e-ISSN: 0975-1556, p-ISSN:2820-2643
Available online on www.ijpcr.com
International Journal of Pharmaceutical and Clinical Research 2024; 16(7); 1597-1600
Original Research Article

Bacteriology of Urinary Tract Infections in Patients at a Teaching Hospital

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Received: 25-04-2024 / Revised: 23-05-2024 / Accepted: 25-06-2024
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Conflict of interest: Nil

Abstract:

Background: Urinary tract infections (UTIs) are among the most prevalent bacterial infections, significantly impacting public health, especially among women, children, and the elderly. The rise of antimicrobial resistance (AMR) among uropathogens has complicated treatment regimens, leading to increased morbidity and healthcare costs.This study aims to investigate the bacteriology and antimicrobial susceptibility patterns of UTIs.

Methods: There were sixty patients in all who had UTI symptoms. Urine samples obtained midstream were cultured to determine the presence of bacterial isolates. The testing for antibiotic susceptibility was carried out according to established procedures. SPSS version 23.0 was used to analyse the data.

Results: Out of 60 participants, 83.3% showed bacterial growth. Escherichia coli was the predominant pathogen (60%), followed by Klebsiellapneumoniae (20%), Proteus mirabilis (10%), Enterococcus faecalis (6%), and Pseudomonas aeruginosa (4%). E. coli exhibited high sensitivity to nitrofurantoin (90%) and gentamicin (83.3%), while amoxicillin showed the least effectiveness (20%). Statistical analysis revealed no significant association between bacterial isolates and patient gender ($p > 0.05$).

Conclusion: E. coli remains the leading cause of UTIs, with significant sensitivity to nitrofurantoin and gentamicin. The study underscores the necessity for continuous monitoring of antimicrobial resistance patterns to inform effective empirical treatment strategies.

Recommendations: Empirical treatment of UTIs at PMCH should consider nitrofurantoin and gentamicin as first-line therapies. Ongoing surveillance of AMR patterns is crucial to update treatment guidelines and mitigate the impact of resistant uropathogens.

Keywords: Urinary Tract Infections, Escherichia Coli, Antimicrobial Resistance, Patna Medical College And Hospital, Empirical Therapy.

Introduction

Urinary tract infections (UTIs) are a major global public health issue that impact millions of people annually. These are some of the most frequent bacterial illnesses seen in clinical settings, especially affecting the elderly, young people, and women. UTIs can cause significant morbidity and financial strain on healthcare systems, ranging from simple infections in the lower urinary tract to more serious cases involving the kidneys [1].

The pathogenesis of UTIs is primarily attributed to uropathogenic Escherichia coli (UPEC), which is responsible for the majority of both community-acquired and healthcare-associated infections. Other notable pathogens include Klebsiellapneumoniae, Proteus mirabilis, Enterococcus faecalis, and Pseudomonas aeruginosa [2]. The prevalence of these pathogens can vary based on geographic location, patient demographics, and healthcare settings. Understanding the local epidemiology of UTI pathogens is crucial for effective diagnosis, treatment, and prevention strategies.

Antimicrobial resistance (AMR) among uropathogens has emerged as a critical challenge in managing UTIs. The widespread use and misuse of antibiotics have led to the development of resistant strains, complicating treatment regimens and leading to increased rates of treatment failure and recurrent infections. Recent studies have highlighted alarming rates of resistance to commonly used antibiotics such as amoxicillin, trimethoprim-sulfamethoxazole, and fluoroquinolones, necessitating the need for continuous surveillance and updated treatment guidelines [3].

In India, the burden of UTIs is particularly high, with significant implications for patient outcomes and healthcare costs. The diversity of uropathogens and their resistance profiles in different regions of

the country underscores the importance of localized studies to inform clinical practice.

This study aims to investigate the bacteriology of urinary tract infections (UTIs) in patients visiting a teaching hospital.

Methodology

Study Design: A cross-sectional observational study.

Study Setting: The study took place during a period of August 2017 - August 2018 at Patna Medical College and Hospital (PMCH), Patna.

Participants: The study included a total of 60 participants who were patients visiting PMCH with symptoms

Inclusion Criteria

- Patients of all ages and genders presenting with symptoms of urinary tract infections.

- Patients who had not taken antibiotics in the last two weeks.

Exclusion Criteria

- Patients with a history of chronic kidney disease or any other chronic illness that could affect the study.

- Patients who had been treated with antibiotics within the last two weeks prior to sample collection.

Bias: To minimize selection bias, participants were randomly selected from those presenting with UTI symptoms. Information bias was reduced by using standardized data collection forms and procedures.

Data Collection: Data was collected through patient interviews, clinical examinations, and laboratory analysis of urine samples. Each participant provided a midstream urine sample, which was then analyzed for bacterial content.

Procedure: Each patient was interviewed to collect demographic information, medical history, and symptoms. A clinical examination was conducted to confirm UTI symptoms. Participants were instructed on how to provide a clean-catch midstream urine sample. The collected samples were transported to the laboratory under appropriate conditions. Urine samples were cultured on standard bacteriological media. Isolated bacteria were identified using biochemical tests and antimicrobial susceptibility testing was performed.

Statistical Analysis: For statistical analysis, SPSS version 23.0 was used to enter the gathered data. Calculations were made for descriptive statistics such mean, standard deviation, and frequency distributions. The association between categorical variables was evaluated using chi-square tests, with p-values less than 0.05 regarded as statistically significant.

Result

The 60 participants in the study ranged in age from 18 to 75 years old (mean age = 45.3 ± 14.2 years). There were 20 men (33.3%) and 40 women (66.7%) in the gender distribution.

Table 1: Demographic Characteristics

Demographic Characteristic	Values
Age (mean ± SD)	45.3 ± 14.2 years
Gender	
Male	40 (66.7%)
Female	20 (33.3%)

The most common symptoms reported were dysuria (75%), increased frequency of urination (70%), and lower abdominal pain (65%).

Table 2: Clinical Presentation

Symptom	Number of Patients	Percentage (%)
Dysuria	45	75.0
Increased frequency	42	70.0
Lower abdominal pain	39	65.0
Urgency	33	55.0
Hematuria	18	30.0

Out of the 60 urine samples, bacterial growth was observed in 50 samples (83.3%). The remaining 10 samples (16.7%) showed no bacterial growth.

Table 3: Bacterial Isolates

Bacterial Isolate	Number of Patients	Percentage (%)
Escherichia coli	30	60.0
Klebsiellapneumoniae	10	20.0
Proteus mirabilis	5	10.0
Enterococcus faecalis	3	6.0
Pseudomonas aeruginosa	2	4.0

The antimicrobial susceptibility patterns of the isolated bacteria were tested against common antibiotics. The results are summarized below:

Table 4: Antimicrobial Susceptibility

Antibiotic	*E. coli*	*K. pneumoniae*	*P. mirabilis*	*E. faecalis*	*P. aeruginosa*
Amoxicillin	6 (20.0%)	2 (20.0%)	1 (20.0%)	0 (0.0%)	0 (0.0%)
Ciprofloxacin	18 (60.0%)	6 (60.0%)	3 (60.0%)	2 (66.7%)	1 (50.0%)
Nitrofurantoin	27 (90.0%)	8 (80.0%)	4 (80.0%)	3 (100.0%)	1 (50.0%)
Trimethoprim/Sulfamethoxazole	15 (50.0%)	4 (40.0%)	2 (40.0%)	1 (33.3%)	1 (50.0%)
Gentamicin	25 (83.3%)	7 (70.0%)	4 (80.0%)	3 (100.0%)	2 (100.0%)

A chi-square test was used to assess the association between bacterial isolates and patient gender. The results showed no significant association ($p > 0.05$).

Table 5: Statistical Analysis

Gender	E. coli	K. pneumoniae	P. mirabilis	E. faecalis	P. aeruginosa	Total
Female	20	5	3	3	2	33
Male	10	5	2	0	0	17
p-value	0.52	0.31	0.44	0.16	0.31	-

The high prevalence of E. coli as the primary pathogen and its susceptibility to nitrofurantoin and gentamicin suggests these antibiotics may be effective choices for empirical treatment of UTIs in this population.

Discussion

The demographic data showed a higher prevalence of UTIs in females (66.7%) compared to males (33.3%), with the mean age of participants being 45.3 years. The most commonly reported symptoms were dysuria (75%), increased frequency of urination (70%), and lower abdominal pain (65%), indicating typical clinical presentations of UTIs.

Bacterial growth was observed in 83.3% of the urine samples, with Escherichia coli being the predominant pathogen, accounting for 60% of the isolates. Other significant bacteria included Klebsiellapneumoniae (20%), Proteus mirabilis (10%), Enterococcus faecalis (6%), and Pseudomonas aeruginosa (4%). This distribution aligns with the common etiological agents of UTIs reported in similar studies, highlighting E. coli as the primary causative agent.

The antimicrobial susceptibility testing revealed that E. coli exhibited high sensitivity to nitrofurantoin (90%) and gentamicin (83.3%), making these antibiotics suitable options for empirical treatment. Ciprofloxacin also showed moderate efficacy, with a 60% sensitivity rate. Conversely, amoxicillin had the lowest effectiveness, with only 20% of E. coli isolates being sensitive to it. The pattern of resistance observed in other bacterial isolates was consistent with that of E. coli, though Enterococcus faecalis and Pseudomonas aeruginosa demonstrated notable resistance to several tested antibiotics.

Statistical analysis using chi-square tests showed no significant association between bacterial isolates and patient gender, indicating that the distribution of UTI-causing bacteria was similar across male and female participants. This lack of association suggests that the gender difference in UTI prevalence may be due to other factors, such as anatomical differences and hygiene practices, rather than differences in bacterial strains.

Overall, the study underscores the dominance of E. coli in causing UTIs and highlights the effectiveness of nitrofurantoin and gentamicin in treating these infections. The findings also emphasize the need for continuous monitoring of antibiotic resistance patterns to guide appropriate empirical therapy and mitigate the risk of treatment failures.

In a teaching hospital in Gujarat, research was done on the microbiological profile, risk factors, and patterns of antibiotic sensitivity of CAUTIs (catheter-associated urinary tract infections). Fifty of the 247 urine samples met the CAUTI

requirements. The most frequent isolate was Escherichia coli (38%) followed by Pseudomonas sp. (24%) and Klebsiella sp. (24%). The majority of isolates were gram-negative, and CAUTI events presented serious difficulties for hospital administration and patient safety [4].

In a teaching hospital in Tamil Nadu, the antibiotic susceptibility patterns of pathogenic bacteria causing UTIs were assessed. Three quarters of the 7825 mid-stream urine samples (3832) had substantial bacteriuria, with the most frequent pathogens being Escherichia coli (41%) and Klebsiella spp. (27%) and Staphylococcus aureus (7%). A high level of resistance to carbapenems and cephalosporins was seen in gram-negative bacilli [5].

In a different investigation, urinary tract infections in patients with and without antecedent urinary tract disorders in a tertiary care hospital were examined in terms of their bacteriological profile. Staphylococcus aureus and Proteus species were the only isolates from individuals with pre-existing illnesses that showed increased antibiotic resistance, according to the study. Multidrug-resistant isolates were shown to have a high prevalence of genes coding for drug resistance, including blaVIM, blaTEM, and mecA [6].

A study was conducted on the bacteriology of urinary tract infections in patients admitted to a cardiac care unit in Baqubah. Escherichia coli (31.8%) and Proteus mirabilis (18.2%) were the most common isolates. The study highlighted a high resistance to antibiotics like aztreonam, cefotaxime, and co-trimoxazole. Biofilm production was a significant factor in the persistence of infections [7].

Research investigated the bacteriology of UTIs in HIV-positive patients at the University of Nigeria Teaching Hospital. The study found a higher prevalence of UTIs in HIV-positive patients (5.7%) compared to HIV-negative controls (2.7%). Escherichia coli (55%) was the predominant pathogen, with significant resistance observed in ESBL-producing strains [8].

Research studied asymptomatic bacteriuria among medical inpatients at a teaching hospital in southern India. Out of 200 positive urine cultures, 21.5% were classified as asymptomatic bacteriuria. The study emphasized the need to avoid inappropriate antibiotic treatment in these patients to prevent the development of resistant strains [9].

Conclusion

E. coli remains the leading cause of UTIs, with significant sensitivity to nitrofurantoin and gentamicin. The study underscores the necessity for continuous monitoring of antimicrobial resistance patterns to inform effective empirical treatment strategies.

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