

Comparison of Efficacy of Nitrofurantoin and Ciprofloxacin in Urinary Tract Infections Due to Escherichia Coli

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Abstract: Background: Urinary tract infections (UTIs) impose a global health challenge contributing to a significant number of morbidity and mortality. Also, increasing trend Antimicrobial resistance (AMR) is a thing of great concern. This study is aimed at evidence based empirical guidelines in cases of UTI due to infection by Escherichia coli. Since more than 80% isolates were E.coli in this region we aimed at this particular species. Objective: To compare the efficacy of Nitrofurantoin and Ciprofloxacin in cases of urinary tract infections due to Escherichia coli. Place And Duration: This is a retrospective observational analysis and the study was conducted in Srinivas Institute of Medical Sciences and Research Centre, Mukka, Suratkal, Mangalore, in the Department of Microbiology from May 2025 to December 2025. Materials and Methods: A total of 1200 patients with Urinary tract infections were selected for the study. Clean catch mid-stream samples were collected from adult patients with aseptic precautions. Bacterial flora were isolated by standard microbiological methods and antimicrobial susceptibility testing was done by Kirby Bauer's disc diffusion method. A Chi-square test was performed to compare the sensitivity of Escherichia coli isolates to Nitrofurantoin and Ciprofloxacin. Sensitivity to Nitrofurantoin (89.1%) was significantly higher than Ciprofloxacin (71.7%). Results: A total of 1200 samples were analysed of which 870 cases were sterile. 330 samples were culture positive of which 276 samples showed the growth of Escherichia coli (83.6%), 32 samples yielded Klebsiella pneumoniae (9.7%) and 22 samples showed the growth of other organisms like Enterococci (4.8 %) and Staphylococci (1.9 %). Only the Escherichia coli isolates were considered for this study as more than 80% cases yielded this organism in pure culture and were tested for the drug sensitivity testing against Nitrofurantoin and Ciprofloxacin using Kirby Bauer's method. From the total of 276 isolates 246 isolates were sensitive to Nitrofurantoin (89.1%) and 198 were found to be sensitive to Ciprofloxacin (71.7 %) and 158 isolates (57.2%) were sensitive to both Nitrofurantoin and Ciprofloxacin. In this study, of the total 276 cultures 69 belonged to male patients, 207 belonged to females making evident that females are more susceptible to UTI than males. Conclusion: 1) Nitrofurantoin and Ciprofloxacin can be used for Urinary tract infection cases in empirical treatment. 2) Compared to Ciprofloxacin drug, Nitrofurantoin was found to be more better a drug.

Keywords: Urinary tract infections, Escherichia coli, Nitrofurantoin, Ciprofloxacin, Antimicrobial resistance

Inclusion Criteria

- Positive urine cultures which were due to Escherichia coli with significant growth irrespective of age and gender.

Exclusion Criteria

- Patients who had taken antibiotic in the past five days.
- Patients with impaired renal functions.

1. Introduction

Urinary tract infections (UTI) is one of the most common infections in all age groups ranging from neonates to geriatric age group and also they cause significant morbidity and mortality. Each and every woman has a lifetime risk of developing UTI is 60%; by contrast, men have a lifetime risk of only 13%. [1]

Females are more susceptible to UTI as compared to males due to the short length of urethra, absence of prostatic secretion, pregnancy and easy contamination of the tract with faecal flora. [2] in our study male to female ratio was found to be 1 : 3. (69: 207)

E. coli is the most common organism causing UTI which accounts for up to 83.6 % of cases followed by Klebsiella pneumoniae which contributed for 9.7 % of cases in this study. Enterococci and Staphylococci contributed to less number of cases (4.8 % and 1.9 % respectively)

UTIs are usually managed empirically without urine culture or susceptibility testing which may lead to the frequent misuse of antibiotics. The AMR pattern (antimicrobial resistance) of UTI-causing microorganisms keeps changing from time to time and from place to place. Most commonly UTIs are treated empirically; in that case the criteria for the selection of antimicrobial agents should be determined on the basis of the most likely pathogen and its expected resistance pattern in that geographic area. Hence, the periodic monitoring of etiologic agents of UTI and their resistance pattern is very essential. The aim of the study is to determine the prevalence of UTI and to analyze the recent sensitivity pattern of Escherichia coli, a major urinary pathogen, in the management of UTI which may help and guide the Medical Practitioners to carry out empirical treatment.

2. Materials And Methods

The Present study is a retrospective study on UTI and was conducted at the Microbiology department of Srinivas Institute of Medical sciences and Research centre, Mangalore, Karnataka.

Midstream urine specimens were made to collect in sterile wide mouth glass container as per the standard operating procedures. Samples were plated using calibrated wire loops (0.001 ml) on medium, MacConkey agar and blood agar and then incubated aerobically at 37 °C for 24 h. From positive

cultures, isolates were identified according to the standard operating procedures.

Antimicrobial susceptibility tests were done as per Kirby-Bauer disk diffusion method. The antimicrobial susceptibility against Nitrofurantoin (300 µg), and Ciprofloxacin (5 µg) were recorded into Excel for analysis and also the statistical analysis was done.

3. Results

A total of 1200 samples collected during a period of eight months (from May 2025 to December 2025) were analysed in this study of which 870 cases were sterile. 330 samples were culture positive of which 276 samples showed the growth of *Escherichia coli* (83.6%), 32 samples yielded *Klebsiella pneumoniae* (9.7%) and 22 samples showed the growth of other organisms like Enterococci (4.8%) and Staphylococci (1.9 %).

Table 1

Number [of total 330]	Isolate	Percentage
276	<i>Escherichia coli</i>	83.6
32	<i>Klebsiella pneumoniae</i>	9.7
16	Enterococci	4.8
06	Staphylococci	1.9

Only the *Escherichia coli* isolates were tested against Nitrofurantoin and Ciprofloxacin considering the majority number of pathogens and the commonly used antibiotics in our country.

From the total of 276 isolates 246 isolates were sensitive to Nitrofurantoin (89.1%) and 198 were found to be sensitive to Ciprofloxacin (71.7 %) in our study.

Table 2

Antibiotic	Sensitive	Resistant
Nitrofurantoin	89.1%	10.9 %
Ciprofloxacin	71.7%	27.3 %

4. Discussion

Even though majority of the UTI cases are uncomplicated infections and are treated empirically, it still is a major problem for the well-being of an individual. Rarely they result in severe complications like renal damage or septicemia.

Although the incidence of UTI is higher in females, they are not uncommon in males. Antimicrobial resistance [AMR] has become a very serious problem throughout the world. Periodic assessment of in vitro susceptibility pattern of UTI pathogens serves to some extent as a guide for antibiotic therapy. In order to prevent resistance to antibiotics, appropriate therapy as per bacterial sensitivity pattern needs to be initiated.

High prevalence was observed in females as compared to males (females 207 and 69 males, that is 3 :1) which goes in par with the study conducted at Bhatia Hospital, Mumbai during July 2018. [3]

Since this is a retrospective study and is based on the results of routine microbiological tests carried out in 2025 due to the nature of the retrospective analysis, we couldn't trace patient's clinical settings. Thus, the study did not consider the features such as inpatient and outpatients, catheterized and non-catheterized patients.

Chi square analysis as per SPSS

A total of 1200 urine samples were analyzed, of which 330 (27.5%) were culture positive. Among the positive cultures, the majority of isolates were *Escherichia coli* (n = 276, 83.6%), followed by *Klebsiella pneumoniae*, (n = 32, 9.7%), and other organisms including Enterococci and Staphylococci (n = 22, 6.7%).

A chi-square goodness-of-fit test demonstrated that the distribution of organisms differed significantly from an equal distribution, $\chi^2(2, N = 330) = 332.07, p < .001$, indicating a statistically significant predominance of *Escherichia coli*.

Among the 276 *Escherichia coli* isolates included in the study, 69 (25%) were from male patients and 207 (75%) were from female patients. A chi-square test showed a statistically significant difference in UTI occurrence between genders, $\chi^2(1, N = 276) = 68.98, p < .001$, suggesting that females were significantly more affected than males.

Regarding antimicrobial susceptibility, 246 isolates (89.1%) were sensitive to Nitrofurantoin and 198 isolates (71.7%) were sensitive to Ciprofloxacin. Additionally, 158 isolates (57.2%) were sensitive to both antibiotics. Nitrofurantoin demonstrated higher sensitivity rates compared to Ciprofloxacin among *Escherichia coli* isolates.

5. Conclusion

- 1) Major culprit in the cases of UTI is *Escherichia coli* as is evident in many other studies all over the world.
- 2) Drug resistance among bacterial pathogens is changing with time and place.
- 3) Regular surveillance and monitoring is very essential to provide clinicians the information of empirical treatment.
- 4) Nitrofurantoin can be considered as the main drug for UTI cases considering its efficacy, cost and safety of use in both males, females, pregnancy and children.
- 5) Second drug that can be considered will be Ciprofloxacin as per our study.
- 6) Females are more affected by UTI compared to males due to shorter urethra, hormonal changes during menstruation or pregnancy or during oldage.

References

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