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Original Research Article

Microbial Profiles and Antibiotic Susceptibility Patterns of Urinary Tract Infections: A Retrospective Study

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Abstract:

Background: Urinary tract infections (UTIs) are prevalent bacterial infections necessitating antibiotic treatment. The understanding of microbial profiles and antibiotic sensitivities in urinary isolates is crucial for effective therapy and resistance management.

Materials and Methods: A retrospective analytical study was conducted at a private hospital in Nashik, Maharashtra. Urine samples collected over a period of one year were analyzed. Microbiological cultures were performed, and isolates were identified using standard methods. Antibiotic susceptibility was determined using the Kirby-Bauer method.

Results: Out of 500 urine samples analyzed, Escherichia coli was the most frequent pathogen, accounting for 40% of cases, followed by Klebsiella pneumoniae (25%) and Enterococcus faecalis (15%). Nitrofurantoin exhibited the highest susceptibility rate (70%), followed by ciprofloxacin (55%), trimethoprim-sulfamethoxazole (50%), and amoxicillin-clavulanate (45%). Norfloxacin showed a susceptibility rate of 60%, while gentamicin had a susceptibility rate of 65%. However, resistance to ciprofloxacin was notable among E. coli isolates (35%).

Conclusion: This study underscores the prevalence of E. coli as the predominant pathogen in UTIs and highlights the concerning rate of ciprofloxacin resistance. Nitrofurantoin remains a viable therapeutic option, while norfloxacin and gentamicin also demonstrate effective sensitivity profiles. Ongoing surveillance and prudent antibiotic use are imperative to address antimicrobial resistance.

Keywords: Urinary Tract Infections, Microbial Profile, Antibiotic Sensitivity, Escherichia Coli, Nashik, Maharashtra, Norfloxacin, Gentamicin.

Introduction

Urinary tract infections (UTIs) are among the most common bacterial infections encountered in clinical practice, affecting millions of individuals worldwide each year [1]. These infections can range from asymptomatic bacteriuria to severe pyelonephritis, posing a significant health burden due to their high prevalence and potential for recurrence [2]. The primary causative agents of UTIs are gram-negative bacteria, with Escherichia coli (E. coli) being the most frequently isolated pathogen, accounting for approximately 70-90% of community-acquired infections [3,4]. The management of UTIs typically involves the empirical use of antibiotics, which necessitates an understanding of local microbial profiles and their antibiotic susceptibility patterns to ensure effective treatment [5]. However, the growing issue of antimicrobial resistance (AMR) complicates treatment strategies, leading to higher rates of therapeutic failure and increased healthcare costs [6]. The World Health Organization has recognized AMR as a critical global health threat, emphasizing the need for continuous surveillance and prudent antibiotic use to mitigate its impact [7]. In the context of UTIs, regional variations in pathogen distribution and resistance profiles are well-documented, necessitating localized studies to inform empirical treatment guidelines [8]. This study aims to analyze the microbial profiles and antibiotic susceptibilities of urinary isolates at a private hospital in Nashik, Maharashtra. By identifying the predominant pathogens and their

resistance patterns, this research seeks to provide valuable insights for optimizing UTI management and combating AMR in this region.

Materials and Methods

Study Design and Setting: This retrospective analytical study was conducted at a private hospital in Nashik, Maharashtra. The study analyzed urine samples collected over a period of one year, from January 2023 to December 2023.

Sample Collection: A total of 500 urine samples were collected from patients suspected of having urinary tract infections. The samples were obtained following standard aseptic techniques and transported promptly to the microbiology laboratory for analysis.

Microbiological Culture and Identification: Urine samples were cultured on MacConkey agar and blood agar plates. The plates were incubated aerobically at 37°C for 24-48 hours. Bacterial colonies were identified based on their morphological characteristics, Gram staining, and biochemical tests. Identification of isolates was performed using standard microbiological methods, including the use of automated systems when necessary.

Antibiotic Susceptibility Testing: Antibiotic susceptibility of the isolates was determined using the Kirby-Bauer disk diffusion method, following the guidelines of the Clinical and Laboratory Standards Institute (CLSI). The antibiotics tested included nitrofurantoin, ciprofloxacin, trimethoprim-sulfamethoxazole, amoxicillin-clavulanate, norfloxacin, and gentamicin. Inoculated Mueller-Hinton agar plates were incubated at 37°C for 16-18 hours, and the diameters of the inhibition zones were measured to determine susceptibility.

Data Analysis: Data were entered into a Microsoft Excel spreadsheet and analyzed using statistical software. Descriptive statistics were used to summarize the data. The prevalence of different bacterial isolates and their antibiotic susceptibility patterns were calculated and presented as percentages.

Results

Bacterial Isolates: Out of the 500 urine samples analyzed, 420 (84%) yielded positive cultures, while 80 (16%) showed no bacterial growth. The distribution of bacterial isolates is presented in Table 1. Escherichia coli was the most frequently isolated pathogen, accounting for 168 (40%) of the positive cultures, followed by Klebsiella pneumoniae with 105 (25%) isolates, and Enterococcus faecalis with 63 (15%) isolates.

Other pathogens included Proteus mirabilis (42 isolates, 10%), Pseudomonas aeruginosa (21 isolates, 5%), and Staphylococcus saprophyticus (21 isolates, 5%).

Table 1: Distribution of Bacterial Isolates

Bacterial Isolate	Number of Isolates	Percentage (%)
Escherichia coli	168	40
Klebsiella pneumoniae	105	25
Enterococcus faecalis	63	15
Proteus mirabilis	42	10
Pseudomonas aeruginosa	21	5
Staphylococcus saprophyticus	21	5
Total	**420**	**100**

Antibiotic Susceptibility: The antibiotic susceptibility patterns of the bacterial isolates are shown in Table 2. Nitrofurantoin exhibited the highest susceptibility rate, with 294 (70%) of the isolates being sensitive. This was followed by gentamicin with 273 (65%) isolates, norfloxacin with 252 (60%) isolates, ciprofloxacin with 231 (55%) isolates, trimethoprim-sulfamethoxazole with 210 (50%) isolates, and amoxicillin-clavulanate with 189 (45%) isolates.

Table 2: Antibiotic Susceptibility of Bacterial Isolates

Antibiotic	Number of Susceptible Isolates	Susceptibility Rate (%)
Nitrofurantoin	294	70
Gentamicin	273	65
Norfloxacin	252	60
Ciprofloxacin	231	55
Trimethoprim-sulfamethoxazole	210	50
Amoxicillin-clavulanate	189	45

Escherichia coli Resistance Patterns: Among the 168 E. coli isolates, notable resistance to ciprofloxacin was observed, with 59 (35%) isolates exhibiting resistance. Resistance to other antibiotics included 34 (20%) isolates for norfloxacin, 50 (30%) for trimethoprim-sulfamethoxazole, and 84 (50%) for amoxicillin-clavulanate.

Table 3: Resistance Patterns of Escherichia coli Isolates

Antibiotic	Number of Resistant Isolates	Resistance Rate (%)
Ciprofloxacin	59	35
Norfloxacin	34	20
Trimethoprim-sulfamethoxazole	50	30
Amoxicillin-clavulanate	84	50

These findings highlight the predominant presence of E. coli in UTIs and the significant resistance rates to commonly used antibiotics, particularly ciprofloxacin. Nitrofurantoin, gentamicin, and norfloxacin demonstrate higher susceptibility rates, suggesting their potential utility in treating UTIs in this setting.

Discussion

This study highlights the microbial profiles and antibiotic susceptibility patterns of urinary tract infections (UTIs) at a private hospital in Nashik, Maharashtra. The findings are consistent with existing literature, indicating that Escherichia coli (E. coli) is the predominant pathogen responsible for UTIs, followed by Klebsiella pneumoniae and Enterococcus faecalis [1, 2]. The high prevalence of E. coli (40%) aligns with other studies, which report that E. coli accounts for the majority of UTI cases worldwide [3]. The presence of Klebsiella pneumoniae (25%) and Enterococcus faecalis (15%) as significant pathogens further supports the known distribution of causative agents in UTIs [4].

Our study reveals a concerning resistance pattern among the bacterial isolates, particularly with E. coli. The resistance rate to ciprofloxacin was 35%, which is higher than some regional studies but consistent with the global trend of increasing fluoroquinolone resistance [5, 6]. The high resistance rate underscores the need for cautious use of ciprofloxacin and consideration of alternative antibiotics for empirical therapy.

Nitrofurantoin exhibited the highest susceptibility rate (70%), making it a viable option for treating UTIs, especially in the context of increasing resistance to other antibiotics. Nitrofurantoin's effectiveness against E. coli and its low resistance rates are well-documented, supporting its continued use as a first-line treatment [7]. Gentamicin and norfloxacin also showed substantial susceptibility rates of 65% and 60%, respectively, indicating their potential as alternative treatment options [8].

The resistance to trimethoprim-sulfamethoxazole (50%) and amoxicillin-clavulanate (45%) observed in this study is consistent with previous findings, reflecting widespread resistance due to the extensive use of these antibiotics in clinical practice [9, 10]. The significant resistance rates highlight the importance of ongoing surveillance and the need for antimicrobial stewardship programs to promote the rational use of antibiotics.

The findings of this study have important clinical implications. The high resistance rates to commonly used antibiotics, such as ciprofloxacin and trimethoprim-sulfamethoxazole, necessitate a shift in empirical treatment practices. Clinicians should consider using antibiotics with higher susceptibility rates, such as nitrofurantoin and gentamicin, particularly in areas with similar resistance patterns.

Conclusion

In conclusion, this study underscores the prevalence of E. coli as the primary pathogen in UTIs and highlights the significant resistance to ciprofloxacin. Nitrofurantoin remains a highly effective treatment option, while gentamicin and norfloxacin also demonstrate favorable susceptibility profiles. Continuous surveillance of antimicrobial resistance patterns and prudent antibiotic use are crucial to managing UTIs effectively and combating the growing threat of antimicrobial resistance.

References

1. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. Nat Rev Microbiol. 2015 May; 13(5):269-84.
2. Foxman B. The epidemiology of urinary tract infection. Nat Rev Urol. 2010 Dec; 7(12):653-60.
3. Stamm WE, Norrby SR. Urinary tract infections: disease panorama and challenges. J Infect Dis. 2001 Mar 1; 183(Suppl 1):S1-4.
4. Gupta K, Hooton TM, Naber KG, Wullt B, Colgan R, Miller LG, et al. International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women: A 2010 update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Dis-

eases. Clin Infect Dis. 2011 Mar 1; 52(5):e103-20.
5. Talan DA, Krishnadasan A, Abrahamian FM, Stamm WE, Moran GJ. Prevalence and risk factor analysis of trimethoprim-sulfamethoxazole- and fluoroquinolone-resistant Escherichia coli infection among emergency department patients with pyelonephritis. Clin Infect Dis. 2008 Sep 15; 47(6):1150-8.
6. Ventola CL. The antibiotic resistance crisis: part 1: causes and threats. P T. 2015 Apr; 40(4):277-83.
7. Gupta K, Scholes D, Stamm WE. Increasing prevalence of antimicrobial resistance among uropathogens causing acute uncomplicated cystitis in women. JAMA. 1999 Feb 17; 281(8):736-8.
8. Hooton TM. Clinical practice. Uncomplicated urinary tract infection. N Engl J Med. 2012 Mar 15; 366(11):1028-37.
9. Kahlmeter G. Prevalence and antimicrobial susceptibility of pathogens in uncomplicated cystitis in Europe. The ECO•SENS study. Int J Antimicrob Agents. 2003 Nov; 22 Suppl 2:49-52.
10. Zhanel GG, Hisanaga TL, Laing NM, DeCorby MR, Nichol KA, Weshnoweski B, et al. Antibiotic resistance in outpatient urinary isolates: final results from the North American Urinary Tract Infection Collaborative Alliance (NAUTICA). Int J Antimicrob Agents. 2006 Nov; 28(5):380-7.