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Original Research Article

Determination of nitrofurantoin and fosfomycin susceptibility among urinary *Escherichia coli* isolates

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ABSTRACT

Background: Urinary tract infections (UTIs) are one of the most common infections. For treatment of UTIs, there are limited antibiotics due to increased resistance among uropathogens. Two older antibiotics; Nitrofurantoin and Fosfomycin have become novel oral therapeutic options against uropathogens. Aim of the study was to identify UTI causing micro-organisms and evaluate in-vitro activity of nitrofurantoin and fosfomycin against most common isolated organism (*E. coli*).
Methods: Results of urine samples culture and susceptibility testing over a period of 1 year were analysed and included in this study.
Results: Micro-organisms were isolated from 568 urine samples. Most commonly isolated organism was *Escherichia coli* (40.50%), followed by *Klebsiella* spp. (20.07%) and *Staphylococcus spp.* (17.07%). Susceptibility of *E. coli* to nitrofurantoin and fosfomycin was 91.74% and 65.65% respectively.
Conclusion: Good activity of nitrofurantoin and fosfomycin against *E. coli* indicates that these two drugs are potential therapeutic alternatives for urinary tract infections.

Keywords: Urinary tract infections, *E. coli*, Nitrofurantoin, Fosfomycin

INTRODUCTION

Urinary tract infections (UTI) are one of the most common infections, affecting people from all population and age groups. It accounts for 25% of all infections.[1] Every year approximately 150 million people are diagnosed with urinary tract infection worldwide.[2]

Usually UTI is managed empirically, leading to antimicrobial agents misuse, development of multi-drug resistance among urinary pathogens and failure of empirical therapy. Empirical antimicrobial agent selection may be determined on the basis of most likely urinary pathogen and its expected susceptibility pattern. Distribution of urinary pathogen and susceptibility to antibiotics varies in different geographic area and time to time. So periodic monitoring of UTI causing organisms and their susceptibility pattern is necessary for effective empirical treatment and management of patients with urinary tract infection.[3–5]

Due to lack of effective therapeutic alternatives to treat multi-drug-resistant infections, old antibiotics like nitrofurantoin, fosfomycin, have become important. Nitrofurantoin, fosfomycin are oral antibiotics and attain high concentrations in the urinary tract with minimal systemic effect.[6,7]

Objective of this study was to determine UTI causing pathogens in patients at a tertiary care center and in vitro

susceptibility of most commonly isolated micro-organism to fosfomycin and nitrofurantoin to choose for empirical treatment of UTI.

METHOD

Study design

The Present study is a retrospective study on UTI in which analysis of urinary culture results is done. This study was conducted at the Microbiology department of Rama Medical College, Hospital & Research Centre, Hapur, U.P. Data of micro-organism isolated from urine culture and the antimicrobial susceptibility profiles were collected from the records. Then data were entered into Excel and statistical analysis was done.

Microbiological methods

All the urine specimens were submitted in sterile wide mouth, screw capped container and processed within 30 minutes of collection.

Urine routine microscopy

Urine specimens were screened manually under high power objective (400X) of optical microscope for presence of leucocytes, RBCs, casts, crystals, bacteria, and budding yeast like cells.

Culture and isolate identification

Urine samples were inoculated on cysteine lactose electrolyte-deficient medium (CLED agar, Hi-Media, India) using semi-quantitative techniques and incubated aerobically at 37 °C for 18-24 hrs. Cultures were examined for growth and colonies counted for determination of significant bacteriuria.

A growth of $\geq 10^5$ CFU/ml was considered as significant bacteriuria, suggestive of UTI. Isolates were identified by standard biochemical procedures. Only a single positive culture per patient was included in the analysis.

Antimicrobial susceptibility tests

Antimicrobial Susceptibility Tests were done on Mueller Hinton agar medium as per Kirby-Bauer disk diffusion method. Nitrofurantoin (300 µg), Fosfomycin (200 µg) were tetsed against urinary *Escherichia coli* isolates. Results were analyzed according to Clinical and Laboratory Standards Institute (CLSI) 2018 guidelines. *E. coli* ATCC 25922 was used as quality control strain.

RESULT

A total of 568 bacterial strains were isolated from the urine samples of indoor patients, who were admitted to the hospital from 1st December 2017 to 30th November 2018.

of these 568 patients with significant growth of organisms, 374 (65.85%) were male and 194 (34.15%) were female. Total 39(6.87%) were of pediatric age group (<18 years) and rest 529(93.13%) were of adult population. Gram negative bacilli (n=407) (71.65%) isolates were more than Gram positive cocci (n=161) (28.35%). *Escherichia coli* (n=230) (40.50%) was the most common isolated organism, followed by *Klebsiella pneumoniae* (n=114) (20.07%) and *Staphylococcus aureus* (n=97) (17.07%) (Table1).

Table 1: Bacterial isolates from urine.

Bacterial Isolates	No. of Strains	Percentage
Escherichia coli	230	40.50
Klebsiella pneumoniae	114	20.07
Staphylococcus aureus	97	17.07
***Enterococcus* species**	39	6.87
***Citrobacter* species**	33	5.81
Coagulase negative *Staphylococcus* species	25	4.40
***Pseudomonas* species**	23	4.05
***Proteus* species**	07	1.23
Total	568	100

Among all isolated *Escherichia coli* (230), Nitrofurantoin susceptible strains were 211 (91.74%) and Fosfomycin susceptible were 151 (65.65%) (Table 2).

Table 2: Nitrofurantoin and Fosfomycin Susceptibility among *Escherichia coli* isolates.

Susceptibility	Nitrofurantoin	Fosfomycin
Susceptible	211 (91.74)	151 (65.65)
Resistant	19 (8.26)	79 (34.35)

Three (1.30%) isolates were resistant to nitrofurantoin only and 66 (28.70%) were resistant to fosfomycin only. Total 16 (6.95%) isolates were resistant to both the drugs.

DISSCUTION

Urinary tract infection is one of the most common infectious diseases worldwide. In the present study, Gram negative bacilli (71.65%), contributed more of the total bacterial isolates than gram positive cocci (28.35%) in causing UTI. *Escherichia coli* (40.50%) was the most common isolated bacteria and *Klebsiella pneumoniae* was the second most frequently isolated organism. These results were consistent with previous studies by Kothari et al, Pardeshi et al, Akram et al, Karishetti et al, Banerjee et al, Vijayganapathy et al, where 68%, 53.77%, 61%, 56.60%, 60.67%, 66.6% isolates were *E. coli* and 16.9%, 27.4%, 22%, 13%, 18.82%, 15.7% isolates were *K. pneumoniae* respectively.[2,3,8-11] Most common UTI causing gram positive organism was found to be *Staphylococcus aureus* (17.07%) in this study, similar to results of studies by Pardeshi et al, Devanand et al while

in other studies it was *Enterococcus spp.*, followed by *Staphylococcus aureus*.[3,9,10,12]

In the present study, *E. coli* isolates were having good in-vitro susceptibility for nitrofurantoin (91.74%), which is quite high compared to some previous studies which was found to be 75.6% (Kothari et al), 79.62% (Pardeshi et al), 72.33%, (Patel et al), 82.3% (Sardar et al), 20% (Akram et al), 74.24 (Devanand et al).[2,3,5,6,8,12]

In this study Fosfomycin susceptibility against *E.coli* was 65.65%, which was found to be more susceptible in various other studies, 100% (Sardar et al, and Maraki et al) 98.14% Banerjee et al, 99.6% Udyan et al.[6,10,13,14] Reason may be excessive use of drug in some regions which may have led to resistance to fosfomycin.

CONCLUSION

In the present study, Nitrofurantoin shows good in vitro activity against most common isolate of urinary pathogen than fosfomycin. But fosfomycin is more convenient to take as it is available in oral, single dose formulation. Both the drugs have potential to be used for empirical treatment of UTI. However, further studies are required to evaluate the in vitro resistance profiles of fosfomycin and nitrofurantoin among uropathogens.

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REFERENCES

1. Ahmed MA, Shukla GS, Bajaj HK. Incidence of Urinary Tract Infections and determination of their susceptibility to antibiotics among Pregnant Women. Int J Cell Sci Biotechnol. 2016;5:12-6.
2. Kothari A, Sagar V. Antibiotic resistance in pathogens causing community-acquired urinary tract infections in India: a multicenter study. J Infect Dev. 2008;2(5):354-8.
3. Pardeshi P. Prevalence of urinary tract infections and current scenario of antibiotic susceptibility pattern of bacteria causing UTI. Indian J Microbiol Res. 2018;5(3):334-8.
4. Chaudhari VL. Profile and antimicrobial susceptibility pattern of urinary bacterial isolates at a tertiary care hospital in central india Biomedical European of profile and antimicrobial susceptibility pattern of urinary. 2016;3(7):2-6.
5. Patel H, Soni S, Bhagyalaxmi A, Patel N. Causative agents of urinary tract infections and their antimicrobial susceptibility patterns at a referral center in Western India: An audit to help clinicians prevent antibiotic misuse. J Fam Med Prim Care. 2019;8(1):154.
6. 6. Sardar A, Basireddy SR, Navaz A, Singh M, Kabra V. Comparative evaluation of fosfomycin activity with other antimicrobial agents against E.Coli isolates from urinary tract infections. J Clin Diagnostic Res. 2017;11(2):DC26-DC29.
7. Gardiner BJ, Stewardson AJ, Abbott IJ, Peleg AY. Nitrofurantoin and fosfomycin for resistant urinary tract infections: Old drugs for emerging problems. Aust Prescr. 2019;42(1):14-9.
8. Akram M, Shahid M, Khan AU. Etiology and antibiotic resistance patterns of community-acquired urinary tract infections in J N M C Hospital Aligarh, India. Ann Clin Microbiol Antimicrob. 2007;6:1-7.
9. Karishetti M, Shaik H. Clinicomicrobial assessment of urinary tract infections in a tertiary care hospital. Indian J Heal Sci Biomed Res. 2019;12(1):69.
10. Banerjee S, Sengupta M, Sarker T. Fosfomycin susceptibility among multidrug-resistant, extended-spectrum beta-lactamase-producing, carbapenem-resistant uropathogens. Indian J Urol. 2017;33(2):149.
11. Vijayganapathy S, Karthikeyan V, Mallya A, Mythri K, Viswanatha R, Keshavamurthy R. Antimicrobial resistance patterns in a tertiary care nephro-urology center in South India. J Integr Nephrol Androl. 2018;5(3):93.
12. Prakash D, Saxena RS. Distribution and Antimicrobial Susceptibility Pattern of Bacterial Pathogens Causing Urinary Tract Infection in Urban Community of Meerut City, India. ISRN Microbiol. 2013;1-13.
13. Maraki S, Samonis G, Rafailidis PI, Vouloumanou EK, Mavromanolakis E, Falagas ME. Susceptibility of urinary tract bacteria to fosfomycin. Antimicrob Agents Chemother. 2009;53(10):4508-10.
14. Udayan D, Khan S, Pullanhi U, Kumar A. Fosfomycin as a promising alternative to treat urinary tract infection due to multidrug resistant uropathogens. Turkish J Urol. 2018;44(6):515.

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