



(RESEARCH ARTICLE)



Pattern of bacterial infections in cancer patients: Experience from a Tertiary Cancer Center

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Abstract

Introduction: Though with the invent of better diagnostic and therapeutic modalities the mortality rates due to cancer have fallen over the past years, but infection remains a primary or associated cause of death, with bacteria most commonly agent.

Objectives: This study was undertaken to monitor the types of pathogens commonly found in cancer patients undergoing anticancer treatment and their antibiotic resistance patterns.

Materials and methods: Total 100 patients, who were admitted for chemotherapy in department from 1 may 2021 to 31st July 2021 were enrolled and different samples were taken were sent to microbiology department for culture and sensitivity and then analysis was done.

Results: Maximum number of samples were of pus (26%) and sputum (26%), followed by urine sample, while blood and vaginal swab samples were least. Overall, 91% organism were gram negative bacteria. In pus samples, maximum no. of microbes found were klebsiella pneumoniae (37.03%) followed by E.coli (33.33%). In stool sample, commonest organism was klebsiella pneumoniae (50%) and in sputum, klebsiella pneumoniae was the most common found organism (57.69%), In urine, commonest organism was E.coli (66.66%), followed by klebsiella pneumoniae (33.33%). ESBL producing microbes were 69.09%, while ESBL non-producing were 30.9%. Highest resistance was seen with flouroquinolones (55%) while least with carbopenem (4%).

Conclusion: Judicial use of antibiotics, based on culture and sensitivity reports wherever possible, is of utmost importance so that further development of antibiotic resistance and infection related mortality can be reduced.

Keywords: Samples; Microbes; Antibiotics; Resistance

1. Introduction

It is a general belief that cancer patients are more prone to bacterial infections. Firstly disease itself present an immunocompromised status, secondarily chemotherapy and radiotherapy further suppress the immunity level which is further overburden by poor nutritional state and poor hygienic conditions in these patients. With the invent of better diagnostic modalities and many technological advancement in treatment delivery, the mortality rates have fallen over the past years, but infection remains a primary or associated cause of death, with bacteria followed by fungi most common agents. ^[1]

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The management of the infections is based on the use of appropriate empirical antimicrobial therapeutic agents with a comprehensive understanding of pathogens which are the commonly encountered in cancer patients in day to day practice and also understanding of antibiotic sensitivity patterns. Though the empirical use of antibiotics has reduced the mortality in patients but has also led to the menace of multidrug-resistant bacteria. [2]

Multidrug-resistant bacteria are commonly encountered among immuno-compromised patients. So it is necessary to be aware with the ever changing spectrum of infection and sensitivity pattern so that judicial and effective use of these drugs can be done with successful control of infections among cancer patients.

This present study aims to evaluate the common types of bacterial infections and their antibiotic susceptibility spectrum in cancer patients with solid tumors, undergoing chemotherapy.

Aims and objectives

This study was undertaken to monitor the types of pathogens commonly found in cancer patients undergoing anticancer treatment and their antibiotic sensitivity and resistance patterns.

2. Material and methods

This study was conducted in department of radiation oncology and total 100 patients, who were admitted for chemotherapy in department from 1 May 2022 to 31st July 2022 were enrolled.

Study design: Prospective observational study

Different samples were taken according to patient's clinical presentation and were sent to microbiology department for culture and sensitivity test. Demographic and clinical data of patients were collected including age, sex, site of malignancy, site of infection, type of bacterial isolates, antibiotic sensitivity pattern. The collected data were entered into Microsoft Excel and analyzed and results obtained are represented in the form of graphs and tables.

Patients receiving immunotherapy or radiotherapy or the patient with any preexisting immunosuppressive status were excluded from this study.

Institutional ethical committee approval was taken for this study.

2.1. Microbiological investigations

The clinical samples like pus, urine, vaginal swab, sputum, blood and stool received from suspected cases of infection and were accordingly stained for microscopical examination and inoculated onto blood agar, chocolate agar and MacConkey's agar (HiMedia) and incubated aerobically at 35 °C for 24 to 48 hrs. Blood Culture is done by FX 40 (Bactec). Identification of the bacterial growth and antimicrobial susceptibility testing of the isolates were interpreted as sensitive, resistant and Intermediate using the latest/ Clinical and Laboratory Standard Institute (CLSI) Guidelines. Antibiotics used for Gram Positive Bacteria were Penicillin-G, Amoxicillin, Carbenicillin, Ticarcillin, Cefoxitin, Amoxy-clavulanic Acid, Ampicillin-Sulbactam, Piperacillin/Tazobactam, Cefepime, Cefuroxime, Cefaclor, Cefodoxime, Ceftriaxone, Chloramphenicol, Ciprofloxacin, Levofloxacin, Ofloxacin, Erythromycin, Azithromycin, Clarithromycin, Doxycycline, Tetracycline, Clindamycin, Teicoplanin, Cotrimoxazole, Linezolid, Vancomycin and for Gram Negative Bacteria were Ampicillin, Piperacillin/Tazobactam, Amoxicillin/ Clavulanic Acid, Ampicillin Sulbactam, Cephalothin, Cefaclor, Cefpodoxime, Ceftriaxone/Sulbactam, Cefotaxime, Ceftazidime, Cefepime, Cefoperazone/Sulbactam, Doxycycline, Tetracycline, Nitrofurantoin (urine), Ciprofloxacin, Levofloxacin, Moxifloxacin, Chloramphenicol, Amikacin, Gentamicin, Cotrimoxazole, Meropenem, Imipenem and for Pseudomonas were Amikacin, Meropenem, Piperacillin, Piperacillin/Tazobactam, Cefepime, Tobramycin, Ceftazidime, Polymyxin-B, Aztreonam, Ciprofloxacin, Levofloxacin, Gemifloxacin. In urine sample CLED Agar was used and in vaginal swab, the first swab was used to make a smear on clean grease-free glass slide for bacterial differentiation by Gram-Stain Examination and the second swab was used for the bacterial culture on blood agar and MacConkey's agar.

3. Results

A total 100 patients were enrolled for the study. Data were collected prospectively and analyzed. Following results were obtained.

Table 1 Demographic characteristics of patients and samples

Age group	No of pts.	%
18-20yr	3	3%
21-30yr	6	6%
31-40yr	17	17%
41-50yr	35	35%
51-60yr	18	18%
61-70yr	14	14%
71-80yr	7	7%
Sex		
Male	59	59%
Female	41	41%
Distribution as per site of cancer		
Head and neck	53	53%
Ca breast	8	8%
Ca cervix	23	23%
GIT	5	5%
Ca lung	5	5%
Others	6	6%
Distribution As Per Sample Sites		
Type of isolates	No of samples	percentage
pus	26	26%
Sputum	26	26%
Blood	6	6%
Vaginal sab	6	6%
Urine	22	22%
stool	14	14%

Maximum numbers of patients (35%) were of 41-50 years age group .Male patients were more (59%) in comparison to female patients. Only patients of solid malignancies were taken in this study. Maximum number of patients belonged to head and neck cancer (53%) followed by carcinoma cervix (23%) and carcinoma breast (8%).Maximum number of samples were of pus (26%) and sputum (26%), followed by urine sample, while blood and vaginal swab samples were least.

In pus samples, maximum no.of microbes found were klebsiella pneumoniae (37.03%) followed by E.coli (33.33%). In stool sample, commonest organism was klebsiella pneumoniae (50%) and in sputum, klebsiella pneumoniae was the most common found organism (57.69%), In urine, commonest organism was E.coli (66.66%) ,followed by klebsiella pneumoniae (33.33%).

In vaginal sab, commonest microbe was E.coli, (57.14%), while in blood samples, staphylococcus aureus was the commonest (60%) microbe.

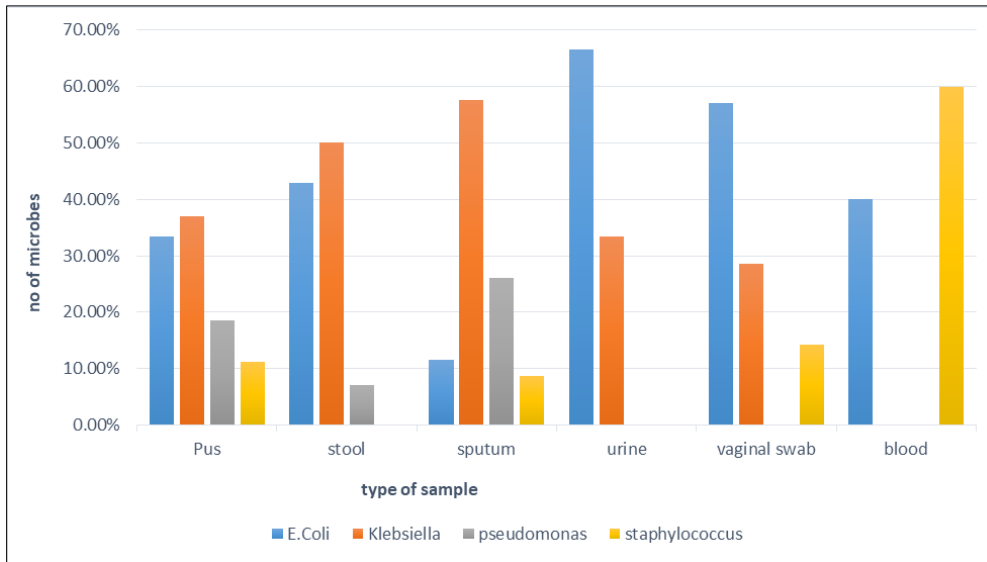


Figure 1 Distribution of microbes as per sample

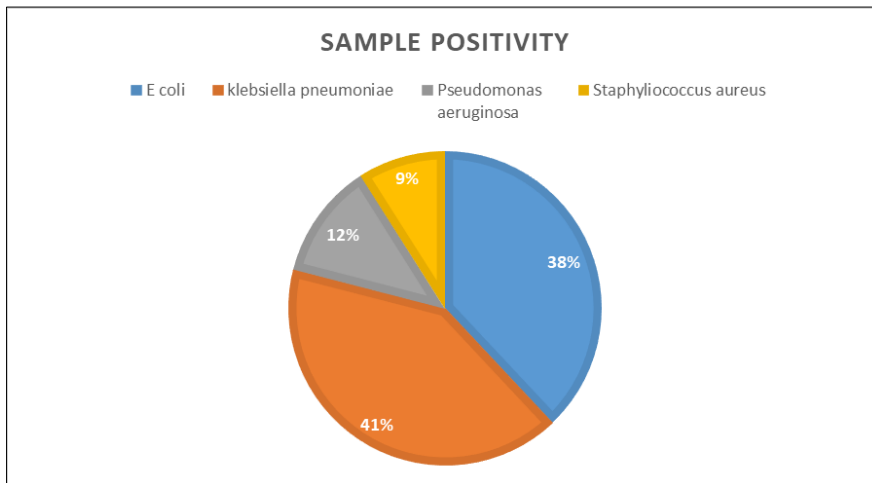


Figure 2 Overall incidence of microbes

Overall, klebsiella pneumonia was found to be commonest microbes followed by E.coli.

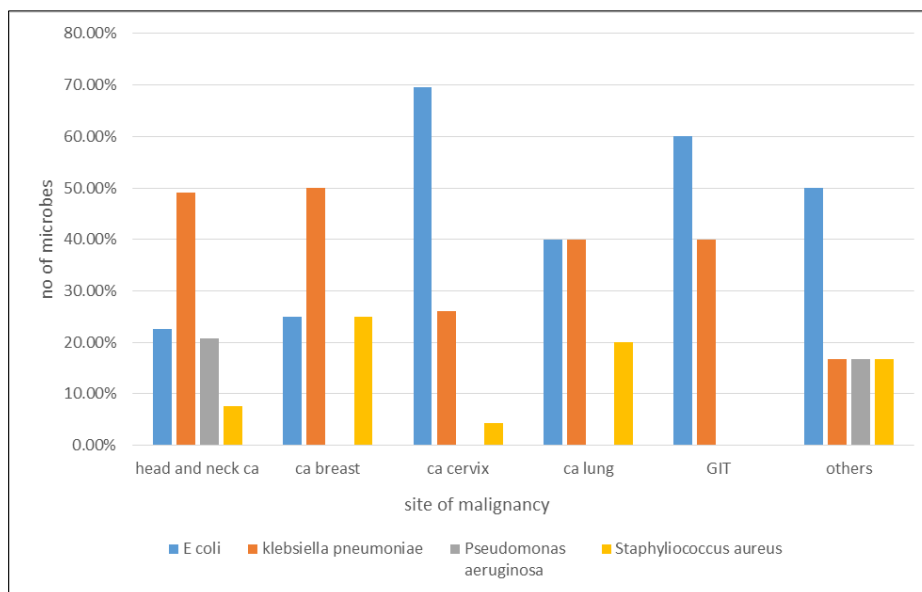


Figure 3 Distribution of microbes per site of malignancy

In head and neck carcinoma, commonest organism found was klebsiella pneumoniae, in carcinoma breast cases also klebsiella pneumoniae was commonest organisms, while E. coli was found in majority of cases of ca cervix, GIT and other malignancies.

Table 2 Pattern of bacterial growth

s.no.	Pattern of growth		
1	Heavy	Moderate	Scanty
	62%(62)	30%(30)	8%(8)
	Pattern among Gram negative bacteria -100%(91)		
2	ESBL producing	ESBL-non producing	
	69.23%(63)	30.77%(28)	
	Pattern among Gram positive bacteria (9)		
3	MRSA	MSSA	
	33.33%(3)	66.67%(6)	

91% of the infections were associated with gram-negative organisms and only 9% were due to gram positive organisms. Heavy growth of organism were found in 62% patients, moderate growth in 30% and scanty in 8%. In gram negative bacterias ESBL status was known in 55% growth, out of which ESBL producing microbes were 69.09%, while ESBL non producing were 30.9%. In gram positive bacterias, 33.33% were MRSA type.

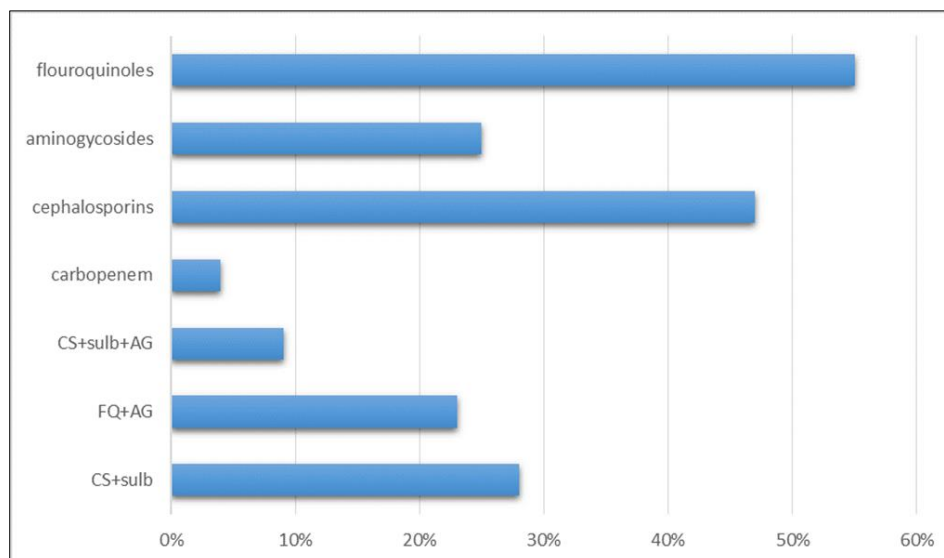


Figure 4 Pattern of antibiotic resistance

47% organism were found to be resistant to flouroquinoles alone, while 23 % were resistant to both flouroquinoles and aminoglycosides.

4. Discussion

Infection is a common complication of cancer itself and cancer treatment. Certain types can be life-threatening if not found and treated early. Several factors increase the risk of infection in patients with solid tumors, and the presence of multiple risk factors in the same patient is not uncommon. These include obstruction (most often caused by progression of the tumor), disruption of natural anatomic barriers such as the skin and mucosal surfaces.

Infection is commonly encountered among cancer patients, leading to disturbances in the treatment regimen, prolonged hospitalization, increased cost of health care, and reduced survival. Important infections like bloodstream infections and pneumonia are major contributors to mortality in oncology patients. The previous studies have reported 36% mortality due to sepsis in cancer patients. [3] Pneumonia, sepsis, influenza, and parasitic infections have been documented among the deceased cancer patients. [4]

In our study, most common infections were seen in head and neck cancer cases (53%) followed by carcinoma cervix cases (23%). This may be attributed to poor oral, skin and genital hygiene. Carcinoma breast patients (8%) presented as large fungating mass. Carcinoma lung cases (5%) presented with lower respiratory tract infection. Maximum numbers of patients (35%) were of 41-50 years age group with male predominance.

In most of the studies from developed countries, around 70% of the infections are caused by gram-positive bacteria. [5] On the contrary, most studies from developing countries have recorded that majority of infections were caused by gram-negative organisms. [6] In our study, 91% of the infections were associated with gram-negative organisms and only 9% were due to gram positive organisms.

Epidemiology of infections in cancer patients has changed across the globe overtime. In the study conducted by Siddaiahgari et al, *Pseudomonas* sp. was the most common causative organism of bloodstream infection, causing 36% of the bloodstream infections. *E. coli* accounted for 46.3% of the urinary tract infection. Characterized Gram-negative bacteria have predominated the scene as a major cause of infections in cancer patients in the last 20 years across the globe in many countries. Among gram-negative bacteria, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii* have been increasingly associated with cancer patients. [7] The findings of a study conducted by Yadegarynia et al. in Texas showed that pneumonia was the most common infection seen in both the groups of patients with solid organ tumours (26%), as well as in patients with haematological malignancies (38%). [8]

In a study conducted by Sirisharani Siddaiahgari, the overall rank order of the most common pathogens was *Pseudomonas* spp. (26.2%) > *Enterococcus* spp. (11.66%) > *S. aureus* (11.44%) > *E. coli* (11.34%) > *Klebsiella* spp.

(10.59%) > *Acinetobacter* spp. (9.95%) > Coagulase-negative *Staphylococcus* (CoNS) (6.52%) > *Streptococcus* spp. (3.42%) > *Enterobacter* spp. (3.1%) > *Burkholderia* spp. (2.35%) [7].

This was not the case in our study, where rank order was *Klebsiella* spp. (41%) > *Escherichia coli* (38%) > *Pseudomonas* spp. (12%) > *Staphylococcus aureus* (9%). In the study conducted by Siddaiahgari et al., *Pseudomonas* spp. was the most common causative organism of bloodstream infection, causing 36% of the bloodstream infections. *E. coli* accounted for 46.3% of the urinary tract [7]. In our study, soft tissue and skin infections (26%) and respiratory tract infections (26%) were more common compared from other studies other studies.

In our study, *Klebsiella pneumoniae* was the most common microbes in pus sample (37.03%) followed by stool (50%) and sputum samples (57.69%). *E. coli* was common organism in urine (66.66%), vaginal swab (57.14%) and blood culture (40%). *Pseudomonas aeruginosa* was commonly found in sputum (26.08%), pus (18.51%) and stool (7.14%), while *Staphylococcus aureus* was seen in vaginal swab (14.28%), pus (11.11%) and sputum (8.69%).

The epidemiology of most of these infections is changing with resistant organisms [MRSA, *Pseudomonas aeruginosa*, extended spectrum beta-lactamase (ESBL)-producing organisms] being isolated more often than in the past. [9]. A study done in New Delhi by Batra et al. noted 80% ESBL production rates among the gram-negative bugs [10]. In our study also, among gram negative bacteria ESBL status was known in 55% of growth, out of which ESBL producing microbes were 69.09%, while ESBL non-producing were 30.9%. In gram positive bacteria, 33.33% were MRSA type.

In our study, we also analysed malignancy site wise organism correlation and found that head and neck carcinoma patients were harboring *Klebsiella pneumoniae* (49.05%) followed by *Pseudomonas aeruginosa* (20.75%). In Carcinoma breast, pattern was *Klebsiella pneumoniae* (50%) followed by *Staphylococcus aureus* (25%); in carcinoma cervix case- *E. coli* (69.56%) > *Klebsiella pneumoniae* (26.08%); in ca lung cases- *E. coli* and *Klebsiella pneumoniae* infections were similar (40% each); in GIT cancer- *E. coli* (60%) > *Klebsiella pneumoniae* (40%).

Sevitha Bhat et al, in their study, observed that among gram-negative organisms 50.4% of the isolates were ESBL producers. Carbapenem resistance in their study was noted to be 15.4% among *Klebsiella* spp. and 17% among *Pseudomonas* spp. In contrast, *E. coli* in their study (15.6%) showed more carbapenem resistance. Fluoroquinolone and aminoglycoside resistance in gram-negative isolates was noted to be 45.6% and 39.20%, respectively and 48.58% showed resistance to third generation cephalosporins, and 26.92% of the organisms are resistant to all three antibiotics. [11] The empirical use of antimicrobials has reduced the mortality in patients but has also led to the menace of multidrug-resistant bacteria. [1] Multidrug-resistant bacteria are commonly encountered among immuno-compromised patients. In our case, we studied antibiotic resistance pattern and observed the pattern -highest resistance to fluoroquinolones (55%) > cephalosporins (47%) > cephalosporins+ sulbactam (28%) > Aminoglycosides (25%) > fluoroquinolones+ Aminoglycosides (23%) > cephalosporins+ sulbactam+ Aminoglycosides (12%) > carbapenems (4%).

Heavy growth of organism were found in 62% patients, moderate growth in 30% and scanty in 8% of cases.

Our study enrolled only those patients in whom infection was suspected and included only the positive cultures. The management of the infections is based on the use of appropriate empirical antimicrobial therapy with a comprehensive understanding of the commonly encountered pathogens and antibiotic sensitivity patterns. In this study, we examined the types of bacterial infections seen in cancer patients undergoing anticancer treatment, the associated bacterial pathogens, and their antibiotic sensitivity patterns

5. Conclusion

Implementation of judicious infection control practices would help in improving this dreaded situation. It is necessary to restrict the use of antibiotics in all clinical practices. To successfully prevent, identify, and treat infections, knowledge of the changing epidemiology of infections is essential, that may lead to a personalised and cost-effective treatment with improving prognosis and ensuring the judicious use of antibiotics.

Compliance with ethical standards

Acknowledgments

We acknowledge co-operation of cancer patients involved in this study.

Disclosure of conflict of interest

There are no conflicts of interest.

Statement of ethical approval

This study was approved by institutional Ethical committee.

Statement of informed consent

Informed consent was taken from all the patients involved in this study.

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