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Urinary Tract Infection: Bacteriological Profile and Its Antibiotic Susceptibility Pattern in a Tertiary Care Hospital in Bangalore, India

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A B S T R A C T

Urinary tract infection (UTI) is one of the most common bacterial illnesses and hence one of the most important indications for antibiotic treatment. Current knowledge of the common organisms implicated in causing UTI in the local community and surveillance to monitor the changes in susceptibility of uropathogens are imperative to ensure appropriate therapy. The study objectives were to assess the proportion of UTI caused by each of the common urinary pathogens, to study the antibiotic drug sensitivity patterns by analyzing the culture and sensitivity reports and to identify the drugs which would be potentially favourable candidates for empirical therapy in the study locale. A total of 210 culture positive bacterial isolates from 514 urine samples; submitted over a period of 6 months were included in this study. Identification of bacterial isolates was done by standard biochemical profile of the organisms. The antimicrobial susceptibility of culture positive bacterial isolates was performed by disk diffusion method as recommended by Clinical Laboratory Standard Institute guidelines (CLSI). The predominant organism isolated was *E. coli* (51.5%) followed by *Klebsiella* spp (25%) and *Pseudomonas* spp (14%). Among the 210 samples which yielded growth 150 (71.4%) were from females and 60 (28.6%) were from males. 160 (76%) samples were from inpatients whereas 50 (24%) samples were from outpatients. The susceptibility pattern of *E. coli* showed that 100 % of the bacterial isolates were sensitive to imipenem and meropenem, 95 % to piperacillin – tazobactam and 92% to nitrofurantoin. *Klebsiella* spp. showed 100 % sensitivity to imipenem and meropenem followed by piperacillin – tazobactam and amikacin. In conclusion majority of the bacterial isolates were sensitive to imipenem, meropenem, and piperacillin/tazobactam while susceptibility to cephalosporins was very low. Among the oral antimicrobials, nitrofurantoin showed good susceptibility against Enterobacteriaceae family.

Introduction

Urinary tract infections (UTIs) are one of the most common human bacterial infections both in the community and hospital setting.[1-3] It is estimated that 20% or more of the female population suffers some form of UTI in their lifetime. Infection in the male population remains uncommon through the fifth decade of life, when enlargement of the prostate begins to interfere with emptying of the bladder.[4]

Members of the family Enterobacteriaceae are a well-known cause of urinary tract infections. *E. coli* is reported to be the most common bacteria with prevalence as high as 71% and resistance to commonly used antimicrobials.[5] Other Gram negative organisms like *P. aeruginosa* and Gram positive organisms like *Enterococcus* spp. are the common urinary tract bacteria frequently involved in hospital acquired infections.[6]

In spite of the availability and use of the antimicrobial drugs, UTIs caused by bacteria have been showing increasing trends. The extensive and inappropriate use of antimicrobial agents has invariably resulted in the development of antibiotic resistance which, in recent years, has become a major problem worldwide.[7]

In patients with suspected UTI, antibiotic treatment is usually started empirically, before urine culture results are available. To ensure appropriate treatment, knowledge of the organisms that cause UTI and their antibiotic susceptibility is mandatory.[8]

Hence this study was undertaken to determine the common pathogens responsible for UTI and their antibiotic sensitivity pattern.

Materials and Methods

The study was conducted in the Department Of Microbiology, East Point College of Medical Sciences & Research Centre, Bangalore from August 2017 to January 2018. A total of 514 patients with clinically suspected urinary tract infection during August 2017 to January 2018 were included in the study.

Collection of Urine Samples

Mid-stream urine samples were collected using sterile, wide mouthed container with screw cap tops. On the urine sample bottles were indicated name, age, sex, and time of collection along with requisition forms. The samples were subjected to microscopy and culture.

Sample processing

Microscopy

The urine samples were mixed and aliquots centrifuged at 5000 rpm for 5 min. The deposits were examined using both 10X and 40X objectives. Samples with ≥10 white blood cells/mm^3 were regarded as pyuric. A volume of the urine samples were applied to a glass microscope slide, allowed to air dry, stained with gram stain, and examined microscopically.

Culture

A calibrated sterile micron wire loop for the semi-quantitative method was used for the plating and it has a 4.0 mm diameter designed to deliver 0.01 ml. A loopful of the well mixed urine sample was inoculated into duplicate plates of Blood and CLED agar. All plates were then incubated at 37^0C aerobically for 24 h. The plates were then examined for bacterial growth. Bacterial isolates were identified generally using biochemical reactions. The bacterial colonies were counted and multiplied by 100 to give an estimate of the number of bacteria present per milliliter of urine. A significant bacterial count was taken as any count equal to or in excess of 10,0000 cfu /ml.[9] Antibacterial susceptibility of the isolates was done using Kirby-Bauer disk diffusion method following CLSI protocol[10]. Commercially available standard antibiotic discs (Himedia) were used. The zones of inhibition were measured and recorded according to the CLSI guidelines. The isolates were tested for Ampicillin (AMP) (10 µg), Cefazolin (CZ) (30 µg), Cefuroxime (CXM)

(30 µg), Ceftriaxone (CTR) (30 µg), Cefepime (CPM) (30 µg), Nitrofurantoin (NIT) (300 µg), Amoxicillin-Clavulanic acid (AMC) (10/20 µg), Co-trimoxazole (COT) (1.25/23.75 µg), Ciprofloxacin(CIP) (5 µg), Gentamicin (G) (10 µg), Amikacin (AK) (30 µg), Tobramycin (TOB) (10 µg), Piperacillin-Tazobactam (PIT) (100/10 µg) and Imipenem (I) (10 µg), Meropenem (MR) (10 µg) (Hi-media, Mumbai). *S. aureus* (ATCC 25923), *E. coli* (ATCC 25922) and *P. aeruginosa* (ATCC 27853) were used as control strains.

Results and Discussion

Out of the 514 urine samples received for culture and sensitivity during the study period, 210 (41%) yielded significant bacteriuria. 150 (71.4%) were from females and 60 (28.6%) were from males.160 (76%) samples were from inpatients whereas 50 (24%) samples were from outpatients.

The predominant organism isolated was *E.coli* (51.5%) followed by *Klebsiella* spp (25%) and *Pseudomonas* spp (14%).

Bacterial infections of the urinary tract are one of the frequent cause for seeking medical attention in community.[11] Effective management of patients suffering from bacterial UTIs commonly relies on the identification of the bacterial isolate and the selection of an effective antibiotic agent used for the treatment of bacterial organisms in question.[12] Antimicrobial resistance is a serious public health threat.

Treatment failure is caused by resistance developed by different bacterial pathogens against commonly used antimicrobials.

In community and hospital settings the etiology of UTIs and the antimicrobial susceptibility of UTI causing bacteria's have been changing over the years.[13, 14]

In this study, the bulk of the urinary isolates were from female patients as UTIs are frequent in females due to short urethra.

The most common urinary tract bacteria was found to be *E. coli*, a frequent causative agent of UTIs. A similar study conducted at Department of Microbiology, Armed Forces Institute of Pathology, Rawalpindi in 2010 and at Mayo Hospital, Lahore in 2013 revealed *E. coli* as the most common bacteria accounting for 63% and 80% of the total culture positive isolates.[15,16] A similar study conducted in Peshawar, Khyber Pakhtunkhwa Pakistan has revealed similar results showing *E. coli* (77%) as the predominant uropathogen.[17] The frequency of *E. coli* as the causative agent of UTIs was found to be 80 - 90 % in two similar studies carried out in Canada and Ethiopia in the recent years. [18, 19]

The second most common urinary isolate in this study was *Klebsiella spp* which is similar to other studies where the second commonest reported isolates were *Staphylococcus* spp. and *K. pneumoniae*[20, 21,22] (Table 1).

Pseudomonas aeruginosa was the third most common isolate in our study. A study conducted at Department of Microbiology, Armed Forces Institute of Pathology, Rawalpindi in 2012 revealed *Pseudomonas aeruginosa* as the second most common isolate in UTI.[23]

In this study, 100% of *E. coli* isolates were susceptible to imipenem, the result being consistent with similar study carried out at AFIP, two years ago and the study conducted in Peshawar.[15, 17]. These results are also similar to earlier studies carried out in India where 96% of *E. coli* isolates were susceptible to imipenem.[24].The results of this study are contrary to a similar study conducted recently in Lahore, Pakistan, where *E. coli* showed 44% resistance to carbapenems[16] (Fig. 1–3).

Fig.1 Antibiotic sensitivity pattern of *E. coli* (%)

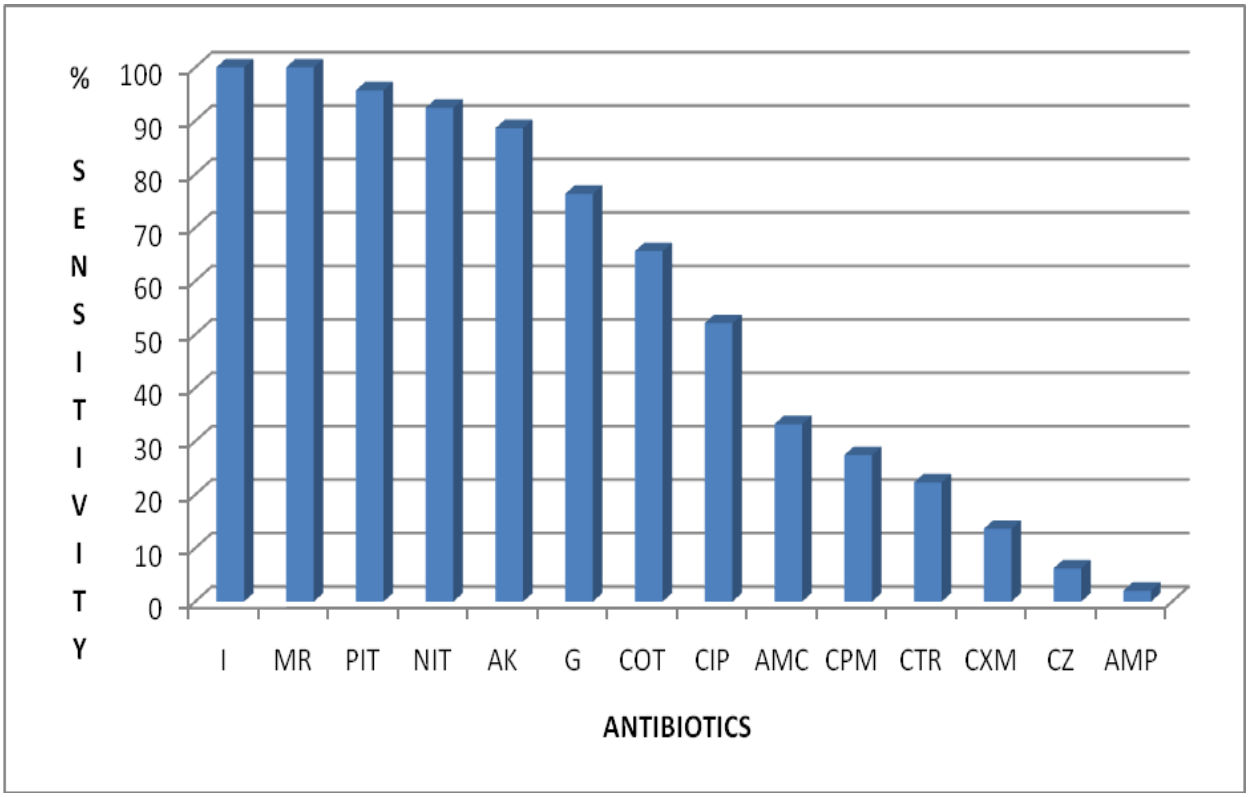

Fig.2 Antibiotic sensitivity pattern of *Klebsiella* spp.

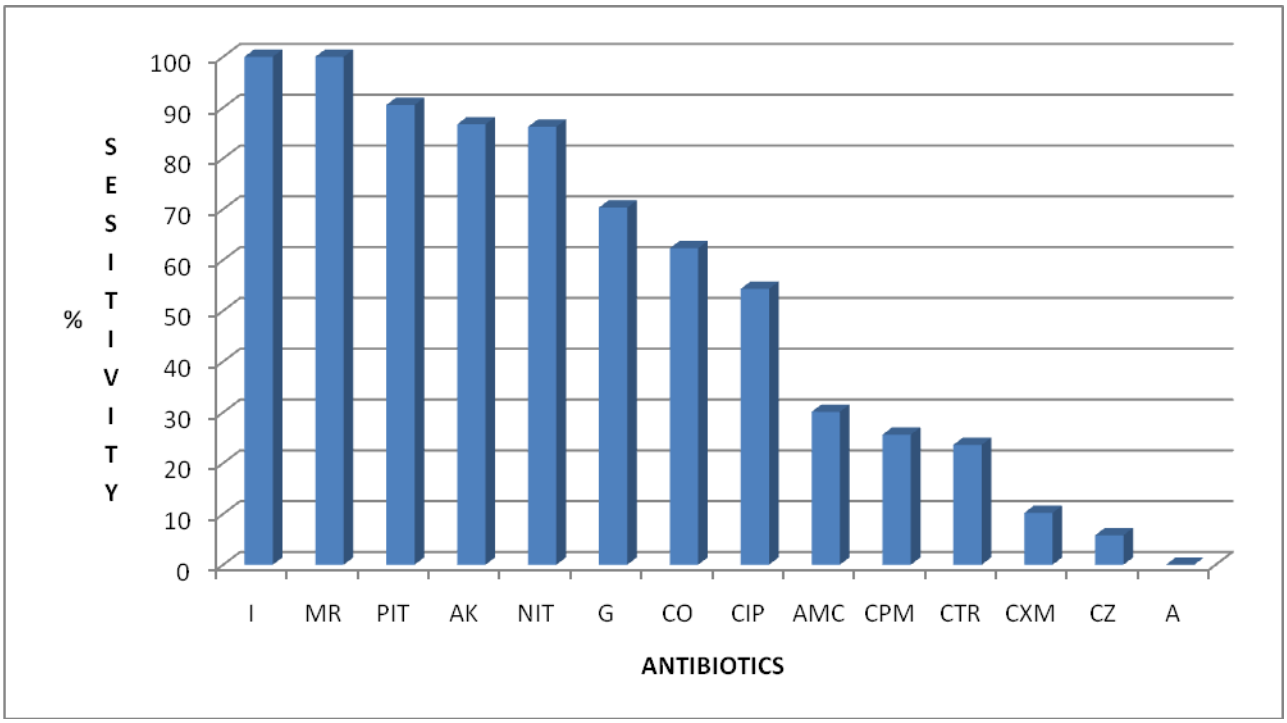

Fig.3 Antibiotic sensitivity pattern of *Pseudomonas* spp.

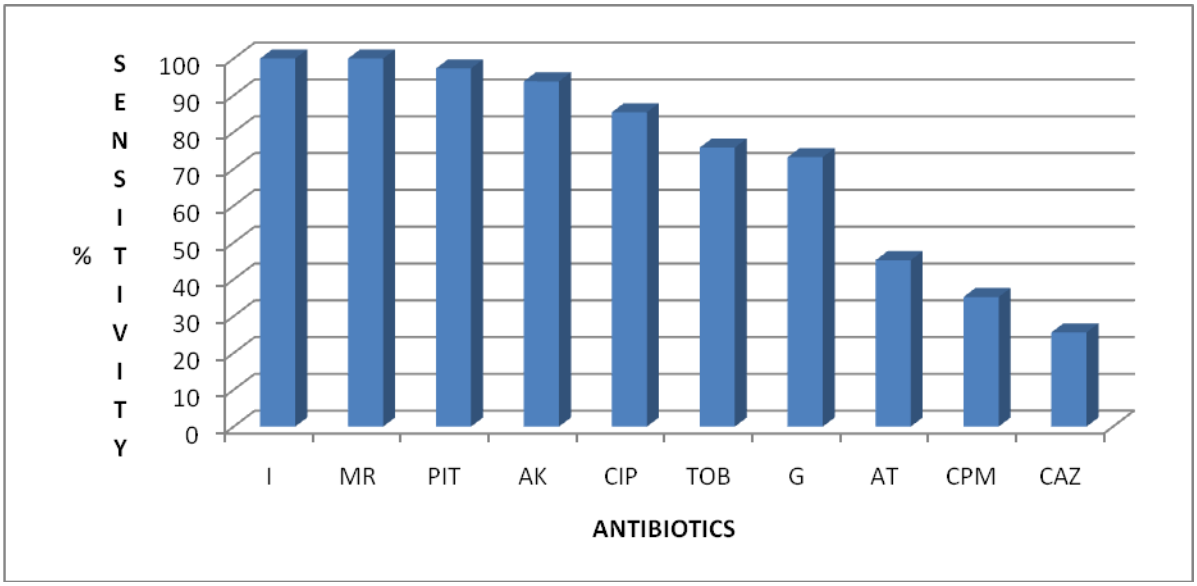

Table.1 Distribution of bacterial pathogens isolated from urine samples

Organism	No.of isolates (%)
E.coli	109 (51.5%)
Klebsiella spp	52 (25%)
Pseudomonas spp	29 (14%)
Enterococcus spp	6 (3%)
Staphylococcus aureus	5 (2%)
Proteus spp	4(2%)
Citrobacter spp	2(1%)
Acinetobacter spp	2(1%)
Serratia spp	1(0.5%)
Total	210

In this study, the susceptibility of *E. coli* to Nitrofurantoin was 92 % compared to 94% in a study done in London.[25]. Nitrofurantoin is effective against many Gram positive and Gram negative urinary isolates and activity of this antimicrobial is greatly enhanced at pH 5.5 and below. It is a cheap antimicrobial and can be given orally for months for the suppression of chronic UTIs. It shows that Nitrofurantoin is still effective against majority of the urinary isolates and can be used prophylactically for recurrent urinary tract infections.[23]

Similarly, another important oral antimicrobial used for empirical treatment of uncomplicated UTIs in our setup is trimethoprim/sulfamethoxazole. The susceptibility of *E. coli* to cotrimoxazole was found to be 65 % in this study. In countries where resistance is low (<20%), trimethoprim-sulfamethoxazole can still be a valid first-line antibiotic, and in many countries where its use has been limited for years, in consideration of the evidence-based international guidelines, the resistance rate has receded and made possible the

reintroduction of this combination as a therapeutic strategy. [26]

As far as the antimicrobial sensitivity of quinolones to *E. coli* is concerned, the susceptibility to ciprofloxacin was 52 %. The situation is quite different with *E. coli* isolated in a study carried out in London where 94% of bacterial isolates were susceptible to ciprofloxacin.[25].These contrasting results clearly suggest the injudicious use of quinolones in this part of the world has led to deteriorating susceptibility to this important antimicrobial group.

In this study, *Klebsiella* spp. isolates showed 100 % susceptibility to Imipenem and Meropenem followed by Piperacillin – Tazobactam and Amikacin. The antimicrobial susceptibility of Enterobacteriaceae has revealed that imipenem was the most effective antibiotic similar to other studies. *In vitro* activity of oral antimicrobials such as fluroquinolones and cephalosporins was low comparable to other studies performed in Pakistan, which is a worrying trend as far as the oral antibiotics are concerned.[17]

Carbapenems, Amikacin, Ceftazidime and antipseudomonal penicillin such as Piperacillin are the recommended antibiotics to treat UTIs caused by *P. aeruginosa*. The antimicrobial susceptibility profile of *Pseudomonas aeruginosa* in this study revealed that 100 % of the isolates were sensitive to Imipenem & Meropenem followed by Piperacillin – Tazobactam and Amikacin. Only very few isolates were sensitive to Ceftazidime and Cefepime. This is a worrying trend with an indication that *P. aeruginosa* is gradually developing resistance against antipseudomonal cephalosporins.

The increasing rates of resistance to uropathogenic isolates warrant evaluation of other antimicrobials such as fosfomycin which can safely be given orally and is highly effective against many uropathogens. [27] The results of this study will benefit clinicians to know the local pattern of antimicrobial susceptibilities and formulate the empirical antibiotic strategies in patients presenting with UTIs.

E. coli was the predominant pathogen causing UTIs in our population followed by *Pseudomonas* spp. A majority of the isolates were sensitive to Imipenem and Piperacillin/Tazobactam limiting the use of oral antimicrobials commonly used to treat UTIs. As far as the oral antibiotics are concerned, Nitrofurantoin revealed encouraging results proving to be the effective oral antibiotic in this study. As drug resistance among bacterial pathogens is an evolving process, routine surveillance and monitoring studies should be conducted in different parts of the country to provide physicians, an effective knowledge regarding the empirical treatment of UTIs in that particular area.

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