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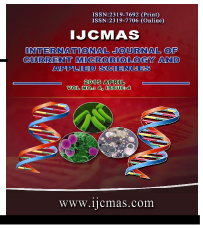

Original Research Article

Aetiology of Urinary Tract Infection and antimicrobial susceptibility pattern of urinary isolates in tertiary care hospital in Central India: A retrospective analysis

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Keywords

Uropathogens, Antimicrobial resistance, UTI, Entero-bacteriaceae, *E. coli*

A B S T R A C T

Urinary tract infections (UTIs) are one of the most common infections encountered in clinical practice. The commonest urinary pathogen accounting for over 80% of community-acquired infection is due to *Escherichia coli*. UTI is a serious ailment in human due to increasing frequency, recurrence and difficulty in eradication; it poses stiff challenge to the medical professionals. So, this retrospective study was undertaken to determine the susceptibility profiles of urinary isolates which would expectedly indicate the most appropriate antibiotic therapy for the treatment of UTIs. The data for urinary isolates and their susceptibility pattern for the years 2012 and 2013 were retrieved from medical records of department of Microbiology and analyzed statistically. Total 456 organisms were isolated during this period. Out of these isolates, 214 (47%) were E. coli, followed by Kleb. pneumoniae 70 (15%) and Enterobacter spp. 46 (10%). Total 346 isolates were from family Enterobacteriaceae. Out of these 283 (82%) were susceptible to Imipenem – Cilastatin, 148 (43%) were susceptible to Piperacillin _ Tazobactam and 141(41%) were susceptible to Amikacin. Of non fermenter isolates 83% (39/47) were susceptible to Imipenem – Cilastatin followed by Meropenem 70% (33/47). From all the Gram positive cocci isolated, 95% (60/63) were susceptible to Vancomycin and Linezolid and 86% (54/63) to Teicoplanin. The result of our study showed that among the heterogeneous causative organisms of UTI, Enterobacteriaceae are the predominant pathogens. The Gram negative uropathogens showed higher susceptibility to the Carbapenems. The next best alternative for treating UTI caused by Gram negative organisms are Piperacillin-Tazobactam and Amikacin. . The Gram positive isolates showed higher susceptibility to Vancomycin, Linezolid and Teicoplanin. The susceptibility data collected in this study suggest that drug resistance is common problem in uropathogens isolated from hospitalized patients as well as OPD patients. So, the proper knowledge of susceptibility pattern of uropathogens is very important before prescribing an empirical antimicrobial therapy.

Introduction

Urinary tract infections (UTIs) are one of the most common infections encountered in clinical practice. (Gatermann SG 2007) Both sexes of all age groups are vulnerable to UTI.

Women are especially prone to UTI. It is estimated that 20% of women experience UTI in their life time. (Ramprasad AV et al 1993) UTI is one major cause among hospital acquired infections. (Ramprasad AV

et al (1993) Urinary tract infections (UTIs) involves bacterial invasion and multiplication in the organs of the urinary tract system including the kidney, bladder, ureters, urethra and other associated appendages, and it is manifested as at least 100,000 organisms per milliliter of urine in asymptomatic patient or as more than 100 organisms per milliliter of urine with accompanying pyuria (white blood cell >7/ml) in a symptomatic patient. (Iroha Ifeanyichukwu et al 2013)

The commonest urinary pathogen accounting for over 80% of community-acquired infection is due to *Escherichia coli*. However, other organisms gain a greater foothold in patients with complicated UTI (D.Mathai 2001). Compounded by a diminishing number of new agents entering clinical practice, resistance is widely recognized as a major threat to public health sectors. UTI is a serious ailment in human due to increasing frequency, recurrence and difficulty in eradication; it poses stiff challenge to the medical professionals. (Shanthi J and Kayathri S 2012)

Area specific monitoring studies aimed to gain knowledge about the type of pathogens responsible for UTIs and their resistant patterns may help the clinicians to choose the correct empirical therapy. So, this retrospective study was undertaken to determine the susceptibility profiles of urinary isolates in the hospitalized patients as well as outdoor patients from Chirayu Medical College and Hospital, Bhopal, MP which would expectedly indicate the most appropriate antibiotic therapy for the treatment of UTIs.

Material and Methods

The present study was conducted at Chirayu Medical College and Hospital, Bhopal, MP state in Central India. The data were retrieved from medical records of department of Microbiology.

Urine specimens received in department of Microbiology were cultured on blood agar and CLED (Cystine lactose electrolyte deficient) agar for 18 - 24 h at 37°C. Then, the colonies were counted and the colonies with more than 10^5 CFU/ml of a single uropathogen was considered as culture positive. Organism was identified by conventional biochemical reactions.(Collee JG 2013) Antibiotic susceptibility was done by disc diffusion method (Modified Kirby Bauer) on Mueller-Hinton agar (Lisa PA 1984) using discs from Himedia Pvt Ltd., India. Members of Enterobactriaceae were tested for Ampicillin, Ampicillin-Sulbactam, Piperacillin, Piperacillin-Tazobactam, Cefotaxime, Ticarcillin-Clavulanic acid, Ceftriaxone, Imipenem-Cilastatin, Meropenem, Amikacin, Gentamicin, Tetracyclin, Nalidixic acid, Ciprofloxacin, Norfloxacin, Cotrimaxazole, Nitrofurantoin. Pseudomonas aeruginosa were tested for Ampicillin- Sulbactam, Piperacillin, Piperacillin- Tazobactam, Cefotaxime, Ticarcillin- Clavulanic acid, Ceftriaxone, Imipenem- Cilastatin, Meropenem, Amikacin, Gentamicin, Tetracyclin, Cotrimaxazole, and Aztreonam. Acinetobacter spp were tested for Ampicillin- Sulbactam, Piperacillin, Piperacillin- Tazobactam, Cefepime, Ticarcillin- Clavulanic acid, Ceftazidime, Imipenem- Cilastatin, Meropenem, Amikacin, Gentamicin, Tetracyclin, Cotrimaxazole, and Aztreonam. Gram Positive cocci were tested for Ampicillin, Amoxicillin- Clavulanic acid, Gentamicin, Ciprofloxacin, Tetracyclin, Cotrimoxazole, Norfloxacin, Nitrofurantoin, Vancomycin, Linezolid, and Teicoplanin.

Result and Discussion

In this retrospective study, data for years 2012 and 2013was analyzed. Total 456 organisms were isolated during this period. Out of these isolates, 278 were from different wards, 103 were from ICU and 75 were from OPD patients. Out of these isolates, 214 (47%) were E. coli, followed by Kleb. pneumoniae 70 (15%) and Enterobacter spp. 46 (10%). The distribution of organisms is shown in table 1.

Out of 278 isolates from wards, 116 (41.7%) were E. coli, out of 103 isolates from ICU, 42 (36.2%) were E. coli, making 158/381 (41.5%) from indoor patients and out of 75isolates 56 (74.7%) from OPD patients were E. coli (Table 1 & 2). Of these E. coli isolates, 95/116 (82%) from wards, 33/42 (79%) from ICU and 52/56 (93%) from OPD patients were susceptible to Imipenem - Cilastatin. Overall susceptibility to Imipenem – Cilastatin by *E. coli* isolates was 84% (180/214). All the E. coli isolates were resistant to Norfloxacin and Tetracyclin. 46.7% (100/214) E. coli were susceptible to Amikacin and 43.45% (93/214) were susceptible to Piperacillin – Tazobactam. Total 346 Isolates were from family Enterobacteriaceae. Out of these 283 (82%) were susceptible to Imipenem – Cilastatin, 148 (43%) were susceptible to Piperacillin _ Tazobactam and 141(41%) were susceptible to Amikacin. Only 0.3% isolates were susceptible to Tetracyclin and 1% isolates were susceptible to Norfloxacin. (Table 3).

Susceptibility to Imipenem – Cilastatin by Ps. aeruginosa isolates from ICU was 87% (26/30), 73% (8/11) isolates from wards while 100% (1/1) from OPD patients. Susceptibility to Imipenem – Cilastatin by Acinetobacter spp from wards was 80% (4/5). In these non fermenter isolates 83% (39/47) were susceptible to Imipenem – Cilastatin followed by Meropenem 70% (33/47). All these isolates were resistant to Ampicillin- Sulbactam and Cotrimoxazole. While 0nly 2% (1/47) were susceptible to Tetracyclin. (Table 4)

Susceptibility to Vancomycin and Linezolid by *Staph. aureus* isolated from wards was 89.5% (17/19), from ICU was 80% (4/5) and from OPD was 100% (9/9). Susceptibility to Teicoplanin was 63% (12/19), from ICU was 100% (5/5) and from OPD was 100% (9/9). Overall susceptibility to Vancomycin and Linezolid by *Staph. aureus* isolates was 91%(30/33). Enterococci were 100% (30/30) susceptible to Vancomycin and Linezolid and susceptibility to Teicoplanin was 93.3% (28/30). From all the Gram positive cocci isolated, 95% (60/63) were susceptible to Vancomycin and Linezolid and 86% (54/63) to Teicoplanin. Susceptibility to Ampicillin and Cotrimoxazole was found to be 11% (7/63) and for Gentamicin, it was 14% (9/63). (Table 5)

The varying trend in the aetio-pathogenesis of UTIs and the rising resistance to the antimicrobial agents are a matter of worldwide alarm. Even with the sufficient precautions, preventive measures and the advances in treatment, UTIs still remain the commonest infections, both in the hospitalized patients and in the community. This may probably be due to the advancing ages, increase in the immune-compromised status, prolonged hospitalizations, insufficient personal and environmental sanitation, increased instrumentation (catheters), co-morbidities and functional or anatomical abnormalities. The indiscriminate, inadequate and irrational usage of antimicrobials has additionally contributed to the appearance of resistant strains, which may turn out to be a chief

cause for the morbidity and mortality in the developing countries.(Kumar Rakesh et al 2014)

This retrospective analysis of a data for a period of two years (2012 - 2013) provided view on the frequency and the antibiogram of the uropathogens which were isolated from Chirayu Medical College & Hospital, Bhopal, M.P. In this study, 381 isolates were from indoor patients (278 from wards and 103 from ICU) while 75 from outdoor patients. Of these total 456 isolates, 214 (47%) were E. coli making it a most common isolates which matches with the other studies like Kumar Rakesh et al (Kumar Rakesh et al 2014), Mallikarjuna Reddy et al (Mallikarjuna Reddy C et al 2014), Azizi Ali et al (Azizi Ali et al 2014). In our study we found that in hospitalized patients, most common agent for UTI is E. coli 41.5% which is in consistent with other studies like Kumar Rakesh et al (Kumar Rakesh et al 2014), KD Deshpande et al(K.D. Deshpande et al 2011) who found 34.42% and 50.2% respectively.

In the context of antibiotic susceptibility in our study, Imipenem – Cilastatin (82%) was found to be highly active against members of Enterobacteriaceae followed by Amikacin (41%) and Meropenem (31%). Other authors like Kumar Rakesh et al(Kumar Rakesh et al 2014), Suzanne Sonya Cherian(Suzanne Sonya Cherian et al 2013), KD Deshpande et al(K.D. Deshpande et al 2011) also found Imipenem is the most effective antibiotic against Gram negative bacilli. In our study, resistant to Fluoroquinolones such as Ciproproxacin and Norfloxacin were on higher sides. The members of Enterobacteriaceae have shown susceptibility to Ciproproxacin and Norfloxacin was 14% and 1% respectively. This finding was not in accordance with other studies. Most of the studies such as Maripandi Arjunan et al (Maripandi Arjunan et al 2010), Azizi Ali et al (Azizi Ali et al 2014) have shown better susceptibility to Fluoroquinolones while Manjunath GN et al (Manjunath GN et al 2014) reported 73% and 53.3% resistance to Ciproproxacin and Norfloxacin respectively.

The isolated non-fermenters have shown 83% and 70% susceptibility to Imipenem – Cilastatin and Meropenem respectively while KD Deshpande et al(K.D. Deshpande et al 2011) found 100% susceptibility to Imipenem and Kumar Rakesh et al(Kumar Rakesh et al 2014) reported 82.4% susceptibility to Imipenem. In our study, susceptibility to Piperacillin – Tazobactam by non-fermenters was found to be 55% while C.P.Baveja et al(C.P.Baveja et al 2014) reported 76.4% and 66.66% susceptibility to Piperacillin – Tazobactam by Pseudomonas spp and Acinetobacter respectively.

In our study, from all the Gram positive cocci isolated, 95% were susceptible to Vancomycin and Linezolid and 86% to Teicoplanin. Kumar Rakesh et al (Kumar Rakesh et al 2014) reported 100% susceptibility to Vancomycin and Linezolid.

The result of our study showed that among the heterogeneous causative organisms of UTI, Enterobacteriaceae are the predominant pathogens. Among Enterobacteriaceae, E.coli is the most prevalent pathogen involved in urinary tract infections. The Gram negative uropathogens showed higher susceptibility to the Carbapenems. The next best alternative for treating UTI caused by Gram negative organisms are Piperacillin-Tazobactam and Amikacin. The Gram positive isolates showed higher susceptibility to Vancomycin, Linezolid and Teicoplanin.

Table.1 Distribution of Bacterial Isolates

Organism	Ward	ICU	OPD	Total
E. coli	116	42	56	214
Kleb. pneumoniae	42	25	3	70
Proteus spp	5	0	0	5
Enterobacter spp	34	8	4	46
Citrobacter spp	9	2	0	11
Pseudo. aeruginosa	30	11	1	42
Acinetobacter spp	5	0	0	5
Staph. aureus	19	5	9	33
Enterococcus spp	18	10	2	30
Total Isolates	278	103	75	456

Table.2 Percentage of isolates

Organism	Total	percentage
E. coli	214	47
Kleb. pneumoniae	70	15
Proteus spp	5	1
Enterobacter spp	46	10
Citrobacter spp	11	3
Pseudo. aeruginosa	42	9
Acinetobacter spp	5	1
Staph. aureus	33	7
Enterococcus spp	30	7
Total	456	100

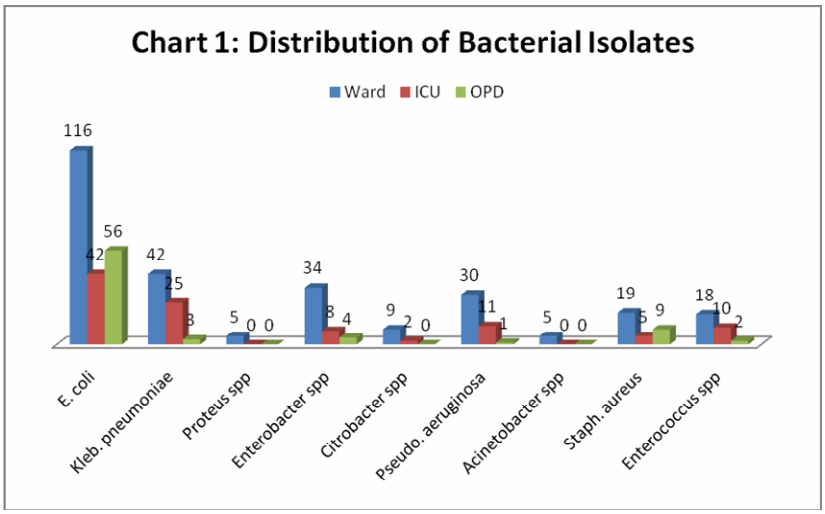


Table.3 Antibiotic Susceptibility Pattern of Enterobacteriaceae

Organism	*E. coli*	*Klebsiella*	*Proteus*	*Citrobacter*	*Enterobacter*	Total	Percentage
Total No.	214	70	5	11	46	346	
Amp	15	7	2	0	0	24	7
A/S	37	11	2	2	0	52	15
PI	34	18	3	2	7	64	18.5
PIT	93	40	3	3	9	148	43
CE	28	4	5	0	4	41	12
TCC	29	19	2	0	2	52	15
CTR	19	2	5	0	0	26	7.5
IC	180	59	3	6	35	283	82
MRP	51	29	3	6	18	107	31
AK	100	23	5	0	13	141	41
G	31	5	5	0	0	41	12
TE	0	1	0	0	0	1	0.3
NX	0	3	0	0	0	3	1
CIP	35	8	0	0	5	48	14
NA	8	1	0	0	0	9	3
COT	19	3	0	0	8	30	9
NT	74	5	43	2	8	132	38

Amp- Ampicillin, A/S- Ampicillin - sulbactam, PI- Piperacillin, PIT- Piperacillin- Tazobactam, CE- Cefotaxime, TCC- Ticarcillin- clavulinic acid, CTR- Ceftriaxone, IC- Imipenem- Cilastatin, MRP- Meropenem, AK- Amikacin, G- Gentamicin, TE- Tetracyclin, NX- Norfloxacin, NA- Nalidixic acid, COT- Cotrimaxazole, NT- Nitrofurantoin

Table.4 Antibioitic Susceptibility Pattern of Non-fermenters

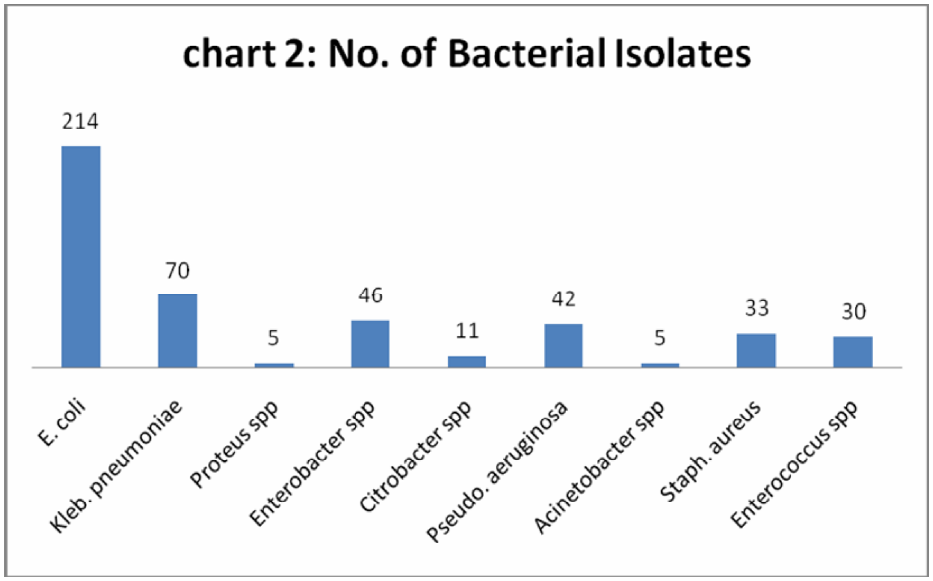
Organism	*Pseudomonas*	*Acinetobacter*	Total	Percentage
Total No	42	5	47	
A/S	0	0	0	0
PI	15	1	16	34
PIT	24	2	26	55
CE/CPM	3	1	4	8.5
TCC	4	1	5	10.6
CTR/CAZ	6	1	7	15
AT	4	0	4	8.5
IC	35	4	39	83
MRP	29	4	33	70
AK	14	2	16	34
G	9	0	9	19
TE	0	1	1	2
CIP	8	1	9	19
COT	0	0	0	0

A/S- Ampicillin - sulbactam, , PI- Piperacillin, PIT- Piperacillin- Tazobactam, CE- Cefotaxime, CPM- Cefepime, TCC- Ticarcillin- clavulinic acid, CTR- Ceftriaxone, CAZ- Ceftazidime, AT- Aztrionam, IC- Imipenem- Cilastatin, MRP- Meropenem, AK- Amikacin, G- Gentamicin, TE- Tetracyclin, CIP- Ciprofloxacin, COT- Cotrimaxazole

Table.5 Antibioitic Susceptibility Pattern of Gram Positive cocci

Organism	***Staph aureus***	***Enterococci***	**Total**	**Percentage**
Total No	33	30	63	
G	9	0	9	14
CIP	14	1	15	24
TE	14	14	28	44
COT	7	0	7	11
VA	30	30	60	95
LZ	30	30	60	95
TEI	26	28	54	86
NX	11	0	11	17.5
NT	12	5	17	27
AMOX/CLAV	5	8	13	21
AMP	2	5	7	11

G- Gentamicin, CIP- Ciprofloxacin, TE- Tetracyclin, COT- Cotrimaxazole,
VA- Vancomycin, LZ- Linezolid, TEI- Teicoplanin, NX- Norfloxacin, NT- Nitrofurantion, AMP- Ampicillin, Amox/Clav- Amoxycillin/Clavulanic acid.



Both Gram negative and Gram positive isolates showed higher resistance to Fluoroquinolones, Penicillins, Cephalosporins and Nitrofurantoin. These are the drugs which are commonly used for treatment of UTI. The emergence and spread of resistance can be reduced through appropriate or careful use of antimicrobial drugs and increasing awareness among the population to the hazards of inappropriate antimicrobial use through public health education campaign. The susceptibility data

collected in this study suggest that drug resistance is common problem in uropathogens isolated from hospitalized patients as well as OPD patients. So, the proper knowledge of sensitivity pattern of uropathogens is very important before prescribing an empirical antimicrobial therapy, this will also discourage the indiscriminate use of antibiotics and prevent further development of bacterial drug resistance.

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