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A prospective study on activity of Fosfomycin on uropathogenic Escherichia coli

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Abstract: *Introduction:* Urinary tract infections (UTIs) are a major global health concern, affecting millions annually. *Escherichia coli* is the most common pathogen responsible for both community-acquired and hospital-associated UTIs. Fosfomycin, an older antibiotic, has gained attention for its efficacy against multidrug-resistant pathogens. This study aims to evaluate the activity of Fosfomycin against uropathogenic *E.coli* in Fosfomycin-naïve patients. *Materials and Methods:* A four-month study was conducted at Rajarajeswari Medical College and Hospital. Urine samples were collected from patients with clinical symptoms of UTIs and processed for microscopy, culture, and antibiotic sensitivity testing. *E.coli* isolates were tested for susceptibility to Fosfomycin using the Kirby Bauer disk diffusion method. *Results:* Of the 1350 samples, 480 yielded bacterial growth, with *E.coli* accounting for 62% of the isolates. Among the *E.coli* isolates, 98% were sensitive to Fosfomycin, demonstrating its high efficacy against multidrug-resistant strains. The study also showed that Fosfomycin had superior efficacy compared to other common antibiotics like nitrofurantoin and ciprofloxacin. *Conclusion:* Fosfomycin proves to be a highly effective treatment option for multidrug-resistant *E.coli* in UTIs, with a single-dose regimen, strong in vitro activity, and minimal side effects. It should be considered as a treatment of choice for complicated UTIs, also in cases of antibiotic failure or intolerance.

Keywords: Uropathogens*, E.coli*, Antibiotic resistance, Fosfomycin activity.

Introduction

Urinary tract infections (UTIs) are among the most common infectious diseases globally, with an estimated 150 million diagnosed annually, marking it as significant global health concern [1-2]. It is the most prevalent infection across all age groups even in neonatal and geriatric populations. Woman being the most common target group has around 60% of risk compared to 13% in men in their life time [3]. *Escherichia coli* is the primary causative pathogen in both community-acquired and hospital-associated urinary tract infections., accounting for 70–95% of acute and uncomplicated UTIs in adults, followed by *Klebsiellaspp, proteus spp* [4-5].

Recurrence rate is very high with Uropathogenic *E.coli* infections which is a major challenge for the treating physicians. Co-morbidities, emergence of drug resistance, recurrent infections stand as hurdles in the effective management of UTI [6-7]. Reassessment and taking into account the overlooked antibacterial medications is one approach to address this complex health issue [8].

One such agent is Fosfomycin, which is a better option for the treatment of UTI. Use of Fosfomycin for urinary tract infection is being advocated by clinicians and also urology standardsprobably because of its rapid absorption, availability for oral route of administration, concentration in urine,also their action on multi drug resistant and biofilm forming bacteria [9]. Thus the present study was done to determine the activity of Fosfomycin on uropathogenic *E.coli* in Fosfomycin naïve patients.

Material and Methods

The study was conducted in the department of Microbiology, Rajarajeswari medical college and hospital. The study was done for a period of 4 months (September 2024- December 2024). The study was approved by institutional ethical committee board with no RRMCH-IEC/09/2023.

Inclusion criteria: Patients presenting with clinical symptoms suggestive of UTI, such as dysuria, increased urinary frequency or urgency, burning micturition, suprapubic pain or discomfort, fever. Both inpatients and outpatients with suspected UTI. Male and female patients of all age groups were included in the study.

Exclusion Criteria: Isolates other than *Escherichia coli*were excluded from the study. Samples that yielded polymicrobial flora were not included in the study

Sample collection: Patients presenting with clinical symptoms of a urinary tract infection were instructed to collect urine samples using aseptic techniques in a wide-mouthed universal container. The samples were then promptly sent to the microbiology department for culture and sensitivity testing.

Processing of samples: The samples collected were processed immediately within 30 minutes for microscopy and culture. Urine microscopy was done to look for presence of inflammatory cells, bacteria by wet mount preparation. With standard calibrated loop urine was inoculated on CLED(cystine–lactose–electrolyte-deficient) agar and chocolate agar (considering enriched and differential media also as use of CLED support both Gram negative and Gram positive bacteria, these were routinely used in our institution for urine samples) by semi quantitative method.

The inoculated plates were incubated aerobically at 37^0c for 18-24hrs. Afterincubation, if the inoculated plate shows colonies of single type of bacteria with colony count more than 100000(10^5) it was further processed for identification and antibiotic susceptibility testing. The samples where the growth of bacteria is not observed after incubation were reported as no growth and reports were dispatched. Identification of the isolated bacterial pathogens was done on the basis of colony morphology, gram staining, and battery of biochemical tests as per standard protocol [10].

In our study we considered only *E.coli* isolates, as according to CLSI (Clinical & Laboratory Standards Institute) guidelines, Fosfomycin sensitivity interpretation by disk diffusion is available only for E.coli isolated. Hence *E.coli* were tested to antimicrobial sensitivity by using Kirby Bauer Disc Diffusion method according to Clinical and Laboratory Standards Institute (CLSI) guidelines [11].

The different antimicrobial agents that were tested are Amoxicillin/clavulonic acid (50/10 µg) cefotaxime (30 µg), ceftazidime (30 µg) ciprofloxacin (5 µg), norfloxacin (10 µg), gentamicin (10 µg), trimethoprim/ sulphamethoxazole (1.25 / 23.75 µg), amikacin (30 µg), nitrofurantoin (300 µg), piperacillin-tazobactam (100 / 10 µg), meropenem (30 µg). All the isolates of E.coli were tested with Fosfomycin (200 µg). As per CLSI guidelines disk diffusion is applicable to only urinary isolates of E.coli. A zone size of > 16mm is considered as sensitive and < 12mm is considered as resistant [11].

Statistical Analysis Data was entered in Microsoft Excel and analysed using SPSS software. Quantitative variables were expressed as percentages.

Results

The present study was done for a period of four months. A total of 1350 urinary samples were received from various departments. The culture yielded growth in 480 samples. The prevalence of UTI was 480/1350 (35.5%). Among them various isolates were identified as *E. coli, Klebsiella pneumonia, Klebsiellaoxytoca, Enterobacterspp, proteusspp, CONS (Coagulase negative staphylococcus*). Table 1 show distribution of various bacteria among culture positive isolates. Among the samples, few did not yield any bacterial growth, those were reported as nobacteriuria.

Table 1 shows; *Escherichia coli (E.coli)* is the most common bacteria isolated accounted for 62% of the overall culture positive samples.

The samples in which *E.coli* was isolated are from various departments. Among 297 cases of *E.coli* isolated Table 2 shows the Distribution of cases among various department

Table-1: Distribution of various bacteria among culture positive isolates

Sl. no	Name of the bacteria	Number of isolates	Percentage (%)
1	Escherichia coli	297	62
2	Klebsiellaspp	96	20
3	CONS	35	7
4	Enterobacter species	27	6
5	Proteus species	15	3
6	Pseudomonas spp	10	2
	Total	480	100

Table 2 shows; Out of 297 isolates, maximum number of cases (n=192, 65%) were seen in the age group of 17-45yr, followed by 46-60yrs (n=82, 23%), >60yrs (n=13, 4%) 1-16years (n=10, 6.73%). The mean age is 32.2yrs.

Table-2: Distribution of Cases by Age Group

Age Group (years)	Number of Cases (n)	Percentage (%)
<16	10	3
17–45	192	65
46–60	82	28
>60	13	4
Total	297	100

Table 3 shows; A total of 297 cases Obstetrics and Gynaecology (OBG) department reported the highest number of cases (n=87), accounting for the largest share. This was followed by Medicine (n=71) and Urology (n=56).

Table-3: Distribution of cases among various departments

Sl. no	Department	No. of cases
1	Obstetrics and Gynaecology(OBG)	87
2	Medicine	71
3	Urology	56
4	Surgery	39
5	Nephrology	34
6	Paediatrics	10
	Total	297

Fig-1: Susceptibility of Escherichia coli Isolates to Various antibiotics

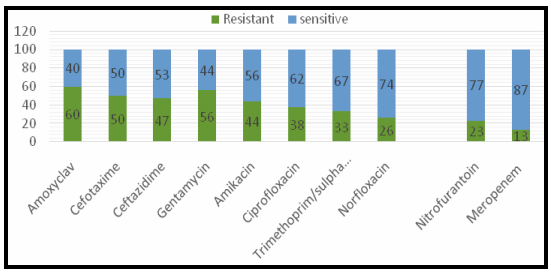
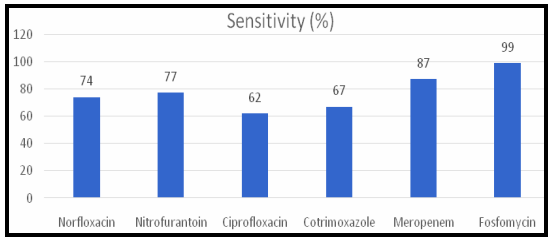


Fig-2: Susceptibility of Escherichia coli Isolates to Fosfomycin when compared to common antibiotics for UTI



Discussion

Empirical antibiotic prescription as a chosen resort of treatment for patient visits in outpatient departments without culture and antibiotic sensitivity reports and inappropriate and non- judicious use of antibiotics has contributed to the global rise of antibiotic resistance. In the Era of antibiotic resistance lack of and novel antimicrobial agents, the re-evaluation and reconsideration of older antibiotic agents would be more insightful option.

Fosfomycin, an older antibiotic once primarily used for uncomplicated urinary tract infections (UTIs), has recently gained interest from clinicians worldwide. As the antimicrobial agent proved its activity against uropathogens exhibiting variedresistance patterns. This antibiotic could offer a valuable treatment option for patients with these challenging-to-treat infections [12].

In our study the prevalence of UTI is around 35.5%, which is almost similar to the study by Gebretensaie Y, et al [13], where in the prevalence rate was 31.6%.Thishas a slight agreement with a prevalence report from Uganda 32.2%, South-Western Uganda 35% [14].

In our study maximum number of cases (n=192, 65%) were seen in the age group of 17-45yr, followed by 46-60yrs (n=82, 23%) as shown in (Table 2) followed by majority of cases are from the department of Obstetrics and Gynaecology (n=87) as shown in (Table 3) .The results were concordant with the studies done by *Arfia N et al* [15], *Gebretensaie Y, et al* [13]. This could be because of more female patients were in the study during that period, inturn can be attributed to short urethra, proximity to perineum, sexually active females etc. However, discordant results were seen in a study done by *Pardeshi P. et al*, showing highest among the elderly (≥48 years, 49.5%) compared to young and middle age patients (18 to 30 years, 12.5%; 31 to 45, 33.5%) [16].

In our study *E.coli* accounted for 62% (Table 1) of the isolates which is the most common isolate from urinary tract infection. The same results are seen in many other studies like Prakash D et al [17], Agbagwa et al [18], Arghya Das et al [19]. The reasons for higher incidence of this bacteria could be presence of bacteria as a part of colonic flora and pathogenicity exhibited by bacteria which includes the establishment of colonisation in urogenital mucosa by adhering to epithelial surface with the help of adhesins, pili, and fimbriae.

Among the various antimicrobials the were tested the organism (*E.coli*) showed highest susceptibility to Meropenem (87%), Nitrofurantoin (77%), norfloxacin (74%) followed by cotrimoxazole (67%), ciprofloxacin, (62%) as shown in (Figure 1). This is concordant with the study done by *Pardeshi P* et al [16]. Among all the isolates that were tested for Fosfomycin only one isolate showed resistance with zone size <12mm. Fosfomycin has shown high efficacy against multidrug-resistant (MDR) *Escherichia coli* causing urinary tract infections (UTIs). In the study, 99% of the MDR *E. coli* isolates were sensitive to Fosfomycin. This efficacy is higher compared to other commonly used antibiotics for UTIs as shown in (Figure 2). Our results were similar to other studies where Fosfomycin is effective against extended-spectrum beta-lactamase (ESBL) producing *E. coli*and has a low propensity for resistance development. Because of its single-dose regimen, strong in vitro activity, and minimal side effects, it presents a promising option for treating uncomplicated UTIs.

In the study, both Fosfomycin and nitrofurantoin showed good efficacy against multidrug-resistant (MDR) *Escherichia coli*causing urinary tract infections (UTIs). Specifically, 99% of the MDR*E. coli*isolates were sensitive to Fosfomycin, while 77% were sensitive to nitrofurantoin. This indicates that Fosfomycin has a higher susceptibility rate compared to nitrofurantoin. Both antibiotics are considered effective options for treating uncomplicated UTIs, with Fosfomycin having the added advantage of a single-dose regimen.

Conclusion

As drug resistance among bacterial uropathogens is an ongoing process, regular surveillance and monitoring is crucial both for epidemiological and clinical perspective to provide physicians updated information on most effective empirical treatment of UTIs. Fosfomycin is a bactericidal agent , an old antibiotic, because for its activity on multidrug resistant uropathogens should be considered as a for the treatment of choice when dealing with multidrug-resistant pathogens In cases where previous antibiotics have failed to resolve the infection or when patients are intolerant to the antibiotics typically used as first-line treatments.

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References

1. Medina M, Castillo-Pino E. An introduction to the epidemiology and burden of urinary tract infections. *Ther Adv Urol.* 2019; 11:1756287219832172.
2. Flores-Mireles AL, Walker JN, Caparon M, et al. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. *Nat Rev Microbiol*. 2015; 13:269-284.
3. Christy VR, Athinarayanan G, Mariselvam R, Dhasarathan P, Singh R. Epidemiology of urinary tract infection in south India. *Biomed Res ClinPrac*. 2019; 4:1-5.

4. Totsika M, Gomes Moriel D, Idris A et al. Uropathogenic Escherichia coli mediated urinary tract infection. *Curr Drug Targets.* 2012; 13(11):1386-1399.
5. Sabih A, Leslie SW. Complicated Urinary Tract Infections. 2024 Dec 7. In: StatPearls [Internet]. Treasure Island (FL): *StatPearls Publishing;* 2025 Jan.
6. Li X, Chen Y, Gao W. A six year study of complicated urinary tract infections in southern china:prevalence, antibiotic resitance, clinical and economic outcomes. *Ther Cli Risk Mang* 2017; 13:1479-1487.
7. Muthulakshmi M, Gopalkrishnan S. Study on urinary tract infection among females of reproductive age group in a rural area of Kancheepruam district, Tamil Nadu. *Int J Commu Med Public Health*. 2017; 4:3915-3921.
8. Ko KS, Suh JY, Peck KR, Lee MY, Oh WS, Kwon KT, Jung DS, Lee NY, Song JH. In vitro activity of fosfomycin against ciprofloxacin-resistant or extended-spectrum beta-lactamase-producing Escherichia coli isolated from urine and blood. *Diagn Microbiol Infect Dis.* 2007; 58(1):111-115.
9. Matthews PC, Barrett LK, Warren S et al. Oral fosfomycin for treatment of urinary tract infection: a retrospective cohort study. *BMC Infect Dis*. 2016; 16: 556.
10. Collee JG, Duguid JP, Fraser AG, Marmion BP, Simmons A. Laboratory strategy in the diagnosis of infective syndromes. In:Collee JG, Fraser AG, Marmion BP, Simmons A, editors. Mackey and McCartney Practical Medical Microbiology. *Churchill Livingstone, Elsevier.* 2006; 53-94.
11. CLSI. Performance Standards for Antimicrobial Susceptibility Testing. 34th ed. CLSI supplement M100. *Clinical and. Laboratory Standards Institute.* 2024.
12. Falagas ME, Vouloumanou EK, Samonis G, Vardakas KZ. Fosfomycin. *Clin Microbiol Rev.* 2016; 29(2):321-347.
13. Gebretensaie Y, Atnafu A, Girma S, Alemu Y, Desta K. Prevalence of Bacterial Urinary Tract Infection, Associated Risk Factors, and Antimicrobial Resistance Pattern in Addis Ababa, Ethiopia: A Cross-Sectional Study. *Infect Drug Resist.* 2023; 16:3041-3050.
14. Johnson B, Stephen BM, Joseph N, Asiphas O, Musa K, Taseera K. Prevalence and bacteriology of culture-positive urinary tract infection among pregnant women with suspected urinary tract infection at Mbarara regional referral hospital, South-Western Uganda. *BMC Pregnancy Childbirth.* 2021; 21(1):159.
15. Nazmeen A, Maiti S. Prevalence, Types and Antibiotic Sensitivity Pattern in Urinary Tract Infection (UTI) In Midnapore Town, India. *Journal of Clinical and molecular Pathology*. 2018; 2(1):16.
16. 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):334-338.
17. 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; 2013:749629.
18. Agbagwa O. E, Ifeanacho Emeka J. U. The Prevalence of UTI Pathogens in Urine Specimen Obtained from a Hospital in Rivers State Nigeria. *Journal of Microbiology Research.* 2015; 5(5):143-148.
19. Das A and Banerjee T. Prevalence of Urinary Tract Infections and Susceptibily Pattern of Uropathogens in Women of Reproductive age Group from North India. *Journal of Advances in Medicine.* 2015; 4(1-2):5-9.

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