Original Article

Antimicrobial Sensitivity Pattern of Bacterial Isolates Associated with Urinary Tract Infection in a Tertiary Care Hospital

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Introduction : Urinary Tract Infection (UTI) is a common infection and a major health problem. Considering the bacterial resistance developed globally, knowledge regarding sensitivity and resistance pattern of isolated uropathogens in a defined area becomes critically important for choosing appropriate antimicrobial agents for treatment.

Objectives : We conducted this study to detect the common UTI causing microorganisms and to evaluate their culture sensitivity pattern in a Tertiary Care Hospital.

Methods : This retrospective record based observational study was conducted over a period of two months (January and February, 2021). Patients in the General Ward in the Department of General Medicine, Medical College, Kolkata whose urine samples were collected within 48 hours of admission were included. Identification of bacteria was done by standard microbiologic methods and using Kirby disc diffusion test their antimicrobial susceptibility test was performed. The causative organisms for UTI along with its antibiotic sensitivity pattern were retrospectively reviewed and analysed.

Results : Among 150 culture positive samples 34.67% were from male and 65.33% were from female with highest prevalence in the age group of 21-30 years (22.67%). Most prevalent uropathogens isolated was *Escherichia coli (E coli)* (60.66%) followed by *Enterobactor* (21.33%) and *Klebsiella* (9.33%). *E coli* showed most sensitivity against ceftazidime, clarithromycin, piperacillin-tazobactam and clindamycin (100% in all cases). Resistance (>70%) of *E coli* was found against levofloxacin and cefotaxime.

Conclusion : The present study reveals microbiological profile regarding UTI in patients attending our hospital. As resistant to first line antibiotic is increasing, antibiotic stewardship programme should be strengthened. Antibiotic policies agreed among Clinicians, Microbiologists and Pharmacologists will guide good prescribing, provide maximum coverage for treating infections and ensure antibiotic cycling.

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***Key words* : Urinary Tract Infection, Antibiotic therapy, Retrospective, Drug-sensitivity pattern.**

Urinary Tract Infection (UTI) is a common infection in the community caused by different species of bacteria resulting in very high morbidity. Globally UTI affects about 150 million people per year. This data indicates UTI a major health problem in the community and it may have an adverse impact on World Economy[1].

UTI may be asymptomatic (subclinical infection) or symptomatic (disease). Thus, the term Urinary Tract Infection encompasses a variety of clinical entities, including Asymptomatic Bacteriuria (ASB), cystitis, prostatitis and pyelonephritis. The distinction between symptomatic UTI and ASB has major clinical implications. In both of the cases bacterial presence in the urinary tract is usually accompanied by urinary white blood cells and inflammatory cytokines[2]. Lower urinary tract is the usual beginning point of the infection which spreads through the upper urinary tract. Depending upon the selection of therapy UTI may be divided into two classes: uncomplicated and complicated[3]. Females are more prone to develop UTI compared to males considering the fact that structurally female urethra is not much competent to inhibit the entry of bacteria in the urinary tract[4]. Factors attributing

Editor's Comment :

- As treatment failure may occur with commonly used antimicrobials, urinary culture and sensitivity may be considered as a routine investigation in suspected cases of UTI. In this regard timely microbiologic surveillance and assessment of antimicrobial resistance may form an important tool to identify microbial resistance and to limit its spread.

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to this may be proximity of the urethra and genital tract, urothelial mucosal adherence to the lining by muco-polysaccharide layer, poor and unhygienic practices during menstruation and use of diaphragm for contraceptive purpose.

In most of the cases of uncomplicated UTIs, *Escherichia coli (E coli,)* the gram-negative bacillus are the causative organisms, other pathogens being *Staphylococcus aureus (S aureus), Klebsiella spp* and *Proteusmirabilis*[5]. Presence of 10^5 cfu/mL in midstream urine is considered as significant number of bacteria for UTI[6]. Effective management of patients suffering from bacterial UTIs commonly relies on the identification of the type of organisms that caused the disease and the selection of an effective antibiotic agent against the organism in question.

However, due to early starting of antibiotic therapy even before the laboratories results are available may result in antibiotic misuse. Global development of antibiotic resistance may be the result of extensive, indiscriminate and inappropriate use of these agents. This has posed a great threat and challenge to the management of UTI. Close monitoring and supervision of uropathogens' antibiotic susceptibility in a particular area should be done on a regular basis to have the knowledge regarding the antibiotic resistance pattern in UTI.

For the effective selection of empirical antibiotic agents to treat UTI, data supplied by local microbiology laboratories regarding the susceptibility pattern of uropathogens to different antibiotics may be of great help[7]. The patterns of antimicrobial resistance developed in micro-organisms have wide variations. This variation has been found among hospitals as well as among countries. Presently, India lacks any local or national level surveillance program to guide the stakeholders on actual prevalence of resistance[8].

In the view of bacterial resistance developed globally with epidemiological significance, physicians should have adequate knowledge regarding microorganisms' antimicrobial sensitivity and resistance pattern in a certain area for choosing the appropriate antibiotic therapy for treatment of UTI.

However, published literature regarding the susceptibility and resistance pattern of community acquired uropathogens in India is few[9]. Moreover, to have the adequate knowledge regarding local antibiotic susceptibility pattern of micro-organism, extensive and thorough studies should be conducted in different area. So, we conducted this study to identify the microorganisms commonly cause UTI and to make out the culture sensitivity pattern of those pathogens in a Tertiary Care Hospital in Eastern India.

Materials and Methods

This retrospective study was conducted in the Department of Pharmacology along with Department of Microbiology, and Department of General Medicine, Medical College & Hospital, Kolkata. Prior to the commencement of the study, approval from Institutional Ethics Committee was taken (Ref No: MC/KOL/IEC/NON-SPON/796/09/20 dated: 04/09/2020).

Patients admitted in the General Ward in the Department of General Medicine, Medical College & Hospital, Kolkata over a period of two months (January and February 2021), whose urine samples were collected within 48 hours of admission were included in the study. Patients who received antibiotic therapy within 48 hours of admission or patients with known anatomic abnormalities of the genitourinary tract were excluded.

For the purpose of avoiding contamination from urethra, patients were provided adequate instructions regarding collection of urine sample aseptically. Collected samples form the study subjects were clean catch midstream urine. The diagnosis of UTI was based on culture finding of more than 10^5 organisms (Colony Forming Unit [cfu])/ml. Identification of organisms were done by conventional methods through culturing of samples followed by biochemical tests including their distinct colony characteristics. First culture was observed following inoculation at 37ºC for 16 hours. Using Kirby disc diffusion test the Antimicrobial susceptibility test was performed. 'Sensitive' or 'Resistant' interpretation was determined depending on the diameters of inhibitory zones of bacterial growth as recommended by the disc manufacturer.

Statistical Methods : For the analysis of the data, Statistical Package for the Social Sciences (SPSS) version 20.0 was used. Qualitative data was presented as frequency and percentage, quantitative data were expressed as percentage.

Results

A total of 395 urine samples from the General Ward in the Department of General Medicine were collected for culture and sensitivity test in the Department of Microbiology. Out of 395 samples, 150 were cultured positive (37.97 %), out of which 52 (34.67%) were from males and 98 (65.33%) were from females (Fig 1). UTI was found to be most prevalent among the age group of 21-30 years (22.67%) (Fig 2).

E coli was the most prevalent uropathogens isolated, the prevalence rate being 60.66%. This was followed by *Enterobactor* (21.33%), *Klebsiella* (9.33%), *Acinetobacter* (3.33%), *Pseudomonas* (3.33%), *Gram positive cocci* (0.67%), *Non Lactose Fermenters (NLF)* (0.67%) and *S. aureus* (0.67%) (Table 1).

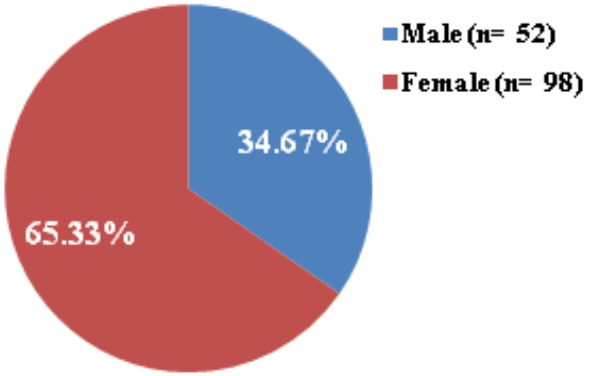

Fig 1 — Prevalence of UTI in different genders (n=150)

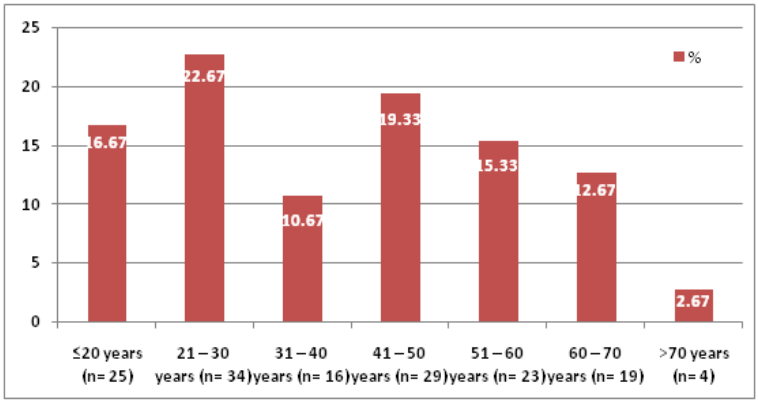

Fig 2 — Prevalence of UTI in different age groups (n=150)

From the antibiotic sensitivity pattern of predominant micro-organisms it was found that *Acinetobacter* was most sensitive to clarithromycin (100%), followed by amikacin (80%). However, it was resistant to meropenem, ertapenem, amoxyclav, nitrofurantoin, Imipemen and cefotaxime (100% in all cases). *E coli* showed most sensitivity to clarithromycin, ceftazidime, piperacillin-tazobactam and clindamycin (100% in all cases). Resistance (>50%) of *E coli* was found against cefotaxime (91.4%), levofloxacin (86.2%), ciprofloxacin (75%), amoxyclav (70%), cefepime (68.1%), amikacin (58.4%) and ertapenem (57.8%).

Enterobactor was most sensitive to vancomycin, linezolid and clarithromycin (100% in all cases). Resistance of *Enterobactor* was found to be 100% in meropenem, ertapenem, amoxyclav, cefepime, cefotaxime, cefoperazone-sulbactam and piperacillin-tazobactam. *Gram positive cocci* were most sensitive to vancomycin, linezolid and nitrofurantoin (100% in all cases). Resistance of *Gram positive cocci* was found to be 100% in penicillin, amoxycillin, doxycycline and levofloxacin (Table 2A).

Klebsiella was most sensitive to clarithromycin and clindamycin (100% in both the cases). *Klebsiella* showed 100% resistance to amoxyclav, cefotaxime and cefoperazone-sulbactam. *NLF* showed most sensitivity to roxithromycin, levofloxacin, nitrofurantoin, meropenem, ertapenem and ciprofloxacin (100% in all cases). This organism was completely resistant (100%) to amikacin. *Pseudomonas* was found to be sensitive to cefoperazone-sulbactam and amikacin (100% in both the cases). 100% resistance was shown by this organism to amoxyclav and imipenem. *S aureus* showed sensitivity to vancomycin, doxycycline, gentamicin, nitrofurantoin, linezolid, cefotaxime and amoxyclav (100% in all cases). This organism was found to be completely resistant (100%) to penicillin (Table 2B)

Table 1 — *Distribution of isolated uropathogens (n=150)*

Organism	Total (n=150)
Acinetobacter	5 (3.33%)
E coli	91 (60.66%)
Enterobactor	32 (21.33%)
Gram positive cocci	1 (0.67%)
Klebsiella	14 (9.33%)
Non lactose fermenters	1 (0.67%)
Pseudomonas	5 (3.33%)
Staphylococcus aureus	1 (0.67%)

Discussion

The present study included the types and antibiotic susceptibility pattern of bacterial organisms isolated from different samples of critically ill patients after 48 hours of admission to identify hospital acquired infections.

In this study, appalling results were obtained about the sensitivity/resistance pattern of microbes to antibiotics. The number of positive isolates was 150 out of 395 samples with an infection rate of 37.97 %. In some other studies conducted in India, prevalence rate of UTI accounted for 34.5%[10] and 36.68%[11].

In our study we found UTI to be highly prevalent in females (65.33%) than in males (34.67%) which is in accordance with the findings of other studies. This may be due to closeness of the anus and urethral meatus as well as females' shorter urethra[4].

We found *E coli* to be the most predominant isolates (60.66%). This was in accordance with the other studies[12].

In our study the second most prevalent isolate was *Enterobactor* (21.33%) followed by *Klebsiella* (9.33%). However, in several studies *Klebsiella* was found to be the second most prevalent isolate[13]. These isolates were tested to find the antimicrobial sensitivity pattern and the pattern was obtained.

Table 2A — *Antibiotic sensitivity pattern of predominant micro-organisms isolated from patients*

Antimicrobial agents	Uropathogens							
	Acinetobacter (n=5)		*E coli* (n=91)		*Enterobactor* (n=32)		*Gram positive cocci* (n=1)	
	T*No.(%)	S** No.(%)	T No.(%)	S No.(%)	T No.(%)	S No.(%)	T No.(%)	S No.(%)
Vancomycin					27(84.4)	27(100)	1(100)	1(100)
Linezolid					28(87.5)	28(100)	1(100)	1(100)
Penicillin					27(84.4)	2(7.4)	1(100)	0 (0)
Amoxycillin					23(71.9)	1(4.3)	1(100)	0 (0)
Doxycycline					27(84.4)	1(3.7)	1(100)	0 (0)
Levofloxacin	5(100)	1(20)	87 (95.6)	12(13.8)	31(96.9)	1(3.2)	1(100)	0 (0)
Amikacin	5(100)	4(80)	89(97.8)	37(41.6)	5(15.6)	1(20)		
Gentamicin	5(100)	3(60)	91 (100)	49(53.8)	5(15.6)	1(20)		
Roxithromycin	4(80)	1(25)	48(52.7)	32(66.7)	5(15.6)	1(20)		
Meropenem	4(80)	0 (0)	91(100)	53(58.2)	4(12.5)	0 (0)		
Ertapenem	5(100)	0(0)	83(91.2)	35(42.2)	3(9.4)	0 (0)		
Amoxyclav	1(20)	0 (0)	20(21.9)	6(30)	1(3.1)	0 (0)		
Nitrofurantoin	5(100)	0 (0)	80(87.9)	52(65)	28(87.5)	9(32.1)	1(100)	1(100)
Cefepime	3(60)	0 (0)	22(24.1)	7(31.9)	1(3.1)	0 (0)		
Ceftazidime			1(1)	1(100)				
Clarithromycin	1(20)	1 (100)	15(16.4)	15(100)	3(9.4)	3(100)		
Imipemen	1(20)	0 (0)	39(42.8)	20(51.3)				
Cefotaxime	1 (20)	0 (0)	35(38.4)	3(8.6)	3(9.4)	0 (0)		
Cefoperazone-Sulbactam			7(7.6)	4(57.1)	2(6.2)	0 (0)		
Piperacillin-Tazobactam			1(1)	1(100)	2(6.2)	0 (0)		
Ciprofloxacin			4(4.3)	1(25)				
Clindamycin			2(2.1)	2(100)				

*T= Tested ; **S= Sensitive

Table 2B — *Antibiotic sensitivity pattern of predominant micro-organisms isolated from patients*

Antimicrobial agents	Uropathogens							
	Klebsiella (n=14)		*NLF* (n=1)		*Pseudomonas* (n=5)		*S. aureus* (n=1)	
	T*No.(%)	S** No.(%)	T No.(%)	S No.(%)	T No.(%)	S No.(%)	T No.(%)	S No.(%)
Vancomycin							1(100)	1(100)
Linezolid							1(100)	1(100)
Penicillin							1(100)	0 (0)
Amoxycillin								
Doxycycline							1(100)	1(100)
Levofloxacin	13(92.8)	3(23)	1 (100)	1(100)	5(100)	1(20)		
Amikacin	14(100)	4(28.6)	1(100)	0 (0)	5(100)	5(100)		
Gentamicin	14(100)	5(35.7)			5(100)	4(80)	1(100)	1(100)
Roxithromycin	4(28.6)	3(75)	1(100)	1(100)	4(80)	3(75)		
Meropenem	14(100)	6(42.9)	1(100)	1(100)	5(100)	3(60)		
Ertapenem	13(92.8)	2(15.4)	1(100)	1(100)				
Amoxyclav	3(21.4)	0 (0)			1(20)	0 (0)	1(100)	1(100)
Nitrofurantoin	12(85.7)	2(16.7)	1(100)	1(100)	2(40)	1(50)	1(100)	1(100)
Cefepime	5(35.7)	1(20)			5(100)	3(60)		
Ceftazidime					5(100)	1(20)		
Clarithromycin	4(28.6)	4(100)						
Imipemen	10(71.4)	4(40)			1(20)	0 (0)		
Cefotaxime	4(28.6)	0 (0)					1(100)	1(100)
Cefoperazone-Sulbactam	1(7.1)	0 (0)			1(20)	1(100)		
Ciprofloxacin			1(100)	1(100)				
Clindamycin	3(21.4)	3(100)						

*T= Tested ; **S= Sensitive

We found *E coli* to be most sensitive to clarithromycin, ceftazidime, piperacillin-tazobactam and clindamycin (100% in all cases). Resistance (>50%) of *E coli* was found against cefotaxime (91.4%), levofloxacin (86.2%), ciprofloxacin (75%), amoxyclav (70%), cefepime (68.1%), amikacin (58.4%) and ertapenem (57.8%).

The fact that micro-organisms show high resistance to fluoroquninolones was suggested by various other works conducted in different parts of the world like Spain[14] and India[15,16]. Indiscriminate and unrestricted use of antibiotics may result this reduced susceptibility.

Another study showed that the driving factor for the development of high resistance of micro-organisms against fluoroquninolones was the physicians' high prescribing habits of this group of antibiotic[17]. In the study done by Mostafa, *et al*[18], *E coli* had a sensitivity rate of 95.2% to cefotaxime in contrast to our study in which cefotaxime was sensitive only in 8.6 % of cases. Extensive use of third generation cephalosporins both as oral and intravenous route may be the reason for increase in resistance in this group of antibiotics.

Compared to the study done by Yolbas, *et al*[19], in which *E coli* was resistant to amikacin in 3%, nitrofurantoin 9%, in our study *E coli* showed more resistant pattern to these antibiotics ie, amikacin (58.4%) and nitrofurantoin (35%).

In our study, we found most of the organisms were resistant to a number of antibiotics. Resistance of *Enterobacteriaceae*, especially *E coli* and *Klebsiella spp*, against multiple antibiotics has significantly increased globally considering high use of empiric antimicrobial therapy for treating UTI.

We found *Klebsiella* to be highly resistant to cephalosporins which was in similarity to a study conducted by Stephanie A, *et al*[20] which showed increased resistant pattern of this micro-organism to third generation cephalosporins in hospital admitted children suffering from UTIs.

Conclusion

Resistance to antibiotics poses a serious and growing problem, because such resistant bacteria are becoming more difficult to treat. The susceptibility data from this study may be worth consideration while implementing empiric treatment strategies for bacterial infections. Avoidance of indiscriminate, unrestricted and empirical use of antibiotics should be followed in order to curtail the emergence and the spread of drug resistance among pathogens.

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