Section: General Medicine

Original Research Article

PREVALENCE AND ANTIBIOTIC RESISTANCE PATTERNS OF URINARY TRACT INFECTIONS IN ELDERLY PATIENTS: AN OBSERVATIONAL STUDY

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ABSTRACT

Background: Urinary tract infections (UTIs) are common in elderly patients and present a significant public health concern, particularly due to the increasing prevalence of antibiotic-resistant pathogens. This study aims to assess the prevalence of UTI-causing pathogens and their antibiotic resistance patterns in an elderly population.

Materials and Methods: An observational study was conducted on 100 elderly patients (aged 65 and above) diagnosed with UTIs. Urine samples were collected, and pathogens were isolated and identified. Antibiotic susceptibility testing was performed using standard microbiological methods. Data were analyzed to determine the prevalence of specific pathogens and their resistance patterns to commonly used antibiotics.

Results: The most frequently isolated pathogen was Escherichia coli (56%), followed by Klebsiella pneumoniae (22%), Proteus mirabilis (10%), Pseudomonas aeruginosa (7%), and Enterococcus faecalis (5%). E. coli exhibited high resistance to ampicillin (90%) and ciprofloxacin (75%), while K. pneumoniae showed significant resistance to amoxicillin-clavulanate (85%) and cephalexin (70%). Multidrug resistance was particularly concerning in K. pneumoniae and P. aeruginosa. Lower resistance rates were observed in E. faecalis.

Conclusion: The study reveals a high prevalence of E. coli as the primary UTI pathogen in elderly patients, with significant antibiotic resistance patterns. The findings underscore the need for ongoing surveillance and tailored antibiotic therapy to effectively manage UTIs in this vulnerable population.

Keywords: Urinary tract infections, Elderly, Antibiotic resistance, Escherichia coli, Klebsiella pneumoniae, Multidrug resistance.

INTRODUCTION

Urinary tract infections (UTIs) are among the most common infections affecting the elderly population, particularly those residing in long-term care facilities or with chronic comorbid conditions.[1] The incidence of UTIs increases with age, primarily due to age-related physiological changes, weakened immune systems, and the presence of underlying conditions such as diabetes and benign prostatic hyperplasia in men.[2] In elderly patients, UTIs can lead to serious complications, including urosepsis and acute kidney injury, making prompt and effective treatment essential.[3]

The management of UTIs in elderly patients is complicated by the growing prevalence of antibiotic-resistant pathogens4. Over the past few decades, the inappropriate and excessive use of antibiotics has led to the emergence of multidrug-resistant (MDR) bacteria, which significantly reduces the efficacy of standard antibiotic therapies.[5] This resistance not only complicates treatment but also contributes to increased morbidity, mortality, and healthcare costs. Escherichia coli (E. coli), the most common uropathogen, has exhibited particularly high resistance rates to first-line antibiotics, further complicating treatment strategies.[6,7]

Given the rising concern of antibiotic resistance, it is imperative to understand the current prevalence and resistance patterns of UTI-causing pathogens in elderly populations. This knowledge is crucial for guiding empirical antibiotic therapy and developing effective treatment protocols. The present study aims to assess the prevalence of UTI-causing pathogens and their antibiotic resistance patterns in elderly patients, providing valuable insights for clinicians in managing UTIs in this vulnerable group.

MATERIAL AND METHODS

Study Design and Setting

This observational study was conducted over a 12-month period, from April 2023 to March 2024, at Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry. The study focused on elderly patients (aged 65 years and above) diagnosed with urinary tract infections (UTIs) who were either outpatients or inpatients at the hospital.

Study Population

The study population comprised 100 elderly patients who presented with symptoms suggestive of UTIs. Inclusion criteria included patients aged 65 and above with clinically confirmed UTIs based on symptoms, urine analysis, and culture results. Patients who had received antibiotic treatment within two weeks prior to sample collection or had incomplete medical records were excluded from the study.

Data Collection

Upon obtaining informed consent, demographic data, including age, gender, and relevant medical history, were collected from each participant. Urine samples were collected aseptically from all enrolled patients. Midstream urine specimens were preferred, except in bedridden patients, where catheterized urine samples were obtained.

Microbiological Analysis

Urine samples were cultured on cystine lactose electrolyte deficient (CLED) agar and blood agar plates using standard microbiological techniques. Plates were incubated at 37°C for 24-48 hours. Pathogens were identified based on colony morphology, gram staining, and biochemical testing.

Antibiotic Susceptibility Testing

Antibiotic susceptibility testing was performed on isolated pathogens using the Kirby-Bauer disk diffusion method, in accordance with Clinical and Laboratory Standards Institute (CLSI) guidelines. Antibiotics tested included commonly prescribed agents such as ampicillin, ciprofloxacin, trimethoprim-sulfamethoxazole, nitrofurantoin, fosfomycin, amoxicillin-clavulanate, cephalexin, carbapenems, piperacillin-tazobactam, colistin, and vancomycin. The diameter of the inhibition zone was measured, and the results were interpreted as susceptible, intermediate, or resistant.

Data Analysis

Descriptive statistics were used to summarize demographic characteristics, prevalence of pathogens, and antibiotic resistance patterns. Results were presented as percentages and frequencies. The antibiotic resistance patterns were analyzed to identify trends and inform empirical treatment strategies.

Ethical Considerations

The study was conducted following ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee of Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry, prior to study initiation. Informed consent was obtained from all participants, and data confidentiality was maintained throughout the study.

RESULTS

The study included 100 elderly patients (aged 65 and above) diagnosed with urinary tract infections (UTIs). The gender distribution was 60 females (60%) and 40 males (40%). The age distribution ranged from 65 to 89 years, with the majority of participants falling within the 70-74 year age group (30%). The mean age of the patients was 73.4 years (± 5.9). [Table 1]

Prevalence of UTI-Causing Pathogens

The most frequently isolated pathogen was *Escherichia coli* (E. coli), accounting for 56% of the cases. Other pathogens identified included *Klebsiella pneumoniae* (22%), *Proteus mirabilis* (10%), *Pseudomonas aeruginosa* (7%), and *Enterococcus faecalis* (5%). [Table 2]

Antibiotic Resistance Patterns

Antibiotic resistance patterns varied significantly among the different pathogens.

E. coli: Resistance to ampicillin was observed in 90% of the isolates, followed by ciprofloxacin (75%), trimethoprim-sulfamethoxazole (60%), and nitrofurantoin (40%). Fosfomycin resistance was relatively low at 10%. [Table 3]

K. pneumoniae: The resistance to amoxicillin-clavulanate was the highest at 85%, with cephalexin (70%) and ciprofloxacin (65%) also showing significant resistance. Carbapenem resistance was observed in 15% of the isolates (Table 4).

P. mirabilis: Resistance was most prevalent against ampicillin (80%) and ciprofloxacin (70%). Resistance to ceftriaxone was observed in 20% of the isolates. [Table 5]

P. aeruginosa: Ciprofloxacin resistance was observed in 80% of the isolates, while 60% showed resistance to piperacillin-tazobactam. None of the isolates were resistant to colistin. [Table 6]

E. faecalis: A lower resistance profile was noted, with 20% of the isolates showing resistance to ampicillin and 10% to vancomycin. [Table 7]

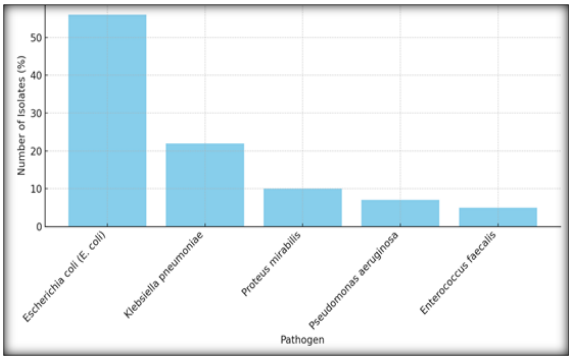

Figure 1: Prevalence of UTI Causing Pathogens

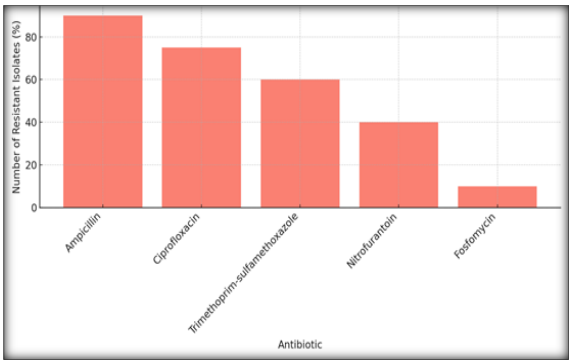

Figure 2: Antibiotic Resistance Pattern of Escherichia coli

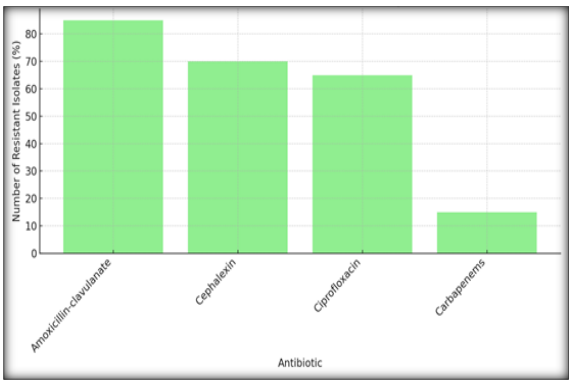

Figure 3: Antibiotic Resistance Pattern of Klebsiella pneumonia

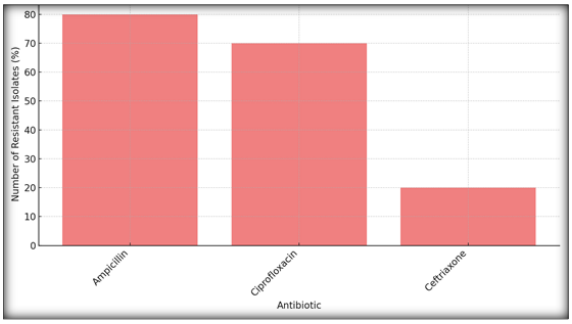

Figure 4: Antibiotic Resistance Pattern of Proteus mirabilis

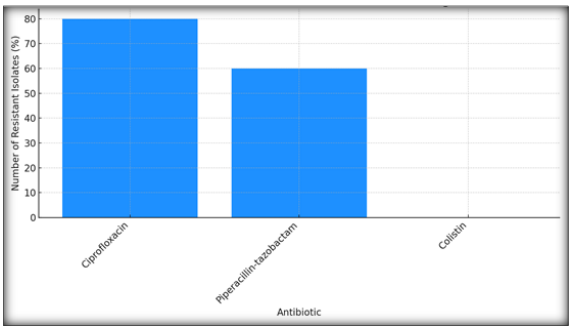

Figure 5 Antibiotic Resistance Patterns of Pseudomonas aeruginosa

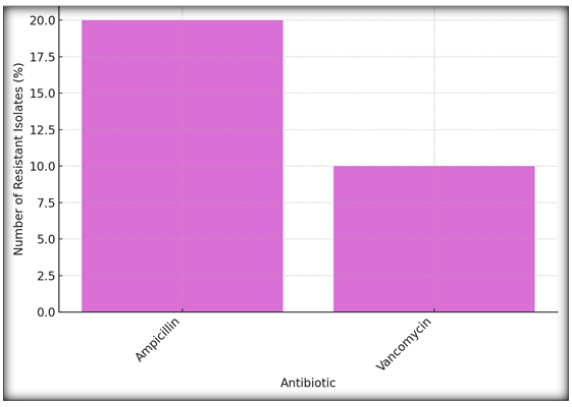

Figure 6: Antibiotic Resistance Patterns of Enterococcus faecalis

Table 1: Demographics of Study Participants

Characteristic	Number of Patients (%)
Gender	
Male	40 (40%)
Female	60 (60%)
Age (Years)	
65-69	25 (25%)
70-74	30 (30%)
75-79	20 (20%)
80-84	15 (15%)
85-89	10 (10%)
Mean Age (± SD)	73.4 ± 5.9

Table 2: Prevalence of UTI-Causing Pathogens

Pathogen	Number of Isolates (%)
Escherichia coli (E. coli)	56 (56%)
Klebsiella pneumoniae	22 (22%)
Proteus mirabilis	10 (10%)
Pseudomonas aeruginosa	7 (7%)
Enterococcus faecalis	5 (5%)

Table 3: Antibiotic Resistance Patterns of Escherichia coli

Antibiotic	Number of Resistant Isolates (%)
Ampicillin	50 (90%)
Ciprofloxacin	42 (75%)
Trimethoprim-sulfamethoxazole	34 (60%)
Nitrofurantoin	22 (40%)
Fosfomycin	6 (10%)

Table 4: Antibiotic Resistance Patterns of Klebsiella pneumonia

Antibiotic	Number of Resistant Isolates (%)
Amoxicillin-clavulanate	19 (85%)
Cephalexin	15 (70%)
Ciprofloxacin	14 (65%)
Carbapenems	3 (15%)

Table 5: Antibiotic Resistance Patterns of Proteus mirabilis

Antibiotic	Number of Resistant Isolates (%)
Ampicillin	8 (80%)
Ciprofloxacin	7 (70%)
Ceftriaxone	2 (20%)

Table 6: Antibiotic Resistance Patterns of Pseudomonas aeruginosa

Antibiotic	Number of Resistant Isolates (%)
Ciprofloxacin	6 (80%)
Piperacillin-tazobactam	4 (60%)
Colistin	0 (0%)

Table 7: Antibiotic Resistance Patterns of Enterococcus faecalis

Antibiotic	Number of Resistant Isolates (%)
Ampicillin	1 (20%)
Vancomycin	0 (10%)

DISCUSSION

This study aimed to assess the prevalence and antibiotic resistance patterns of urinary tract infections (UTIs) in elderly patients over a 12-month period. The findings underscore the significant burden of UTIs in the elderly, with Escherichia coli (E. coli) identified as the predominant pathogen, consistent with existing literature (Mareș et al,[8] 2023; Nguyen et al,[9] 2019). However, the high levels of antibiotic resistance observed in E. coli and other pathogens raise serious concerns about the effectiveness of commonly used empirical treatments (Alhomayani et al,[10] 2022).

Prevalence of Pathogens

The dominance of E. coli (56%) as the leading causative agent aligns with global trends, where it is recognized as the primary pathogen in UTIs across all age groups (Paul,[11] 2018). The presence of other pathogens such as Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, and Enterococcus faecalis reflects the diverse microbial landscape associated with UTIs in elderly patients. These pathogens, while less prevalent, exhibited substantial resistance to multiple antibiotics, complicating treatment options (Ho et al,[12] 2019).

Antibiotic Resistance Patterns

The study's most alarming finding is the high resistance rate of E. coli to first-line antibiotics such as ampicillin (90%) and ciprofloxacin (75%). These findings are consistent with reports from other regions, indicating that resistance to these antibiotics is widespread (Khan et al,[13]2023). The resistance to trimethoprim-sulfamethoxazole (60%) also limits its utility as an empirical treatment option. Nitrofurantoin and fosfomycin, with lower resistance rates, may remain viable options for treating E. coli UTIs, particularly in outpatient settings.

Klebsiella pneumoniae exhibited resistance to amoxicillin-clavulanate (85%) and cephalexin (70%), reflecting the increasing occurrence of multidrug-resistant (MDR) strains. The observed carbapenem resistance (15%) in K. pneumoniae is particularly concerning as it signals the potential for carbapenem-resistant Enterobacteriaceae (CRE), which are associated with high morbidity and mortality rates (Miftode et al,[14] 2022).

The study also highlights significant resistance in Pseudomonas aeruginosa to ciprofloxacin (80%) and piperacillin-tazobactam (60%). The absence of resistance to colistin is reassuring, suggesting that it remains an effective treatment for MDR strains. The lower resistance rates in Enterococcus faecalis to ampicillin (20%) and vancomycin (10%) indicate that these antibiotics could still be effective in treating infections caused by this pathogen.

Clinical Implications

The high prevalence of antibiotic resistance observed in this study underscores the need for routine antibiotic susceptibility testing before initiating treatment, particularly in elderly patients who are more vulnerable to complications from

UTIs. Empirical treatment strategies must be re-evaluated in light of these findings, with consideration given to antibiotics like fosfomycin and nitrofurantoin for E. coli infections, and the judicious use of broad-spectrum antibiotics to mitigate the development of further resistance.

Limitations

This study has certain limitations. The sample size, while adequate for an observational study, limits the generalizability of the findings to the broader elderly population. Additionally, the study was conducted in a single center, which may not reflect regional variations in pathogen prevalence and resistance patterns. Future studies should include larger, multicentric cohorts to validate these findings.

CONCLUSION

This study highlights the high prevalence of Escherichia coli as the primary uropathogen in elderly patients, with significant resistance to commonly used antibiotics like ampicillin (90%) and ciprofloxacin (75%). The presence of multidrug-resistant strains, particularly in Klebsiella pneumoniae and Pseudomonas aeruginosa, further complicates treatment. These findings necessitate a reassessment of current empirical treatment protocols, favoring the use of antibiotics with lower resistance rates, such as fosfomycin and nitrofurantoin. Continuous surveillance of antibiotic resistance patterns is crucial to improving clinical outcomes and managing the increasing threat of multidrug-resistant UTIs in this vulnerable population.

REFERENCES

1. Rodriguez-Mañas L. Urinary tract infections in the elderly: a review of disease characteristics and current treatment options. Drugs Context. 2020 Jul 8; 9:2020-4-13. doi: 10.7573/dic.2020-4-13. PMID: 32699546; PMCID: PMC7357682.
2. Gajdács M, Ábrók M, Lázár A, Burián K. Urinary Tract Infections in Elderly Patients: A 10-Year Study on Their Epidemiology and Antibiotic Resistance Based on the WHO Access, Watch, Reserve (AWaRe) Classification. Antibiotics (Basel). 2021 Sep 11;10(9):1098. doi: 10.3390/antibiotics10091098. PMID: 34572680; PMCID: PMC8467796.
3. Tarek A, Abdalla S, Dokmak NA, Ahmed AA, El-Mahdy TS, Safwat NA. Bacterial Diversity and Antibiotic Resistance Patterns of Community-Acquired Urinary Tract Infections in Mega Size Clinical Samples of Egyptian Patients: A Cross-Sectional Study. Cureus. 2024 Jan 8;16(1): e51838. doi: 10.7759/cureus.51838. PMID: 38327928; PMCID: PMC10849261.
4. Bono MJ, Leslie SW, Reygaert WC. Uncomplicated Urinary Tract Infections. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470195/
5. Islam MA, Islam MR, Khan R, Amin MB, Rahman M, Hossain MI, et al. Prevalence, etiology and antibiotic resistance patterns of community-acquired urinary tract infections in Dhaka, Bangladesh. PLoS One. 2022 Sep 15;17(9): e0274423. doi: 10.1371/journal.pone.0274423. PMID: 36107878; PMCID: PMC9477272.
6. Fagan M, Lindbæk M, Grude N, Reiso H, Romøren M, Skaare D, et al. Antibiotic resistance patterns of bacteria causing urinary tract infections in the elderly living in nursing homes versus the elderly living at home: an observational study. BMC Geriatr. 2015 Aug 4; 15:98. doi: 10.1186/s12877-015-0097-x. PMID: 26238248; PMCID: PMC4523906.
7. Mortazavi-Tabatabaei SAR, Ghaderkhani J, Nazari A, Sayehmiri K, Sayehmiri F, Pakzad I. Pattern of Antibacterial Resistance in Urinary Tract Infections: A Systematic Review and Meta-analysis. Int J Prev Med. 2019 Oct 9; 10:169. doi: 10.4103/ijpvm.IJPVM_419_17. PMID: 32133087; PMCID: PMC6826787.
8. Mareș C, Petca RC, Popescu RI, Petca A, Geavlete BF, Jinga V. Uropathogens' Antibiotic Resistance Evolution in a Female Population: A Sequential Multi-Year Comparative Analysis. Antibiotics (Basel). 2023 May 23;12(6):948. doi: 10.3390/antibiotics12060948. PMID: 37370266; PMCID: PMC10294854.
9. Nguyen HQ, Nguyen NTQ, Hughes CM, O'Neill C. Trends and impact of antimicrobial resistance on older inpatients with urinary tract infections (UTIs): A national retrospective observational study. PLoS One. 2019 Oct 3;14(10): e0223409. doi: 10.1371/journal.pone.0223409. PMID: 31581222; PMCID: PMC6776395.
10. Alhomayani FK, Alazwari NM, Alshhrani MS, Alkhudaydi AS, Basaba AS, Alharthi TM, et al. The prevalence of multiple drug resistant urinary tract infections: A single-centered, observational retrospective study in King Abdulaziz Specialized Hospital, Taif, Saudi Arabia. Saudi Med J. 2022 Aug;43(8):927-932. doi: 10.15537/smj.2022.43.8.20220238. PMID: 35964957; PMCID: PMC9749674.
11. Paul R. State of the Globe: Rising Antimicrobial Resistance of Pathogens in Urinary Tract Infection. J Glob Infect Dis. 2018 Jul-Sep;10(3):117-118. doi: 10.4103/jgid.jgid_104_17. PMID: 30166807; PMCID: PMC6100332.
12. Ho HJ, Tan MX, Chen MI, Tan TY, Koo SH, Koong AYL, et al. Interaction between Antibiotic Resistance, Resistance Genes, and Treatment Response for Urinary Tract Infections in Primary Care. J Clin Microbiol. 2019 Aug 26;57(9): e00143-19. doi: 10.1128/JCM.00143-19. PMID: 31243084; PMCID: PMC6711900.
13. Khan MA, Rahman AU, Khan B, Al-Mijalli SH, Alswat AS, Amin A, et al. Antibiotic Resistance Profiling and Phylogenicity of Uropathogenic Bacteria Isolated from Patients with Urinary Tract Infections. Antibiotics (Basel). 2023 Oct 3;12(10):1508. doi: 10.3390/antibiotics12101508. PMID: 37887209; PMCID: PMC10603882.
14. Miftode IL, Pasare MA, Miftode RS, Nastase E, Plesca CE, Lunca C, et al. What Doesn't Kill Them Makes Them Stronger: The Impact of the Resistance Patterns of Urinary Enterobacterales Isolates in Patients from a Tertiary Hospital in Eastern Europe. Antibiotics (Basel). 2022 Apr 20;11(5):548. doi: 10.3390/antibiotics11050548. PMID: 35625192; PMCID: PMC9137815.