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Original Research Article

Culture and sensitivity in cancer patients presenting with sepsis

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Abstract

Introduction: Cancer therapies such as chemotherapy, radiotherapy, and immunotherapy improve outcomes but also suppress immune function, increasing susceptibility to infections. Sepsis remains a critical complication, especially in patients with high Tumor burden or Tumor lysis syndrome (TLS). Timely identification of pathogens and antimicrobial resistance is essential for effective management.

Aims and Objectives: This study aimed to identify the most common pathogens responsible for sepsis in cancer patients, determine the primary sites of infection, and evaluate the antibiotic resistance patterns of isolated organisms. Additionally, it sought to analyse the correlation between the type of organism (Gram-positive vs. Gram-negative) and clinical outcomes such as ICU admission and mortality, and to assess variations in causative organisms following chemotherapy or radiotherapy.

Materials and Methods: This retrospective observational study was conducted between January 2022 and April 2024 at the Departments of Radiation Oncology and Microbiology, Swami Rama Himalayan University. Cancer patients (18–75 years) who presented with sepsis and had positive cultures from blood, urine, chemo ports, ET secretions, or pus were included. Demographic data, culture results, antibiotic sensitivity, and treatment history were collected and analysed.

Results: Out of 112 cancer patients, the mean age was 61.3 years (range: 14–87), with a male-to-female ratio of 1.67:1. Chemotherapy had been administered to 36.6% of patients and radiotherapy to 16.1%, with sepsis typically occurring within weeks of treatment. Positive cultures were found in 34.8% of cases, most frequently from urine and blood. *E. coli* was the most common organism, followed by *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. Gram-negative bacteria predominated and showed resistance to fluoroquinolone and beta-lactams but retained sensitivity to colistin and carbapenems. The average hospital stay was 6.8 days, with longer durations observed in bloodstream infections and multi drug-resistant cases.

Conclusion: Gram-negative organisms predominate in cancer-related sepsis. Regular surveillance of pathogen profiles and resistance trends is critical to guiding empirical treatment and improving outcomes.

Keywords: Cancer, Sepsis, Antibiotic resistance, Culture and Sensitivity, Bacteraemia, Chemotherapy, Retrospective study.

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1. Introduction

The management of cancer has witnessed remarkable progress with the integration of multidisciplinary treatment modalities. Chemotherapy, immunotherapy, radiotherapy, and surgical resection form the cornerstone of modern oncologic care.[1] However, while these modalities aim to reduce Tumor burden and prolong survival, they concurrently induce varying degrees of immunosuppression, rendering patients highly susceptible to infections.[2]

Chemotherapy and radiotherapy, for instance, suppress haematopoiesis and disrupt mucosal barriers, which are key components of innate immunity. Immunotherapy, while revolutionizing cancer treatment by enhancing host immune responses against tumors, can paradoxically result in immune-related adverse events and dysregulated inflammation.[3] Surgical procedures, particularly in immunocompromised patients, further heighten the risk of postoperative infections and sepsis.[4]

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Sepsis in cancer patients is thus a frequent and critical complication.[5] It may arise from endogenous flora, hospital-acquired pathogens, or opportunistic infections, often involving multi-drug-resistant organisms.[6] The diagnosis can be challenging due to overlapping symptoms with cancer-related symptoms or treatment side effects.

In patients with aggressive malignancies such as high-grade lymphomas, leukaemia, or bulky tumors, the phenomenon of Tumor lysis syndrome (TLS) further complicates the clinical picture.[7] TLS occurs when a large number of Tumor cells lyse spontaneously or in response to therapy, releasing potassium, phosphate, and nucleic acids into the bloodstream. This can lead to acute renal failure, metabolic acidosis, and systemic inflammation — setting the stage for systemic infections and sepsis.[8]

Given the complexity and vulnerability of this patient cohort, timely identification of the source and type of infection is paramount. Culture and sensitivity testing not only confirms the causative organism but also provides critical insights into antibiotic susceptibility, guiding effective empiric and targeted antimicrobial therapy.[9]

This study aims to investigate the culture and sensitivity profiles of pathogens isolated from cancer patients presenting with sepsis. It seeks to understand the prevailing microbial patterns, resistance trends, and correlations with treatment histories, thereby aiding clinicians in optimizing sepsis management protocols within oncology settings.

2. Aims and Objectives

1. To identify common pathogens causing sepsis in cancer patients.
2. To determine primary sites of infection.
3. To assess antibiotic resistance patterns.
4. To correlate organism type (Gram-positive vs. Gram-negative) with ICU admission and mortality.
5. To evaluate differences in pathogens post-chemotherapy or radiotherapy.

3. Materials and Methods

3.1. Study design and setting

A retrospective observational study was performed at Swami Rama Himalayan University from January 2022 to April 2024.

3.2. Inclusion criteria

1. Age 18–75 years
2. Histologically confirmed malignancy
3. Clinical presentation of sepsis or fever
4. Culture and sensitivity data from blood, urine, chemo port, ET secretions, or pus

3.3. Exclusion criteria

1. Incomplete records
2. Empirical antibiotics given before sample collection

3.4. Data collected

1. Demographics: Age, sex, cancer diagnosis
2. Treatment history: chemotherapy/radiotherapy
3. Site and organism from positive cultures
4. Antibiotic sensitivity and resistance

4. Result

*4.1. Patient demographics (**Figure 1** and **3**)*

A total of 112 cancer patients who presented with clinical signs of sepsis were included in the study. The mean age of the population was 61.3 years, with an age range of 14 to 87 years. The majority of patients (42; 37.5%) belonged to the 60–69 year age group, followed by 23 patients (20.5%) who were aged 70 years or older. The distribution across other age groups was as follows: 50–59 years (20 patients), 40–49 years (12 patients), 30–39 years (8 patients), 20–29 years (5 patients), and under 20 years (2 patients).

In terms of gender distribution, 70 patients (62.5%) were male, and 42 patients (37.5%) were female, resulting in a male-to-female ratio of 1.67:1.

*4.2. Treatment history (**Figure 4**)*

Out of the total cohort, 41 patients (36.6%) had received chemotherapy prior to the onset of sepsis, while 18 patients (16.1%) had received radiotherapy. Among these, 31 patients had received only chemotherapy, 8 had received only radiotherapy, and 10 had received both treatments. The remaining 63 patients (56.3%) had not received either chemotherapy or radiotherapy during the period leading up to sepsis presentation.

The interval between the last treatment and onset of sepsis ranged from a few days to several weeks, though the majority developed sepsis within two weeks of receiving chemotherapy.

*4.3. Culture positivity and site of infection (**Figure 5** and **6**)*

Of the 112 patients evaluated, 39 patients (34.8%) had positive microbiological cultures. The most common sites from which pathogens were isolated included urine (16 patients; 41% of culture-positive cases), followed by blood (13 patients; 33%), endotracheal secretions (7 patients; 17%), and other sterile body fluids such as pus, pleural, or ascitic fluid (3 patients; 9%).

These findings highlight the urinary tract and bloodstream as the predominant sources of infection in septic cancer patients.

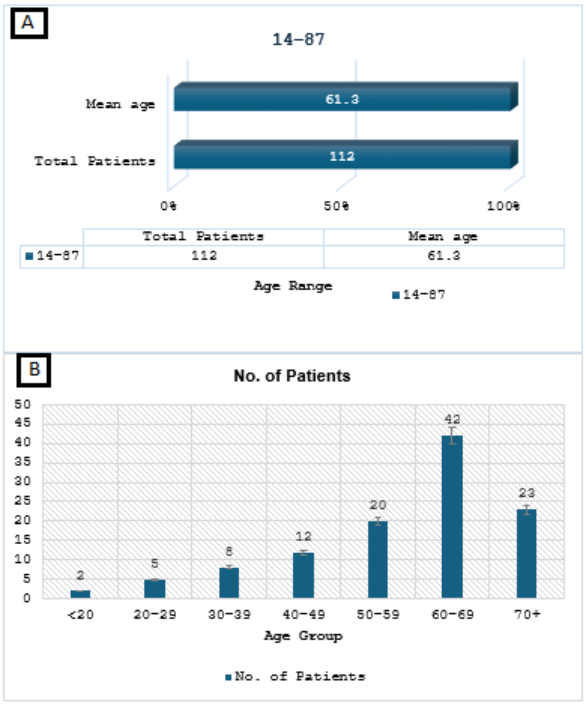

Figure 1: A-B: Age distribution of population (n=112)

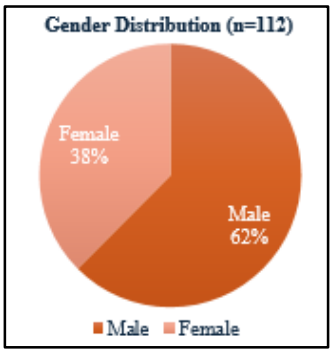

Figure 2: Gender distribution (n=112)

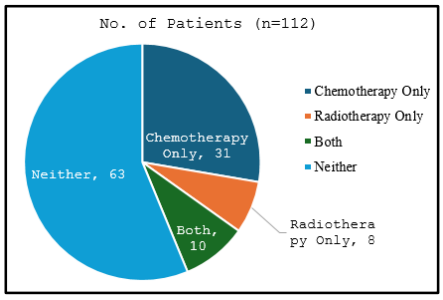

Figure 3: Treatment received (n=112)

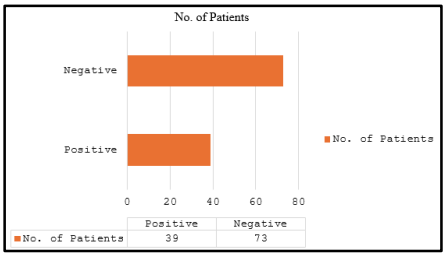

Figure 4: Culture sensitivity (n=112)

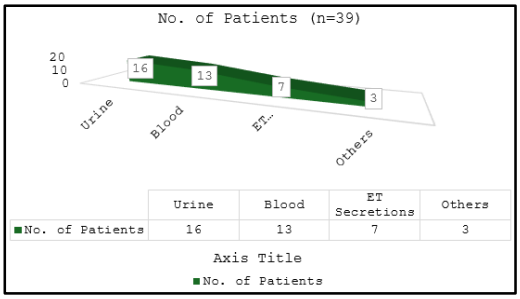

Figure 5: Culture site (n=39)

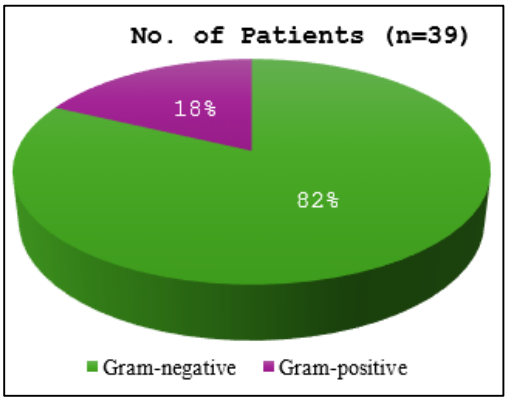

Figure 6: Organism type (n=39)

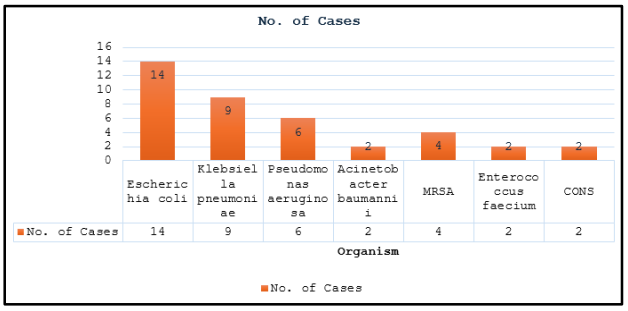

Figure 7: Individual Organism (n=39)

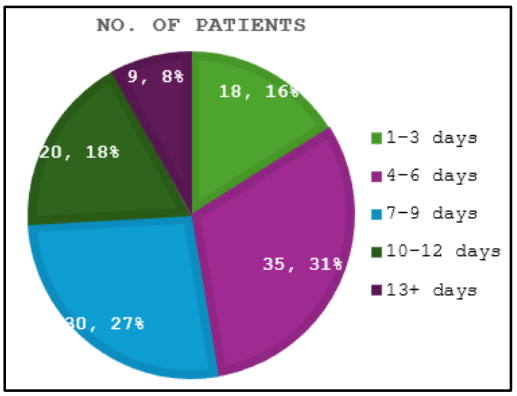

Figure 8: Number of hospital stays in days

*4.4. Microbiological spectrum (**Figure 7** and **8**)*

Among the 39 culture-positive patients, Gram-negative organisms were predominant, accounting for 32 cases (81%), while Gram-positive organisms were isolated in 7 cases (19%).

The most frequently isolated pathogen was *Escherichia coli*, identified in 14 patients (35.9%), followed by *Klebsiella pneumoniae* in 9 patients (23.1%) and *Pseudomonas aeruginosa* in 6 patients (15.4%). Other Gram-negative isolates included *Acinetobacter baumannii* in 2 cases.

Among Gram-positive organisms, methicillin-resistant *Staphylococcus aureus* (MRSA) was isolated in 4 patients, while *Enterococcus faecium* and coagulase-negative *Staphylococcus* (CONS) were each identified in 2 cases.

These results demonstrate a marked predominance of multi drug-resistant Gram-negative bacilli in this patient population.

4.5. Antibiotic sensitivity and resistance trends

Antibiotic resistance was a notable concern in this cohort. *E. coli* isolates frequently exhibited resistance to ciprofloxacin, cotrimoxazole, and third-generation cephalosporins like ceftriaxone. However, they remained sensitive to colistin, amikacin, and carbapenems such as imipenem and meropenem.

Klebsiella pneumoniae also demonstrated broad-spectrum resistance, particularly to cephalosporins and amino glycosides, while retaining sensitivity to colistin and imipenem. *Pseudomonas aeruginosa* isolates showed variable resistance profiles but were responsive to ceftazidime, cefepime, and amikacin.

Among Gram-positive isolates, MRSA was uniformly sensitive to vancomycin, linezolid, and tetracycline. *Enterococcus faecium* isolates showed reliable sensitivity to linezolid and Fosfomycin.

*4.6. Hospital stay duration (**Figure 8**)*

All 112 patients were evaluated for hospitalisation duration. Eighteen patients (16.1%) had brief hospital stays of 1–3 days, while 35 patients (31.3%) stayed for 4–6 days. Thirty patients (26.8%) remained hospitalised for 7–9 days, 20 patients (17.9%) for 10–12 days, and 9 patients (8%) were admitted for more than 13 days.

Prolonged hospitalisation was frequently associated with bloodstream infections and infections caused by multi drug-resistant organisms, particularly *Pseudomonas aeruginosa*, MRSA, and polymicrobial infections. Patients requiring intensive care unit (ICU) admission tended to fall within the higher range of hospital stay durations.

5. Discussion

Sepsis in cancer patients remains a significant cause of morbidity and mortality, particularly among those undergoing chemotherapy and radiotherapy.[10] In our retrospective study, we evaluated the microbiological spectrum and antibiotic sensitivity patterns in cancer patients presenting with sepsis at a tertiary care oncology centre. Our findings support the increasing dominance of Gram-negative organisms and growing antimicrobial resistance, echoing global concerns reported in recent literature.

In our cohort, Gram-negative organisms accounted for 81% of culture-positive infections, with *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa* being the most prevalent. This aligns with findings from studies Trecarichi et al. (2011), both of which identified a similar predominance of Gram-negative infections among cancer patients, especially those with haematological malignancies and neutropenia.[11] Our data, while focused more on solid Tumor patients, similarly highlight the heightened risk posed by urinary tract and bloodstream infections caused by these pathogens.

The high prevalence of *E. coli* as a urinary pathogen also reflects patterns seen in general and oncology-specific populations. Our resistance patterns—marked by high levels of fluoroquinolone and cephalosporin resistance—parallel reports from Indian tertiary hospitals, including studies by Shariati et al which highlighted *E. coli* resistance to ciprofloxacin in more than 60% of isolates.[12]

Klebsiella pneumoniae, the second most common organism in our study, exhibited multidrug resistance, with sensitivity largely restricted to colistin and carbapenems. This is concerning and consistent with surveillance data from the Indian Council of Medical Research (ICMR), which reported widespread resistance in *Klebsiella* isolates from ICUs.[13,14]

MRSA and *Enterococcus faecium*, though less frequent, were clinically significant, particularly in bloodstream infections. MRSA sensitivity to vancomycin and linezolid remained intact in our study, similar to reports by Blot et al. (2003), indicating that glycopeptides and oxazolidinones remain viable empiric options in Gram-positive sepsis in oncology setting.[9]

6.1. Treatment implications

Our findings stress the importance of targeted empiric antibiotic therapy in febrile cancer patients. Given the high prevalence of resistant *Enterobacteriaceae* and *Pseudomonas*, empirical regimens should ideally include carbapenems or beta-lactam–beta-lactamase inhibitor combinations, with escalation to colistin or amikacin in suspected resistant infections. For Gram-positive coverage, vancomycin or linezolid may be considered, especially in central line–associated infections.

Moreover, our study underlines the need for regular review and updating of institutional antibiotic policies based on local resistance trends. Early de-escalation based on culture results is crucial to prevent further antimicrobial resistance and adverse drug effects.

6.2. Association with treatment modalities

Patients who had recently received chemotherapy, particularly within two weeks of sepsis onset, were at higher risk for infection. Myelosuppression and mucosal damage from cytotoxic agents likely contribute to this increased susceptibility. Furthermore, we observed Tumor lysis syndrome (TLS)–like presentations in a few patients with aggressive histologies such as small cell tumours, neuroendocrine tumours, mirroring previous reports by mirakhimmov, who outlined the infectious complications associated with TLS in hematologic malignancies.[15]

Interestingly, radiotherapy-associated sepsis was less clearly defined in our dataset, likely due to under-documentation. However, prior studies suggest that mucositis, local tissue damage, and immunosuppression related to high-dose radiotherapy can also predispose to infection.

6. Conclusion

Cancer patients presenting with sepsis are most commonly infected with Gram-negative organisms, especially *E. coli* and *Klebsiella pneumoniae*. Resistance to standard antibiotics is high, making culture-based guidance essential. Improved infection control, regular sensitivity audits, and antimicrobial stewardship are necessary to improve outcomes.

7. Source of Funding

None.

8. Conflict of Interest

None.

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