Original Research Article

Microbiological Profile and Antibiogram of Uropathogens Isolate in Tertiary Care Hospital

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Abstract

Introduction: Urinary tract infections (UTIs) are one of the most common bacterial infections in humans, both in the community and the hospital settings. The distribution of antimicrobial susceptibility data of UTI-causing microorganisms changes from time to time and from place to place. The susceptibility data provided by regional microbiology laboratories helps to choose the empirical antimicrobials to treat UTI.

Materials and methods: Total 1381 urine were received in Bacteriology section of microbiology department from January 2022 to August 2022. Urine was processed for culture according to standard operating procedures at Microbiology laboratory, tertiary care hospital. Identification and antibiotic sensitivity testing was performed by automated VITEK-2 compact system.

Results: In total, 1381 urine were received during the study period, 433(31.35%) cultures yielded significant pathogens and no organisms were isolated in 941 cultures and some sample was contaminate. The most commonly isolated organism were Escherichia coli (38.8%), followed by Candida spp. 88(20.32%), Klebsiellaspp (13.40%), Pseudomonas aeruginosa (12.24%), Gram positive organisms 12(2%) isolated. E. coli were most susceptible to Amikacin (87%), Fosfomycin (83%), colistin (82%), and tigecycline (78.39%). Klebsiella spp were most susceptible to colistin (72%). Nearly, 75% strains of Klebsiella spp were showing resistance to Carbapenems due to Carbapenemase production.

Conclusion: Over enthusiastic use of the antibiotic has resulted in the emergence of drug-resistant bacterial strains in patients. The study of antimicrobial susceptibility patterns of uropathogens in a particular area can guide the clinicians in the rational choice of empirical treatment to prevent the misuse of antibiotics.

Key words

Antibiogram, Uropathogenes, Urinary tract infection.

Introduction

Urinary tract infection (UTI) is one of the most common infectious diseases, particularly in developing countries, overwhelmed with healthcare and economic constraints [1]. The infection has clinical signs and symptoms such as dysuria, frequency, urgency, suprapubic tenderness, fever, chills, nausea, and vomiting [2, 3]. Poor personal hygiene and urinary tract abnormalities are some of the highlighting factors causing urinary tract infections [4-6]. The infection is higher in females due to biological factors such as the short urethra, anal-genital proximity, and use of spermicides [7]. Approximately 150 million people suffer from UTI annually all over the world counted for almost 40-50% of nosocomial infections [8]. The most common pathogenic organisms of UTI are Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus spp, Candida, and Enterococci [9-11]. E. coli is a leading cause of the vast majority of UTIs, and has a wide variety of specific virulence factors such as adhesins and toxins in addition to the common ones [12]. This observational study was undertaken to determine the bacteriology and antimicrobial susceptibility pattern of uropathogens in a tertiary care hospital. Urine samples from patients suspected of having UTI were collected and processed according to standard microbiological techniques [13]. The study was aimed to identify the microorganisms and analyze their antimicrobial susceptibility pattern of prevalent uropathogens isolated from a tertiary care hospital, Ahmedabad and to help the clinicians choosing antibiotic therapy based on antibiogram.

Materials and methods

This study was conducted in a tertiary care hospital from 1st January, 2022 to 31st August, 2022.

Study population

The present study included 1381 urine samples collected from the suspected cases of UTI.

Inclusion criteria

All patients attending the outpatient and inpatient department of Sardar Vallabhbhai Patel Hospital presented with signs and symptoms of UTI irrespective of their age groups or genders.

Collection of urine samples

Clean catch midstream urine or catheterized urine samples were collected in a sterile wide-mouthed screw-capped container. Urine samples were sent to the bacteriology lab and processed immediately within 2 hours of collection. Samples were stored at 4°C in the case of any undue delay.

Sample processing and incubation of culture media

Samples were inoculated with a calibrated loop of 2.2 mm diameter dispensing volume of 0.005 ml on Blood agar and MacConkey agar and incubated aerobically overnight at 37ºC. After incubation, the plates were examined for bacterial growth.

Culture

The colony count was done using a semiquantitative method. A count equal to or in multiply of 10^5 bacteria per ml was taken as a significant bacterial count. If CFU was less than 10^5 bacteria per ml, it was considered as insignificant and not processed further. The patients were asked to submit repeat samples with early morning fresh midstream urine specimens in cases of contaminate growth.

Identification of uropathogens

VITEK 2 is an automated system used for identification and Antimicrobial Susceptibility Testing (AST) of bacteria and yeast. Separate cards are available for the identification of Gram-negative bacteria, Gram-positive bacteria, fastidious bacteria, and yeasts. Cards for AST testing are available as N235, N405 and N406 for Gram negative bacteria, GP-628 for Gram positive bacteria, and YST-08 for yeast. The 64 well plastic GN card contains 41 tests which include 18 tests for sugar assimilation, 18 tests for sugar fermentation, 2 decarboxylase tests, and 3 miscellaneous tests for (urease, utilization of malonate, and tryptophan deaminase). Identification and AST cards are inoculated with microorganism suspensions of 0.5 McFarland standards from a plate of pure culture using an integrated vacuum apparatus. The results of identification were usually available within 4-6 hours and AST within 16-18 hours. The VITEK-2 system automatically processes the antimicrobial susceptibility cards until Microbial Inhibition Concentration (MIC)'s are obtained. The VITEK-2 compact system subsequently corrects, where necessary for MIC or clinical category by the internal database of possible phenotypes for microorganism antimicrobial agent combinations [14].

Results

Out of the 1381 urine samples that were processed in present study, 941 samples showed no growth or insignificant bacteriuria while 433 showed significant bacteriuria on aerobic culture. Overall prevalence of UTI in the whole population was 31.35%. Females (51%) showed a higher prevalence as compared to males (48%) (**Table – 1**).

Out of the remaining 433 urine samples that yielded significant growth, E.coli were the commonest isolate (38.8%) followed by Candida spp. 88 (20.32%)isolated, C. tropicalis the highest in number 68(15.17%), Klebsiella spp. (13.4%), Pseudomonas spp. (12.24%) and Providencia rettgeri (4.81%) (**Table - 2**).

Table - 1: Gender wise distribution of the culture positive UTI cases.

Gender	Total samples	Positive cases (%)
Male	737	209(48%)
Female	644	224(51%)
Total	1381	433(31%)

Table - 2: Distribution of uropathogens in culture positive cases (n=433).

Uropathogenes	Isolation rate (%)
Escherichia coli	168(38.8%)
Candida spp.	88(20.32%)
K. pneumoniae subsp. Pneumoniae	58(13.40%)
Pseudomonas aeruginosa	53(12.24%)
Providencia rettgeri	21(4.81%)
Acinetobacter baumannii complex	8(1.84%)
Myroides species	7(1.61%)
Enterococcus faecalis	6(1.38%)
Morganella morganii	4(0.92%)
Enterobacter cloacae complex	4(0.92%)
Staphylococcus aureus	4(0.92%)
Proteus mirabilis	3(0.6%)
Pseudomonas putida	3(0.6%)
Enterococcus faecium	2(0.46%)
Citrobacter freundii	1(0.23%)
Enterobacter aerogenes	1(0.23%)
Serratia marcescens	1(0.23%)
Sphingomonas paucimobilis	1(0.23%)
Total	**433(31.35%)**

In a case of *E.coli* amikacin showed the highest sensitivity (87%) followed by Fosfomycin (83%), colistin (82%) and tigecycline (78%). Imipenem and meropenem showed susceptibility of 67.14% and 56.36% respectively. Nitrofurantoin, the drug used exclusively to treat UTI showed a sensitivity of 60.74%. Fluoroquinolones like ofloxacin, ciprofloxacin, levofloxacin vary in susceptibility from 9-15%. Cephalosporins-ceftriaxone, and cefuroxime 7% and 5%. Least susceptibility was observed to nalidixic acid (5.57%) and ampicillin (5.21%).

Table - 3: Antibiotic sensitivity pattern of isolated uropathogens.

Antibiotic	E.coli N=168(%)	Klebsiella N=58(%)	P.aeruginosa N=53(%)	P. rettgeri N=21(%)	S. aureus N=4(%)	Enterococcus N=8(%)
Amikacin	146(87%)	29(50%)	7(13%)	1(5%)		
Ampicillin	9(5%)	0				
Aztreonam	17(10%)	0		3(14%)		
Cefoperazone/ Sulbactam	88(53%)	10(17%)	7(13%)			
Cefepime	55(32%)	12(20%)	9(17%)			
Ceftazidime	18(10%)	4(7%)	7(13%)			
Ceftriaxone	12(7%)	9(15%)				
Cefuroxime	9(5%)	14(7%)				
Ciprofloxacin	18(10%)	10(17%)	7(13%)		1(25%)	0
Clindamycin					4(100%)	0
Colistin	138(82%)	42(72%)	47(89%)			
Ertapenem	89(53%)	18(31%)				
Erythromycin					3(75%)	0
Fosfomycin	140(83%)	16(28%)				
Gentamicin	117(69%)	22(38%)	7(13%)	1(5%)	3(75%)	
Imipenem	112(67%)	14(7%)	5(10%)			
Oxacillin					2(50%)	
Linezolid					4(100%)	8(100%)
Meropenem	94(56.36%)	11(19%)	8(15%)			
Nalidixic Acid	6(5.23%)	8(14%)				
Nitrofurantoin	102(60%)	15(26%)			4(100%)	6(75%)
Norfloxacin	9(5%)	6(10%)				
Piperacillin/ Tazobactam	96(58%)	15(26%)	6(11%)	2(7%)		
Tigecycline	131(78%)	16(28%)			4(100%)	8(100%)
Trimethoprim/ Sulfamethoxazole	57(34%)	18(31%)			4(100%)	
Vancomycin					4(100%)	8(100%)
Teicoplanin					4(100%)	8(100%)
Tetracycline					4(100%)	8(100%)
Rifampicin					4(100%)	

Klebsiella species were most susceptible to the colistin (72.78%). Sensitivity to amikacin was 50% and gentamicin sensitivity was 38%. Imipenem and meropenem showed sensitivity of 7% and 19% respectively, reflecting increasing resistance pattern towards carbapenems in Klebsiella spp. Other widely used antibiotics like tigecycline and nitrofurantoin were found sensitive in only 28.99% and 26.74% isolates respectively. Highest resistance rate was seen towards ampicillin and nalidixic acid. Fluoroquinolone (ciprofloxacin, ofloxacin, levofloxacin) sensitivity ranges between 2-10% which showed Third generation cephalosporins sensitivity was found between 4-10% only due to ESBL production.

Pseudomonas spp were most susceptible to colistin (89%) followed by levofloxacin (15%) and gentamicin (13%). Sensitivity to carbapenem

was 10% and 15% for imipenem and meropenem respectively as many strains of P. aeruginosa were producing Metallo β-Lactamase (MBL) or carbapenemase. Piperacillin/ tazobactam was sensitive in 11%. *Providencia rettgeri* was most sensitive to aztreonam-14%. Most of P. rettgeri isolates (80-90%) were multi drug resistance. Amongst fluoroquinolone group, only gentamycin showed sensitivity in 5% isolates. Gram positive isolates showed 100% sensitivity to linezolid and vancomycin. Nitrofurantoin also turn out to be effective with s.aureus showing 100% sensitivity. Majority of gram positive bacterial were resistant to penicillin (**Table – 3**).

Discussion

Urinary tract infections (UTIs) accounts for highly prevalent infection around the globe. The appropriate choice for empirical management of UTI is always a challenging task for the clinicians Many national and internationally published studies support the fact that the selection of antibiotic should vary based upon the nature of UTI, acute lower or upper UTI, recurrent UTI, or a case of complicated UTI [15].

The prevalence of UTI in the population was 31.35%. This figure corresponds to the prevalence rate of 31.35% reported by Savitha T, et al. and Singh, et al. 33% [16-17]. Previous studies have suggested E. coli to be the most common cause of UTIs in the Indian population, followed by other uropathogens like Klebsiella spp, Pseudomonas spp, Proteus spp Enterococcus spp, and S. aureus [17-18].

In this study, the prevalence of UTI in females (51%) is more than in males (48%). It correlates to the findings of Kumar R, et al.; Aruna K, et al. and Singh, et al. who have also reported high prevalence rate of UTI among females as compared to males [19-21].

High E. coli isolation rate of 69.8% and 65.8% was observed in studies conducted by George, et al. and Mangalgi, et al. respectively in Karnataka, whereas 37.7% was seen in a study done by Kasew, et al. which is closely comparable to 38.8% seen in our study [22-24].

Susceptibility to amikacin (87%) was comparable to the study done by Somashekara, et al. (sensitivity - 84%), George, et al. (sensitivity 90%) and higher than a recent study done by Harsh Kumar, et al. This finding suggests amikacin good to treat complicated UTI [25, 22, 32].

Fosfomycin sensitivity rate of 83.46% in our study is comparable to a study done by Maraki, et al. in Greece, while a study done by Stefaniuk, et al. showed a sensitivity of 77.6% and 62.2% for uncomplicated and complicated UTI respectively [26-27].

High susceptibility of E. coli to meropenem (91.89%) and imipenem (91.69%) was noted in other studies across India [1, 17-20, 28] whereas a study done in Lahore, Pakistan by Sabir et al. reported a low E. coli susceptibility rate of 39.5% to imipenem [28]. In our study, we have noted 67% susceptibility to imipenem and 56% to meropenem.

Susceptibility of E. coli to cotrimoxazole was 34% in this study, while in other studies across India it is varied from 15.15% to 52.3% [1, 16, 30].

Klebsiella spp were the second most commonly isolated uropathogens (isolation rate 13.40%), findings was similar with Kashyap et al study with klebsiella (11.65%) [29]. Klebsiella spp were most susceptible to colistin (72%) which is similar to study done by Saha et al. (sensitivity-89.42%)whereas in a study done by Varghese, et al., the sensitivity of colistin was 77% only [30-31].

Conclusion

The treatment of UTI in general population is often done empirically by the general practitioners. Antibiotic susceptibility tests are ordered by the doctors only when the patient has

failed to recover from UTI even after taking one or more courses of antibiotics. The study of antimicrobial susceptibility pattern of UTI in a particular area can guide the clinicians in the rational choice of antibiotic treatment so that misuse of antibiotics may be prevented. E. coli is still most common bacterial pathogen causing UTI. For E.coli the preferred antibiotic is amikacin and Fosfomycin. For UTI caused by Klebsiella spp, the preferred antibiotic is colistin. To avoid/contain the emergence of antibiotic resistance in bacteria, the government must introduce laws requiring the prudent use of these antibiotics.

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