



Evaluation of risk factors and antimicrobial susceptibility pattern of community and hospital isolates of urinary tract infection

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Abstract

Background: Urinary tract infection (UTI) is a significant and a serious health affecting problem encountered both in the community and hospital settings each year worldwide. The causative pathogen and their susceptibility pattern varies from region to region and changes with time.

Objective: To investigate the etiologic agents and its antimicrobial susceptibility pattern of UTI in a tertiary care hospital

Material and Methods: Clean catch, mid-stream urine samples were received in sterile universal containers. Urine culture was done by a semi-quantitative method. Antibiotic sensitivity was done on bacterial isolates according to the Clinical and Laboratory Standards Institute CLSI guidelines for disc diffusion susceptibility test.

Results: Significant Bacteriuria was present in 54.66% sample and 45.34% were sterile. The most common pathogens isolated among gram negative bacteria were *E.coli* (57%) while in gram positive cocci *Enterococcus species* was the most prevalent 26(8.09%) Gram negative organisms showed highest sensitivity to nitrofurantoin (65.66%), followed by amikacin (56.22%). Gram positive organisms showed highest sensitivity to linezolid (83.33%) followed by vancomycin (75.00%).

Conclusion: Constant evaluation of the antibiotic sensitivity pattern of UTI pathogens for commonly used antimicrobial agents in a particular environment should be carried out regularly.

Keywords: urinary tract infection, antibiotic sensitivity pattern, *Escherichia coli*

Introduction

Urinary tract infection (UTI) is a significant and a serious health affecting problem encountered both in the community and hospital settings each year worldwide [1]. It is the most common nosocomial infection, accounting for upto 40% of all nosocomial infections [2] while the prevalence of Community-associated UTI is 0.7% in all over the world. *Escherichia coli* is the predominant pathogen in both the community-acquired urinary tract infection and hospital-acquired urinary tract infection and it is solely responsible for more than 80% of these infections [4]. The other bacteria which are also responsible for urinary tract infections are *Proteus*, *Klebsiella*, *Enterobacter*, *Pseudomonas*, *Enterococcus* and *Staphylococcus* species. Now a day's antibiotics are invariably used for the treatment of UTIs, though resistance to antibiotics has been reported all over the world, particularly in developing countries [5]. Treatment of UTI is a challenge due to the increasing level of antimicrobial resistance [6]. There is an increased emergence of antimicrobial resistance in the uropathogens, probably due to the empirical administration of anti-bacterial therapy, even before the availability of the urine culture result [7]. The prevalence of antimicrobial resistance in patients with UTI is increasing and can vary according to geographical and regional location [8]. This study is undertaken to determine etiologic agents, risk factors and antibiotic sensitivity pattern of community and hospital uroisolates and appropriate empiric antibiotic selection for urinary tract infection.

Material and Methods

The present study was conducted in Bacteriology Laboratory of the Department of Microbiology SMS Medical College & Attached Hospital, Jaipur from April 2016 to September 2017. A total of 600 urine samples collected from the suspected cases of UTI from patients attending hospital both OPD and IPD were included in the study. A structured proforma was used to collect data on age, gender, risk factor and clinical history. The study protocol was approved by the ethical committee of SMS Hospital Clean catch, mid-stream urine samples were received in sterile universal containers. Urine samples were processed within 2 hour of collection. A calibrated loop method (semi quantitative method) [9] was used for the isolation of bacterial pathogens from urinary samples. A loopful urine sample was plated on Mac Conkey agar & Blood agar. The inoculated plates were incubated at 37°C for 24 hour. A specimen was considered positive for UTI if growth detected at a concentration of $\geq 10^5$ CFU/mL [10]. Growth with three or more types of colonies is excluded from study. Significant isolates were identified by conventional methods according to the standard laboratory protocol, including colony morphology, gram staining and biochemical reactions. *Candida species* were also identified by Gram stain and speciation was done by CHROM Agar. The antibiotic sensitivity test was performed by modified Kirby Bauer disc diffusion technique [11] with commercially available Hi-Media antibiotic discs according to Central Laboratory Standard Institute (CLSI) guidelines on Mueller Hinton agar plates. The

antibiotics which were used in our study were based on the standard protocol of the hospital and departmental policies. Statistical analysis was performed with the SPSS, Trial version 23. The qualitative data were expressed in proportion and percentages. The difference in proportion was analyzed by using chi square test. Probability P value <0.05 was considered statistically significant.

Results

Among 600 clinically suspected cases of urinary tract infection 328 (54.66%) showed significant growth and 272(45.34%) were sterile. Among that 180(54.87%) were from OPD while 148(45.13%) were from IPD. In this study out of the 328, 283(86.28%) were bacterial and 45(13.72%) were *Candida species*. out of 328 positive culture 198(60.37%) were of female and 130 (39.63%) were of male patients. We found that in females, the highest susceptible age group for UTI was 21-30 years followed by 31-40 years. In males, highest susceptible age group to UTI was 35 -60 years followed by 61-70 years of age. We found that most prevalent risk factor was Diabetes 131(39.93%), followed by catheterization 60 (18.29%), recurrent UTI, renal calculi, benign prostatic hypertrophy, immunocompromised state and pregnancy. (Table 1) Among gram negative bacteria, *E.coli* was the most prevalent 183 (57%), followed by *Enterobacter species* 50(15.57%). Similarly in gram positive bacteria, *Enterococcus species* was the most prevalent 26(8.09%) followed by CONS 7(2.18%) (Table 2) Gram negative organisms showed highest sensitivity to Nitrofurantoin (65.66%), followed by Amikacin (56.22%) and Cefoperazone-sulbactam (52.45%). They showed least susceptibility to Cefixime (14.71%). (Table 3) *Pseudomonas species* showed

highest sensitivity to polymixin B and colistin (100%), followed by gentamycin (60%) and aztreonam (50%) while the least sensitive was imipenem (15%). Gram positive organisms showed highest sensitivity to linezolid (83.33%) followed by vancomycin (75.00%) and chloramphenicol (69.44%). They showed least sensitivity to cotrimoxazole (5.55%). (Table 4)

Table 1: Risk factors of UTI Patients (N=328)

Risk Factor	Number	Percentage (%)
Diabetes	131	39.93
Catheterization	60	18.29
Recurrent UTI	42	12.80
Renal calculi	35	10.67
Benign Prostatic Hypertrophy	30	9.14
Immunocompromised	22	6.70
Pregnancy	08	2.43
Total	328	100

Table 2: Distribution of bacterial isolates in culture positive cases (N=321)

Gram negative Bacteria	Number	Percentage (%)
<i>Escherichia coli</i>	183	57.00
<i>Enterobacter spp</i>	50	15.57
<i>Pseudomonas spp</i>	20	6.23
<i>Klebsiella spp</i>	14	4.36
<i>Acinetobacter spp.</i>	10	3.11
<i>Proteus spp.</i>	07	2.18
<i>Citrobacter spp.</i>	01	0.31
Gram Positive Bacteria		
<i>Enterococcus spp.</i>	26	8.09
Coagulase negative Staphylococcus	07	2.18
<i>Staphylococcus aureus</i>	03	0.93
Total	321	100.00

Table 3: Comparative antibiotic susceptibility pattern of gram negative bacteria

Antibiotics	<i>E. coli</i> (N= 183)		<i>Enterobacter</i> (N=50)		<i>Klebsiella</i> (N=14)		<i>Proteus</i> (N=07)		<i>Acinetobacter</i> (N=10)		<i>Citrobacter</i> (N=01)	
	S	R	S	R	S	R	S	R	S	R	S	R
Amikacin	108	75	24	26	7	7	3	4	6	4	1	0
Ampicillin	67	116	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Cefixime	25	158	10	40	2	12	0	7	2	8	0	1
Cefoperazone Sulbactam	99	84	23	27	6	8	4	3	7	3	0	1
Ceftazidime	51	132	13	37	6	8	1	6	4	6	0	1
Ceftriaxone	30	153	14	36	3	11	3	4	3	7	0	1
Cotrimoxazole	40	143	7	43	6	8	1	6	4	6	0	1
Doxycycline	50	133	10	40	4	10	2	5	4	6	0	1
Imipenem	90	93	11	39	6	8	2	5	5	5	0	1
Nitrofurantoin	134	49	23	27	8	6	NT	NT	6	4	0	1
Norfloxacin	51	132	8	42	3	11	1	6	6	4	0	1

Table 4: Comparative antibiotic susceptibility pattern of gram positive bacteria

Antibiotics	<i>Enterococcus spp</i> (n=26)		Coagulase Negative Staphylococcus (n=7)		<i>Staphylococcus aureus</i> (n=3)	
	S (%)	R	S (%)	R	S (%)	R
Amoxyclav	11 (42.30%)	15	03 (42.85%)	04	00	03
Ampicillin	10 (38.46%)	16	01 (14.28%)	06	00	03
Cefoxitin	NT	NT	06 (88.71%)	01	01 (33.33%)	02
Ceftriaxone	NT	NT	02 (28.57%)	05	01 (33.33%)	02
Chloramphenicol	18 (69.23%)	08	06 (85.71%)	01	01 (33.33%)	02
Cotrimoxazole	00	26	01 (14.28%)	06	01 (33.33%)	02
Doxycycline	11 (42.30%)	15	05 (71.42%)	02	01 (33.33%)	02
Linezolid	21 (80.76%)	05	06 (85.71%)	01	03 (100 %)	00
Norfloxacin	04 (15.38%)	22	00	07	00	03
Vancomycin	17 (65.38%)	09	07 (100%)	00	03 (100%)	00

Discussion

Urinary tract infection is caused by microbial invasion and subsequent multiplication in urinary tract. It is the most common infection, in both community and hospitalized patients, associated with significant morbidity. In the community and hospital settings, the etiology of UTIs and the antimicrobial susceptibility of UTI causing bacteria have been changing over the years [12]. In this study 600 urine samples were cultured, out of which 328 (54.66%) gave significant growth of pathogens. Our findings are in accordance with Prakash D et al., [13] (53.82%), Rangari A et al., [14] (58.82%). We found that out of 328 sample showing significant growth 180(54.87%) were from OPD patients while 148(45.13%) were from hospitalized patients. (IPD). Similar findings were also reported by Surinder K et al., [15] (64.61% OPD & 35.38% IPD). This is supported by the fact that hospitalization is not required for uncomplicated UTI and mostly patients are treated in OPD. In this study 283 out of 328 (86.28%) were bacterial growth while 45 of 328 (13.72%) were candidial growth which is in agreement with study conducted by Singhal A et al., [16] who reported 10% *Candida* isolation rate. We found a high prevalence of UTI in females (60.36%) than in males (39.64%) which correlates with other findings which revealed that the frequency of UTI is greater in females as compared to males [17]. The reason behind this high prevalence of UTI in females is due to close proximity of the urethral meatus to the anus, shorter urethra, sexual intercourse and incontinence [18]. We found *Escherichia coli* the most common isolated urinary pathogen (57%). As *E. coli* is a major normal flora in the gut and most of the time poor hygiene will lead to cross contamination and then urinary tract infection occurs [19]. Other isolated bacteria were *Enterobacter spp* (15.57%), *Enterococcus spp* (8.09%), *P. aeruginosa* (6.23%), *Klebsiella* (4.36%), *Acinetobacter spp.* (3.11%), *Proteus spp.* (2.18%), *CONS* (2.18%), *Staphylococcus aureus* (0.93%) and the least was *Citrobacter spp* (0.31%). Our findings are in accordance with Surinder K et al. [15] who reported *Enterobacter species* (15.6%), *Pseudomonas* (3.33%). Sujatha R et al., [20] reported *Pseudomonas* in (6.49%) cases and Vaishali et al., [27] in year 2014 reported (6.54%) *Pseudomonas species*. Our study showed *Enterococci* (8.09%) to be the predominant amongst gram positive uropathogen followed by Coagulase negative *Staphylococcus* (2.18%), *Staphylococcus aureus* (0.93%) which is in accordance with the other studies conducted in India. Sujatha R et al., [20] also reported *Enterococci* in (6.6%) cases and *CONS* in 1.92% cases, while Vaishali et al., [21] reported around (8.5%) *Enterococci* and 1.3% *Staphylococcus aureus* in 2014. In this study we found 45(13.71%) *Candida spp* which is approximately similar to studies conducted by Singhal A et al., [16] (10.3%), Meltem et al., [22] (15.8%) which reports a similar isolation rate, thereby implying the presence of factors predisposing for fungal infections, like long-term antibiotic treatment, steroids, chronic illness, cancer patients or other immunocompromised conditions [23]. In our study, out of 45 *Candida* isolates, 18(40%) were *C.tropicalis*, followed by *C.albicans* 16(35.56%), *C.glabrata* 7(15.56%) and *C.krusei* 4(8.88%) We observed that non-albicans *Candida species* had predominance over *C. albicans* which is consistent with the studies done by others from different parts of the world [24-26]. This may be due to emergence of resistance

to antifungal agents and change in virulence factor. Antibiotic susceptibility pattern of microorganisms has been changing rapidly over a short period. It is especially true for developing countries where antibiotics are prescribed irrationally not only by the medical practitioners but the antibiotics are also purchased directly from the chemist without prescription. The antimicrobial susceptibility (AST) pattern differs in different studies as well as at different times in the same hospital. We found that majority of Gram negative bacteria were sensitive to nitrofurantoin (65.66%), followed by amikacin (56.62%), cefoperazone -sulbactam (52.45%), imipenem (47.92%) and the least sensitive was cefixime (14.71%). Our findings are consistent with Singhal A et al., [16] and Amit Ranjan et al. [27] We also found 52% resistance to imipenem, similar to study done by Dalal P et al., [28] who reported 51.15% resistance to carbapenem In this study majority of Gram positive cocci were sensitive to linezolid (83.33%), followed by vancomycin (75%), chloramphenicol (69.44%) and were least sensitive to cotrimoxazole (5.55%). In this study resistance to vancomycin is reported among *Enterococci* to be 34.62% which is consistent with the studies conducted by Singhal A et al., [16] who reported 23.10% resistance. However there are studies which shows 100% susceptibility to vancomycin among Gram positive cocci by Dalal P et al. [28] It has been observed that each study has its own susceptibility pattern of that region, the reason for difference might be factors related to difference in antibiotic use, patient population and prescribing rate [29-30]. The regional variations of resistance to antibiotics may be explained in part by different local antibiotic practices [31].

Conclusion

A high isolation rate of pathogens from urine samples of clinically-suspected UTI shows a good correlation between clinical findings and microbiological methods. Knowledge on the antibiotic susceptibility testing pattern of the uropathogens is vital for proper treatment of UTI because antibiotic susceptibility pattern varies from place to place and changes with time. Constant evaluation of the antibiotic sensitivity pattern of UTI pathogens for commonly used antimicrobial agents in a particular environment should be carried out regularly.

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