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Journal of Cancer Research and Cellular Therapeutics
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Research Article

Pattern of Bacterial Infections in Cancer Patients -Experience from a Tertiary Cancer Center

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Received Date: May 16, 2022; **Accepted Date:** May 26, 2022; **Published Date:** June 06, 2022

Citation: Surabhi Gupta. (2022). Pattern of Bacterial Infections in Cancer Patients -Experience from a Tertiary Cancer Center. *Cancer Research and Cellular Therapeutics*. 6(4); DOI:10.31579/2640-1053/120

Abstract

It is a general belief that cancer patients are more prone to infections, particularly bacterial infections. Firstly, disease itself present an immuno-compromised 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 most commonly accounting for infection-associated mortality, followed by fungi.

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.

Keywords: bacterial infections; cancer patients; tertiary cancer center

Introduction

It is a general belief that cancer patients are more prone to infections, particularly bacterial infections. Firstly, disease itself present an immuno-compromised 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 most commonly accounting for infection-associated mortality, followed by fungi [1].

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 undergoing chemotherapy for solid tumors.

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.

Materials 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 2021 to 31st July 2021 were enrolled. Different samples were taken according to patient's presentation. These samples were collected in our department and were sent to microbiology department for culture and sensitivity. Demographic and clinical data of patients were collected including age, sex, site of malignancy, site of infection, type of bacterial isolates, antibiotic sensitivity pattern and details of anthropometry, comorbidities, haematological examination results, and any procedures (urinary catheterization, central or peripheral IV cannulation, endotracheal intubation, and ventilator management) were collected. The

collected data were entered into Microsoft Excel and analyzed and results obtained are represented in the form of graphs and tables.

Inclusion criteria

1. Histopathological confirmed case of solid malignancy

2. Patients undergoing only chemotherapy

3. Age > 18 yrs.

Exclusion criteria

1. Patients receiving immunotherapy or radiotherapy

2. Patient with any immunosuppressive status

Microbiological investigations

The clinical samples like pus, urine, vaginal swab, sputum, blood and stool received from suspected cases of infection and accordingly were 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). Positive cultures were sub cultured onto blood agar, chocolate agar and Mac Conkey's agar and incubated aerobically at 35^0C for 24hrs. 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 are Ampicillin, Piperacillin/Tazobactam, Amoxicillin/ Clavulanic Acid, Ampicillin Sulbactam, Cephalothin, Cefaclor, Cefpodoxime, Ceftriaxone/Sulbctam, Cefotaxime, Ceftazidime, Cefepime, Cefoperazone/Salbactam, Doxycycline, Tetracycline, Nitrofurantoin (urine), Ciprofloxacin, Levofloxacin, Moxifloxacin, Chloramphenicol, Amikacin, Gentamicin, Cotrimoxazole, Meropenem, Imipenem and for Pseudomonas are Amikacin, Meropenem, Piperacillin, Piperacillin/Tazobactam, Cefepime, Tobramycin, Cefftazidime, Polymyxin-B, Aztreonam, Ciproflaxacin, Levofloxacin, Gemifloxacin . In urine sample we are using CLED Agar. In vaginal swab, the first swab is used to make a smear on clean grease-free glass slide for bacterial differentiation by Gram-Stain Examination and the second swab is used for the bacterial culture on blood agar and Mac Conkey's agar.

Result

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

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%

Table 1: *Maximum numbers of patients (35%) were of 41-50 years age group .Male patients were more (59%) in comparison to female patients.*

Figure no.1

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%).

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%

Table 2: *Maximum number of samples were of pus (26%) and sputum (26%), followed by urine sample, while blood and vaginal swab samples were least.*

Figure No.2

Overall, 91% organism were gram negative bacteria.

Figure no 3

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 no 4

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

E.coli.

Figure no 5

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

Figure no 6

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

Figure no 7

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 no 8

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

Discussion

Infection is a common complication of cancer and cancer treatment and 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 were 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 site of infections seen was 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 our study, 91% of the infections were associated with gram-negative organisms and only 9% were due to gram positive organisms. It is in contrast to the earlier reports from developed countries, where the incidence of infections caused by gram-positive bacteria is higher. 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 conducted in developing countries have recorded that majority of infections were caused by gram-negative organisms [6].

Epidemiology of infections in cancer patients has changed across the globe overtime. 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 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 our study, soft tissue and skin infections (26%) and respiratory tract infections (26%) were more common compared from other studies other studies.

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 bacterias, 33.33% were MRSA type.

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, klabesilla pneumoniae was the most common microbes in pus sample (37.03%), 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 auregenoa 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%).

In our study, we also correlated malignancy site wise organism correlation and found that Head and neck carcinoma patients were harboring klebsiella pneumoniae (49.05%) commonest followed by Pseudomonas aeruginosa (20.75%). In Ca breast pattern was klebsella pneumoniae (50%) followed by staphylococcus aureus (25%). In ca 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%).

In a study by Sevitha Bhat et al, analysis of antibiotic resistance of gram-negative organisms revealed 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% show 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 immunocompromised patients.

In our case, we studied antibiotic resistance pattern and observed-highest resistance toflouroqunolones (55%)>cephelosporins (47%)>cephelosporins+sulbactum (28%)> Aminoglycosides (25%)>flouroquinoles+Aminoglycosides (23%)>cephalosporins+ sulbactum+Aminoglycosides (12%)> carbopenems (4%).

In our study, chemotherapy was the most common mode of treatment with appr.80% of patients undergoing chemotherapy. 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 not of all cancer patients 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:

Conclusion

Implementation of judicial infection control practices would help in improving this dreaded situation. It is of 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 judicial use of antibiotics.

Financial support and sponsorship -Nil.

Conflicts of interest -There are no conflicts of interest

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DOI: 10.31579/2640-1053/120