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Original Research Article

Microbial spectrum of urinary tract infections and its antibiogram in a tertiary care hospital

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ABSTRACT

Background: Urinary tract infections are one of the major health problem effecting both sexes of all age group. UTIs are often treated with different broad-spectrum antibiotics. The aim of this study was to determine the prevalence of bacteria causing urinary tract infections and their susceptibility pattern from patients reporting in RIMS Hospital.
Methods: Mid stream urine (MSU) specimens sent to the laboratory from October 2014 to September 2016 were collected and inoculated onto blood agar and MacConkey agar and incubated at 37ºC for 24 hours. Identification and antibiotic susceptibility test was done following standard operative procedures.
Results: 25.66% (1142/4450) samples showed a significant growth out of which 42% (479/1142) were male and 58% (663/1142) were female. *E. coli* has been found to be the major pathogen causing UTI which account for 61% (696/1142) followed by *Staphylococcus aureus* 12% (137/1142), CONS 7% (79), *Enterococcus spp.* 6% (67), *Klebsiella spp.* 5% (57), *Proteus spp.* 2% (22), *Pseudomonas spp.* 2%, *Acinetobacter spp.* 2% and *Candida spp.* 3%. Imipenem was the most susceptible antibiotic for *Enterobacteriaceae*, *E. coli* (85.9%), *Klebsiella spp.* (89.4%) and *Proteus spp.* (95.4%). Vancomycin is 100% sensitive while Linezolid, Nitrofurantoin and Gentamicin are also highly sensitive for both *Staphylococcus aureus* and CONS.
Conclusions: These data may be used to determine trends in antimicrobial susceptibilities, to formulate local antibiotic policies in order to assist clinicians in the rational choice of antibiotic therapy to prevent misuse, or overuse, of antibiotics.

Keywords: Antibiotic policies, Antibiotic susceptibility, Rational choice, Urinary tract infections

INTRODUCTION

Urinary tract infections are one of the major health problem effecting both sexes of all age group. *E. coli* remain the commonest pathogen causing UTI which account for 75-90% and the rest are *Enterococcus*, *Klebsiella*, *Enterobacter*, *Citrobacter*, *Serratia*, *Pseudomonas aeruginosa*, *Providencia*, and *Staphylococcus epidermidis*.[1] Risk factors include immunosuppression, trauma, foreign body, broad-spectrum antibiotic use, infused body fluids like saline irrigations and also urinary catheterization.[2] UTI has become the most common hospital acquired infection, accounting for as many as 35% of nosocomial infections.[3] UTI is the second most common infectious presentation in community practice. It accounts for approximately one million hospitalizations annually worldwide.[4] It presents a spectrum of clinical entities upon severity ranging from asymptomatic infection to acute pyelonephritis with sepsis.[5] Asymptomatic bacteriuria (ABU) occurs in a small number of healthy individuals and may not need treatment, which makes it different from symptomatic bacteriuria. It often affects pregnant women, with varying prevalence among different populations, depending on factors such as age, sex, sexual activity, and the presence of genitourinary abnormalities.[6]

UTIs are often treated with different broad-spectrum antibiotics. antimicrobial susceptibility testing of the urinary pathogens constitutes the basis for antibiotic therapy. However, in view of the increasing bacterial resistance, regular monitoring of resistance patterns is necessary to improve guidelines for empirical antibiotic therapy.[7] To ensure appropriate therapy, current local based knowledge of the organisms that cause UTI and their antibiotic susceptibility testing is mandatory.[8] The aim of this study was to determine the prevalence of bacteria causing urinary tract infections and their susceptibility pattern from patients reporting in RIMS Hospital.

METHODS

This Study was conducted in the Department of Microbiology, RIMS, Imphal, Manipur, india from October 2014 to September 2016. Mid stream urine (MSU) specimens sent to the laboratory are collected and inoculated onto Blood agar and MacConkey agar and incubated at 37ºC for 24 hours. A specimen was considered positive for UTI if the bacterial colony count is >105 cfu/ml. They were further processed for identification following standard operative procedures.[9] Antibiotic susceptibility test was performed by Kirby Bauer's disc diffusion method using Muller Hinton Agar as per Clinical Laboratory Standards Institute (CLSI) guidelines and susceptibility pattern was noted.10 The following antibiotic discs (drug concentrations in µg) were used: gentamicin (10), ceftazidime (30), ceftriaxone (30), cotrimoxazole (25), ciprofloxacin (5), nitrofurantoin (300), imipenem (10) and piperacillin-tazobactum (10/100) were used for Gram negative organisms. In addition cefoxitin (30), linezolid (30), teicoplanin (30) high level gentamicin (120) and vancomycin (30) were used for Gram positive organisms.

Quality control strains used were:

- *Staphylococcus aureus* ATCC 25923,
- *Enterococcus faecalis* ATCC 29212,
- *Escherichia coli* ATCC 25922,
- *Pseudomonas aeruginosa* ATCC 27853

All the analysis was performed using simple percentage method.

RESULTS

A total of 4450 urine samples were processed and 25.66% (1142/4450) samples showed a significant growth out of which 42% (479/1142) were male and 58% (663/1142) were female. Out of 1142 significant growth 66% (688/1142) from wards, 2% (21/1142) from ICU and 32% (340/1142) from OPD.

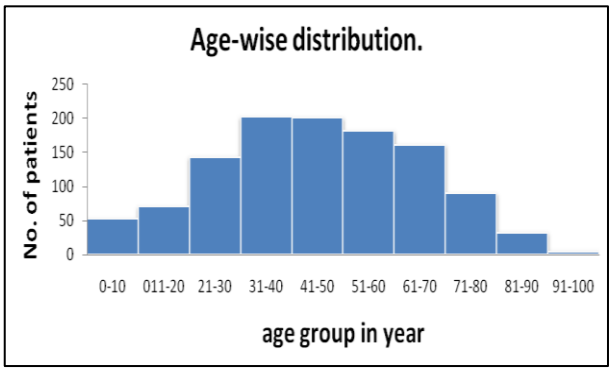

Figure 1: Age-wise distribution of UTI.

Figure 1 shows that maximum number of UTI patients falls in the age group of 31 to 50 years which is the sexually reproductive age group. *E. coli* has been found to be the major pathogen causing UTI which account for 61% (696/1142) followed by *Staphylococcus aureus* 12% (137/1142), CONS 7% (79), *Enterococcus spp.* 6% (67), *Klebsiella spp.* 5% (57), *Proteus spp.* 2% (22), *Pseudomonas spp.* 2%, *Acinetobacter spp.* 2% and *Candida spp.* 3% as shown in Figure 2.

Table 1: Antimicrobial susceptibility pattern of *Enterobacteriaceae*.

Antibiotics	*E. coli* n=696	*Klebsiella spp.* n=57	*Proteus spp.* n=22
Ceftazidime	143 (20.5%)	19 (33.3%)	10 (45.5%)
Ciprofloxacin	313 (44.9%)	15 (26.3%)	15 (68.2%)
Amikacin	532 (76.4%)	42 (73.6%)	18 (81.8%)
Imipenem	598 (85.9%)	51 (89.4%)	21 (95.4%)
Nitrofurantoin	544 (78.1%)	31 (54.3%)	10 (45.5%)
Cotrimoxazole	211 (30.3%)	16 (28.1%)	9 (40.9%)

Table 1 shows the antimicrobial susceptibility pattern of *Entrobacteriaceae*, Imipenem is the most susceptible antibiotic for *Enterobacteriaceae*, *E. coli* (85.9%), *Klebsiella spp.* (89.4%) and *Proteus spp.* (95.4%). The least susceptible antibiotic for *E. coli* is Ceftazidime (20.5%), for *Klebsiella spp.* is ciprofloxacin (26.3%) and for *Proteus spp.* is cotrimoxazole (40.9%). Table 2 shows that Vancomycin is 100% sensitive to both

Staphylococcus aureus and CONS while linezolid, nitrofurantoin and gentamicin are also highly sensitive to both *Staphylococcus aureus* and CONS.

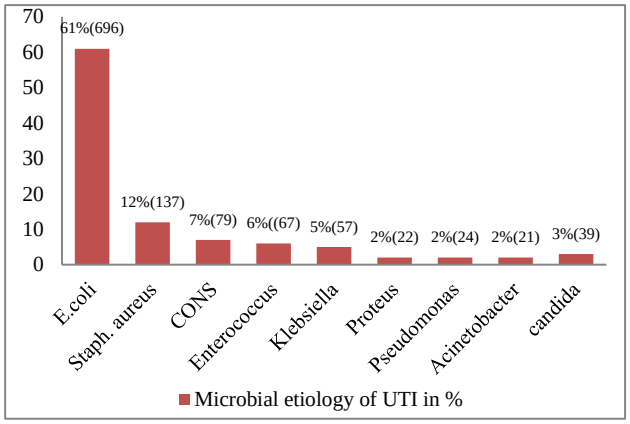

Figure 2: Microbial etiology of UTI.

Table 2: Antimicrobial susceptibility pattern of *Staphylococcus*.

Antibiotic	*Staph. aureus* n=137	CONS n=79
Vancomycin	137 (100%)	79 (100%)
Linezolid	130 (95.2%)	69 (87.8%)
Cefoxitin	46 (33.6%)	15 (19.6%)
Cotrimoxazole	13 (53.9%)	25 (31.8%)
Nitrofurantoin	199 (87.4%)	65 (82.8%)
Gentamicin	144 (83.4%)	60 (76.4%)
Ciprofloxacin	60 (43.8%)	49 (62.7%)

Cefoxitin sensitivity is seen in 33.6% of *Staphylococcus aureus* and 19.6% of CONS. All the isolates of *Enterococci* were sensitive to vancomycin, linezolid and teicoplanin, 81.4% of Isolates were nitrofurantoin sensitive and 62.9% of enterococcal isolates were susceptible to high level gentamicin (HLG) as shown by Table 3. Table 4 shows that Imipenem is highly sensitive to non-fermenter gram negative bacilli, 91.6% in *Pseudomonas spp.* and 85% in *acinetobacter spp.* Ciprofloxacin is least sensitive in case of *pseudomonas spp*. (20.8%) and ceftriaxone in case of *acinetobacter spp*. (9.5%).

Table 3. Antimicrobial susceptibility pattern of *Enterococcus spp*.

Antibiotic	*Enterococcus spp.* n=67
Penicillin	5 (7.5%)
Ciprofloxacin	13 (19.2%)
High level gentamicin	42 (62.9%)
Nitrofurantoin	55 (81.4%)
Vancomycin	67 (100%)
Linezolid	67 (100%)
Teicoplanin	67 (100%)

Table 4. Antimicrobial susceptibility pattern of non-fermenters.

Antibiotic	*Pseudomonas spp.* n=24	*Acinetobacter spp.* n=21
Imipenem	22 (91.6%)	18 (85%)
Amikacin	17 (70.8%)	15 (71.4%)
Ciprofloxacin	5 (20.8%)	3 (14.2%)
Ceftazidime	8 (33.3%)	4 (19%)
Cefipime	12 (50%)	5 (23.8%)
Ceftriaxone	7 (29.1%)	2 (9.5%)
Piperacillin/tazobactum	16 (66.6%)	8 (38.1%)

DISCUSSION

Urinary tract infection (UTI) is one of the most frequent causes of nosocomial infections. Effective treatment of patients with UTIs commonly relies on the identification of the type of organisms and the selection of an effective antibiotic agent to the organism in question.[11]

The pattern of antimicrobial resistance of bacteria producing UTI varies in different regions.[12] Monitoring of antimicrobial susceptibility can aid clinicians for prescribing appropriate antibiotics and in prevention of development of drug resistance.[13] The prevalence of UTI for our study is 25.66 which is similar to Niranjan et al (21%) and lower than Patel et al (46.48%).[14,15] UTI is the most predominant in reproductive age group 30-50 years 405 (35%) may be because of frequency of sexual intercourse. Our findings in accordance with other studies indicated that females (58%) have a notable frequency of UTI versus males (42%). This difference in frequency could be due to several clinical factors, including anatomic differences, hormonal effects, and behavioral patterns.[16,17] In study of Azra S et al prevalence rate in female (70.5%) and male (29.5%).[18] The most prevalent organisms in our study was *E. coli* (61%), followed by *Staphylococcus aureus* (12%), CONS (7%), *Enterococcus* (5%), *Klebsiella pneumoniae* (5%), *Candida spp.* (3%), *Proteus spp.* (2%), others (6%). While in a study conducted by Patel et al in Jamnagar, Gujarat, India *E. coli* was (53.38%), *Klebsiella spp.* (18.92%) *P. aeruginosa* (10.74%), *P. mirabilis* (5.38%), and *S. aureus* (7.2%).[15] The findings pattern in study of Savitha et al were *E. coli* (48.04%), *Klebsiella spp.* (8.82%), *P. aeruginosa* (0.98%), *Proteus spp.* (4.9%), and Gram positive organisms (37.26%).[19] UTI is most prevalent in ward patients 688 (66%), followed by OPD 340 (32%), ICU 21 (2%) because of prevalence of nososcomial UTI in wards patient. *E. coli* and *Klebsiella spp.* are more sensitive to nitrofurantoin, gentamicin, and imipenem, while less sensitive to ceftazidime, cotrimoxazole and ciprofloxacin which is similar to study done by Niranjan et al in Puducherry, India. [14] A low degree of resistance to amikacin and gentamicin (aminoglycoside drug) was observed for both gram negative and gram positive organisms and hence may be helpful in combating severe infections. Aminoglycosides

being injectables are used restrictively in the community care setting and hence have showed lesser resistance rates.[20] Resistance to antibiotics like ciprofloxacin, cotrimoxazole, and third generation cephalosporin (eg. ceftriaxone) is very high. Such findings are attributed to excessive use of antibiotics in both community and hospital settings, uncontrolled prescription practices and incomplete dosage consumption by patients. Another oral antibiotic nitrofurantoin was found to be more effective in treatment of UTI in our case and the findings are in agreement with similar surveillance studies by Sasirekha and Khameneh and other Indian studies, which have demonstrated nitrofurantoin as an appropriate agent for first line treatment of community acquired UTI.[21,22] Low antimicrobial resistance for nitrofurantoin can be attributed to its localized action on urinary tract and not being exposed outside urinary tract.[23] Resistance to imipenem, which is used as last resort drugs in the health-care settings was found to be around 10%-15% in our study which is quite alarming. Carbapenem resistance is usually multifactorial. Resistance to carbapenems occurs through bacterial production of betalactamase enzymes that hydrolyse the antibacterial agent or through porin changes in the bacterial cell wall that reduce the permeability of the drug into the organism. In addition, upregulation of efflux pumps result into reduced susceptibility of organisms toward carbapenems. Most studies showed 100% sensitivity toward imipenem.[21,24,25]

CONCLUSION

The findings of this study emphasized the need for constant monitoring of susceptibility of specific pathogens in different populations to commonly used antimicrobial agents. These data may be used to determine trends in antimicrobial susceptibilities, to formulate local antibiotic policies in order to assist clinicians in the rational choice of antibiotic therapy to prevent misuse, or overuse, of antibiotics. Present study suggest that nitrofurantoin and aminoglycosides should be used as empirical therapy for UTI. The antibiotics like carbapenems, vancomycin and linezolid should be used as last line resort and only after urine culture and antibiotic sensitivity report, they should not be used as empirical therapy to prevent occurrence of resistance for these antibiotics.

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