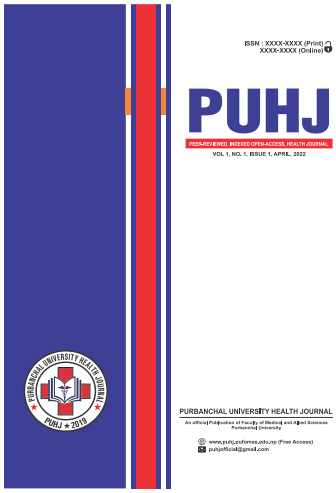

ISSN : 2961-1636 (Print)
ISSN : 2961-1644 (Online)

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Submitted:
2nd Sept, 2024
Accepted:
24th October, 2024
Published:
28th October 2024

OA 3

Citation:
Abish Adhikari, Subhas Pandit, Simit Sapkota, Jeebana Bhandari, Atul Suwal. Antibiotic Susceptibility Pattern among Cancer Patients with Urinary Tract Infection at a Tertiary Cancer Hospital in Nepal. Purbanchal University Health Journal. 2024 October; 2(1): 13-17

DOI:

Antibiotic Susceptibility Pattern Among Cancer Patients with Urinary Tract Infection at a Tertiary Cancer Hospital in Nepal

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Abstract

Background: Cancer patients are at a higher risk of infection due to the nature of treatment modalities used that lead to immunosuppression. Urinary tract infections are the most common cause of morbidity among cancer patients.

Objective: The objective of this study is to determine antibiotic sensitivity and resistance pattern in cancer patients with urinary tract infections at a tertiary cancer hospital in Nepal.

Method: A retrospective analysis was conducted on cancer patients with urinary tract infections from September 2020 to June 2024 at a tertiary cancer hospital in Nepal. Antibiotic susceptibility testing was performed using the Kirby-Bauer disk diffusion method. Data on positive urine cultures were extracted from the medical laboratory system. Bacterial profiles and antibiotic susceptibility test results were assessed. Data were analyzed using R-statistical software.

Result: A total of 613 urine cultures were performed during the study period among which 116 were positive cultures. After excluding ineligible cultures, 102 (16.63%) positive cultures from 97 patients were included. Most of the patients were females (79.38%). The most common cancers were gynecological (43.39%) followed by genitourinary (9.28%), central nervous system (9.28%) and lung (8.25%) cancers. The most isolated bacteria were *Escherichia coli* (62.88%) followed by *Klebsiella pneumonia* (14.43%). The most sensitive antibiotics were Amikacin (68.42%), Nitrofurantoin (63.54%), Gentamicin (41.43%), Co-trimoxazole (40.63%), Ofloxacin (38.10%), Amoxicillin/Clavulanate (31.51%), Norfloxacin (26.09%), Ciprofloxacin (20.93%), Cefixime (13.85%) and Amoxicillin (8.33%) while the antibiotics in reverse order were most resistant antibiotics among top 10 tested antibiotics.

Conclusion: The findings of this study can guide clinicians to make an informed decision in the selection of antibiotics and management of urinary tract infections in cancer patients.

Keywords: Antibiotic Susceptibility; Bacteria; Cancer; Urinary Tract Infection

Introduction

Cancer is a significant cause of mortality worldwide and more than half of the cancer-attributed deaths occur in developing countries.[1] According to GLOBOCAN, 22008 new cancer cases and 14704 cancer deaths were reported in Nepal in 2022 with the most common cancers being lung, breast, cervix, stomach, and colorectal cancer, respectively.[2]

The survival of cancer patients is increasing with advancements in treatment strategies.[3] However, treatment modalities including chemotherapy cause immunosuppression, and use of devices such as stents, shunts, urinary catheters and central venous catheters increase the chances of bacterial colonization. As a result, they are at a significantly elevated risk of opportunistic infections. [4–7]

Every year, antimicrobial resistance (AMR) causes more than 700,000 deaths globally with an estimated 10 million rise in deaths each year by 2050.[8] Similarly, the burden of AMR is also increasing in Nepal due to the irrational use of antibiotics.[9] Increasing evidence shows the high prevalence of AMR among cancer patients. The emergence of multiple-drug-resistant (MDR) strains of gram-negative bacteria causing nosocomial infection has become a serious concern, especially in cancer patients.[10]

There are limited studies on antimicrobial resistance conducted in cancer patients. [10–13] Urinary Tract Infection (UTI) is the most prevalent infection in patients with or without cancer. [14,15] Management of UTI in cancer patients is challenging as many patients are prone to developing AMR due to immunosuppression and prolonged use of antibiotics. For the appropriate use of antibiotics and prevention of AMR, evidence-based practice is crucial during the management of UTI among cancer patients. This study aims to analyze the bacterial profile and antibiotic susceptibility pattern in cancer patients presenting UTI.

Method

A retrospective analysis was conducted on patients diagnosed with various cancers undergoing urine culture tests from September 2020 to June 2024 at a comprehensive cancer center, Kathmandu Cancer Center (KCC) in Nepal. The positive urine cultures obtained during the study period were identified from the medical laboratory system. Patients whose diagnoses were available in the medical records were included in the study. Patients whose diagnoses were unknown and whose medical record files were not available were excluded from the study. For the patients with multiple positive urine cultures, only the first one was considered for the analysis to avoid duplicate data.

Antibiotic Susceptibility Testing (AST) was performed by the Kirby-Bauer disk diffusion method following the Clinical and Laboratory Standards Institute (CLSI) guidelines.[16] The results of AST were interpreted as susceptible (S), intermediate (I) and resistant (R). The antibiotics used in AST were purchased from Tulip and Himedia (India).

Data on the patient's age and gender were collected from the electronic record system of the medical laboratory. Data on cancer diagnoses were collected from the medical record system in the Department of Medical Records. Data on all urine cultures were extracted from the electronic record system and culture-positive results were identified. R-statistical software (version 4.4.0) was used to analyze the data. Two descriptive statistics, frequency and percentage were used to summarize the data.

This study was approved by the Ethical Review Board (ERB) of the Nepal Health Research Council (NHRC) (Approval Number 97_2024). The patient's informed consent was waived by the ERB due to the retrospective nature of the study.

Result

Demographic profile of cancer patients

A total of 613 urine cultures were performed during the study period, with 497 (81.07%) being culture-negative and 116 (18.93%) culture-positive. After excluding non-cancer patients and repeat cultures, 102 (16.63%) positive cultures from 97 cancer patients were included in the analysis.

Most patients were female (75.26%) and the most common cancer type was gynecological cancer (46.39%). Nearly half of the patients (47.42%) were aged 60 years and above, with 30.93% aged 45-59 years. Other cancer types included genitourinary, central nervous system, lung, head and neck, breast, gastrointestinal, and hematological cancers, each representing smaller proportions of the cohort.

Table 1: Baseline demographics of patients n=97

	Frequency (f)	Percentage (%)
Age (in years)		
15-29	3	3.09
30-44	18	18.56
45-59	30	30.93
≥60	46	47.42
Sex		
Female	73	75.26
Male	24	24.74
System		
Gynaecologic	45	46.39
Genitourinary	9	9.28
Central Nervous System	9	9.28
Lungs	8	8.25
Head & Neck	7	7.23
Breast	7	7.22
Gastrointestinal	4	4.12
Hematological	4	4.12
Others	4	4.12

Bacterial profile of urine culture samples of cancer patients

The bacterial isolates identified in the urine cultures of cancer patients are summarized in **Figure 1**. The most common pathogen was *Escherichia coli*, accounting for 62.88% of infections, followed by *Klebsiella pneumoniae* (14.43%) and *Pseudomonas aeruginosa* (9.27%). Other bacterial species including *Staphylococcus spp.*, *Klebsiella spp., Pseudomonas spp., Staphylococcus aureus, Klebsiella oxytoca, Enterococcus spp.* and *Citrobactor koseri* were responsible for a smaller proportion of the UTIs.

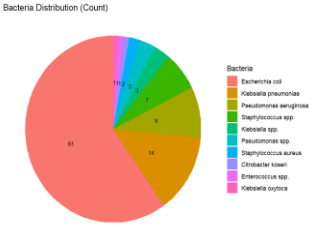

Figure 1 Proportion of bacterial isolates causing urinary tract infection in cancer patients

Antibiotic sensitivity pattern

The antibiotic sensitivity pattern is depicted in **Figure 2.** The frequency of sensitivity of different bacteria towards antibiotics is enumerated in **Table 2**. Among the top 10 tested antibiotics, the order of most sensitive antibiotics includes Amikacin (68.42%), Nitrofurantoin (63.54%), Gentamicin (41.43%), Co-trimoxazole (40.63%), Ofloxacin (38.10%), Amoxycillin/Clavulanate (31.51%), Norfloxacin (26.09%), Ciprofloxacin (20.93%), Cefixime (13.85%) and Amoxicillin (8.33%).

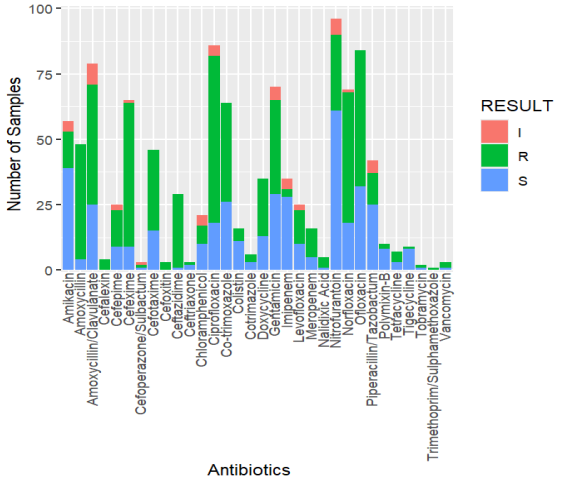

Figure 2 Antibiotic susceptibility pattern in cancer patients with urinary tract infection diagnosed between September 2020 - June 2024. *R = Resistant, I = Intermediate and S = Sensitive.*

Table 2 Sensitivity patterns of different antibiotics

Antibiotics	S (%)	I (%)	R (%)	Total sample tested
Cefixime	9 (13.85%)	1 (1.54%)	55 (84.62%)	65
Nitrofurantoin	61 (63.54%)	6 (6.25%)	29 (30.21%)	96
Ciprofloxacin	18 (20.93%)	4 (4.65%)	64 (74.42%)	86
Ofloxacin	32 (38.10%)	0 (0.0%)	52 (61.90%)	84
Amoxycillin/Clavulanate	25 (31.64%)	8 (10.13%)	46 (58.23%)	79
Gentamicin	29 (41.43%)	5 (7.14%)	36 (51.43%)	70
Norfloxacin	18 (26.09%)	1 (1.45%)	50 (72.46%)	69
Co-trimoxazole	26 (40.63%)	0 (0.0%)	38 (59.38%)	64
Amikacin	39 (68.42%)	4 (7.02%)	14 (24.56%)	57
Amoxicillin	4 (8.33%)	0 (0.0%)	44 (91.67%)	48
Cefotaxime	15 (32.61%)	0(0.0%)	31 (67.39%)	46
Piperacillin/Tazobactum	25 (59.52%)	5 (11.90%)	12 (28.57%)	42
Doxycycline	13 (37.14%)	0 (0.0%)	22 (62.86%)	35
Imipenem	28 (80.0%)	4 (11.43%)	3 (8.57%)	35
Ceftazidime	1 (3.45%)	0 (0.0%)	28 (96.55%)	29
Cefepime	9 (36.0%)	2 (8.0%)	14 (56.00%)	25
Levofloxacin	10 (40.0%)	2 (8.0%)	13 (52.0%)	25
Chloramphenicol	10 (47.62%)	4 (19.05%)	7 (33.33%)	21
Colistin	11 (68.75%)	0 (0.0%)	5 (31.25%)	16
Meropenem	5 (31.25%)	0 (0.0%)	11 (68.75%)	16
Polymixin-B	8 (80.0%)	0 (0.0%)	2 (20.0%)	10
Tigecycline	8 (88.89%)	0 (0.0%)	1 (11.11%)	9
Tetracycline	3 (42.86%)	0 (0.0%)	4 (57.14%)	7
Co-trimazole	3 (50.0%)	0 (0.0%)	3 (50%)	6
Cefalexin	0 (0.0%)	0 (0.0%)	4 (100%)	4
Cefoperazone/Sulbactam	1(33.33%)	1 (33.33%)	1 (33.33%)	3
Cefoxitin	0 (0.0%)	0 (0.0 %)	3 (100%)	3
Ceftriaxone	2 (66.67%)	0(0.0%)	1 (33.33%)	3
Nalidixic Acid	1 (25%)	0 (0.0%)	3 (75%)	4
Tobramycin	1 (50%)	0 (0.00%)	1 (50%)	2
Trimethoprim/Sulphamethoxazole	0(0.00%)	0(0.00%)	1(100%)	1
Vancomycin	1 (33.33%)	0(0.00%)	2 (66.66%)	3

Discussion

This study demonstrated significant insights into the bacterial profile and antibiotic sensitivity pattern in Nepalese cancer patients with UTIs.

Among all the urine tests, cancer patients exhibited 16.64% positive cultures. Previous studies have reported the prevalence of UTI in cancer patients ranging from 6%-72% however, its prevalence in the Nepalese setting has been reported at 24% among cancer patients[17].

In the current study, the majority of UTIs were caused by gram-negative bacteria (94.85%) in line with the findings of AbuSara et al. that showed gram-negative bacteria as the causative agent in the majority of UTIs cases (88.7%)[18] where *E. coli* was identified as the most prevalent pathogen accounting for 62.88% of UTIs, followed by *Klebsiella pneumoniae* (14.43%) and *Pseudomonas aeruginosa* (9.27%). Consistent findings have been reported in the study by Shrestha et al. with *E. coli* being the most common bacteria causing UTIs (58%).[17].

In our study, Amikacin, Nitrofurantoin, Gentamicin, Co-trimoxazole and Ofloxacin showed a low level of resistance, making these drugs a reasonable alternative in managing UTIs in cancer patients. On the other hand, Amoxicillin, Cefixime, Ciprofloxacin, Norfloxacin and Amoxycillin/Clavulanate showed the highest level of resistance. Shrestha et al. also report a low level of resistance in Nitrofurantoin and Amikacin and the highest level of resistance in Ampicillin, Cefixime, Ciprofloxacin, and Norfloxacin[17].

UTI is the most prevalent type of infection in cancer patients as Fazeli et al. identified UTIs in 65.6% of patients followed by skin and soft-tissue infection[13]. Thus, our findings hold significant implications in the management of UTI among cancer patients. The findings of this study on antibiotic sensitivity patterns can work as a guide for clinicians to make an informed decision while prescribing antibiotics to cancer patients, especially those who present UTIs.

While our study holds significant implications for clinical practice in Nepalese settings, the study has few limitations. The study's retrospective nature may introduce selection biases within the cohort. The single centre-based data limits the generalizability of its findings to a broader population. Moreover, critical factors such as cancer stages, history of treatment and underlying comorbidities were not assessed which could influence likelihood of UTIs in the patient population.

Conclusion

Our study provides a comprehensive analysis of the bacterial profile and antibiotic sensitivity patterns in cancer patients with (UTIs). Notably, among the commonly tested antibiotics, resistance rates were found to be higher than sensitivity rates. These findings can serve as a valuable resource for clinicians, helping to inform more effective antibiotic selection and management strategies for UTIs in cancer patients.

Recommendation

Antibiotic prescription should be based on AST results for better treatment outcomes and prevention of antibiotic resistance in cancer patients. We recommend regular assessment of antibiograms to ensure the adequate prescription of antibiotics and management of infections, especially in cancer patients.

Conflict of Interest

The author declares no conflict of interest.

Financial Disclosure

The author has no financial disclosure. No financial cost was incurred in this research.

Acknowledgements

We would like to thank the department of pathology at Kathmandu Cancer Center for providing the needful data. We also extend our gratitude to the IT team of the hospital as well as Medipro System for helping in data extraction.

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