

Nitrofurantoin Use as Empirical Antibiotic in UTI Cases

Dr. Shailaja Amur¹, Dr. Rajeshwari Surpur², Dr. Mahalaxmi³

¹Assistant Professor, Department of Microbiology, Navodaya Medical College, Raichur, Karnataka, India

²Professor and HOD, Department of Microbiology, Navodaya Medical College, Raichur, Karnataka, India

³Associate professor, Department of Microbiology, Navodaya Medical College, Raichur, Karnataka, India

Abstract: Selection of antibiotic to treat multidrug resistant urinary tract infections [UTIs] empirically has become a real challenge due to the resistance exhibited by the multidrug resistant bacterial infections. Considering this fact, a retrospective study was conducted to determine an empiric antibiotic for treating UTIs. Results of our study suggested that UTIs were caused by Enterobacteriaceae and most cases were due to infection by Escherichia coli. We could also conclude that empirically the physician can start treatment with Nitrofurantoin in UTI patients on OPD basis.

Keywords: Urinary tract infection, Nitrofurantoin, empirical treatment

1. Introduction

Urinary tract infection due to bacteria is one of the most common of all infections in our country. These infections are often very hard to treat and are posing major health issues in recent years due to the changing trend of the antibiotic sensitivity of bacteria causing urinary tract infections. They have become hard to treat and if not treated properly on time may lead to serious consequences like involvement of kidneys eventually increased morbidity and mortality rates.

Use of Nitrofurantoin in uncomplicated urinary tract infections appears to be a hopeful remedy in controlling UTI of bacterial origin. This study is also aimed at assessing the efficacy of Nitrofurantoin in treating urinary tract infections and also, using it as prophylactic treatment in recurrent uncomplicated UTIs.

Aim of the Study

The aim of the current study is to provide an updated systematic review of clinical and microbiological efficacy of Nitrofurantoin in uncomplicated urinary tract infection cases in adults compared to other antibiotics.

A secondary aim is to assess whether use of Nitrofurantoin is associated with significant side effects as compared to other treatment regimens.

2. Materials and Methods

This is a structured, retrospective, observational study. A total of 400 cases of urinary tract infections who attended Navodaya Medical college Hospital were studied in the present study. All patients aged 12 yrs or more with positive urine cultures were selected.

We analysed antibiotic susceptibility against Nitrofurantoin, Ciprofloxacin, Amoxicillin + Clavulanic acid, Amikacin, Tazobactam + piperacillin drugs.

Inclusion criteria- all patients aged 12 years or more with uncomplicated urinary tract infections irrespective of gender were included.

Elimination criteria- Subjects who received antimicrobial drugs during past one month, those with upper urinary tract infections and renal impairment were excluded from the study.

3. Methodology

Patients were guided to collect midstream urine sample in the sterile urine containers provided by the Microbiology Department of Navodaya Medical college Hospital.

Urine culture was done by standard loop method, a semiquantitative method. Samples were seeded on Macconkey's agar, blood agar and nutrient agar media. The isolates were identified by standard methods. Only the first episode of urinary tract infection which showed positive culture were selected. The samples collected during one year period were (2nd June 2021 to 2nd June 2022) included in the present study.

Enterobacteriaceae were found to be the causative agents of all cases in this present study.

The majority of uropathogens in our study were found to be Escherichia coli [325 (81.2%)] species followed by Klebsiella species [64 (16%)] and Proteus species [11 (2.7%)]. Since more than 80% of uropathogen isolates were Escherichia coli we considered mainly these 325 isolates for testing against various antibiotics.

We analysed antibiotic susceptibility against Nitrofurantoin, Ciprofloxacin, Amoxicillin/Clavulanic acid, Amikacin, Tazobactam/ piperacillin drugs.

Antibiotic susceptibility discs supplied by Microexpress, a division of Tulip Diagnostics were used in the current study.

Details of the discs are as follows.

Antibiotic Discs	Strength	Zone of Inhibition [Escherichia coli isolates]
Nitrofurantoin	100 mcg	17 to 23 mm
Ciprofloxacin	10 mcg	10 to 40 mm
Amikacin	10 mcg	16 to 23 mm
Amoxicillin+ clavulanic acid	50 + 10 mcg	24 to 10 mm
Piperacillin +Tazobactam	10 + 10 mcg	24 to 30 mm

The gold standard, the disk diffusion method introduced by Bauer and Kirby using Muller Hinton agar was followed for confirming the susceptibility of bacteria. In this method, the isolated bacterial colony was selected, suspended into growth media, and standardized through a turbidity test. The standardized suspension was then inoculated onto the solidified agar plate, and the antibiotic discs were applied on the inoculated plate. The disc containing the antibiotic was

Antimicrobial disc	E.coli [percentage of susceptibility]	Klebsiella species [percentage of susceptibility]	Proteus species [percentage of susceptibility]
Nitrofurantoin	93.3	74.8	96
Ciprofloxacin	63	45	62
Amoxicillin +clavulanic acid	79	65	89
Amikacin	92	86	92
Piperacillin+tazobactam	94	71	99%

5. Discussion

Urinary tract infection [UTI] is one of the most common of all bacterial infections that affects healthy individuals as well as those with comorbidities. Escherichia coli was the cause for most of the UTI cases. [1]

It was observed that 94% isolates were susceptible to Piperacillin+tazobactam followed by 93.3% isolates susceptible to Nitrofurantoin. Third better drug was found to be Amikacin to which 92% isolates were sensitive.

Also it is evident from the above table that 96 % isolates of Proteus species were also sensitive to Nitrofurantoin. Though 99% proteus species were found to be sensitive to piperacillin + taobactum it is better to start Nitrofurantoin as the first drug for empirical treatment considering the advantages of it over Amikacin or Tazobactam + Piperacillin. Intermediate sensitivity was considered as resistant for this study purpose.

More than ninety per cent patients receiving nitrofurantoin maintained clinical resolution, versus of those receiving Amikacin or combination of Tazobactam +Piperacillin though this difference was not statistically significant. [1] Our results are comparable with other clinical trials comparing Nitrofurantoin with these two drugs.

Though Amikacin and Tazobactam+piperacillin drugs too demonstrated higher levels of susceptibilities the risk of nephrotoxicity and ototoxicity particularly in the elderly whose creatinine levels may underestimate the true glomerular filtration rate, should be borne in mind. Also, many a times the clinicians are generally reluctant to use even a single dose of aminoglycoside in patients with active kidney disease or in patients receiving concomitant

allowed to diffuse through the solidified agar, resulting in the formation of an inhibition zone after the overnight incubation done at 35 °C. Thereafter, the size of the inhibition zone formed around the paper disc was measured; this method has potential for the routine testing of susceptibility in clinical laboratories. Furthermore, the method is widely accepted because it offers a simple, cost-effective protocol for the detection of multiple targets.

4. Results

Total number of cases were 400 in the current study and majority of the isolates were Escherichia coli [325 cases out of 400 i.e. 81.2 %] followed by Klebsella species [16 %] and Proteus species. [2.8%].

In vitro susceptibility rates of uropathogens is as follows.

nephrotoxic drugs and prefers to reserve amikacin for the treatment of multidrug-resistant organisms. There are few drugs which can be given orally with minimal side effects.

Nitrofurantoin is one such broad spectrum antibiotic which is effective against many Gram negative and Gram positive bacteria. [3]It is also prescribed for recurrent UTIs and as a prophylactic drug for recurrent UTI. It is useful in treating aged people with decreased glomerular filtration rate. It is normally well tolerated with common side effects like nausea and headache.

6. Conclusion

In the light of growing reports of antibiotic resistance coupled with multidrug resistance organisms, there is a pressing need of newer and effective agents for complete cure of UTI. Recent researches have suggested nitrofurantoin as the treatment choice for UTI caused by multi drug resistant bacteria as agreed in our present study. [4]

Nitrofurantoin 100 mg twice a day for 5 days is considered as an appropriate choice of therapy due to minimal resistance and propensity for collateral damage. [5] as is seen in the study conducted by Kalpana Gupta, Thomas Hootan et al.

References

- [1] Urinary tract infections: epidemiology, mechanisms of infection and treatment options Ana L Flores-Mireles Jennier N Walker, Michael Caparon and Scott J. Hultgren Published online 2015 Apr.8 , doi : 10.1038/nrmicro3432
- [2] Stein G.E. Comparison of single dose Fosomycin and 7 days of Nitrofurantoin in female patients with

- uncomplicated urinary tract infections. Clin Ther. 1992;22:1864 -1872 [Pub Med] [Googe Scholar] [Ref list]
- [3] Huttner A, Kowalczyk A, Turjeman A et al. Effect of 5 days nitrofurantoin vs single dose Fosomycin on clinical resolution of uncomplicated lower urinary tract infection in women. JAMA.2018;319:1781- 1789 [PMC free article] [Pubmed] [Google scholar]
- [4] Fosomycin versus Nitrofurantoin for the treatment of Lower UTI in Outpatients Shraddha Sharma, Pankaj kumar Verma, Vinita Rawat, Umesh Varshney and Rajesh kumar singh J.of Lab Physicians 2021 Jun ; 13(2) : 118- 122, published online 2021 May 30
- [5] International Clinical Practice guidelines for the Treatment of Acute Uncomplicated Cystitis and Pylonephritis in Women : A 2010 Update by the infectitious Diseases Society of America and the European Society for Microbiology and Infectitious Diseases.
- [6] Kalpana Gupta, Thomas M. Hooton, Kurt G. Naber, Bourn Wullt, Richard Colgan, Loren G Miller, Gregory J Moran, Lindsay E Nicolle, Raul Raz, Anthony J. Schaeffer...Clinical Infectious Diseases, volume 52, Issue 5, March 2011, page e 103 – e 120.