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"Bacterial Causing Burn Wound Infections in Burn Patients"

A Thesis

Submitted to the Council of the College of Medicine, University of Diyala , Department of Surgery , as a Partial Fulfillment in the Requirements for the Degree of MBChB

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Dedication

I dedicate this work to everyone who has supported me throughout my medical journey:

To my family, for their endless love, patience, and encouragement,

To my Assist Lect. Dr. Raghad Hameed Khaleefa, who inspired me with their knowledge and guidance,
And to those who shared with me the challenges and triumphs of this path.

I strive to contribute to the betterment of humanity through the art and science of medicine.

Acknowledgment

BEFORE READING MY RESEARCH, I would like to thank my family, my first support after God. This journey would not have been possible without you. Thank you for your endless encouragement, guidance, and love. This accomplishment is as much yours as it is mine, a testament to everything you have given me. With all my love and gratitude, thank you for believing in me.

I would also like to thank my supervisor, *Assist Lect. Dr. Raghad Hameed Khaleefa* , without whom this work would not have seen the light. I deeply appreciate your efforts.

SUPERVISOR CERTIFICATIONS

I certify that the preparation of this research titled (Bacterial Causing burn wound infections in burn patients) and conducted by the students (Karar Mohammed Hadied) was conducted under my supervision, College of Medicine, Diyala University, which is part of the requirements for obtaining a bachelor's degree in medicine.

Name of supervisor: Dr. Raghad Hameed Khaleefa

Academic degree: Assistant Lecturer

Signature:

Date:

Certificate

We, the examining committee after reading this research and examining the students in its content, find it adequate as a project for the degree of MBChB.

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List of Abbreviation

Abbrevation	Meaning
BWI	Burn Wound Infection
TBSA	Total Body Surface Area
BWs	Burn Wounds
BWS	burn wound sepsis
QBC	quantitative biopsy culture

Abstract

Background : Burns are among the most prevalent and destructive types of trauma. Serious thermal damage patients need specialised care right away to reduce morbidity and death. In the United States, there are about 2 million fires reported annually, resulting in 1.2 million burn injuries, according to data from the National Centre for Injury Prevention and Control.

Objective : to determine the bacteriological profile and the resistance pattern of burn wound bacteria to the most common antibiotics.

Method and patient: A cross-sectional study was conducted at Baqubah General Teaching Hospital, Diyala province, Iraq, between 21 October 2024 and 25 December 2024, involving 100 participants (35 females and 65 males). Data were obtained from hospital records, including age, sex, type of bacteria, antibiotic sensitivity and resistance, contamination, healing outcomes, and degree of burn severity. Statistical analysis using Microsoft Excel 2013 and SPSS V21 included descriptive statistics, chi-square tests, and Pearson correlation analysis to evaluate relationships between variables. The findings highlight significant correlations between contamination, degree of burn, and healing outcomes while maintaining participant confidentiality and ethical standards.

Result : The study revealed that burn wound infections were more prevalent among younger individuals, with 71% of patients under the age of 30 and a mean age of 23.46 years. Males constituted the majority of cases (65%). The most frequently isolated pathogens were Acinetobacter baumannii (52%) and Staphylococcus aureus (32%), followed by Pseudomonas aeruginosa (10%) and Klebsiella pneumoniae (6%). Antibiotic sensitivity testing showed limited effectiveness for commonly used antibiotics, with high resistance observed in A. baumannii and P. aeruginosa. A strong negative correlation (-0.772) was identified between bacterial contamination and

wound healing, emphasizing the significant impact of infections on recovery outcomes.

Conclusion: The results of this study demonstrate that burn wound infections are more prevalent among younger individuals, particularly males, who accounted for the majority of cases. The research identified Acinetobacter baumannii and Staphylococcus aureus as the most common pathogens isolated from burn wounds, both exhibiting high levels of resistance to antibiotics.

Chapter One

((Introduction))

Introductions

Burns are among the most prevalent and destructive types of trauma. Serious thermal damage patients need specialised care right away to reduce morbidity and death. In the United States, there are about 2 million fires reported annually, resulting in 1.2 million burn injuries, according to data from the National Centre for Injury Prevention and Control [1].

Approximately 100,000 of these instances include moderate to severe burn injuries that necessitate hospitalisation, and approximately 5,000 patients may away annually due to complications from burns [2].

One of the leading causes of morbidity and death among burn patients is burn wound infection (BWI). Silver sulfadiazine and early, vigorous debridement were used in the 1990s, which caused BWI to drop from the top cause of death to the second place, after pneumonia [3,4]. But because it progresses quickly after immunosuppression brought on by burn injuries, this consequence is linked to a high death rate, particularly in serious burn patients (adults > 20% total body surface area [TBSA]; children > 10% TBSA)[5].

An important risk factor for sepsis and septic shock in critically ill burn patients is burn wound infection (BWI). While pneumonia is currently the leading cause of death for burn patients, burn wound sepsis is still a significant infectious complication in this population, and BWI is still a major complication specific to burn recipients. There is a specific period for burn wound colonisation [6–7].

Inflammatory cytokines, chemokines, and metabolic hormones are among the reactions that may significantly rise after burn injuries, however the duration of these increases may vary [8].

Clinicians always face the issue of managing the microflora in burn wounds because proper evaluation and therapy are crucial to preventing potentially catastrophic consequences. For the routine collection of several superficial wound samples used for

the monitoring of organisms from burn wounds, surface swab culture is a conventional, practical, and efficient technique[9].

When patients with severe burns are treated in a critical care unit, nosocomial bacteria with high virulence are typically the source of BWI. The surface of burn wounds (BWs) is initially sterile, but bacteria from the skin flora quickly colonise it, forming what are known as biofilms—a dynamic exchange with the outside world [10]. Using topical sulfadiazine derivatives, surgical debridement aims to eliminate biofilms and regulate their growth. A skilled surgeon must therefore evaluate BW at each wound dressing change in order to distinguish clinical indicators of normal BW from those of burn wound infection (BWI)[11].

The development of burn wound sepsis (BWS) has been linked to numerous clinical factors, including comorbidities, clinical presentation, and microbiological pathogenicity [12].

Qualitative methods including culture by standard agar and burn surface swab are utilised for BWI assessment; however, they have a higher prevalence of false positives and frequently result in overdiagnosis. Due to the small number of BWI studies that were validated by quantitative biopsy culture (QBC), there is insufficient data to suggest one over the other[13].

Aim of Study: to determine the bacteriological profile and the resistance pattern of burn wound bacteria to the most common antibiotics.

Chapter Two

((Patients and Methods))

Method and Materials

Study Design : Cross-sectional study.

Sampling Technique : The study involved 100 participants (35 females and 65 males) in Diyala province, Iraq. Data were collected from records at Baqubah General Teaching Hospital between 21 October 2024 and 25 December 2024.

Data Collection: Data were obtained from hospital records, including age, sex, type of bacteria causing infections, patterns of antibiotic sensitivity and resistance, presence of contamination in burn wounds, healing outcomes classified as good or poor, and the degree of burn severity categorized as first, second, or third degree.

Ethical Approval : In our research, we did not include the names of participants or any other sensitive data belonging to them, ensuring confidentiality and compliance with ethical guidelines.

Statistical Analysis : Data were organized and analyzed using Microsoft Excel 2013 and SPSS Statistics V21. Descriptive statistics (cross-tabulations) and chi-square tests were used to evaluate relationships between the variables. Additionally, Pearson correlation analysis was performed to measure the strength and direction of associations between healing, contamination, degree of burn severity, and other variables.

Chapter Three

((Results))

Results

Table 1 presents the demographic characteristics of the study sample, including age groups and gender distribution. The total sample size is 100 participants. Regarding age, the majority of the participants (71%) are under 30 years old, with a mean age of 23.46 years, a standard deviation of 14.567, a minimum age of 1 year, and a maximum age of 57 years. Participants aged above 30 years constitute 29% of the sample.

In terms of gender distribution, 65% of the participants are male, while females represent 35% of the sample.

Table 1 : Demographic characteristics of the study sample

		Frequency	Percent	Mean	Std. Deviation	Maximum	Minimum
Age group	**<30**	71	71.0	23.46	14.567	57	1
	>30	29	29.0				
	Total	100	100.0				
sex	**Female**	35	35.0	N/A	N/A	N/A	N/A
	Male	65	65.0				
	Total	100	100.0				

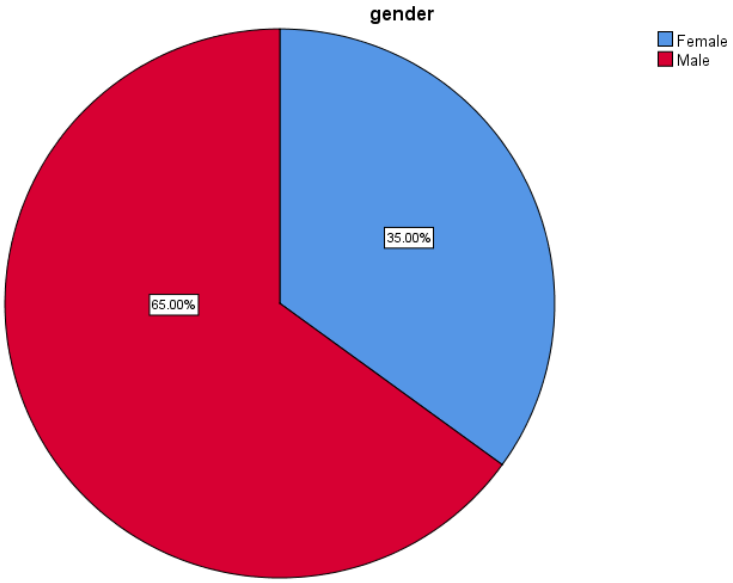


Figure 1 : gender distrubation

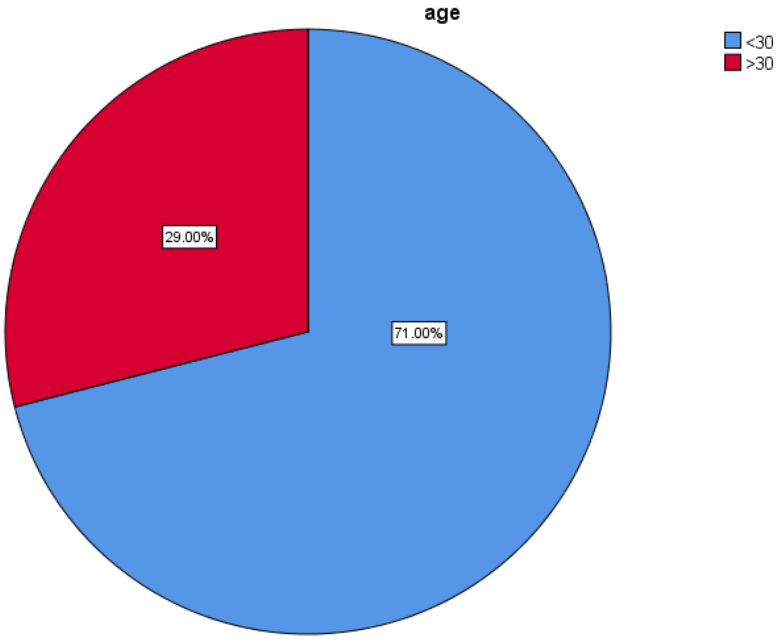


Figure 2 : age distrubation

Table 2 : The table presents the distribution of bacterial isolates from burn wounds among 100 samples. Acinetobacter baumannii* was the most frequently isolated pathogen, accounting for 52 cases (52%), followed by Staphylococcus aureus, which was identified in 32 cases (32%). Pseudomonas aeruginosa was responsible for 10 cases (10%), while Klebsiella pneumoniae was the least common, detected in 6 cases (6%). These findings indicate that Acinetobacter baumannii and Staphylococcus aureus are the predominant pathogens in burn wound infections, collectively constituting 84% of the bacterial isolates.

Table 2 : Distribution of Bacterial Isolates in Burn Wounds

Type of Bacteria		
	Frequency	**Percent**
Acinetobacter baumannii	52	52.0
Klebsiella pneumonia	6	6.0
Pseudomonas aeruginosa	10	10.0
Staphylococcus aureus	32	32.0
Total	100	100.0

Table 3 : The table shows the antibiotic sensitivity patterns of bacterial isolates from burn wounds, including *Acinetobacter baumannii*, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Staphylococcus aureus. Acinetobacter baumannii demonstrated the highest sensitivity to trimethoprim-sulfamethoxazole (13%) and levofloxacin (12%), while its sensitivity to amoxicillin (8%) and ceftriaxone (6%) was significantly lower. Klebsiella pneumoniae exhibited minimal sensitivity, with only 2% responding to amoxicillin and azithromycin, and 0% to most other antibiotics. Pseudomonas aeruginosa showed moderate sensitivity to gentamycin (3%) and trimethoprim-sulfamethoxazole (2%), but complete resistance to ceftriaxone and levofloxacin. Staphylococcus aureus displayed higher sensitivity to azithromycin (9%) and trimethoprim-sulfamethoxazole (5%), with lower rates for gentamycin and doxycycline (4% each).

Table 3 : Antibiotic sensitivity patterns of bacterial species

Antibiotic Sensitive	Type of Bacteria			
	Acinetobacter baumannii	Klebsiella pneumonia	Pseudomonas aeruginosa	Staphylococcus aureus
Amoxicillin	8	2	4	2
	8.0%	2.0%	4.0%	2.0%
Azithromycin	0	2	0	9
	0.0%	2.0%	0.0%	9.0%
Ceftriaxone	6	0	0	0
	6.0%	0.0%	0.0%	0.0%
Ciprofloxacin	1	0	0	2
	1.0%	0.0%	0.0%	2.0%
Doxycycline	3	0	1	4
Gentamycine	4	0	3	4
	4.0%	0.0%	3.0%	4.0%
levofloxacin	12	0	0	0
	12.0%	0.0%	0.0%	0.0%
Nitrofurantion	5	0	2	2
	5.0%	0.0%	2.0%	2.0%
Trimethoprim_sulfamethoxazole	13	2	0	5
	13.0%	2.0%	0.0%	5.0%
Vancomycine	0	0	0	4
	0.0%	0.0%	0.0%	4.0%

Table 4 : The table presents the antibiotic resistance profiles of three bacterial species isolated from burn wounds: Acinetobacter baumannii*, Klebsiella pneumoniae, and Pseudomonas aeruginosa, as well as Staphylococcus aureus. Acinetobacter baumannii showed high resistance to levofloxacin (13%), gentamycin (7%), and tobramycin (6%), with lower resistance rates to amoxicillin (1%) and ceftriaxone (3%). Klebsiella pneumoniae demonstrated minimal resistance overall, with the highest rate observed for amoxicillin (2%) and azithromycin (1%). Pseudomonas aeruginosa exhibited significant resistance to amoxicillin (5%), ciprofloxacin (2%), and trimethoprim-sulfamethoxazole (2%), reflecting its multidrug-resistant nature. Staphylococcus aureus showed resistance to multiple antibiotics, with the highest resistance observed for gentamycin (7%), followed by azithromycin (3%) and trimethoprim-sulfamethoxazole (5%).

Table 4 : Antibiotic Resistance profiles of bacterial species

Antibiotic Resistance	Type of Bacteria			
	Acinetobacter baumannii	Klebsiella pneumonia	Pseudomonas aeruginosa	Staphylococcus aureus
Amoxicillin	1	2	5	2
	1.0%	2.0%	5.0%	2.0%
Azithromycin	5	1	0	3
	5.0%	1.0%	0.0%	3.0%
Ceftazidime	3	0	0	0
	3.0%	0.0%	0.0%	0.0%
Ceftriaxone	3	1	1	2
	3.0%	1.0%	1.0%	2.0%
Ciprofloxacin	2	1	0	2
	2.0%	1.0%	0.0%	2.0%
Doxycycline	1	0	1	3
	1.0%	0.0%	1.0%	3.0%
Gentamycine	7	1	0	7
	7.0%	1.0%	0.0%	7.0%
Levofloxacin	13	0	0	0
	13.0%	0.0%	0.0%	0.0%
Meropenem	4	0	0	3
	4.0%	0.0%	0.0%	3.0%
Tobramycine	6	0	0	4
	6.0%	0.0%	0.0%	4.0%
Trimethoprim_sulfamethoxazole	4	0	2	5
	4.0%	0.0%	2.0%	5.0%
Vancomycine	3	0	1	1
	3.0%	0.0%	1.0%	1.0%

Table 5 : The table demonstrates the relationships between healing, type of bacteria, contamination, and degree of burn. A strong negative correlation was observed between healing and contamination (r = -0.772), indicating that higher contamination levels significantly impair the healing process. Similarly, a moderate negative correlation between healing and degree of burn (r = -0.355) reflects the prolonged recovery time associated with more severe burns. A weak positive correlation was noted between healing and type of bacteria (r = 0.165), suggesting minimal influence of bacterial type on recovery within this dataset. The relationship between contamination and degree of burn showed a weak negative correlation (r = -0.068), implying no substantial dependence between burn severity and contamination risk.

Table 5 : Correlation Between Healing, Type of Bacteria, Contamination, and Degree of Burn,

	Healing	**Type of Bacteria**	**Contamination**	**Degree of Burn**
Healing	1.000	0.165	-0.772	-0.355
Type of Bacteria	0.165	1.000	-0.138	0.034
Contamination	-0.772	-0.138	1.000	-0.068
Degree of Burn	-0.355	0.034	-0.068	1.000

Chapter Four

((Discussion))

Discussion

In this study conducted at Ba'aqubah Hospital, Diyala, Iraq, we investigated demographic distributions, bacterial isolates, antibiotic sensitivity and resistance patterns, and their correlations with wound healing and burn severity in patients with burn wound infections.

The demographic data revealed that 71% of the patients were under the age of 30, with a mean age of 23.46 years. Males accounted for 65% of the total participants, indicating a higher prevalence of burn injuries among young males. These findings align with the study conducted by Al-Zacko (2012)[14], which reported a similar pattern of young males being disproportionately affected due to occupational risks and high-risk behaviors in Middle Eastern settings.

The results showed that Acinetobacter baumannii (52%) was the most frequently isolated pathogen, followed by Staphylococcus aureus (32%), Pseudomonas aeruginosa (10%), and Klebsiella pneumoniae (6%). This distribution mirrors the findings of Church et al. (2006)[15], who identified A. baumannii as a major contributor to hospital-acquired infections, particularly in burn units, due to its resistance and biofilm-forming capabilities. Similarly, the role of S. aureus as a leading cause of opportunistic infections was emphasized in their study.

The analysis of antibiotic sensitivity patterns showed low sensitivity rates for commonly used antibiotics such as amoxicillin and ceftriaxone. Trimethoprim-sulfamethoxazole (13% for A. baumannii) and levofloxacin (12%) exhibited slightly better sensitivity but were still inadequate for effective infection control. These findings align with Brusselaers et al. (2010)[16], who highlighted the global prevalence of multidrug-resistant

bacteria in burn wound infections. The resistance data further revealed that A. baumannii and P. aeruginosa exhibited significant resistance to ciprofloxacin and ceftriaxone, consistent with De Macedo and Santos (2005)[17], who noted similar trends in burn unit isolates.

The correlation analysis demonstrated that bacterial contamination negatively impacted wound healing (-0.772) and was associated with the severity of burns. This finding is supported by Mosier et al. (2012)[18], who explained that microbial contamination exacerbates inflammation, delays healing, and increases the risk of complications in burn wounds.

Chapter Five

((Conclusion and Recommendations))

Conclusion

The results of this study demonstrate that burn wound infections are more prevalent among younger individuals, particularly males, who accounted for the majority of cases. The data identified Acinetobacter baumannii and Staphylococcus aureus as the most common pathogens isolated from burn wounds, both exhibiting high levels of resistance to antibiotics. Additionally, the study revealed a strong negative correlation between bacterial contamination and wound healing, highlighting the significant impact of infections on the recovery process. These findings are consistent with previous research, emphasizing the ongoing challenge posed by multidrug-resistant bacteria in the management of burn wound infections.

Recommendation

Based on the findings of this study, the following recommendations are proposed:

1. Implement Strict Infection Control Measures

Ensure proper sterilization techniques, isolation protocols for infected patients, and adherence to hygiene practices in burn units to minimize the risk of cross-contamination and the spread of multidrug-resistant bacteria.

2. Routine Microbial Surveillance

Conduct regular cultures and sensitivity testing to identify the bacterial pathogens present and their resistance patterns. This allows for more targeted and effective antibiotic use, improving treatment outcomes.

3. Antibiotic Stewardship Programs

Limit the misuse of antibiotics by implementing stewardship programs that focus on prescribing the appropriate antibiotics based on microbial surveillance data to reduce the development of resistant bacteria.

4. Educational Campaigns

Provide educational programs for both healthcare professionals and the public, focusing on the prevention of burns and the importance of early, appropriate infection management to enhance recovery and reduce complications.

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