

Bacterial and Antimicrobial Resistance Profile of Urinary Tract Infections among Women in Reproductive Age Group Attending the Tertiary Care Hospital Set Up

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ABSTRACT

Introduction: Urinary tract infections (UTI) are one of the commonest community and nosocomial infections encountered by the clinicians in developing countries like India. UTI can occur in any age group and in both sexes but is more common in women than men due to anatomical differences. The present study was aimed to determine the bacterial and antimicrobial profile of UTI among women in reproductive age group.

Material and Methods: Urine samples were collected from women in reproductive age group i.e. between 15-45 years attending the hospital. Culture and identification of bacteria was done as per standard laboratory protocol. Antimicrobial susceptibility testing was done on the isolates obtained as per CLSI guidelines.

Results: Out of 1523 obtained isolates, most commonly isolated organism was *Escherichia coli* (49.3%) followed by *Pseudomonas spp.* (12.4%) and *Klebsiella spp.* (12.0%). Antimicrobial susceptibility test showed that most of the isolates were resistant to commonly used antibiotics. Carbapenems, aminoglycosides and nitrofurantoin were found to be most effective.

Conclusion: The study has found a higher prevalence of UTI among women in reproductive age group and the potential pathogens are resistant to most of the antibiotics commonly used to treat the condition. Routine screening of women in reproductive group attending the hospital for UTI should be done.

Keywords: UTI, Urinary Tract Infections, Cystitis, Women in Reproductive Age Group, 15-45 Years

INTRODUCTION

Urinary tract infections (UTI) are one of the commonest community and nosocomial infections encountered by the clinicians in developing countries like India.^{1,2} It is defined as presence of microorganism/s in the urinary tract with or without symptoms. Currently the most widely used classifications of UTI classified it either as symptomatic UTI, asymptomatic bacteriuria, and other infections of the urinary tract or as complicated and uncomplicated UTI. The European Section of Infection in Urology (ESIU)/European Association of Urology (EAU) proposed an improved classification of UTI as asymptomatic bacteriuria, acute uncomplicated UTI/cystitis in women, acute uncomplicated pyelonephritis, complicated UTI and recurrent UTI.³

UTI can occur in any age group and in both sexes but is more common in women than men due to anatomical difference in urethra which makes them more prone to the entry of bacteria causing UTI.^{4,5} Approximately 40-50% women are affected by UTI at least once in their reproductive age i.e. between 15 to 45 years.⁶ It accounts for about 8 million visit to the hospital each year. UTI in women are mostly caused by the perineal or periurethral microorganisms as they can easily ascend

the urinary tract during sexual activity, catheterization etc.⁷ Infections are high among post-menopausal women due to various factors such as changes in vaginal commensal flora caused by lack of estrogen, incomplete emptying of bladder due to bladder or uterine prolapse and associated chronic illness, such as diabetes.^{5,8}

UTI in women is most commonly caused by gram negative bacteria especially *Escherichia coli* and other members of *Enterobacteriaceae* including *Proteus spp.*, *Citrobacter spp.*, *Enterobacter spp.*, *Klebsiella spp.*, and other bacteria such as *Pseudomonas spp.*, *Staphylococcus aureus* and *Enterococcus spp.*^{9,10} The spectrum of causative microorganisms is much broader in complicated UTI than uncomplicated UTI.⁹ Although the microbial aetiology remains consistent for decades, the characteristics of microorganisms have been changed due to increasing problem of antimicrobial resistance. Extended spectrum beta-lactamase (ESBL) and metallobeta-lactamase (MBL) producing gram negative bacteria are posing serious challenges to clinicians especially in treatment of hospitalised patients.^{6,11}

The knowledge of real time prevalence of causative agents and their antimicrobial resistance pattern is important in determining the empirical therapy. With this aim the present study determined the bacterial and antimicrobial profile of UTI among women in reproductive age group.

MATERIAL AND METHODS

The present study was an observational, cross-sectional study, conducted after ethical clearance and was conducted in the Department of Microbiology, Mayo Institute of Medical Sciences, Barabanki, Uttar Pradesh. Urine samples were collected from women in reproductive age group i.e. between 15-45 years attending both inpatient and outpatient departments of the hospital. Patients with history of recent hospitalisation and antibiotic intake were excluded from the study. After inclusion of the patients in the study detailed information including personal detail, demographic profile, medical history

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and physical examination was recorded in a proforma.

Sample collection and processing: After obtaining consent, patients were instructed properly to collect the samples aseptically. Midstream urine samples were collected in a sterile universal container from each patient and transported immediately to the bacteriology laboratory for further processing. Urine samples were inoculated in Cysteine Lactose Electrolyte Deficient (CLED) agar and incubated at 37°C temperature aerobically for 24-48 hours. After 24 hours incubation plates were examined for growth, in absence of growth the plates were re-incubated for another 24 hours and reported negative if no growth appears.

The growth was further processed for identification on the basis of colony morphology, gram-staining and other biochemical reactions such as catalase, oxidase, urease, nitrate reduction, decarboxylase, indole, methyl-red, Voges Proskauer, citrate utilization test, oxidation-fermentation tests.

The samples were also subjected to microscopic examination to determine the presence of pus cells, RBCs, epithelial cells and microorganisms. Presence of more than one pus cells per seven high power field in un-centrifuged urine was considered as significant pyuria.

Antimicrobial susceptibility testing: This test was performed by Kirby-Bauer disc diffusion method as per CLSI guidelines.¹³ Antibiotics discs used for different organisms are listed in the table 1. The diameter of zone of inhibitions were measured by unaided eye and recorded as sensitive, intermediate and resistant are per CLSI zone diameter interpretative criteria.¹³ The quality control of test was done by using *Escherichia coli* ATCC 25922 and *Staphylococcus aureus* ATCC 25923.

STATISTICAL ANALYSIS

Statistical analysis was done with the help of Microsoft office 2007. Descriptive statistics were used to interpret the results.

RESULTS

Out of 3069 urine samples collected from women in reproductive age group, 1523 (49.62%) isolates were obtained. Of these isolates, 1155 (75.8%) were gram negative bacteria and 249 (16.4%) were gram positive bacteria [Table 2]. The most commonly isolated organism was *Escherichia coli* (49.3%) followed by *Pseudomonas spp.* (12.4%) and *Klebsiella spp.* (12.0%) [Table 3]. Other organisms isolated includes *Staphylococcus aureus* (8.5%), *Candida spp.* (7.8%), *Enterococcus spp.* (4.8%).

Rest of organisms are listed in the Table 3.

Antimicrobial resistance profile of the isolated organisms is listed in Table 4. Analysis of resistance profile of Gram-negative bacteria showed that members of *Enterobacteriaceae* are mostly resistant to ampicillin (91.8%), amoxyclav (90.2%), ticarcillin-clavulanate (89.3%), cefazolin (89.2%), and norfloxacin (84.1%) whereas mostly showed susceptibility to imipenem (5.5%), meropenem (7.8%), piperacillin-tazobactam (8.5%), aminoglycosides (19.8%) and nitrofurantoin (32.2%). *Pseudomonas spp.* showed a higher rate of resistance to most of the antibiotics compared to *Enterobacteriaceae* with resistance mostly to aztreonam (96.3%), ticarcillin (95.7%) and norfloxacin (89.4%). Carbapenems (16.4%) and piperacillin-tazobactam (23.3%) showed a higher sensitivity rate among *Pseudomonas spp.* followed by levofloxacin (46.7%) and ciprofloxacin (65.6%).

Analysis of antimicrobial resistance profile of gram positive bacteria showed that *Staphylococcus spp.* had a greater degree of resistance to penicillin (88.1%), ampicillin (81.7%), cotrimoxazole (79%), and norfloxacin (77%) while highly susceptible to linezolid (1.4%), vancomycin (1.7%), tetracycline (12%) and nitrofurantoin (12.6%). *Enterococcus spp.* also showed a similar pattern of resistance to most of the antibiotics.

DISCUSSION

UTI has been one the commonest cause of visit to the hospitals and clinics by the women in reproductive age group in country like India since several decades. It is also a leading cause of hospital acquired infections seen in admitted patients. The problem with the disease is not only because of the symptoms as most of them remains asymptomatic, but the increasing development of resistance to commonly used antibiotics among the commonest causative agents such *Escherichia coli*, *Pseudomonas spp.* etc.

The present study has found that 49.62% samples collected showed growth of organisms. Out of which *Escherichia coli* (49.3%) were the most commonly isolated organism. Similar results were found by Banerjee et al in their study during 2013 (53.69%) which was followed by an increasing trend from 2014 (64.29%) to 2015 (71.79%).⁶ However during this study period they have found a decreasing prevalence of UTI among women in reproductive age group from 16.69% to 8.46%. In an another study conducted by Tuli et al showed that 47.5% growth of organisms were obtained from women between 18-60 years of age.¹⁴ Thapa et al also showed a

Organism	Antibiotics															
	AMP	CZ	CPM	CTR	G	TOB	AK	PIT	AMC	TCC	CIP	LE	NX	IMP	MRP	NIT
Enterobacteriaceae																
Pseudomonas spp.																
Staphylococcus spp.																
Enterococcus spp.																

AMP: Ampicillin, P: Penicillin, TI: Ticarcillin, CTR: Ceftriaxone, CZ: Cefazolin, CAZ: Cefazidime, CPM: Cefepime, CX: Cefoxitin, AMC: Amoxiclav, TCC: Ticarcillin-clavulanate, PIT: Piperacillin-tazobactam, IMP: Imipenem, MRP: Meropenem, G: Gentamicin, AMK: Amikacin, TOB: Tobramycin, CIP: Ciprofloxacin, LE: Levofloxacin, LX: Norfloxacin, VA: Vancomycin, LZ: Linezolid, COT: Cotrimoxazole, TE: Tetracycline, DO: Doxycycline, HL: High level gentamicin, HLS: High level streptomycin

Table-1: List of antibiotics used for various bacteria

Organism	Antibiotics															
	AMP	CZ	CPM	CTR	G	TOB	AK	PIT	AMC	TCC	CIP	LE	NX	IMP	MRP	NIT
<i>Escherichia coli</i>	94.6	89.3	41.7	67.6	23.3	21.5	12.7	9.2	91.3	86.4	46.2	39.1	85.1	5.4	7.2	21.1
<i>Klebsiella spp.</i>	97.1	91.3	36.2	51.6	18.6	16.1	9.1	6.4	95.6	91.3	31.3	26.7	89.6	4.7	7.6	36.7
<i>Proteus spp.</i>	83.8	87.1	35.5	51.6	32.3	29.1	16.1	9.7	83.9	90.3	67.7	41.9	77.4	6.4	8.6	38.7
<i>Pseudomonas spp.</i>	AT	CAZ	CPM	TI	G	TOB	AK	PIT	CIP	LE	NX	IMP	MRP			
<i>Staphylococcus aureus</i>	96.3	63.6	31.3	95.7	47.8	41.7	34.7	23.3	65.6	46.7	89.4	15.3	17.4			
	AMP	P	CX	COT	G	TE	DO	VA	LZ	CIP	LE	NX	NIT			
CoNS	86.6	94.9	41.3	84.6	23.1	15.7	9.6	1.3	0.8	56.7	45.1	81.7	13.6			
	76.7	81.3	21.6	73.4	15.6	8.2	4.8	2.1	2.1	45.6	43.4	72.2	11.6			
<i>Enterococcus spp.</i>	AMP	P	HLG	HLS	VA	LZ	CIP	LE	NX	NIT						
	89.1	91.7	41.1	34.2	5.4	2.7	63.1	50.7	83.6	15.5						

AMP: Ampicillin, P: Penicillin, TI: Ticarcillin, CTR: Ceftriaxone, CZ: Cefazolin, CAZ: Ceftazidime, CPM: Cefepime, CX: Cefoxitin, AMC: Amoxiclav, TCC: Ticarcillin-clavulanate, PIT: Piperacillin-tazobactam, IMP: Imipenem, MRP: Meropenem, G: Gentamicin, AMK: Amikacin, TOB: Tobramycin, CIP: Ciprofloxacin, LE: Levofloxacin, NX: Norfloxacin, VA: Vancomycin, LZ: Linezolid, COT: Cotrimoxazole, TE: Tetracycline, DO: Doxycycline, HLG: High level gentamicin, HLS: High level streptomycin, CoNS: Coagulase-negative *Staphylococcus*

Table-4: Antibiotic resistance profile of all isolates

Gram negative bacteria	1155(75.8%)
Gram positive bacteria	249 (16.4%)
Candida spp.	119 (7.8%)
Total	1523

Table-2: Percentage distribution of gram-positive, gram-negative, and Candida spp. isolates among total isolates

Name of organisms	No. of isolates (Percentage)
<i>Escherichia coli</i>	751 (49.3)
<i>Pseudomonas spp.</i>	190 (12.4)
<i>Klebsiella spp.</i>	183 (12.0)
<i>Staphylococcus aureus</i>	130 (8.5)
Candida spp.	119 (7.8)
<i>Enterococcus spp.</i>	73 (4.8)
Coagulase negative <i>Staphylococcus</i>	46 (3.1)
<i>Proteus spp.</i>	31 (2.1)
Total	1523

Table-3: Distribution of organism among total isolates

similar result with 43.3% of samples showed growth of potential pathogens causing UTI they have also found *Escherichia coli* (65.1%) as the predominant bacterial pathogen.¹⁵

Antimicrobial resistance profile of gram negative bacteria in present study showed that the penicillin and cephalosporins except carbapenems and piperacillin-tazobactam and fluoroquinolones were not effective against most of the *Enterobacteriaceae*. Similar findings were found in the study conducted by Banerjee et al, Tuli et al and Thapa et al.^{6,14,15} Banerjee et al found a higher resistance to ampicillin and fluoroquinolones with susceptibilities ranging from 20-25% and 23-33% respectively.⁶ Thapa et al also found ampicillin as the least sensitive with 25% sensitivity.¹⁵ Aminoglycosides and nitrofurantoin were found highly effective against members of *Enterobacteriaceae* in present study with only 19.8% and 32.2% resistance. Thapa et al, Banerjee et al and Tuli et al have found similar findings with 94%, 89.29% and 94.5% susceptibility of aminoglycosides and 69%, 90% and 80% susceptibility of nitrofurantoin.^{6,14,15}

Among gram positive bacteria it was found that vancomycin, linezolid and nitrofurantoin were still effective despite the irrational use of these antibiotics. Similar results were also observed by Khoshbakht et al which have found a high susceptibility of gram positive bacteria to nitrofurantoin and vancomycin.¹⁶ Nitrofurantoin was found to be the most effective oral antibiotic against both gram negative and gram positive bacteria ensuring safe and cost effective treatment of UTI.

CONCLUSION

The present study has found a higher prevalence of UTI among women in reproductive age group. It has also found that the potential pathogens are resistant to most of the antibiotics commonly used to treat the condition. Thus making the situation alarming and raising the need of screening of the all the women in the reproductive group attending the clinics and hospitals to determine the presence of UTI and the antibiogram of the causative agents.

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