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ORIGINAL ARTICLE

A study of Seasonal Variation in the Incidence of Acinitobacter Baumanii Isolated from Infected Burn Wounds and their Antibiotic Susceptibility Patterns in a Tertiary Care Burns Hospital

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ABSTRACT

Background: Acinetobacter baumannii is a major pathogen in burn wound infections due to its resilience in hospital environments and high levels of multidrug resistance. Seasonal variation in its incidence has been reported globally, yet data from specialized burn care settings in Pakistan remain limited.

Objective: To investigate seasonal variation in the incidence of Acinetobacter baumannii isolated from infected burn wounds and to evaluate its antibiotic susceptibility pattern in a tertiary care burns hospital.

Methods: This retrospective cross-sectional study was conducted at the Burns and Plastic Surgery Center in Hayatabad, Peshawar, over a two-year period December 2020 to November 2022. All culture-positive A. baumannii isolates from burn wound infections were included. Data were grouped by meteorological season, and antibiotic susceptibility was assessed using the Kirby-Bauer disk diffusion method. Statistical analysis was performed using SPSS v25.

Results: Out of 3884 bacterial isolates obtained from infected burn wounds, 474 (12.21%) were identified as A. baumannii. The incidence remained relatively stable across seasons, with no statistically significant seasonal variation ($p = 0.74$). Highest susceptibility was observed to colistin (74.1%) and tigecycline (62.5%), while high resistance was noted to cefepime (80.5%), ciprofloxacin (70.4%), and amikacin (57.7%). More than half of the affected patients had hospital stays exceeding 20 days.

Conclusion: The study found no significant seasonal pattern in the incidence of A. baumannii in burn wound infections. The organism's high resistance to most antibiotics, except colistin and tigecycline, underscores the urgency for stringent antibiotic stewardship, routine sensitivity testing, and continuous infection control practices throughout the year.

Keywords: Acinetobacter baumannii, burn wound infection, incidence, seasonal variation, antibiotic resistance, multidrug resistance, colistin, tigecycline, Peshawar, ICU

INTRODUCTION

Burn injuries represent some of the most susceptible and critical entry points for microorganisms to invade the human body, as they can lead to infections which subsequently complicate treatment. Out of the five species of Acinitobacter, Acinetobacter baumanii is responsible for 80% of all acinetobacter infections (CDC). Of all the pathogens associated with infections in burn wounds, Acinetobacter baumannii is considered one of the most dangerous. Its ability to withstand dry environments, endure prolong surface colonization, and its multidrug resistance renders critical areas of hospital difficult to manage, particularly the Intensive Care Units and Burns Units[1-5]

Numerous global investigations have looked into the potential seasonal fluctuation in the occurrence of A. baumannii infections, with many studies noting an increase during warmer months. Researchers attribute these trends to climate factors, which may influence the growth of microbes, the transmission of infections, or patterns in human behaviour. However, such seasonal trends do not have universal applicability, and results diverge considerably across different regions[6-8]

In Pakistan, while the burden of burn injuries and infections is well recognized, there is limited data on the seasonal behaviour of A. baumannii, particularly in specialized burns hospitals. Given the rising concern over multidrug resistance (MDR) and the narrowing of therapeutic options, it becomes increasingly important to understand local epidemiological trends to guide timely infection control strategies and antibiotic use[9-12]

This study was conducted to evaluate the seasonal distribution of Acinetobacter baumannii isolates from burn wound infections in a tertiary care setting, along with their antibiotic susceptibility patterns, in order to provide insight into whether seasonal factors influence infection rates and to help inform empiric treatment protocols.

METHODOLOGY

This retrospective cross-sectional study was conducted at the Burns and Plastic Surgery Center, Hayatabad Peshawar, a tertiary care facility that receives burn patients from across the region. The study covered a two-year period, from December 2020 to November 2022.

Patient records were reviewed to identify clinically infected burn wounds from which bacterial cultures had been performed. Only samples yielding positive bacterial cultures were included in the analysis. From these, 474 isolates identified as Acinetobacter baumannii were selected for further evaluation.

For each included case, the following data were extracted from patient files:

- Demographic information: Age and gender
- Clinical data: Type of burn (flame, scald, electrical, or chemical), Total Body Surface Area (TBSA) involved, duration of hospital stay, and ICU admission status

Samples (wound swabs or tissue) were processed in the hospital's microbiology lab using standard bacteriological techniques. Identification of A. baumannii was based on colony morphology, Gram staining, and biochemical testing. Only those confirmed as Acinetobacter baumannii were included in the study.

All confirmed isolates underwent antibiotic susceptibility testing using the Kirby-Bauer disk diffusion method, following Clinical and Laboratory Standards Institute (CLSI) guidelines. The antibiotics tested included:

- Colistin
- Tigecycline
- Amikacin
- Imipenem
- Cefoperazone-sulbactam
- Ceftazidime
- Cefepime
- Ciprofloxacin
- Piperacillin-tazobactam

Each isolate was classified as sensitive or resistant based on standardized interpretation criteria.

To examine seasonal variation, month-wise data on A. baumannii isolates were grouped into four meteorological seasons based on regional climate:

- Winter: December – February
- Spring: March – May
- Summer: June – August
- Autumn: September – November

Average seasonal temperatures for Peshawar were obtained from publicly available climate data by Ali et al. (2018) for classification support [13].

All collected data were entered into a structured database and analyzed using IBM SPSS version 25. Descriptive statistics including frequencies and percentages were used to summarize categorical variables. Chi-square tests were applied to assess Seasonal variation in A. baumannii incidence Associations between infection and clinical factors such as TBSA and ICU admission A p-value of <0.05 was considered statistically significant.

RESULTS

During the two-year period from Decemeber 2020 to November 2022, a total of 3884 bacterial isolates were obtained from infected burn wounds at the Burns and Plastic Surgery Center, Hayatabad, Peshawar. Out of these, 474 isolates (12.21%) were identified as Acinetobacter baumannii.

Among these 474 cases, 265 (55.9%) were male and 209 (44.1%) were female. The majority of affected patients belonged to the 18–40 years age group (56.5%), followed by >40 years (23.8%) and <18 years (19.7%). In terms of burn type, flame burns were the most frequent (79.2%), with scald (10.5%), electrical (6.6%), and chemical burns (3.6%) comprising the rest. Regarding burn severity, 40.2% of patients had TBSA >40%, 39.3% had 20–40%, and 20.5% had <20%.

Table 1: Demographic and Clinical Characteristics of Patients with A. baumannii (n = 474)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	265	55.9%
	Female	209	44.1%
Age Group	<18 years	93	19.7%
	18–40 years	268	56.5%
	>40 years	113	23.8%
Type of Burn	Flame	375	79.2%
	Scald	50	10.5%
	Electrical	31	6.6%
	Chemical	17	3.6%
TBSA	<20%	97	20.5%
	20–40%	186	39.3%
	>40%	191	40.2%

In terms of hospital stay, more than half of the patients (52.1%) were admitted for over 20 days. The detailed distribution is shown below. Outcome-related data were not analyzed due to limited access to follow-up and mortality records.

Table 2: Hospital Stay Duration in Patients with A. baumannii (n = 474)

Duration	Frequency (n)	Percentage (%)
<10 days	71	14.9%
10–20 days	156	32.9%
>20 days	247	52.1%

Seasonal distribution showed minor variations in percentage, but no statistically significant difference was observed across the four meteorological seasons (p = 0.74). A. baumannii incidence remained relatively stable.

Table 3: Seasonal Distribution of A. baumannii Isolates (n = 474)

Season	Avg Temp (°C)	Total Isolates	A. baumannii (n)	Percentage (%)	p-value
Winter	12.8°C	967	86	8.89%	
Spring	22.8°C	783	68	8.68%	
Summer	31.1°C	776	69	8.89%	
Autumn	22.8°C	1149	101	8.79%	0.74
Total	—	3884	474	12.21%	

Antibiotic sensitivity patterns revealed the highest susceptibility to colistin (74.1%) and tigecycline (62.5%), while notable resistance was observed for cefepime (80.5%), ciprofloxacin (70.4%), and amikacin (57.7%).

Table 4: Antibiotic Susceptibility of A. baumannii Isolates (n = 474)

Antibiotic	Sensitive (%)	Resistant (%)
Colistin	74.1%	25.9%
Tigecycline	62.5%	37.5%
Amikacin	42.3%	57.7%
Imipenem	49.0%	51.0%
Cefoperazone–Sulbactam	27.0%	73.0%
Ceftazidime	21.6%	78.4%
Cefepime	19.5%	80.5%
Ciprofloxacin	29.6%	70.4%
Piperacillin–Tazobactam	41.4%	58.6%

A comparative analysis of TBSA involvement with A. baumannii infection indicated no significant association (p = 0.62), though infection frequency was higher among those with TBSA >40%.

Table 5: Association Between TBSA and A. baumannii Infection

TBSA Category	A. baumannii (+)	A. baumannii (–)	p-value
<20%	97	261	
20–40%	186	285	
>40%	191	242	0.62

Similarly, while A. baumannii was more frequently isolated in ICU patients, the association with ICU admission was not statistically significant (p = 0.59).

Table 6: ICU Admission and A. baumannii Infection

ICU Admission	A. baumannii (+)	A. baumannii (–)	Total	p-value
Yes	258	254	512	
No	216	315	531	0.59

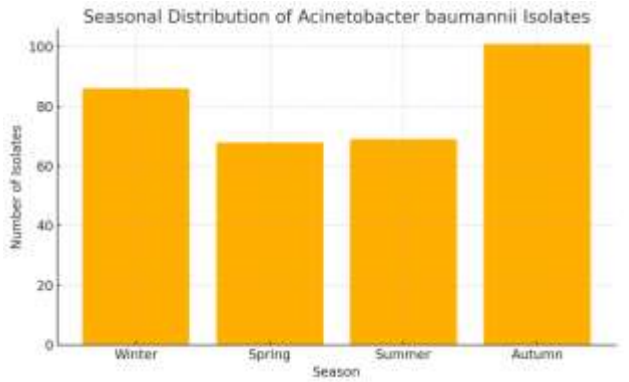

Figure 1: Bar graph illustrating the seasonal distribution of Acinetobacter baumannii isolates from burn wounds.

DISCUSSION

The present study aimed to assess the seasonal variation in the incidence of Acinetobacter baumannii isolated from infected burn wounds and to analyze its antibiotic susceptibility pattern in a tertiary care burns hospital. Over a span of two years, 474 A. baumannii isolates were identified from 3884 culture-positive burn wound infections, resulting in an incidence rate of 12.21%.

One of the key findings was the lack of significant seasonal variation in A. baumannii isolation. Previous research in various regions, including Brazil and the United States, has shown higher rates of A. baumannii infections during the warmer months, suggesting an environmental influence such as ambient temperature and humidity on bacterial transmission and survival[14]. A study by Filho et al. observed season-dependent bloodstream infections in different climatic regions of Brazil[14], while Kim et al. found increased colonization during warmer temperatures in community-onset cases[15]. Similarly, Gupta et al. documented seasonal variation in resistant Acinetobacter species across US hospitals[16]. However, our data revealed no such trend, with relatively consistent infection rates across all four seasons. This deviation may reflect differences in climatic stability, building infrastructure, and institutional infection control practices specific to our setting.

The demographic distribution of affected patients demonstrated a slight male predominance and a higher infection rate among individuals aged 18–40 years, which aligns with regional epidemiology of burn injuries. In South Asian contexts, flame burns in young, working-age males are common due to occupational exposures and domestic accidents involving fire. A multicenter review across Southeast Asia confirmed similar age and gender patterns in burns-related A. baumannii infections[17], while a hospital-based study in Indonesia also reported a predominance of young male patients with severe burns and sepsis[18].

In terms of hospital course, over half of the A. baumannii-infected patients had hospital stays exceeding 20 days. Although infection was more frequently isolated from ICU-admitted patients and those with >40% TBSA involvement, these associations were not statistically significant, suggesting that A. baumannii colonization may occur independently of burn severity or care setting.

The antibiotic resistance pattern observed is particularly alarming. The majority of isolates demonstrated resistance to commonly used antibiotics, including cefepime, ciprofloxacin, amikacin, and imipenem. Only colistin (74.1%) and tigecycline (62.5%) retained notable susceptibility. This pattern mirrors regional and international studies reporting widespread multidrug resistance (MDR) in A. baumannii, especially in ICUs and burn units. Banerjee et al. highlighted endemic MDR strains in Indian intensive care units[19], and similar findings have been reported in Iran and Saudi Arabia[20,21].

Additionally, recent studies from Oman and Northeast Iran have shown comparable resistance profiles, indicating a regional crisis in therapeutic options for managing MDR A. baumannii[22,23]. A long-term surveillance study from India further confirmed increasing resistance trends over five years in trauma settings[24]. These findings emphasize the urgent need for localized antibiotic guidelines, routine susceptibility testing, and strict infection control measures.

The lack of seasonal correlation in our study may indicate that environmental factors such as temperature and humidity are less impactful in indoor hospital settings, where controlled air systems and cleaning protocols dominate. Instead, factors like hand hygiene, surface disinfection, and equipment sterilization likely play a more critical role in limiting or enabling A. baumannii transmission.

CONCLUSION

This study highlights Acinetobacter baumannii as a persistent and drug-resistant pathogen in burn wound infections, with a 12.21% incidence over a two-year period in a tertiary care burns hospital. Unlike trends reported in other geographical regions, no seasonal variation in its incidence was detected. The organism exhibited extensive multidrug resistance, leaving colistin and tigecycline as the only reliably effective agents.

These findings emphasize the critical need for Year-round infection control protocols. Routine culture and sensitivity testing. Judicious antibiotic use, especially in ICU and burn units. Ongoing surveillance to monitor evolving resistance trends

Future studies with larger multicenter datasets and molecular resistance profiling are recommended to better understand transmission dynamics and guide empirical therapy.

REFERENCES

1. Wong, D., et al., Clinical and pathophysiological overview of Acinetobacter infections: a century of challenges. 2017. 30(1): p. 409-447.
2. Harding, C.M., S.W. Hennon, and M.F.J.N.R.M. Feldman, Uncovering the mechanisms of Acinetobacter baumannii virulence. 2018. 16(2): p. 91-102.
3. Lee, C.-R., et al., Biology of Acinetobacter baumannii: pathogenesis, antibiotic resistance mechanisms, and prospective treatment options. 2017. 7: p. 55.
4. Kyriakidis, I., et al., Acinetobacter baumannii antibiotic resistance mechanisms. 2021. 10(3): p. 373.
5. Vázquez-López, R., et al., Acinetobacter baumannii resistance: a real challenge for clinicians. 2020. 9(4): p. 205.
6. Kritsotakis, E., A.J.C.M. Groves-Kozhageldiyeva, and Infection, A systematic review of the global seasonality of infections caused by Acinetobacter species in hospitalized patients. 2020. 26(5): p. 553-562.
7. Kim YoungAh, K.Y., et al., Seasonal and temperature-associated increase in community-onset Acinetobacter baumannii complex colonization or infection. 2018.
8. Da Silveira, M., et al., Weather, climate control, and imipenem-resistance in Acinetobacter baumannii: an ecological approach. 2018. 39(9): p. 1133-1135.
9. Asif, M., et al., Insight into Acinetobacter baumannii: pathogenesis, global resistance, mechanisms of resistance, treatment options, and alternative modalities. 2018: p. 1249-1260.
10. Khalid, F., S. Saleem, and I.J.J.P.M.A. Ahmad, High prevalence of carbapenem-resistant Acinetobacter baumannii associated respiratory tract infections in Pakistani hospitals. 2020.
11. Ul Ain, Q., et al., Prevalence and resistance profile of clinical isolates of Acinetobacter species from Karachi, Pakistan. 2019. 10(1): p. 6-13.
12. Waseem, H., et al., Antimicrobial Resistance Mechanisms in Acinetobacter baumannii in Recent Decade. 2021. 6: p. 179-186.
13. Ali, A., T.A. Khan, and S.J.I.R.J.E.T. Ahmad, Analysis of climate data of Khyber Pakhtunkhwa, Pakistan. 2018. 5(5): p. 4266-4282.
14. Filho, S.P.F., et al., Seasonality and weather dependance of Acinetobacter baumannii complex bloodstream infections in different climates in Brazil. 2021. 16(8): p. e0255593.
15. Kim, Y.A., et al., Seasonal and Temperature-Associated Increase in Community-Onset Acinetobacter baumannii Complex Colonization or Infection. 2018. 38(3): p. 266-270.
16. Gupta, V., et al., Trends in resistant Enterobacteriaceae and Acinetobacter species in hospitalized patients in the United States: 2013–2017. 2019. 19(1): p. 742.
17. Teerawattanapong, N., et al., A systematic review of the burden of multidrug-resistant healthcare-associated infections among intensive care unit patients in Southeast Asia: the rise of multidrug-resistant Acinetobacter baumannii. 2018. 39(5): p. 525-533.
18. Soedjana, H., et al., The profile of severe burn injury patients with sepsis in hasan sadikin bandung general hospital. 2020. 33(4): p. 312.
19. Banerjee, T., et al., High prevalence and endemicity of multidrug resistant Acinetobacter spp. in intensive care unit of a tertiary care hospital, Varanasi, India. 2018. 2018(1): p. 9129083.
20. Moghadam, R.H., et al., The frequency of multidrug-resistance and extensively drug-resistant Acinetobacter baumannii in west of Iran. 2018. 6(2): p. 112-9.
21. Ibrahim, M.E.J.A.o.c.m. and antimicrobials, Prevalence of Acinetobacter baumannii in Saudi Arabia: risk factors, antimicrobial resistance patterns and mechanisms of carbapenem resistance. 2019. 18(1): p. 1.
22. Sannathimmappa, M.B., et al., Antibiotic resistance pattern of Acinetobacter baumannii strains: a retrospective study from Oman. 2021. 9(3): p. 254-260.
23. Sedaghat, A., et al., Antibacterial resistance pattern of Acinetobacter baumannii in burn patients in Northeast of Iran. 2019. 12(10): p. 1-8.
24. Kumari, M., et al., A 5-year surveillance on antimicrobial resistance of Acinetobacter isolates at a level-I trauma centre of India. 2019. 11(01): p. 034-038.