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FREQUENCY OF MRSA BACTEREMIA IN CANCER PATIENTS

Original Research

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ABSTRACT

Background: Methicillin-resistant *Staphylococcus aureus* (MRSA) is a major pathogen responsible for bloodstream infections, particularly in immunocompromised individuals such as cancer patients. Due to their immunosuppressive therapies, prolonged hospital exposures, and frequent invasive procedures, oncology patients remain highly vulnerable to MRSA bacteremia. Early identification and management of these infections are essential to reducing morbidity, hospital stay, and overall mortality. In Pakistan, data on MRSA prevalence in the cancer population remain limited, necessitating localized research.

Objective: To assess the frequency of Methicillin-resistant *Staphylococcus aureus* (MRSA) infections primarily in the bloodstream of cancer patients in a tertiary care setting in Pakistan.

Methods: This cross-sectional study was conducted in the Department of Medicine, Shaukat Khanum Memorial Cancer Hospital, Lahore, from July 12, 2024, to January 12, 2025. A total of 115 cancer patients aged 19 to 60 years were enrolled through consecutive non-probability sampling from the outpatient department. Inclusion criteria included diagnosed cancer patients not currently on antibiotics or with other known bacterial infections. Blood samples were aseptically collected and cultured to identify MRSA. Data were recorded using a structured proforma and analyzed in SPSS version 25.0. Descriptive statistics were calculated, and MRSA prevalence was determined.

Results: The mean age of participants was 41.27 ± 11.34 years, with 65 (56.5%) males and 50 (43.5%) females. Among the participants, MRSA was confirmed in 60 (52.2%) patients. Cancer types included blood (13.9%), liver (15.6%), head and neck (18.3%), brain (11.3%), colon (13.0%), pancreatic (11.3%), and other cancers (16.5%). Regarding treatment, 42 (36.5%) were receiving chemotherapy, 44 (38.3%) radiotherapy, and 29 (25.2%) both modalities.

Conclusion: The study identified a notably high prevalence of MRSA bacteremia in cancer patients, emphasizing the urgent need for early detection, preventive strategies, and timely initiation of targeted antibiotic therapy to reduce complications and disease progression.

Keywords: Bacteremia, Cancer Patients, Chemotherapy, Methicillin-Resistant Staphylococcus aureus, Oncology, Pakistan, Radiotherapy.

INTRODUCTION

Cancer remains a leading cause of morbidity and mortality globally, yet significant advancements in oncological treatment over the past two decades have contributed to improved disease-free and overall survival rates. These improvements are largely attributed to the widespread use of chemotherapy, radiotherapy, and surgical interventions, either as standalone treatments or in combination (1,2). However, these life-saving therapies often compromise the immune system, rendering patients highly susceptible to healthcare-associated infections (HAIs), which in turn escalate treatment complications, prolong hospital stays, and increase both mortality and healthcare costs (3). Among the most serious complications observed in cancer patients are bloodstream infections, which contribute substantially to the overall disease burden (4,5). Notably, gram-positive bacteria have emerged as the predominant pathogens responsible for invasive infections in this vulnerable population. Despite the diversity of potential microbial agents, staphylococci, streptococci, and enterococci have been identified as the three most clinically significant gram-positive organisms implicated in these infections (6,7). Changes in the epidemiology of these infections—driven by factors such as antimicrobial resistance, frequent hospital exposure, and alterations in the patient microbiome due to aggressive therapies—underscore the need for renewed surveillance and targeted intervention strategies (8,9).

The emergence of multidrug-resistant organisms, particularly Methicillin-resistant *Staphylococcus aureus* (MRSA), further complicates clinical management. MRSA infections are not only challenging to treat but are also associated with a higher incidence of comorbidities and consistently poorer outcomes in cancer patients (10). Despite these concerning trends, limited data exist regarding the incidence and clinical impact of MRSA infections within specific regional or community-based cancer populations. The lack of localized epidemiological insights hampers clinicians' ability to proactively identify high-risk patients and implement context-specific infection control measures (11,12). Given this gap in the literature, the present study aims to investigate the prevalence, clinical course, risk factors, and 30-day mortality associated with MRSA infections among cancer patients treated at a regional cancer research center. By contextualizing MRSA-related bacteremia within the local population, this research intends to inform evidence-based clinical practices and optimize infection prevention strategies, thereby ultimately improving patient outcomes.

METHODS

This cross-sectional study was conducted over a period of six months, from July 12, 2024, to January 12, 2025, at the Department of Medicine, Shaukat Khanum Memorial Cancer Hospital and Research Centre, Lahore. The study aimed to determine the frequency and clinical relevance of Methicillin-resistant *Staphylococcus aureus* (MRSA) bacteremia in cancer patients. A sample size of 115 participants was calculated using the WHO sample size calculator, based on a 95% confidence level, 5% margin of error, and an estimated MRSA prevalence of 8% among cancer patients (10). A non-probability consecutive sampling technique was employed for the recruitment of eligible participants. Patients were enrolled through the outpatient department (OPD) after obtaining written informed consent. Ethical approval for the study was obtained from the Institutional Review Board of the hospital. Inclusion criteria consisted of cancer patients aged between 8 and 60 years, of either gender. Patients were excluded if they had a known concurrent bacterial infection or were already receiving antibiotic therapy, as recorded in their medical history.

Sociodemographic and clinical data were systematically collected using a structured proforma. This included information such as name, age, gender, body mass index (BMI), type and duration of cancer, current oncological treatment, comorbidities including diabetes and hypertension, history of recent hospital admissions, residential background, and socioeconomic status. Blood samples were obtained aseptically from all participants for microbiological evaluation. MRSA bacteremia was confirmed through culture testing, and a diagnosis was established if Methicillin-resistant *Staphylococcus aureus* was detected at a concentration exceeding 10^5 organisms per high-power field (HPF). All data were entered and analyzed using SPSS version 25.0. Descriptive statistics were used to assess the frequency and percentage of MRSA-positive cases within the study population.

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RESULTS

A total of 115 patients diagnosed with various types of cancer were enrolled in the study, with a mean age of 41.27 ± 11.34 years, ranging from 19 to 60 years. Among them, 65 (56.5%) were male and 50 (43.5%) were female. The average body mass index (BMI) was 25.18 ± 5.59 kg/m². The mean duration of cancer diagnosis was 14.50 ± 6.06 months. The cohort included 16 (13.9%) patients with blood cancer, 18 (15.7%) with liver cancer, 21 (18.3%) with head and neck cancer, 13 (11.3%) with malignant brain tumors, 15 (13.0%) with colon cancer, 13 (11.3%) with pancreatic cancer, and 19 (16.5%) with other types of cancer. Regarding ongoing oncological treatment, 42 (36.5%) patients were receiving chemotherapy, 44 (38.3%) were undergoing radiotherapy, and 29 (25.2%) were receiving both modalities. A history of diabetes mellitus was observed in 52 (45.2%) patients, while hypertension was present in 59 (51.3%). Additionally, 52 (45.2%) had a prior history of hospital admission. With respect to residential background, 39 (33.9%) patients were from rural areas, 36 (31.3%) from urban regions, and 40 (34.8%) from semi-urban locations. Socioeconomic status distribution showed that 34 (29.6%) belonged to the low-income group, 44 (38.3%) to the middle-income group, and 37 (32.2%) to the high-income group.

MRSA was detected in 60 out of 115 patients, yielding an overall prevalence of 52.2%. Stratified analysis by age groups revealed MRSA positivity in 15 (68.2%) patients aged 19–30 years, 22 (44.9%) patients aged 31–45 years, and 23 (52.3%) patients aged 46–60 years ($p > 0.05$). Among male patients, 33 (50.8%) tested positive for MRSA, while among female patients, 27 (54%) were MRSA positive ($p > 0.05$). Regarding BMI, MRSA was found in 9 (52.9%) underweight patients, 18 (47.4%) patients with normal BMI, 20 (60.6%) overweight individuals, and 13 (48.1%) obese individuals ($p > 0.05$). MRSA was observed in 7 (70%) patients with cancer duration less than 6 months, 11 (56.4%) with cancer duration of 7–12 months, and 31 (47%) with cancer duration greater than 12 months ($p > 0.05$), indicating no statistically significant relationship between cancer duration and MRSA occurrence. The distribution of MRSA by cancer type showed positivity in 9 (56.3%) with blood cancer, 9 (50%) with liver cancer, 8 (38.1%) with head and neck cancer, 8 (61.5%) with malignant brain tumors, 8 (53.3%) with colon cancer, 5 (38.5%) with pancreatic cancer, and 13 (68.4%) with other cancers ($p > 0.05$), suggesting no significant association with cancer subtype. MRSA positivity was recorded in 25 (59.5%) patients receiving chemotherapy, 26 (59.1%) receiving radiotherapy, and 9 (31%) receiving both types of treatments. This distribution showed a statistically significant difference ($p < 0.05$), indicating a potential protective effect of combined therapy against MRSA infection. Among diabetic patients, 29 (55.8%) were MRSA positive compared to 31 (49.2%) non-diabetics ($p > 0.05$). Similarly, MRSA was found in 35 (59.3%) hypertensive patients versus 25 (48.1%) non-hypertensive ones ($p > 0.05$). Of those with prior hospital admissions, 25 (48.1%) tested positive, while among those without, 35 (55.6%) were positive ($p > 0.05$). In terms of residence, MRSA was detected in 23 (59%) rural residents, 16 (44.4%) urban residents, and 21 (52.5%) semi-urban residents ($p > 0.05$).

Table 1: Basic information of enrolled patients (n = 115)

	Mean ± SD, F (%)
Age (years)	41.27 ± 11.34
Gender	
Male	65 (56.5%)
Female	50 (43.5%)
BMI (kg/m^2)	25.18 ± 5.59
Diabetes mellitus	52 (45.2%)
Hypertension	59 (51.3%)
Residence	
Rural	39 (33.9%
Urban	36 (31.3%)
Semi-urban	40 (34.8%)
Socioeconomic status	
Low	34 (29.6%)
Middle	44 (38.3%)
High	37 (32.2%)
Duration of cancer (months)	14.50 ± 6.06
Type of cancer	

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	Mean ± SD, F (%)
Blood cancer	16 (13.9%)
Liver cancer	18 (15.7%)
Head and neck cancer	21 (18.3%)
Malignant brain tumors	13 (11.3%)
Colon cancer	15 (13.0%)
Pancreatic cancer	13 (11.3%)
Other type of cancer	19 (16.5%)
Treatment taking	
Chemotherapy	42 (36.5%)
Radiotherapy	44 (38.3%)
Combination of both	29 (25.2%)
History of hospital admission	52 (45.2%)

Table 2: Comparison of MRSA with effect modifiers

		MRSA		p-value
		Present (n = 60)	Absent (n = 55)	
Age (years)	19-30	15 (68.2%)	7 (31.8%)	0.192
	31-45	22 (44.9%)	27 (55.1%)	
	46-60	23 (52.3%)	21 (47.7%)	
Gender	Male	33 (50.8%)	32 (49.2%)	0.731
	Female	27 (54%)	23 (46%)	
BMI	Underweight	9 (52.9%)	8 (47.1%)	0.689
	Normal BMI	18 (47.4%)	20 (52.6%)	
	Overweight	20 (60.6%)	13 (39.4%)	
	Obese	13 (48.1%)	14 (51.9%)	
Diabetes	Yes	29 (55.8%)	23 (44.2%)	0.483
	No	31 (49.2%)	32 (50.8%)	
Hypertension	Yes	35 (59.3%)	24 (40.7%)	0.115
	No	35 (44.6%)	28 (55.4%)	
Hospital admission	Yes	25 (48.1%)	27 (51.9%)	0.424
	No	35 (55.6%)	28 (44.4%)	
Residence	Rural	23 (59%)	16 (41%)	0.452
	Urban	16 (44.4%)	20 (55.6%)	
	Semi-urban	21 (52.5%)	19 (47.5%)	
Duration (months)	<6 months	7 (70%)	3 (30%)	0.321
	7-12 months	22 (56.4%)	17 (43.6%)	
	>12 months	31 (47%)	35 (53%)	

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		MRSA		p-value
		Present (n = 60)	**Absent (n = 55)**	
Type of cancer	Blood cancer	9 (56.3%)	7 (43.8%)	0.511
	Liver cancer	9 (50%)	9 (50%)	
	Head and neck cancer	8 (38.1%)	13 (61.9%)	
	Malignant brain tumor	8 (61.5%)	5 (38.5%)	
	Colon cancer	8 (53.3%)	7 (46.7%)	
	Pancreatic cancer	5 (38.5%)	8 (61.5%)	
	Others	13 (68.4%)	6 (31.6%)	
Treatment	Chemotherapy	25 (59.5%)	17 (40.5%)	0.031

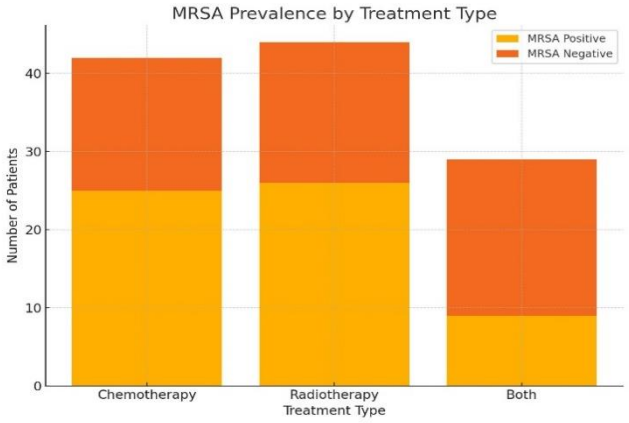

Figure 1 MRSA Prevalence by Treatment Type

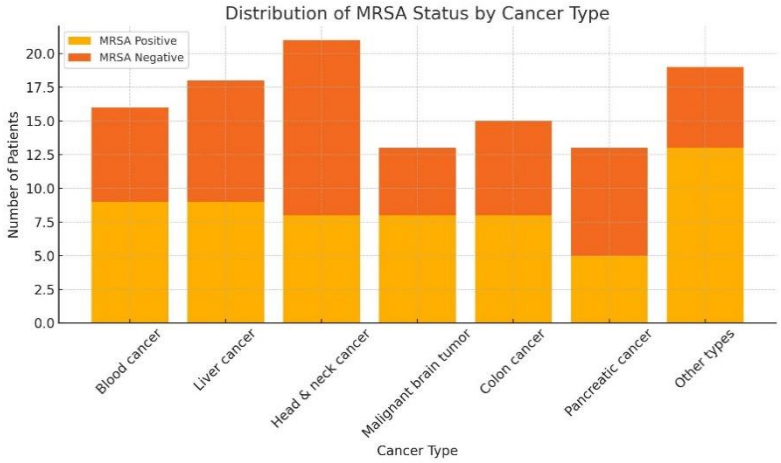

Figure 2 Distribution of MRSA Status by Cancer Type

DISCUSSION

The present study observed a notably high prevalence of MRSA bacteremia among cancer patients, with 52.2% of individuals testing positive. This prevalence aligns with findings from certain regions but remains lower than others. Studies conducted in Egypt and Iran have reported MRSA frequencies as high as 70% and 76.3%, respectively, while findings from Libya (35.5%), France (44.4%), and Kerman, Iran (28%) showed comparatively lower rates (13-15). The variability in prevalence may reflect differences in regional infection control practices, antibiotic stewardship programs, healthcare infrastructure, and microbial resistance patterns. Notably, the MRSA prevalence in this study exceeds pooled regional estimates reported in larger meta-analyses, such as 3% among all bloodstream infections globally, and 0–8% in specific regions, including the Eastern Mediterranean and South-East Asia (16). The susceptibility of cancer patients to MRSA infections has been widely acknowledged due to their frequent exposure to immunosuppressive therapies, prolonged hospital stays, invasive procedures, and broad-spectrum antibiotics. These factors contribute to the breakdown of host immune defenses and disruption of microbial balance, resulting in heightened vulnerability to bloodstream infections. Although recent trends suggest a shift from Gram-positive to Gram-negative organisms in oncologic infections (17,18), *Staphylococcus aureus* continues to be

a dominant pathogen, particularly in skin, soft tissue, and bloodstream infections due to its colonization capacity and increasing resistance to commonly used antibiotics.

The present study identified no significant association between MRSA occurrence and demographic variables such as age, gender, BMI, or duration of cancer. These findings are consistent with prior literature that also reported no significant demographic predictors for MRSA positivity among cancer patients (19). Interestingly, MRSA prevalence was substantially lower in patients receiving both chemotherapy and radiotherapy compared to those receiving either treatment alone, indicating a statistically significant inverse relationship. While this finding could suggest a potential protective effect of combined treatment protocols, it may also reflect unmeasured clinical factors such as better supportive care or earlier-stage disease in this subgroup. Further controlled investigations are required to explore these possibilities (20,21). The lack of association between MRSA prevalence and comorbidities such as diabetes and hypertension, as well as residential or socioeconomic status, suggests that infection risk may be more directly influenced by healthcare-related exposures rather than patient-level demographic factors. Prior hospitalization, often a significant risk factor for healthcare-associated infections, also did not significantly correlate with MRSA incidence in this cohort. However, this may be attributed to the relatively high proportion of outpatient-based recruitment, which could have diluted the observable impact of inpatient exposures.

Emerging evidence highlights the growing challenge of antibiotic resistance among *Staphylococcus aureus* strains isolated from cancer patients. Recent analyses have shown that prior antibiotic exposure significantly increases the risk of harboring multidrug-resistant strains, particularly in immunocompromised individuals (22). Although this study did not stratify MRSA prevalence by prior antibiotic use, the literature suggests that prior antimicrobial exposure within six months may double the risk of resistance development. This underscores the critical importance of implementing robust antimicrobial stewardship policies in oncology care. Despite global improvements in hospital-based infection control measures, including enhanced hand hygiene, barrier precautions, and antibiotic policies, MRSA remains a persistent threat in the oncology setting. While the incidence of hospital-acquired MRSA infections has declined in the general population, such reductions have not been uniformly reflected among cancer patients. This discrepancy likely arises from continued use of immunosuppressive agents, frequent invasive interventions, and ongoing exposure to hospital environments. Moreover, community-associated MRSA has become increasingly prevalent, particularly in densely populated areas, and lacks the defined prevention protocols that are effective in nosocomial settings (23,24).

This study's strengths lie in its focused assessment of MRSA prevalence in a well-defined oncology population, with stratified analyses across relevant clinical and demographic variables. However, several limitations merit consideration. The study was cross-sectional in nature, limiting its ability to establish causal relationships. Data were collected from a single tertiary center, which may reduce generalizability. Additionally, the absence of molecular typing of MRSA strains and lack of information on antibiotic susceptibility profiles limit insights into resistance patterns. Importantly, key clinical outcomes such as the 30-day mortality rate and the clinical course of MRSA bacteremia were not assessed, despite being included in the original objective. Their omission represents a critical gap in evaluating the full burden and prognostic significance of MRSA in this population. Future studies should include longitudinal designs with extended follow-up to assess clinical outcomes, incorporate molecular epidemiology to track strain variation, and analyze the impact of prior antibiotic exposure. Investigations into targeted prevention strategies for community-associated MRSA in oncology patients also remain a pressing need, particularly in regions where healthcare resources are constrained.

CONCLUSION

The findings of this study highlight a notably high occurrence of MRSA infections among cancer patients in the local population, particularly those already undergoing treatment. This underscores the critical need for vigilant monitoring, timely diagnosis, and tailored infection control strategies in oncology care settings. Recognizing MRSA as a prevalent and significant risk factor will enable healthcare providers to refine patient management protocols, enhance infection prevention measures, and ultimately improve clinical outcomes. The study reinforces the importance of integrating infection risk assessment into routine cancer care to safeguard this immunocompromised population.

AUTHOR CONTRIBUTION

Author	Contribution
Mouzma Komal*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Haroon Hafeez	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Saba Naeem	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Summiya Nizamuddin	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Usman Shabbir	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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