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Antibiotic resistance pattern of Uropathogens in a tertiary care hospital of Central India

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Abstract

Background: Urinary tract infection is one of the most common bacterial infections in human being. The causative agent of UTI varies from place to place and they also vary in their resistance pattern.

Objective: This study was conducted to know the most common causative agents, determine distribution and resistance pattern of bacterial strains isolated from patients with UTI from a tertiary care hospital of Central India.

Materials and Method: Urinary isolates from symptomatic UTI patents were identified by conventional methods. Antimicrobial susceptibility testing was performed by Kirby Bauer's disk diffusion method.

Results: Of the 1800 tested samples, 696 samples showed growth of organisms among which the most prevalent were E.coli (60%), followed by Klebsiella species (10.4%).The majority of isolates were from female patients of reproductive age group. *E.coli* and *Klebsiella spp.* showed high resistance to Ampicillin, Third generation cephalosporin (3GC) and Norfloxacin and best sensitivity for Imipenem and Nitrofurantoin. Among gram positive bacteria high resistance was observed against Penicillin and Ampicillin and all isolates were sensitive to Vancomycin.

Conclusion: This study revealed that UTI is more common in females particularly in reproductive age group. *E.coli* was the predominant bacterial pathogen. Urinary pathogens showed resistance to commonly used antibiotics like Ampicillin, 3GC and Norfloxacin. As good sensitivity was seen for Nitrofurantoin in all organisms, it can be used for empirical treatment against UTI.

Keywords: Urinary tract infection (UTI), Antimicrobial susceptibility, Urinary pathogens, Nitrofurantoin

Introduction

Urinary tract infection (UTI) is the third most common infection experienced by humans after respiratory and gastro-intestinal infections.[(1)]Although, the urinary tract is normally free of bacterial growth, bacteria that generally ascend from the rectal reservoir may cause UTI. Careful diagnosis and treatment results in successful resolution of infections in most cases.[(2)]Most of the UTI are caused by Gram negative bacteria like *Escherichia coli*, *Proteus spp.*, *Klebsiella spp.*, *Pseudomonas aeruginosa*, *Acinetobacter*, *Serratia* and *Morganella morganii.* UTI also caused by Gram positive bacteria like Enterococcus, Staphylococcus especially coagulase negative staphylococci and *Streptococcus agalactiae*.[(3)] UTI is much more common in women than in men due to anatomical and physiological reason; by virtue of its position urogenital tract is more vulnerable to bacterial infections.[(4)]UTIs are often treated with different broad spectrum antibiotics when one with a narrow spectrum of activity may be appropriate because of concerns about infection with resistant organisms. Fluoroquinolones are preferred as initial agents for empiric therapy of UTI in area where resistance is likely to be of concern. This is because they have high bacteriological and clinical cure rates, as well as low rates of resistance, among most common uropathogens.[(5)] However, the extensive use of antimicrobial agents have invariably resulted in the development of antibiotic resistance, which, in recent years, has become a major problem worldwide.[(6)] Increasing antimicrobial resistance complicates uncomplicated UTI treatment by increasing patient morbidity, costs of reassessment and retreatment and use of broader-spectrum antibiotics. Patterns of antibiotic resistance in a wide variety of pathogenic organisms vary from place to place and even over short periods of time. Periodic evaluation of antibacterial activity is needed to update this information. For effective treatment and control of UTI in a particular area/hospital, a good knowledge of the antibiotic sensitivity pattern of the causative agents in that area/hospital is of ultimate importance.

Materials and Method

The present study was carried out in Ruxmaniben Deepchend Gardi Medical College, Department of Microbiology from January 2016 to December 2016. Patients attending OPD and IPD with any complaint pointing towards UTI were included study. Freshly voided, clean-catch midstream urine was collected from each patient into sterile screw-capped universal container. Specimen in unsterile container, time delayed specimen for culture, which were not kept refrigerated at 4°C and inadequate sample for urine culture were excluded from the study. The specimen was labeled and transported to the microbiology laboratory for processing within 2 hours. Semi quantitative urine culture was done using a calibrated loop. A 4mm loopful of well mixed un-centrifuged urine was inoculated onto the surface of MacConkey and blood agar media. All

plates were then incubated at 37°C aerobically for 24 hours. The plates were then examined for bacterial growth. A significant growth is considered if the number of colony is $\geq 10^5$ colony forming unit (cfu)/ml[7]. Colonial appearance and morphological characters of isolated bacteria was noted and isolated colonies were subjected to preliminary tests like Gram staining, motility by hanging drop, catalase test and oxidase test. These preliminary tests were followed by biochemical reactions for identification of the isolated organism. All the isolated organisms were subjected for antibiotic susceptibility testing. Antimicrobial susceptibility testing was done by Kirby-Bauer Disk diffusion method using Mueller Hinton Agar plates after quality control as per guideline.[8,9] Commercially available Hi Media discs were used. The bacterial suspension was made by inoculating tip of 2-3 well isolated identical colonies in peptone water. After 2 hours of incubation the turbidity was standardized by using 0.5 McFarland standards. By using a sterile swab stick a lawn culture was made on the Mueller-Hinton agar plates. The antibiotic discs (as per CLSI guideline)[9]were placed and inoculated plates were incubated at 37 ℃.The results were read after overnight incubation and compared with standard chart. The control strains used were *E. coli* ATCC 25922, *P. aeruginosa* ATCC 27853, and *S. aureus* ATCC 25923.

Result

During study period, a total of 1800 urine samples were received, of which 696 (38%) samples showed significant growth, among them females were 522 and males were 174, as shown in the Table 1. *E.coli* was the most commonly isolated urinary pathogens (60%), followed by Klebsiella spp. (10.4%), *Pseudomonas aeruginosa* (8.6%), *and Enterococcus faecalis* (6.32%) as shown in Table 2. *E.coli* and Klebsiella spp. showed high resistance to Ampicillin, third generation cephalosporins (3GC) and Norfloxacin and good sensitivity for Imipenem and Nitrofurantoin. *P.aeruginosa* showed best sensitivity to Tobramycin (95%) and high resistance to Ceftazidime (72%) and Piperacillin (80%) (Table 3).*E. faecalis* showed high resistance to Ampicillin (87%) and Penicillin (88%), and good sensitivity for Vancomycin(100%). *S. saprophyticus* was isolated from adult female patients and showed higher resistance to Penicillin (94%), Norfloxacin (51%) and methicillin (cefoxitin)(72%) (Table 4).

Table 1: Age and Sex wise distribution of culture positive patients

Age group in years	Male	Female	Total
0-10	1	7	8
11-20	3	10	13
21-30	30	272	302
31-40	40	78	118
41-50	70	80	150
>50	30	75	105
Total	174(25%)	522(75%)	696(100%)

Table 2: Organisms causing UTI

Organism	Number	Percentage
Escherichia coli	416	60
Klebsiella species	72	10.4
Pseudomonas aeruginosa	60	8.6
Staphylococcus saprophyticus	40	5.75
Citrobacter species	36	5.17
Enterococcus faecalis	44	6.32
Proteus mirabilis	16	2.30
Staphylococcus aureus	12	1.72
Total	696	100

Table 3: In Vitro Antibiotic Resistance Pattern of Gram Negative Bacteria

Antimicrobial agents	*Escherichia coli (%)*	Klebsiella spp. *(%)*	*P. aeruginosa (%)*	*Citrobacterkoseri (%)*	*P. mirabilis (%)*
Ampicillin	85	94	-	82	80
Amikacin	16	14	49	68	37
Gentamicin	10	21	54	38	25
Ciprofloxacin	69.31	61	65	32	15
Cefotaxime	80	78	-	40	19
Ceftazidime	79	81	72.1	42.3	23
Cefepime	84	84	43	42.5	10
Imipenem	12	4.50	11	2.3	1
Cefoxitin	70	78	-	38	45
Cotrimoxazole	30	43	-	41	42
Piperacillin	78	83	80	73	79
Piperacillin+ Tazobactum	45.4	40	56	32	28
Tobramycin	-	-	5	-	-
Norfloxacin	85	68	63	15	11
Nitrofurantoin	14	12.4	-	9	17

Table 4: In Vitro Antibiotic Resistance Pattern of Gram Positive Bacteria

Antimicrobial agents	*S.saprophyticus (%)*	*S. aureus (%)*	*Enterococcus faecalis (%)*
Ampicillin	-	-	87
Amikacin	38	13	-
Gentamicin	37	25.35	-
Ciprofloxacin	45	32.65	-
Cotrimoxazole	35	36	-
Tetracycline	32	23	-
Clindamycin	25	15.80	-
Cefoxitin	72	65	-
Linezolid	0.0	0.5	1.5
Vancomycin	0.0*	0.1*	0.0
Penicillin	94	85	88
Norfloxacin	51	30.10	13.5
Nitrofurantoin	12	10.15	3
Erythromycin	2.3	1.15	-
HLG**	-	-	8.5
HLS***	-	-	6

*Antibiotic susceptibility test performed by E Test, **High level Gentamicin, ***High level Streptomycin

Discussion

Effective management of patients suffering from bacterial UTIs commonly relays on the identification of type of organisms that caused the disease and selection of an effective antibiotic agent to the organism. Diagnosis of UTIs is a good example of the need for close cooperation between the clinician and the microbiologist.

The study observes that UTI was high among the females (75%) than males (25%). Among females, highest prevalence is seen in reproductive age group (67%). Close proximity to female urethral meatus to anus, shorter urethra and sexual intercourse have been reported as factors that influences this higher prevalence in women.[10] Among males an increased prevalence of UTI was recorded among more than 40 years of age group (58%). Increasing frequency of prostate disease in males and diabetes mellitus are responsible for increasing the incidence of UTI in these age group.[11,12]

In our study, *E.coli* was the predominant organism followed by Klebsiella species. This correlates with studies carried out at Haryana, Chandigarh and Aligarh.[13,14,15] Our study observed *E.coli* to be most resistant to Ampicillin (85%), and Norfloxacin (85%%) and sensitive to Imipenem(98%). Similar findings were reported from South India,[15] which concluded that the organisms showed resistance to older urinary antimicrobial agents such as Ampicillin and Norfloxacin which indicates that increased consumption of particular antibiotics can be the pathway to its resistance.[16] *Klebsiella spp.* was most sensitive to Imipenem (96%) and highly resistant to Ampicillin (94%) and Piperacillin (83%) correlates with study conducted by Jubina et al.[17] *Pseudomonas aeruginosa* showed their best sensitivity to Tobramycin (95%)in contrast to study from Aligarh,[13] where *P. aeruginosa* showed only 33% sensitivity. Present study observed high resistant to Ceftazidime (72%) and Piperacillin (80%) which was correlated with studies from Aligarh and Barabanki.[13,18]

Enterococcus faecalis and *Staphylococcus saphrophyticus* were most sensitive to Vancomycin and Linezolid, similar findings were reported by Choudhary et al.[18]

In our study, Nitrofurantoin has showed better sensitivity against most organisms causing UTI. These results correlate with other studies also.[11,17,18,19] Thus, Nitrofurantoin can be used as initial agent for empirical treatment till culture reports are available.

Conclusion

Urinary tract infection is huge burden on health care due to high prevalence of infection in community. UTI in general practice is high among young females in reproductive age groups. Gram negative organisms were most commonly isolated organisms in UTI among which *E.coli* was the most frequent agent. Urinary pathogens showed resistance to commonly used antibiotics like Ampicillin, 3 GC and Norfloxacin. On the basis of this study, we can conclude that the resistance of commonly used antibiotics is very high. However, Nitrofurantoin yet has good sensitivity to help clinician to start empirical treatment. As drug resistance among pathogens in an evolving process, routine surveillance and monitoring studies should be conducted at different areas to help physician to start most effective empirical treatment.

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