Prevalence of bacteria isolated from patients with burn infection at a burn hospital in Baghdad and study of their antimicrobial susceptibility patterns

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ABSTRACT

Background: The skin functions as a barrier to the external environment, damage to this barrier following a burn disrupts the innate immune system and increases susceptibility to bacterial infection.

Objective: This study was carried out to determine the bacterial isolates and study their antimicrobial susceptibility in burned wound infections at one burn's hospital in Baghdad.

Type of study: Cross-sectional study.

Methods: The bacteria were identified at species level by using Analytic Profile Index (API) system and The antimicrobial susceptibility test was performed according to Kirby-Bauer (disk diffusion) technique.

Results: Over a period of one year (from October 2014 to October 2015). Out of 848 patients with different degrees of burns, 186 (19.81%) positive bacterial isolates. Out of 186 bacterial isolates, the isolation rate of Gram positive was 14(7.53%) and Gram negative isolates was 172(92.47%). From those 172 Gram negative bacteria the most frequently isolated bacteria was *Pseudomonas aeruginosa* 60(32.26%) isolates followed by *Acinetobacter baumannii* 40(21.51) and all Gram positive bacteria were *Staphylococcus aureus* 14(7.53). The most effective antibiotic on *Staphylococcus aureus* isolates was Vancomycin (sensitivity rate was 11(92.86%)), while the highest resistance was to Penicillin and the rate of resistance was 14(100%) followed by Ampicillin 12(85.71%). The most effective antibiotic on Gram-Negative isolates was Imipenem (sensitivity rate was 165(95.93%)) followed by Amikacin (sensitivity rate was 146(84.88%)). On the other hand the Gram negative bacteria in this study were mostly resistant to Ampicillin 164(95.35%) and Amoxicillin-Clavulanic acid 157(91.28). *Acinetobacter baumannii* and *Klebsiella pneumoniae* isolates were the mostly resistant isolates than other gram negative bacteria under this study.

Conclusion: *Pseudomonas aeruginosa* was the most frequently isolated bacteria among gram negative bacteria and the most effective antibiotics on Gram-Negative and *Staphylococcus aureus* isolates were Imipenem and Vancomycin, respectively.

Keywords: Burns, Gram-Negative bacteria, *Staphylococcus aureus* and Antimicrobial susceptibility test

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Burn is a thermal injury of the skin, although electrical and chemical injuries may also result in burn. Thermal injury destroys the physical skin barrier that normally prevents invasion of microorganisms (1).

Burn injury patients are at high risk of infections for a variety of reasons. For instance, the readily available exposed body surface, immunocompromizing effects of burns, invasive diagnostic and therapeutic procedures and prolonged hospital stay (2).

Infection is a major cause of morbidity and mortality in hospitalized burn patients. It has been estimated that about 75% of the mortality associated with burn injuries is related to sepsis especially in developing countries (3).

The use of topical antimicrobial agent can reduce overgrowth of microorganism but it seldom prevents colonization. This combined with suppression of the immune system, translocation of organisms from intestinal tract, long hospital stay, multiple diagnostic and therapeutic procedures, all contribute to infections (4). Multidrug resistant bacteria have frequently been reported as the cause of nosocomial outbreaks of infection in burn units or as colonizers of the wounds of burn patients (5).

Burn patients are infected by hospital acquired bacteria by various invasive and noninvasive procedures. Early diagnosis of microbial infections and screening for drug resistance is aimed to institute the appropriate antibacterial therapy and to avoid further complications. Nowadays, majority of the bacteria that cause burn infection in hospitals are resistant to at least one of commonly used drugs (6 &7).

The aims of this paper are to isolate and identify bacterial species causing burn infections from the burn specialist hospital / Medical city in Baghdad as well as determination of the antimicrobial susceptibility of the isolated bacteria.

Materials and Methods:

Period of Study

This study was conducted over a period of one year (from October 2014 to October 2015). It included inpatients of either gender and all ages at the burn specialist hospital / Medical city in Baghdad.

Isolation and Identification of bacterial isolates

Burn specimens were cultured and the bacteria were isolated from all specimens according to standard microbiology methods (8). Then bacteria were identified

at species level by using Analytic Profile Index (API) system (Bio-Merieux, France), including:
API Staph for the identification of the *Stphylococcus* spp, API 20 E which is a standardized identification system for members of *Enterobacteriaceae* family and API 20 NE which is a standardized system for the identification of bacteria belong to non *Enterobacteriaceae* family.

Antibiotic Susceptibility Test
The antimicrobial susceptibility test was performed according to Kirby-Bauer (disk diffusion) technique (9), using Muller-Hinton agar and different single antimicrobial discs supplied commercially (Table-1). Inhibition zones developed around the discs were measured by millimeter (mm) using a metric ruler according to Clinical Laboratories Standards Institute (10).

Table-1: Type and potency of antimicrobial discs.

Antimicrobial drug	Code	Disk potency	Company
Amikacin	Ak	30 µg	Bioanalyse/ Turkey
Amoxicillin-Clavulanic acid	AMC	20/10 µg	Bioanalyse/ Turkey
Ampicillin	Am	30 µg	Bioanalyse/ Turkey
Aztreonam	ATM	30 µg	Bioanalyse/ Turkey
Cefepime	FEP	30 µg	Bioanalyse/ Turkey
Cefotaxime	CTX	30 µg	Bioanalyse/ Turkey
Ceftazidime	CAZ	30 µg	Bioanalyse/ Turkey
Ceftriaxone	CRO	30 µg	Bioanalyse/ Turkey
Chloramphenicol	C	30 µg	Bioanalyse/ Turkey
Ciprofloxacin	CIP	5 µg	Bioanalyse/ Turkey
Clindamycin	CL	2 µg	Bioanalyse/ Turkey
Erythromycin	E	15 µg	Bioanalyse/ Turkey
Gentamicin	CN	10 µg	Bioanalyse/ Turkey
Imipenem	IPM	10 µg	BD/ Ireland
Nitrofurantin	NFT	300 µg	Bioanalyse/ Turkey
Penicillin	P	10 unit	Al-Razi/ Iraq
Piperacillin	pr	100 µg	Bioanalyse/ Turkey
Tetracycline	TE	30 µg	Bioanalyse/ Turkey
Tobramycin	TB	10 µg	Bioanalyse/ Turkey
Trimethoprime-Sulphamethoxazole	TMP	1.25/ 23.75 µg	Bioanalyse/ Turkey
Vancomycin	VA	30 µg	Bioanalyse/ Turkey

Results:

Study patients
Through a period extended for one year (from October 2014 to October 2015), 848 patients with burn wounds enter to the burn specialist hospital in Baghdad with different degrees of burns. The age of patients ranged from 1 year to 70 years of either gender.

Burn specimen cultures
The frequency of positive burn specimen cultures that indicates bacterial infections in the studied patients was 186 (19.81%) cases out of 848 burn patients. The positive burn swabs cultures were from patients within different age groups and either gender.

Frequency of bacteria among burn specimens culture
Frequency of isolated bacteria causing burn infections in burn specialist hospital were summarized in table-2. In which out of 186 bacterial isolates, the isolation rate of Gram positive and Gram negative isolates was 14(7.53%) and 172(92.47%), respectively (figure-1).

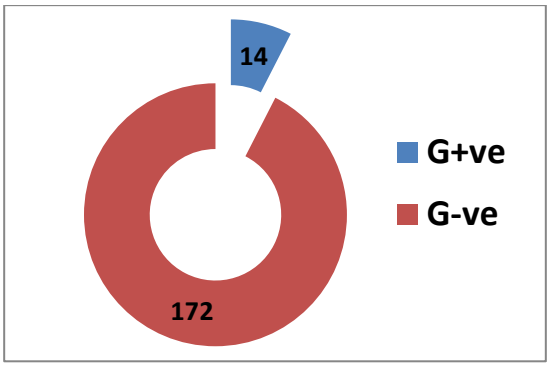

Figure-1: Numbers of Gram -Positive and Gram -Negative bacteria isolated from burn specimen cultures.

Table -2: Frequency of bacterial isolates from burn specimen cultures.

Gram positive bacteria	No.	%
Staphylococcus aureus	14	7.53
Gram negative bacteria	**No.**	**%**
Pseudomonas aeruginosa	60	32.26
Acinetobacter baumannii	40	21.51
Klebsiella pneumoniae	32	17.20
Escherichia coli	18	9.67
Enterobacter ssp.	11	5.91
Proteus mirabilis	9	4.84
Citrobacter freundii	1	0.54
Serratia marcescens	1	0.54
Total	186	100

As shown in table-2, out of 172 Gram negative bacteria the most frequently isolated bacteria was *Pseudomonas aeruginosa* 60(32.26%) isolates following by *Acinetobacter baumannii* 40(21.51), while all Gram positive bacteria were *Staphylococcus aureus* 14(7.53). Also the most frequently isolated bacteria from burn specimen cultures was *Pseudomonas aeruginosa* 60(34.88%) isolates followed by *Acinetobacter baumannii* 40(23.26%).

Antimicrobial sensitivity Test

Antimicrobial sensitivity test results of Gram negative bacteria and Gram positive bacteria (*Staphylococcus aureus*) from burn specimens to various antimicrobial drugs are shown on figure-2 and figure-3.

As shown in figure-2, the most effective antibiotic on *Staphylococcus aureus* isolates was Vancomycin and the sensitivity rate was 11(92.86%) while the highest resistance was to Penicillin and the rate of resistance was 14(100%) followed by Ampicillin 12(85.71%).

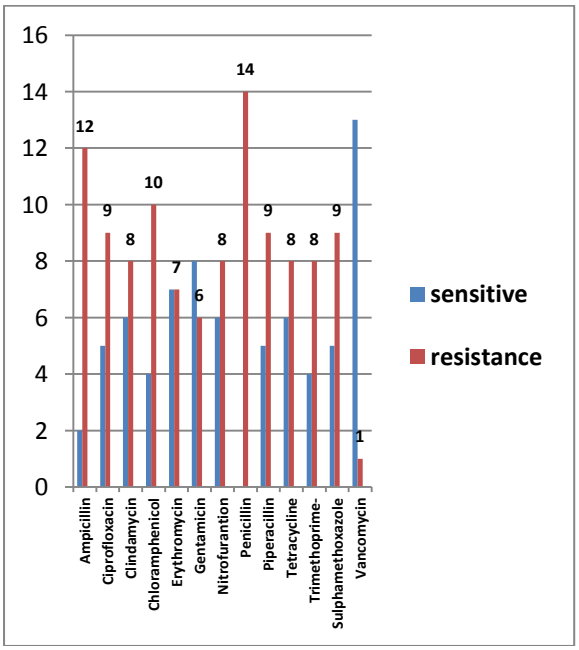

Figure-2: Antibiotic resistance of 14 *Staphylococcus aureus* isolates

The results of antimicrobial sensitivity test towards Gram-Negative bacteria was summarized in figure-3, in which shown that the most effective antibiotic on Gram-Negative isolates was Imipenem and the sensitivity rate was 165(95.93%) followed by Amikacin which the sensitivity rate was 146(84.88%). From 172 Gram-Negative isolates only 7(4.07%) isolates were resist to Imipenem (one isolate was *Escherichia coli*, one isolate was *Pseudomonas aeruginosa*, two isolates were *Klebsiella pneumoniae* and three isolates were *Acinetobacter baumannii*). On the other hand the Gram negative bacteria in this study were mostly resistant to Ampicillin 164(95.35%) and Amoxicillin-Clavulanic acid 157(91.28). Also *Acinetobacter baumannii* and *Klebsiella pneumoniae* isolates were the mostly resistant isolates than other gram negative bacteria under this study.

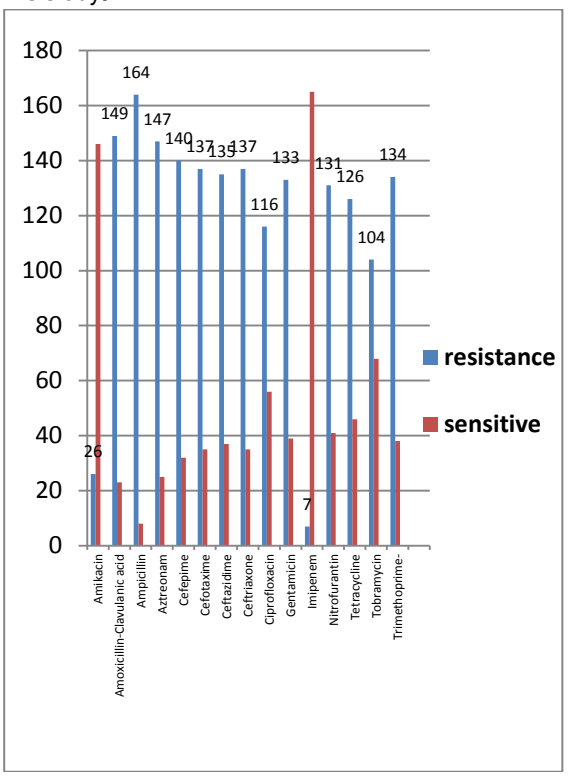

Figure-3: Antibiotic resistance of 172 Gram-Negative isolates

Discussion:

Infection in burn wound is still considered as the most important cause of disability and mortality in all ages and in both developed and developing countries (11).

Nosocomial infections play a role in quality and control in health care. Surveillance of these infections is the only way to gain more insight into their frequency and cause.

Surgical site infections are a problem in all fields of surgery. In addition, burned patients are at a high risk for nosocomial infections by multiresistant bacteria, a large proportion of which are gram negative (12).

Antimicrobial resistance among nosocomial pathogens is a significant problem in clinical settings that may be added to

the cost of medical care and the morbidity and mortality of patients (13).

In conclusion, *Pseudomonas aeruginosa* was the most frequently isolated bacteria among gram negative bacteria and the most effective antibiotic on Gram-Negative isolates was Imipenem while the most effective antibiotic on *Staphylococcus aureus* isolates was Vancomycin.

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