكلافولانيك و20/30 ميكروجرام من سيفوروكسيم و30 ميكروجرام من سيفوروكسيم. كما أظهرت عزلات البكتيريا القولونية مقاومة (100%) لـ 30 ميكروجرام من سيفنازيديم و30 ميكروجرام من سيفنازيديم و30 ميكروجرام من فانكومايسين و30 ميكروجرام من أمبيسلين/سولباكتام و20 ميكروجرام من أموكسيسيلين/حمض الكلافولانيك و20/30 ميكروجرام من سيفوروكسيم وقد تم تسجيل أن معظم البكتيريا المعزولة مقاومة للغاية لمعظم المضادات الحيوية التي تم اختبارها. وقد تم الإبلاغ عن أن المكورات العنقودية الذهبية حساسة لجرعة 10 ميكروجرام من الجنتاميسين ومقاومة للغاية لـ 30 ميكروجرام من سيفنازيديم، و30

ميكروجرام من سيفيبيم، وأمبيسلين/سولباكتام، وأموكسيسيلين/حمض الكلافولانيك 20/30 ميكروجرام، وسيفوروكسيم 30 ميكروجرام. وأظهرت عزلات الاشريكية القولونية مقاومة (100%) لـ 30 ميكروجرام من سيفنازيديم، و30 ميكروجرام من سيفنازيديم، وفانكومايسين 30 ميكروجرام، وأمبيسلين/سولباكتام 20 ميكروجرام، وأموكسيسيلين/حمض الكلافولانيك 20/30 ميكروجرام وسيفوروكسيم 30 ميكروجرام. وقد أظهرت عزلات الزائفة الزنجارية انها مقاومة (100%) لجميع المضادات الحيوية باستثناء سيفترياكسون 30 ميكروجرام (50%). أظهرت عزلات *P. mirabilis* مقاومة (100%) لجميع المضادات الحيوية باستثناء جنتاميسين 10 ميكروجرام (50%). لذلك، يوصى بإجراء تحليل ميكروبيولوجي روتيني لعينات الجروح واختبار حساسية المضادات الحيوية حتى يقوم الطبيب بعلاج عدوى الجروح.

الكلمات المفتاحية: المضادات الحيوية، عزلات البكتيريا، عدوى الجروح

[1]كلية الطب والعلوم الصحية- جامعة سيئون

[2]كلية الزراعة والأغذية- جامعة سيئون