Original Article

Antibiotic Sensitivity and Resistance Patterns of Common Microbes among Burn Patients at Ayub Teaching Hospital, Abbottabad

Firdous Khan, Abdullah Mahmood and Saad Iqbal

ABSTRACT

Objective: To determine the most frequently occurring microbes in burn infections, along with their antibiotic sensitivity and resistance profile and to revise treatment protocols accordingly.

Study Design: Descriptive cross- sectional study

Place and Duration of Study: This study was conducted at the Department of Plastic Surgery & Burns, Ayub Teaching Hospital Abbottabad from 1st January 2024 to 30th June 2024.

Methods: This descriptive cross-sectional study included 97 patients with burn injuries having a Total Burn Surface Area (TBSA) greater than 10% and who had not been previously treated. Data were collected using a non-probability consecutive sampling technique after obtaining informed consent. Microbial analysis was performed and data were analyzed. Pearson chi-square test was applied and P value ≤ 0.05 was considered significant.

Results: Mean age of patients was 33.3 years. Out of 97 patients, majority of cases were seen in females (58.8%). Methicillin Resistant Staphylococcus Aureus (MRSA) and Pseudomonas Aeruginosa were the most commonly isolated organisms (34% and 30.90%) respectively. Linezolid (68%) and Meropenem (58%) are the most sensitive antibiotics while Amoxicillin-Clavulanic acid and Erythromycin carries the highest resistance rate i.e. 93.8% for both.

Conclusion: There is a rising concern of multidrug resistant organisms especially Pseudomonas Aeruginosa and MRSA. Several antibiotics like Piperacillin, Tazobactum, and Meropenem are becoming more and more resistant. Some drugs like Linezolid and Vancomycin still have better efficacies but they should be used cautiously.

Key Words: Burn injury, Sensitivity, Multidrug resistant organisms

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INTRODUCTION

Burn injury is one of the most devastating forms of injury that leads to grave outcomes. It carries a significantly high mortality and morbidity due to post burn infections[1]. An estimated 120,000 deaths occur annually due to burns. More than half of these deaths are reported from Southeastern Asia and low to middle income countries[2]. The causes of burns can be thermal, electrical, chemical, radiation or contact[3], irrespective of the cause; all burn injuries damage the largest organ of body i.e. skin.

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Skin is responsible for thermoregulation, hemostasis, sensations and also acts as a primary immunological barrier[4]. Once burn injury occurs, it damages the skin and increases the susceptibility to infections due to loss of primary barrier as well as local inflammatory response[5]. Burn wounds release large amounts of exudates which are protein rich; it acts as a medium which favors bacterial growth[6]. Burn wounds remain sterile for about first 48 hours, after that the damaged skin starts getting colonized by pathogens. Majority of these come from patient's normal flora from gastrointestinal and respiratory tracts and the rest are acquired from the environment. If not treated promptly, patient can develop uncontrolled sepsis which leads to increased mortality[7].

Diagnosis of infection is made on the basis of physical examination, vital signs (temperature, pulse rate) and infection biomarkers (TLC count and CRP)[8]. Major cause of gram positive infections is Staphylococcus Aureus. In normal individuals, Staphylococcus aureus does not cause infection but in burn patients, it causes opportunistic infections due to compromised immunity and lack of skin barrier. Among gram negatives,

Pseudomonas Aeruginosa is the leading causative organism[9].

In developing countries like Pakistan, late presentations, overburdened hospitals, inappropriate use of antibiotics and lack of practice of performing cultures is leading to an increase in antibiotic resistance which makes it difficult to effectively treat burn infections which increases mortality and morbidity[10].

METHODS

This descriptive, cross sectional study was conducted at the Department of Plastic Surgery & Burns, Ayub Teaching Hospital Abbottabad from 1st January 2024 to 30th June 2024. Ethical approval was taken. Patients of burn injury with Total Burn Surface Area (TBSA) greater than 10% who have not been treated previously in any other hospital were included irrespective of age or cause of burn. Based on these criteria, data was collected by non-probability consecutive sampling method after taking informed consent from 97 patients. Samples from wound sites were taken using sterile swabs under aseptic conditions. Swabs were immediately sent to microbiologic laboratory where they have been inoculated on Blood and MacConkey agar. Microbes were identified using gram staining, morphological features and certain biochemical tests, after 24 to 48 hours of incubation at 37 degree Celsius. Antibiotic sensitivity patterns have been identified by Kirby-Bauer Disk Diffusion method. Data was analyzed using data analysis software SPSS v.27. Quantitative variables were described in terms of mean and standard deviation while qualitative variables were analyzed using Pearson chi square test and results were deemed significant for a P value of ≤0.05.

RESULTS

Out of the total 97 cases, majority of burn injuries were seen in females (n=57) as compared to males (n=40). Mean age of patients were 33.3 years. Most common cause of burn was flame burn which accounted for (58.8%) followed by scald (32%) and electric (9.2%). Second degree burns were more prevalent (60.8%) as compared to first degree (15.5%) and third degree (23.7%). In females, most burns were due to flame injury while in males mostly scald injury was the cause (P value <0.001). Our results are described in the following tables & figures.

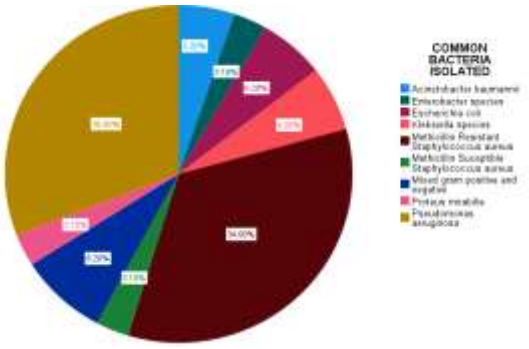

Figure No.1: Percentages of Common Bacterial isolates.

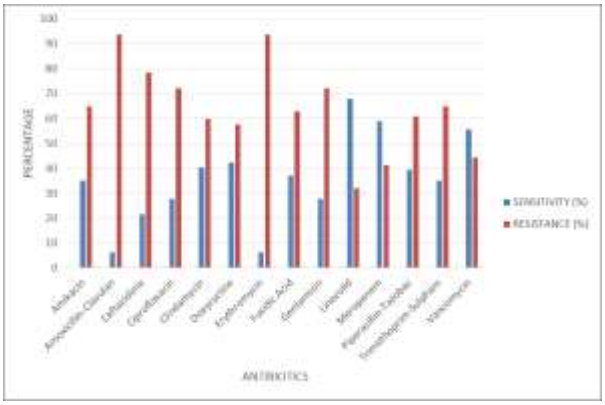

Figure No.2: Sensitivity and resistance of individual antibiotics

Table No.1: Socio- demographic characteristics.

Total Burn Patients (N=97)				
			Frequency (n)	Percentage
Gender	Male		40	41.2 %
	Female		57	58.8 %
Cause of burn Injury	Scald		31	32.0%
	Flame		57	58.8%
	Electric		09	9.2%
Degree of burn	First degree		15	15.5%
	Second degree		59	60.8%
	Third Degree		23	23.7%
Gender Relationship with Cause of Burn P value <0.001	Male	Scald	23	57.5 %
		Flame	9	22.5 %
		Electric	8	20.0 %
	Female	Scald	8	14.0 %
		Flame	48	84.2 %
		Electric	1	1.8 %

Table No.2: Antibiotic sensitivity and resistance patterns of common burn wound isolates.

		Pseudomonas aeruginosa n=30	MRSA n=33	Klebsiella species n=6	Acinetobacter baumannii n=5	Escherichia coli n=6	Enterobacter species n=3	Mixed growth n=8	Proteus mirabilis n=3	MSSA n=3	P Value
Amoxicillin-Clavulanic acid	Sensitivity	0.0%	9.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.000
	Resistance	100.0%	90.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	
Piperacillin-Tazobactam	Sensitivity	43.3%	27.3%	50.0%	60.0%	0.0%	100.0%	12.5%	100.0%	100.0%	0.003
	Resistance	56.7%	72.7%	50.0%	40.0%	100.0%	0.0%	87.5%	0.0%	0.0%	
Ceftazidime	Sensitivity	30.0%	9.1%	50.0%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	0.000
	Resistance	70.0%	90.9%	50.0%	100.0%	100.0%	100.0%	100.0%	0.0%	0.0%	
Meropenem	Sensitivity	56.7%	45.5%	100.0%	60.0%	50.0%	100.0%	50.0%	100.0%	100.0%	0.098
	Resistance	43.3%	54.5%	0.0%	40.0%	50.0%	0.0%	50.0%	0.0%	0.0%	
Vancomycin	Sensitivity	40.0%	90.9%	50.0%	60.0%	0.0%	100.0%	0.0%	0.0%	100.0%	0.000
	Resistance	60.0%	9.1%	50.0%	40.0%	100.0%	0.0%	100.0%	100.0%	0.0%	
Amikacin	Sensitivity	50.0%	0.0%	50.0%	100.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.000
	Resistance	50.0%	100.0%	50.0%	0.0%	100.0%	0.0%	0.0%	100.0%	100.0%	
Gentamicin	Sensitivity	50.0%	0.0%	50.0%	100.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.000
	Resistance	50.0%	100.0%	50.0%	0.0%	100.0%	100.0%	50.0%	100.0%	100.0%	
Erythromycin	Sensitivity	10.0%	9.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.901
	Resistance	90.0%	90.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Doxycycline	Sensitivity	20.0%	54.5%	50.0%	100.0%	50.0%	100.0%	0.0%	0.0%	100.0%	0.000
	Resistance	80.0%	45.5%	50.0%	0.0%	50.0%	0.0%	100.0%	100.0%	0.0%	
Ciprofloxacin	Sensitivity	40.0%	18.2%	50.0%	0.0%	0.0%	0.0%	37.5%	100.0%	0.0%	0.011
	Resistance	60.0%	81.8%	50.0%	100.0%	100.0%	100.0%	62.5%	0.0%	100.0%	
Trimethoprim-Sulphamethoxazole	Sensitivity	10.0%	45.5%	50.0%	0.0%	50.0%	100.0%	12.5%	100.0%	100.0%	0.000
	Resistance	90.0%	54.5%	50.0%	100.0%	50.0%	0.0%	87.5%	0.0%	0.0%	
Clindamycin	Sensitivity	50.0%	45.5%	0.0%	60.0%	0.0%	100.0%	0.0%	100.0%	100.0%	0.001
	Resistance	50.0%	54.5%	100.0%	40.0%	100.0%	0.0%	100.0%	0.0%	0.0%	
Linezolid	Sensitivity	80.0%	100.0%	50.0%	60.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.000
	Resistance	20.0%	0.0%	50.0%	40.0%	100.0%	100.0%	100.0%	100.0%	0.0%	
Fusidic Acid	Sensitivity	60.0%	27.3%	0.0%	60.0%	0.0%	100.0%	0.0%	0.0%	100.0%	0.000
	Resistance	40.0%	72.7%	100.0%	40.0%	100.0%	0.0%	100.0%	100.0%	0.0%	

DISCUSSION

Burn wound infections present a difficult clinical challenge, due to their complex microbiological profiles and evolving antibiotic resistance. This study aimed to determine the common pathogens isolated from burn wounds and their respective antibiotic resistance and sensitivity profiles. By comparing our findings with existing literature, we can better understand the present issues surrounding burn wound infections and devise strategies to address them. Our study identified that gender difference exists in burn injuries with a higher incidence among females (58.8%) compared to males (41.2%) (Table1). This finding contrasts with previous studies such as the one reported by Chaudhary et al.[11] which observed a higher prevalence of burns in males (55%) compared to females (45%). However, gender based variations can be present among populations of different areas. Various factors can contribute to this aspect, for example housing conditions, occupational risks, psychosocial factors, access to medical facilities, availability of safety equipment etc.

The mean age of burn patients in our study was 33.3 years, which is nearly consistent with the age distribution reported by Gu et al. who found a mean age of 37 years[12]**.** Regarding the causes of burn injuries, we found that flames were the predominant cause (58.8%), followed by scalds (32%) and electric burns (9.2%). This distribution is similar with findings from another study[13]. Ji S et al. provided a consensus in 2023 after analyzing burn cases for a period of 10 years and agreed that second degree burns were most common type of burns in clinical practice[14] which is similar to what we observed in our patients. When gender-specific analysis of burn injuries was done, we came across the fact that females experienced a higher incidence of flame burns (84.2%) compared to males (22.5%) which was similar to results of another study[15]**.** This is logical to think that a female is more vulnerable to flame burns because of house hold exposures to gas and fire appliances. All these findings show that most

demographic characteristics of our study align with broader trends observed worldwide among burn patients.

We identified Methicillin- Resistant Staphylococcus Aureus (MRSA) is the most common pathogen in burn wound infections accounting for 34% of isolates. Pseudomonas Aeruginosa was the second most common pathogen representing 30.9% of the isolates. These findings are consistent with a study by El Hamzaoui N et al. which also identified Staphylococcus aureus is the most common pathogen (33.85%) followed by Pseudomonas occurring in 18.46%[16]. This indicates that MRSA and Pseudomonas Aeruginosa are the main contributors in burn infections and they need to be addressed properly. We observed a concerning trend in our study related to Pseudomonas Aeruginosa. A study was conducted on burn wound isolates back in 2020 in our unit; at that time Pseudomonas Aeruginosa was found to be the lowest isolate (7%) [17]. However, our 2024 data reveals that Pseudomonas Aeruginosa is the second most common isolate (30.9%). This fourfold increase in Pseudomonas over a period of just four years is an alarming sign and it indicates towards increased resistance or adaptability of Pseudomonas in the burn wound environment, raising concerns about its potential impact on patient mortality and morbidity.

When sensitivity and resistance patterns of Pseudomonas Aeruginosa were analyzed, they demonstrated only 56.7% sensitivity to Meropenem, a drastic decline from the 97.62% sensitivity reported by Shukla et al.[18]. Similarly, sensitivity to Piperacillin-Tazobactum was 43.3% in our study compared to 90.48% in Shukla's research. This dramatic difference in sensitivity of two antibiotics demonstrates that prevalence of multidrug resistant organisms is more in our setup. Linezolid and Vancomycin exhibited sensitivities of 100% and 90.9% respectively, against MRSA. These results are consistent with a study conducted in a Burn unit in Peshawar which reported Linezolid sensitivity at 97% and Vancomycin at 98%[19]. This suggests that Linezolid and Vancomycin are still an effective option to treat MRSA in our region for burn injuries. High sensitivities of these drugs do not imply that we start using them indiscriminately. It is crucial that these antibiotics should be used more cautiously because in a few more years to come these might be the only resort to treat MRSA. Mantal and Das reported that Piperacillin-Tazobactum was the most sensitive antibiotic followed by Imipenem[20] but in our setting, we identified that Linezolid was the most potent antibiotic followed by Meropenem. When data for most resistant antibiotics was drafted, it revealed Amoxicillin-Clavulanic acid and Erythromycin carried 93.8% resistance rate which was highest among all antibiotics tested. This finding is particularly concerning because we use Amoxicillin-Clavulanic acid as a first line empiric drug for all burn patients being admitted to our unit. These results warrant a change in empiric therapy to decrease the incidence of multidrug resistant organisms and improve patient outcome.

CONCLUSION

In summary, our study points out several important problems in treating burn wound infections. There is a growing concern about the bacteria Pseudomonas Aeruginosa and its increasing resistance to major antibiotics like Meropenem and Piperacillin-Tazobactum which needs urgent attention. Although Linezolid and Vancomycin seem to work well, they should be used carefully to prevent the development of resistance. The high resistance rates of Amoxicillin-Clavulanic Acid show that we need to update our treatment protocols.

Limitations: There are several limitations to our study which include:

1. Insufficient testing of antibiotics due to limited availability of antibiotic discs commercially thus only a finite number of discs are being used which does not provide a complete picture of resistance patterns.
2. If one drug from a class is sensitive other drugs of that class are not being tested, ideally 3 to 4 drugs from each class should be tested to determine other variables like cross resistance of drugs across a genera and individual efficacies.

Recommendations:

1. We recommend that future researches should test a wide variety of antibiotics to assess the resistance patterns more accurately. At least, 3 antibiotics from a class should be tested to determine individual efficacies and cross resistance among drugs.
2. Periodic culture and sensitivities should be carried out to keep an eye on changing trends over the time. This will not only improve literature and guide clinical decisions but also improve patient outcome.

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Author's Contribution:

Concept & Design of Study:	Firdous Khan, Abdullah Mahmood
Drafting:	Abdullah Mahmood, Saad Iqbal
Data Analysis:	Firdous Khan, Abdullah Mahmood, Saad Iqbal
Revisiting Critically:	Firdous Khan, Abdullah Mahmood, Saad Iqbal
Final Approval of version:	By all above authors

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