Antibiotics Susceptibility Pattern of Bacteria associated with Wound Sepsis in Burn Patients

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Abstract: Investigating antibiotic susceptibility in burn wound sepsis is crucial for effective treatment, as burn patients have compromised skin and immunity, making them highly vulnerable to infections. These infections can delay healing, lead to severe complications, and increase mortality. This study aimed to isolate bacteria from burn wound infections, assess their antibiotic sensitivity, and analyze the relationship between patient characteristics and susceptibility patterns.

Material and Methods: T Non-probability convenience sampling was used in a five-month cross-sectional study at Jinnah Hospital Lahore. Samples from burn patients were aseptically collected after consent. Patients on recent antibiotics, with non-burn wounds, or immunocompromised were excluded. Samples were cultured on Blood Agar, MacConkey Agar, and Mannitol Salt Agar at 37°C for 24–48 hours. Identification used Gram staining and biochemical tests. Antibiotic susceptibility was tested by Kirby-Bauer disc diffusion on Mueller-Hinton Agar, following Clinical and Laboratory Standards Institute (CLSI) guidelines, using antibiotics such as gentamicin, ciprofloxacin, ceftriaxone, meropenem, and vancomycin. Reagents were from Sigma-Aldrich and quality control was maintained.

Results: Of 185 samples, 128 showed growth. Predominant Gram-negative isolates identified included *Pseudomonas aeruginosa, E. coli, Klebsiella spp*., and *Proteus spp*; Gram-positive included *S. aureus*, Coagulase-Negative *Staphylococci* (CoNS), and *S. pyogenes*. Amikacin was effective across both groups. Cephalexin was least effective for Gram-positive strains, while amoxicillin showed high resistance in Gram-negatives.

Conclusion: Blood and wound swabs had the highest growth. *S. aureus* was the most common isolate. Most bacteria were Gram-negative. Most effective were Amikacin and gentamicin; cephalexin and amoxicillin were least effective.

Keywords: burn wound sepsis, antibiotic susceptibility, Gram-negative bacteria, S. aureus, Amikacin

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Introduction

180,000 deaths each year caused by various types of burn injuries from heat, radiation, electricity, friction, or chemicals produce, mainly in low- and middle-income areas.[1] Children and women face the highest incidence of short-term (17%) and long-term (18%) disabilities in Bangladesh, Colombia, Egypt, and Pakistan.[2]

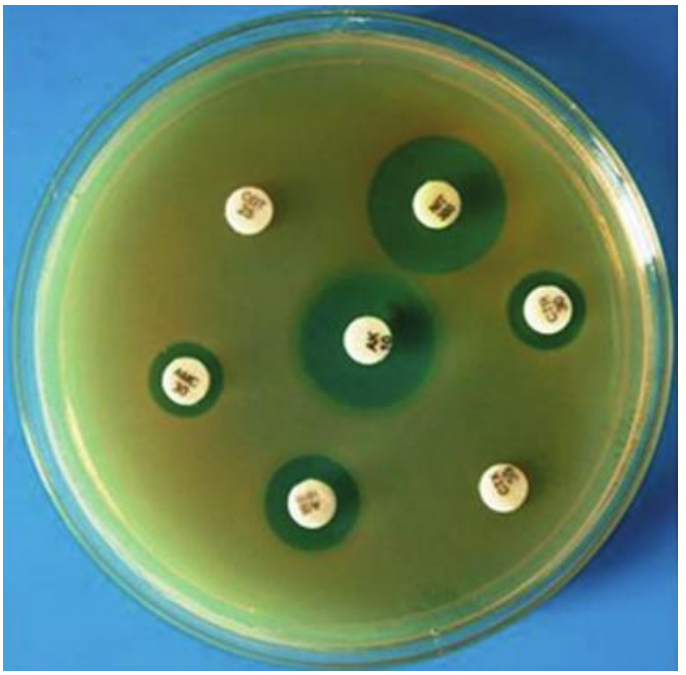
Burn wounds have larger surface areas and damaged skin barriers, enabling bacteria colonization and infections to occur much easier compared to surgical wounds.[3] Infections will delay the healing process and may result in life-threatening processes like sepsis or multi-organ failure.[4] The environment of wounds provides warm, moist conditions, and nutrients whereby microbial growth is aided.[5] Pseudomonas aeruginosa, E. coli, Klebsiella

pneumoniae, and S. aureus are some of the common pathogens found.[6]

Burn patients who sustain body surface area burns greater than 20% face a higher risk of death from sepsis which develops as a result of bacteremia.[7]The primary risk factors for infection include delayed surgical removal of wounds, compromised immune systems, and infections caused by multidrug-resistant bacteria.[8] Successful diagnosis of wound infections requires physical exams and biomarkers along with cultures because both endogenous and exogenous organisms involved.[9] Burn patients treatment becomes more complex due to multidrug-resistant pathogens.[10] The global health threat of antibiotic resistance stems from the inappropriate use and excessive consumption of antibiotics.[11] In hospitals patients experience a transition from Gram-positive bacterial infections to Gram-negative ones which may also involve fungal pathogens.[12] The "ESKAPE" pathogens pose significant danger because they show resistance to multiple antibiotics.[13].

Material and Methods

This study was conducted using a cross-sectional design over a period of approximately five months, encompassing all stages from literature review to data collection, laboratory analysis, and data interpretation. Data were aseptically collected from clinically infected burn wounds through swabs, biopsies, or fluid aspiration, following informed consent from patients admitted to the burn unit. Patients on antibiotics within the previous 48 hours, those with non-burn wounds, or who were immunocompromised were excluded. Samples were cultured on Blood Agar, MacConkey Agar, and Mannitol Salt Agar and incubated at 37°C for 24–48 hours. Bacterial identification was performed using Gram staining and standard biochemical tests. Antibiotic susceptibility was tested using the Kirby-Bauer disc diffusion method on Mueller-Hinton Agar, following Clinical and Laboratory Standards Institute (CLSI) guidelines. Antibiotics tested included gentamicin, ciprofloxacin, ceftriaxone, meropenem, and vancomycin. Reagents were sourced from Sigma-Aldrich to ensure consistency, and all microbiological procedures adhered to strict quality control standards. Data analysis was performed using SPSS version 20.0 (SPSSA Inc., Chicago, USA). Bacterial isolates were examined through laboratory testing, and the findings were presented using relevant tables, graphs, and statistical summaries.



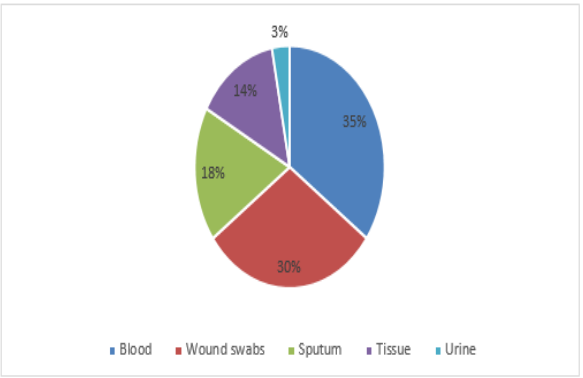
Results

A total of 185 wound samples were collected from Jinnah Hospital Lahore and analyzed for bacterial isolates. Both genders were included in this study. In this study. it was observed that the rate of infection was most pronounced among male patients. Among the causes of burn, thermal burns were found to be the most predominant followed by electric burns and chemical burns. The identified bacteria species were exposed to antibiotic susceptibility testing using the diffusion method. A self- structured questionnaire was used.

Table 1: Genomic sequence selection

Characteristic	Details
Number of Patients	185
Age Range	All ages
Gender	Both males and females
Type of Burn	Fire, gas, electrical, chemical
Total Body Surface Area (TBSA)	4.5% – 80%

Figure 1: Spectrum of specimen culture



Out of the 185 samples processed, bacterial growth was detected in 128 samples, while the remaining showed no microbial growth. Among the 128 culture-positive samples, Gram-negative bacteria were slightly more prevalent, comprising 68 isolates (53.2%), whereas Gram-positive bacteria accounted for 60 isolates (46.8%). Staph. Aureus was most common 34.

Figure 2: Rate of isolation in gram positive organisms

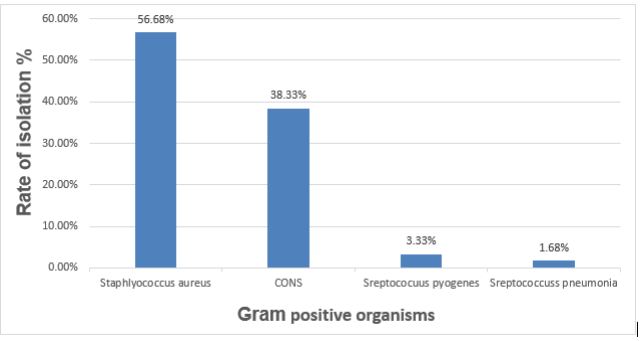


Figure 2: Rate of isolation in gram negative organisms

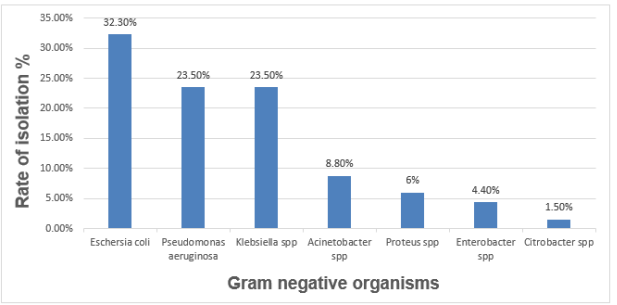


Table 1: Antibiotics susceptibility pattern of bacteria isolated from wound infection

Antibiotics

Table 2: Antibiotics susceptibility pattern of bacteria isolated from wound infection

Abbrevation:S, senstivity; I, intermediate; R, resistance.

Antibiotics	Klebsiella spp.			Acineto-bater			Pseudomo-nas spp.			E. coli			Coagulase -ve staph.			Staph Aureus		
	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
Amikacin	8	2	6	0	0	6	2	3	11	18	0	4	16	1	6	28	3	5
Ciproflaxcin	3	1	12	0	0	6	2	0	14	10	0	12	11	1	11	20	1	13
Ceftriaxone	5	2	9	0	0	6	7	0	9	14	0	8	15	2	6	17	6	11
Meropenem	13	0	3	0	0	6	8	0	8	13	3	6	-	-	-	-	-	-
Amoxcilin	3	0	13	0	0	6	0	0	16	5	0	17	15	0	8	11	3	20
Tazobactam	13	0	3	1	0	5	13	0	3	14	2	6	-	-	-	-	-	-
Gentamicin	7	6	9	0	0	6	3	0	13	16	3	3	14	2	7	29	0	5
Cefixim	5	1	10	0	0	6	2	0	14	8	0	14	-	-	-	-	-	-
Cotrimoxazole	-	-	-	-	-	-	-	-	-	-	-	-	12	1	10	16	1	17
Cloxacilin	-	-	-	-	-	-	-	-	-	-	-	-	15	0	8	17	1	16
Cephalexin	-	-	-	-	-	-	-	-	-	-	-	-	10	0	13	15	15	18

Discussion

Total of 185 samples were collected out of which 128 showed growth and remaining samples did not detect any growth with the isolation rate of 70.6%. In terms of the patients' sex distribution in this study, the male to female ratio was 1.5:1, meaning that males (60.7%) prevailed over females (39.3%).

The most common types of burns were discovered to be thermal burns, which were followed by electric burns and scald burns respectively.[16]

The result showed a high isolation rate with the majority of bacterial etiology being represented by gram-negative isolates. Gram-negative bacteria were found in most of the instances, indicating that the majority of these wounds may have occurred from extended hospital stays. *Staphylococcus aureus* was the most common isolated bacteria from the blood of patients as a causative agents of septicemic attack followed by *p. aeruginosa.*[17] *Klebsiella pneumonia* was the 3rd bacteria isolated from the blood of septicemic burn patients followed by B-hemolytic *S. pyogenes, E. coli, Acinetobacter spp., Klebsiella spp., Proteus spp.*[18] Facts like age, comorbidities, and the depth and extent of the burn, have been linked to an increased risk of infection.[19]

Most gram-negative bacteria appeared resistant to most to most of antimicrobial agents such as amoxicillin, gentamicin, meropenem, tobramycin, tetracycline. In this study, *E. coli* was susceptible to amikacin and resistant to amoxicillin.[20].

Conclusion

Bacterial growth was most commonly observed in blood and wound swab specimens, with a significantly higher proportion of Gram-negative isolates found in inpatient samples. Staph. aureus was the most recurrent isolate, followed by E. coli and staphylococci (CoNS). Gram-negative bacteria predominated overall. Cephalexin was least efficient against the gram positive isolates, while amikacin and gentamicin were the most effective. Amikacin was the most effective against the negative isolates, whereas amoxicillin showed the least effectiveness.

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