Bacteriological profile of urinary tract infection in a tertiary care centre

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Abstract

Introduction: Urinary tract infection (UTI), being one of the most common infections, regular surveillance of the changing trends in its bacteriological profile is mandatory. The present study aims at finding the prevalence of UTI and distribution of bacterial agents in different demographic groups of patients over a period of one year from May 2016- April 2017 in a tertiary care centre which caters to the rural population of Palakkad, Kerala. An attempt was also made to find out the differences in the antibiotic resistance pattern among inpatients and out patients.

Materials and Method: In a prospective study, we categorized and analyzed all the urine culture samples, bacterial isolates and their resistance rate based on age, sex and hospital status of the patients.

Results: Total number of urine samples processed is 3772 of which 1265(33.5%) are culture positive. Highest rate of UTI is seen in elderly females (49.7%) followed by elderly males (39.1%), with least from paediatric patients. *E.coli*, *Klebsiella* and *Enterococci* are the three most common isolates from all different categories of patients and constituted ~ 75% of total. Emergence of non-fermenter Gram negative bacilli and Gram positive cocci like *Enterococci* and *Staphylococci* as major causative agents is noted in men, especially in adult men.

Conclusion: Similar to several other studies, rate of infection and resistance is more in elderly. Even though the most common isolate is *E.coli*, its percentage varies in different groups of patients.

Keywords: Urinary tract infection; Bacteriological profile; Patient demographics; Hospital status

Introduction

Urinary tract infection (UTI) is among the most common of infections especially in women, the prevalence of which is age and sex dependant. According to Stamm et al, there are an estimated 150 million UTIs per annum worldwide.[1] Young sexually active women are at high risk of contracting UTIs compared to their male counter parts. In elderly individuals the chances of acquiring urinary tract infections increases drastically in both the sexes due to prostatic and gynecologic problems. Children with structural abnormalities of urinary tract are also at high risk. Among the bacterial agents of UTI, *E.coli* continues to be the commonest in both community acquired and hospital acquired cases.[2] Other pathogens include *Klebsiella, Pseudomonas* and other non-fermenters, *Enterococcus, Staphylococcus, Enterobacter, Citrobacter, Proteus* etc…..

Since there is a lot of regional variation in the rate of infection, type of organism and their resistance pattern among various demographic groups, regular surveillance of the changing trends in the etiology of UTI is mandatory and it is better to depend on local data than text book data. Though there are various studies on urinary tract isolates from other parts of India, U.S. and European countries,[3,4,5] to the best of our knowledge, there are only limited publications from this part of the country. The present study is carried out with the aim of finding out rate of UTI and distribution of urinary isolates in different age and sex groups and in admitted and outpatient cases from a tertiary care centre in Palakkad, Kerala, India.

Materials and Method

We conducted a prospective analysis of all urine culture samples and significant bacterial isolates from our department for a period of one year from May 2016- April 2017. 3772 samples from clinically suspected cases of UTI, both hospitalized and out patients, irrespective of their age and sex from PK Das Institute of Medical Sciences, Palakkad, Kerala, India were included in the study. Most of them are clean voided mid-stream samples and the rest, catheter samples and supra pubic aspirates. All samples are processed within 2hrs of collection. Microscopy and culture on Mac Conkey agar and blood agar was done. Significance of the isolates was assessed on the basis of colony count ($>10^5$ cfu /ml) and the clinical features. Colony counts $<10^5$ also are considered significant on an individual basis by correlating the microscopic findings, type of specimen and the clinical history.

Identification of the isolates is done by standard bacteriological methods.[6] Staphylococcal isolates are tested for coagulase production by tube method and Enterococci are identified by colony morphology, catalase production, bile esculin hydrolysis and smear examination. *Pseudomonas aeruginosa* is identified by oxidase test and pigment production. Antibiotic susceptibility testing of the isolates is performed by Kirby-Bauer disc diffusion method on MHA as per CLSI guidelines.[7] Production of ESBL is checked with cefotaxime and cefotaxime clavulanate discs. Quality control is performed by standard strains, *E.coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853, and *Staphylococcus aureus* ATCC 25923.

Since age, sex and hospital status are the important parameters which decide the type of organism and its resistance pattern, patients are grouped into five categories: paediatric (<15years), adult male (15-55), adult female (15-55), elderly male and elderly female (>55 years). Samples and isolates are analyzed using SPSS software to find out the prevalence of infection, type of organism and their antibiotic susceptibility in different age and sex groups. Further characterization of isolates based on the hospital status of patients is also done.

Results

During the one year study period, 3772 urine samples are subjected to culture and microscopy in the clinical microbiology department of our institution, of which 1265(33.5%) samples gave significant bacterial growth (>10^5 cfu/ml).

Table 1: Rate of isolation in various age and sex categories

Categories	Paediatric <15 years Category I		Adult male (15-55) Category II	Adult female (15-55) Category III	Elderly male >55yrs Category IV	Elderly female >55yrs Category V	Total
	Male	Female					
Samples processed n (%)	238 (6.3)	255 (6.8)	665 (17.6)	815 (21.6)	913 (24.2)	886 (23.5)	3772 (100)
Number of isolates n (%)	42 (17.6)	58 (22.7)	148 (22.3)	220 (27)	357 (39.2)	440 (49.7)	1265 (33.5)

Table 2: Distribution of the isolates in different categories

Organism	Category I		Category II		Category III		Category IV		Category V	
	n	%	n	%	n	%	n	%	n	%
E.coli	52	52	53	35.8	121	55	139	38.9	254	57.7
Klebsiella sp	15	15	11	7.4	25	11.4	49	13.7	73	16.6
Proteus sp	1	1	5	3.4	1	0.5	5	1.4	4	0.9
Citrobacter sp	5	5	2	1.4	4	1.8	7	2	0	0
Enterobacter sp	4	4	5	3.4	7	3.2	13	3.6	7	1.6
Pseudomonas sp	1	1	16	10.8	5	2.3	32	9	26	5.9
Other NFGNB	1	1	12	8.1	16	7.3	17	4.8	12	2.7
Enterococcus sp	13	13	26	17.6	28	12.7	60	16.8	50	11.4
Staphylococcus sp	8	8	18	12.1	13	5.9	35	9.8	14	3.2

Maximum number of samples (24.2%), is from Category IV, elderly men. In all age groups, UTI is predominant in females which constituted 56.8% of total infected patients. The highest rate of isolation is from elderly females (49.7%), followed by elderly males (39.2%), with least isolations from male pediatric patients. (Table 1)

Of the total 1265 isolates, *E.coli* comes to 49%, *Klebsiella sp*. 14%, *Enterococcus sp*.14%, *Staphylococcus sp*.7%, *Pseudomonas* 6%, other non-fermenter Gram negative bacilli (NFGNB) 5%, *Enterobacter* 3% and *Citrobacter* sp and *Proteus* sp.1% each. (Fig. 1)
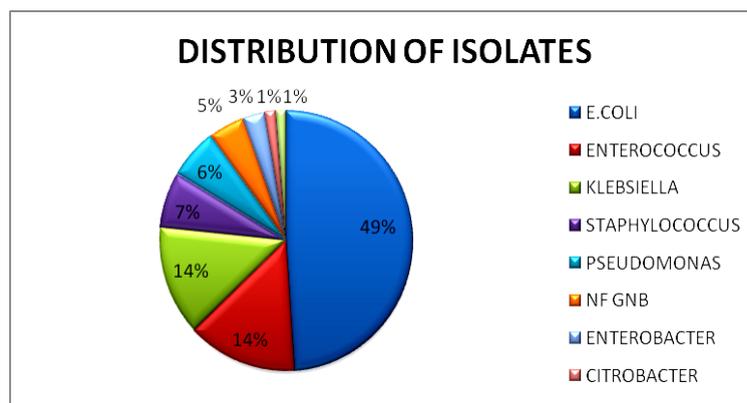

Fig. 1

Table 3: Distribution of the isolates based on the hospital status of the patients

Organisms	OP	IP
	n (%)	n (%)
E.coli	280(57.7)	339(43.5)
Klebsiella sp	80(16.5)	93(11.9)
Proteus sp	7(1.4)	9(1.2)
Citrobacter sp	12(2.5)	6(0.8)
Enterobacter sp	17(3.5)	19(2.4)
Pseudomonas sp	19(3.9)	61(7.8)
Other NFGNB	15(3.1)	43(5.5)
Enterococcus sp	36(7.4)	141(18.1)
Staphylococcus sp	19(3.9)	69(8.8)
Total	485(38)	780(61.6)

In all the five age and sex categories, *E. coli* is the predominant isolate followed by *Enterococcus* sp. except in pediatric and elderly females, where *Klebsiella* sp. is the second common organism. In all groups ~ 75% of total isolates is constituted by *E.coli*, *Klebsiella* and *Enterococcus* sp. Category II shows maximum rate of isolation of *Pseudomonas* and other NFGNB. (Table 2)

Table 4: Antibiotic Resistance rate (%) of *E.coli* in various age groups

Categories	Ampicillin	Co-trimoxazole	Ciprofloxacin	Nitrofurantoin	Amikacin
<15 yrs	92	59.6	53.8	9.6	5.7
15-55 yrs	89.6	54	55	15.5	2.3
>55 yrs	91.6	60.8	73	19.8	10.4

When we analyzed the isolates according to the hospital status of the patients, 38% (n=485) is from outpatients and 61.6% (n=780) from inpatients. In both the groups, *E.coli* is the predominant isolate, constituting 57.7% (n=280) of total isolates from outpatients and 43.5% (n=339) of the isolations from inpatients. Among the hospitalized patients, the rate of isolation of *Enterococcus, Pseudomonas*, other NFGNB and *Staphylococcus* is more compared to outpatients. (Table 3)

Nitrofurantoin and amikacin are found to be least resistant among the common organisms in both outpatients and hospitalized patients. In *E.coli* nitrofurantoin resistance is 14.6% and 20.4% respectively in OP and IP. Among the first line antibiotics, ampicillin & co-trimoxazole are found to be equally resistant in different age groups, ~ 91.1% and 58.1% respectively whereas the resistance to ciprofloxacin, nitrofurantoin and amikacin is found to be higher among elderly patients. The isolates did not exhibit any significant difference in resistance between men and women. (Table 4)

Discussion

In general, UTIs are more common in females and such infections in female outpatients are mostly uncomplicated with a more predictable spectrum of causative agents which are amenable to empirical therapy.[8] In comparison, UTIs in men and children are more complicated necessitating a laboratory based therapy. Though there are several studies on UTI, most of these addresses either antibiotic resistance alone or are restricted to a small specific area only. There are only limited number of studies where UTI as a whole; where all the etiological agents are analyzed on the basis of patient demographics and hospital status, especially from this part of the world.

During the study period, we received 3772 samples from different age and sex categories. Maximum number of sample is received from elderly males, 24.2% followed by 23.5% from elderly females which agrees with the increased prevalence of UTI in advancing age.[9]

Of the 3772 samples processed, 1265(33.5%) showed significant bacterial growth. In a study from Cameroon in 2016, the positivity rate was 59.8%[10] and another study from south India showed 26.01% significant growth.[2] Even though our most common isolate is *E. coli* (49%), the rate is less compared to western studies where the corresponding rate ranges from 80- 85%.[11,4] Studies from other parts of India also show a similar reduced rate of 50-60%[3,2] which is an important point to be considered. Another important finding noticed in the present study, as in other Indian studies,[12] is the rate of isolation of *Klebsiella* (14%), which is more in this part of the world compared to US and Europe where the rate is very less.[11] Similar to *Klebsiella, Enterococcus* (14%) is also an important pathogen in our locality which agrees with another Indian study.[2] But according to a study from North India, the rate of *Enterococci* is only 6.9%.[3] These

data clearly demonstrate the regional differences in the rate of infection and the type of bacterial agents.

We could isolate several other organisms known to cause UTIs, including *P. aeruginosa,* other non-fermenter Gram negative bacilli including *Acinetobater sp., Staphylococcus, Proteus sp., Enterobacter sp., Citrobacter* sp. which are already reported by earlier workers.[2]

In the present study, maximum number of isolates is obtained from elderly women i.e. 34.8% of total, followed by men of >55 yrs, 28.2% which agrees with a study by Rutuja Raval from rural India, where the age group with a dramatic increase in the incidence of UTI was 50 to 69 years with 41.25%.[13] Predisposing factors for elderly persons for UTI include chronic diseases, functional abnormalities and low estrogen levels which makes vagina or urethra more susceptible to UTI in postmenopausal women. According to W.E. Stamm, in young adult women, UTI is 50 times more common than men and in elderly men and women the ratio is 35% to 40%.[14] In the present study, 11.7 and 17.4% of total isolates are from adult men and women respectively. 56.8% of our total isolates is from female patients which agrees with many other studies including one from Pune, India, where 66% of UTIs was in females.[15] This can be easily attributed to short urethra in females. Least number of isolates is from Category I patients as in a North American study, where the rate of isolation from patients <15yrs was only 1.6 %.[16]

In each category of patients, *E.coli* is found to be the most frequent isolate whereas *Klebsiella and Enterococci* emerged as 2nd and 3rd common in all groups except adult men. In all five categories of patients, ~ 75% of total isolates is constituted by these three organisms whereas in many other Indian studies, *Enterococcus* was not a major etiological agent.[3,13] From this data we can attribute these three agents as the most common bacterial causes of UTI in all age and sex groups in this part of the country. In women and children, *E.coli* accounts for >50% of infection, where as in men UTI being more complicated, it is low and is replaced by *Enterococci* and NFGNB. 26.3% of total isolates from men is constituted by *Enterococci and Staphylococci.* Similarly, highest number of NFGNB including *Acinetobacter & Pseudomonas* is isolated from adult men followed by elderly men, constituting 18.9% & 13.8% respectively.

On analyzing the patients according to the hospital status, 61.7% (n=780) of total isolates is from inpatients and the rest 38.3% (n=485) is from out patients as in another study from rural India.[13] Unlike our finding, in a study by Emilia et al and another study from US, a predominance of *E.coli* infection among out patients was noted.[17,18] In the present study, in both the groups, *E. coli* stands as the commonest isolate which comes to 57.7% of the outpatient and 43.5% of inpatient isolates respectively. In contrast to this finding, in a study from south India by Mandal et al, the rate of isolation of *E. coli* was more among hospitalized cases, 52.89% compared to 47.13% from outpatients.[2] Members of Enterobacteriaceae constitute 81.6% of the total isolations in outpatients, whereas among inpatients, it is only 59.8%. Since hospitalized cases are more complicated, rate of isolation of *Enterococci, Staphylococci, Pseudomonas* and other NFGNB is more among them compared to outpatients which corresponds with other studies from India.[2]

As a reflection of antimicrobial resistance (AMR) all over the world especially developing countries, isolates from our study are also found to be highly drug resistant. Among the outpatients, 39.9% of *E.coli* isolates are ESBL producers whereas it is 60.1% in admitted patients. This shows the increased rate of AMR in hospitalized patients compared to community acquired cases as reported in a study from Mysore, India.[19] The resistance pattern of *E.coli* towards beta lactam antibiotics is almost similar in both sexes and different age groups which is depicted by ESBL production of 65.4, 58.6 and 70.7% in children, adults and elderly groups respectively. But a marked increase in resistance to quinolones, amikacin and nitrofurantoin is detected in elderly patients as reported by Gobernado et al.[5]

Conclusion

A commendable difference is observed in the type of organism and the sensitivity pattern among different age and gender groups as well as among out patients and inpatients. Similarly the bacterial pathogens of UTI exhibit a marked regional variation in their characteristics which necessitates periodic region wise analysis of uropathogens.

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