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Nitrofurantoin Susceptibility in Urinary Tract Infections (UTIs) in an Era of Drug Resistance

J. Mariraj, S. Sadiqa Begum*, S. Krishna and Qurath Saba

Department of Microbiology, Vijaynagar Institute of Medical Sciences, Ballari 583104, Karnataka, India

**Corresponding author*

A B S T R A C T

UTI are the most common bacterial infections that account for significant morbidity and health care cost world-wide. The most profound advance in the management of UTIs has been the introduction of antimicrobial agents. An old drug Nitrofurantoin has increased as a solution to the ever increasing menace of antimicrobial resistance. In this study, we studied the susceptibility pattern of Nitrofurantoin to the common uropathogens. Study was conducted from January 2015 to December 2015 in VIMS hospital Ballari. All the urine isolates are subjected to susceptibility for Nitrofurantoin and results were interrupted. Among 1372 urinary isolates, 86.7% of *E.Coli*, 89.9% of *S.aureus*, 92.3% of *Enterobacter* spp, 88.6% of *Klebsiella spp*, 90% of *Enterococcus* were susceptible to Nitrofurantoin. Overall Nitrofurantoin showed 89.3% of susceptibility and 10.7% of resistance in urinary isolates. In this study nitrofurantoin showed 89.3% of susceptibility to the most common urinary isolates. Nitrofurantoin should be considered as an acceptable treatment for uncomplicated UTIs and should be considered the first line treatment.

Keywords

Urinary tract infection(UTI), Nitrofurantoin, antimicrobial susceptibility pattern, uropathogens, antimicrobial resistance.

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Introduction

UTI are one of the most common bacterial infections among the community and hospital acquired infections (Alicem Tekin *et al*., 2012). Worldwide about 150 million people are being diagnosed with urinary tract infection every year (Manikandan *et al*., 2011). Approximately 95% cases of UTIs are bacterial in origin (Bonadio *et al*., 2001). Today inappropriate use of antibiotics has led to increasing resistance rates of Gram negative bacteria against standard antibiotics (Alicem Tekin *et al*., 2012). With the ever increasing menace of antimicrobial resistance, an old drug Nitrofurantoin has increased as a solution. Among susceptible uropathogens after extensive use worldwide for >50 years, there has been virtually no acquired resistance to Nitrofurantoin (Rizvi *et al*., 2011).

Treatment of uncomplicated UTI is not usually problematic, but alarmingly, in the

recent years, the incidence of multi-drug resistant uropathogens has been undergoing a steady and rapid increase (Rizvi *et al*., 2011). High concentration is achievable in urine makes it an ideal choice for treatment of urinary tract infection (UTI). Nitrofurantoin can be hypothesized to be the best choice for first line empirical treatment. In ths study we aim to analyze the susceptibility pattern of most common urinary isolates in patient with UTI.

Objectives

To determine the antibiotic susceptibility pattern of Nitrofurantoin among urinary isolates.

Materials and Methods

All the urine isolates are subjected to susceptibility for Nitrofurantoin.

Among all the patients in whom urine culture was performed in our laboratory, those showing significant bacteriuria (more than 1,00,000 colony forming units per ml of urine) were included in this study.

The urine cultures were performed from mid stream specimens of urine that were sent to clinical microbiology laboratory. The mid stream specimens of urine were obtained from patients with a preliminary diagnosis of UTIs. The urine specimens were inoculated quantitatively onto 5% sheep blood agar and McConkey agar. Then, media plates were incubated aerobically at 35±2°C for 18-24 hours (Colle *et al*., 1996).

Antimicrobial susceptibility testing was done by Kirby- Bauer disc diffusion method on Mueller Hinton Starch Casein Hydrolysate Agar. The antibiotic discs were supplied by Hi-Media laboratories Pvt. Ltd. Mumbai, India. The antibiotics used and susceptibility test results were interpreted according to the Clinical Laboratory Standard Institute (CLSI) 2016 guidelines.

Results and Discussion

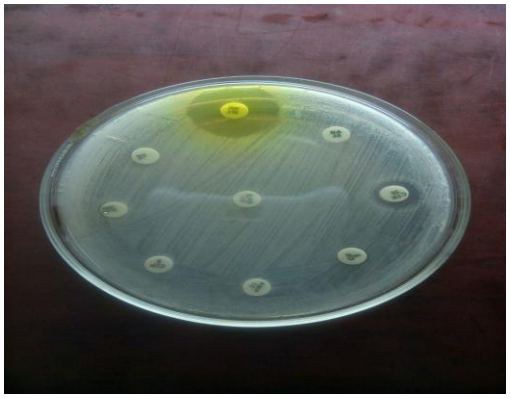
Total number of urine samples tested in the study period were 3251, out of which 1372(42.2%) showed growth of bacteria with significant count. *E.coli*(69.3%) was the commonest organism isolated followed by *Klebsiella spp*(14.2%), *S.aureus*(9.3%), *Enterobacter* (7.6%), *Enterococcus*(4.5%) and others.

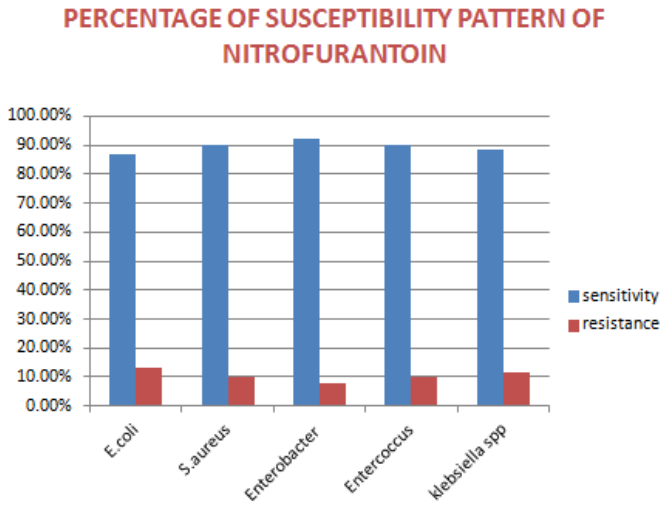
Among 1372 urinary isolates, 86.7% of *E.Coli*, 89.9% of S.aureus, 92.3% of Enterobacter spp, 88.6% of *Klebsiella spp*, 90% of *Enterococcus* were susceptible to Nitrofurantoin.

Overall Nitrofurantoin showed 89.3% of susceptibility and 10.7% of resistance in urinary isolates.

Nitrofurantoin is a broad-spectrum bactericidal antibiotic. Since its discovery in 1952, and its use for more than four decades no clinically significant resistance has developed, as seen with other commonly used antibiotics. This is probably because Nitrofurantoin has multiple sites and levels of action in contrast to antibiotics that attack a single target like ampicillin or two targets like cotrimoxazole. Bacterial nitroreductase enzyme converts nitrofurantoin to highly reactive electrophilic intermediates which non-specifically attack bacterial ribosomal proteins resulting in complete inhibition of protein synthesis (McOsker *et al*., 1994) and cause single-strand breaks in DNA (McCalla *et al*., 1970).

Fig.1 Nitrofurantoin susceptibility





Nitrofurantoin is usually well tolerated. Side-effects occur at rates <0.001% (Munoz-Davila, 2014). Nitrofurantoin is active against most common uropathogens including *E. coli*, *Citrobacter* spp., *Staphylococcus saprophyticus*, and *Enterococcus* spp.whereas, *Enterobacter* spp. and *Klebsiella* spp. are only moderately inhibited, *Proteus* spp., *Providencia* spp., *Morganella morgannii*, *Serratia* spp., *Pseudomonas* spp., and *Acinetobacter* spp. are mostly resistant to nitrofurantoin. Sandegren *et al*. found the mutation frequency to be approximately 10−7/cell for *E. coli*. Mutations in the genes encoding bacterial nitroreductase *nfsA* and *nfsB* were responsible for high-level nitrofurantoin resistance (median MIC of 96 μg/mL) (Sandegren *et al*., 2008; Whiteway *et al*., 1998).

Nitrofurantoin is recommended as the first choice for the treatment of uncomplicated cystitis and pyelonephritis in women by Infectious Disease Society of America and the European Society for Microbiology and Infectious Disease (Gupta *et al*., 2011).

In conclusion, in this study nitrofurantoin showed 89.3% of susceptibility to the most common urinary isolates. Nitrofurantoin should be considered as an acceptable treatment for uncomplicated UTIs and

should be considered the first line treatment. To provide optimum use and to avoid misuse and overuse of this drug, culture and susceptibility testing is the need of the hour.

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References

Alicem Tekin, *et al*, 2012. In vitro efficasy of nitrofurantoin and some antibiotics in E.coli strain isolated from urine culture, *New J. Medi.,* 29(2): 89-91.

Barry, A.L. 1990. Nitrofurantoin susceptibility test criteria. *J. Antimicrobial Chemother.,* 25: 711‑3.

Bonadio, M., *et al*. 2001. Current microbiological and clinical aspects of urinary tract infections. *European Urol.,* 40(4): 439–445.

Colle, J.G., Miles, R.S., Watt, B. 1996. Tests for identification of Bacteria. Mackie and Mc Cartney's Practical Medical Microbiology,14th ed. Edinburgh, Churchill Livingston, p. 146.

Gupta, K., *et al.* 2011. 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 Diseases. *Clin. Infect. Dis.,* e103-20.

Manikandan, S., *et al*. 2011. Antimicrobial susceptibility pattern of urinary tract infection causing human pathogenic bacteria. *Asian J. Med. Sci.,* 3(2): 56-60.

McCalla, D.R. *et al*, 1970. Mode of action of nitrofurazone. *J. Bacteriol.,* 04: 1126-34.

McOsker, C.C., *et al*. 1994. Nitrofurantoin: mechanism of action and implications for resistance development in common uropathogens. *J. Antimicrobial Chemother.,* 33(Suppl A): 23-30.

Munoz‑Davila, M.J. 2014. Role of old antibiotics in the era of antibiotic resistance. Highlighted nitrofurantoin for the treatment of lower urinary tract infections. *Antibiotics*, 3: 39‑48.

Rizvi, M., *et al*. 2011. Rising prevalence of antimicrobial resistance in urinary tract infections during pregnancy: necessity for exploring newer treatment options. *J Lab Physicians,* 3(2): 98-103.

Ronald, A.R., Turck, M. 1967. Comparison of oxafuradene and nitrofurantoin *in vitro* and clinical assessment of oxafuradene in bacteriuria. *Antimicrob. Agents Chemother.,* (Bethesda) 7: 506‑9.

Sandegren, L., *et al*. 2008. Nitrofurantoin resistance mechanism and fitness cost in *Escherichia coli*. *J. Antimicrob. Chemother.,* 62: 495‑503.

Whiteway, J., *et al.* 1998. Oxygen‑insensitive nitroreductases: Analysis of the roles of nfsA and nfsB in development of resistance to 5‑nitrofuran derivatives in *Escherichia coli*. *J. Bacteriol.,* 180: 5529‑39.

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