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Urinary tract infections- prevalence and antibiogram of uropathogens in a tertiary care centre from north Kerala

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Abstract

Background: Urinary Tract Infection (UTIs) is one of the most common bacterial infections in routine clinical practice. Among the bacterial agents of UTI, E. coli continues to be the commonest in both communities acquired and hospital acquired cases, FOLLOWED BY Klebsiella, Pseudomonas and Enterococci.

Materials and Methods: Mid stream clean catch urine samples were obtained both from outpatient and wards. Microscopy and culture was done. Antimicrobial susceptibility was done as per CLSI.

Results: Out of 3500 samples were processed, significant growth was seen in 1097 samples. 363(33 %) were from males and 734 (67 %) were from females. E. coli was isolated in 58.6 % in OP and 45.13 % in IP. Klebsiella was next common in 24 % in both OP and in IP. Fluoroquinolones resistance was seen in 63.35 % in IP and 40.16 % in OP by E. coli .

Conclusion: while prescribing empirical antimicrobial therapy, clinicians must have an in depth knowledge of the predisposing factors, the aetiology, the cultural positivity and the continued evaluation of the susceptibility patterns of the uropathogens to the traditional as well as the new antimicrobials . This will prevent irrational drug usage and to ascertain the optimal prophylactic therapy.

Keywords: Uropathogens, E Coli, Antibiogram, Bacterial Resistance

Introduction

Urinary Tract Infection (UTIs) are one of the most common bacterial infection in routine clinical practice, clinical presentation of which ranging from asymptomatic to severe sepsis [1]. UTIs can be classified into community-associated UTIs and hospital-associated UTIs. Gram negative bacteria, specifically Enterobacterales are the common cause of UTIs .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. Common antibiotics used in the therapy of UTI are

Ampicillin, Cephalosporins, Gentamicin, Quinolones, Cotrimoxazole and Nitrofurantoin.[3]

Treatment of UTI is often empiric and the extensive and inappropriate use of antibiotics has resulted in the emergence of multi drug resistant bacteria which is a major problem worldwide. Knowledge of the etiological agents of UTI and their antibiotic susceptibility pattern is necessary for ensuring appropriate treatment [4]. This study aimed to know the prevalence and the antimicrobial sensitivity patterns of the uropathogens which were isolated at a medical college hospital, which will enable the clinicians to devise and endorse a potent, competent and a rational antibacterial policy to reduce the incidence of UTIs.

Materials and Methods

This was a retrospective study, based on laboratory data on the bacterial isolates from suspected UTI patients, urine samples submitted for culture and antibiotic susceptibility to the department of microbiology both from the hospitalised and outpatient department. The study was conducted in KMCT Medical College, a tertiary-care teaching hospital in KOZHIKODE, Kerala, India, and was cleared by the Institution Ethics Committee.

All the patients who were suspected to have UTI, samples were collected with aseptic technique sent to our laboratory and subjected to urine culture from 01.01.2022 to 31.12.2023. Most of the samples were clean catch mid-stream samples and the rest, catheter samples and supra pubic aspirates. All the samples are processed within 2 hrs of collection. Microscopic examination and culture on Mac-Conkey agar and 5% sheep blood agar weredone., Significance of the isolates was assessed by following the recommendations of Kass, microscopic findings as well as the clinical features. All those with significant bacteriuria (more than 1,00,000 colony forming units per ml of urine) were included in this studyirrespective of age, gender and underlying diseaseand clinical history.Cultures that did not show significant bacteriuria were excluded from the study.

A separate panel of antibiotics was used for gram negative and gram-positive organisms. Isolates of Pseudomonas aeruginosa are known to be intrinsically resistant to ampicillin, cefazolin, cefuroxime, cefotaximecotrimoxazole and nitrofurantoin.[5,6]. Hence these isolates were counted as resistant to these drugs.Second and third generation cephalosporins are not usually tested in Gram positive urinary isolates.[7]

As per the above criteria, 1097 urinary isolates were included in this study. These organisms had been isolated in culture and identified as per standard microbiological techniques. Antibiotic susceptibility testing had been performed using Kirby Bauer's disc-diffusion method, as per the CLSI guidelines which were recommended at that time. [7-10]

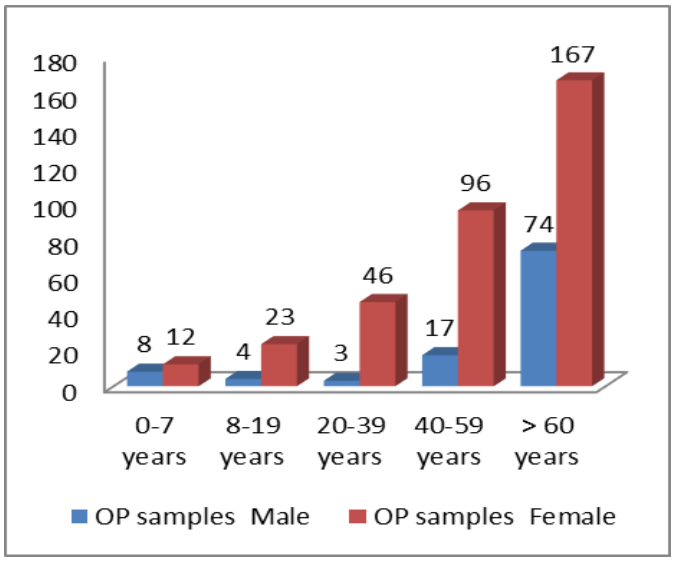
Antibiotic discs used were procured from HiMedia. Following antibiotic disc were tested: ampicillin (10µg), norfloxacin (10µg), ciprofloxacin (5µg), nitrofurantoin (300µg), co-trimoxazole (1.25/23.75µg), cephalothin (30µg), cefuroxime (30µg), cefotaxime (30µg), ceftazidime (30µg), gentamicin (10µg), piperacillin (100µg), amikacin(30µg), ampsulbactam (10/10µg), piperacillin-tazobactam (100/10µg), imipenem (10µg), meropenem (10µg), high level gentamicin (120µg), tetracycline (30µg), cefoxitin (30µg), vancomycin (30µg), linezolid (30µg).Quality control is performed using standard strains, E. coli ATCC 25922, Pseudomonas aeruginosa ATCC 27853, and Staphylococcus aureus ATCC 25923.

Based on expert consensus, Centers for Disease Control and Prevention (CDC) and European Centre for Disease

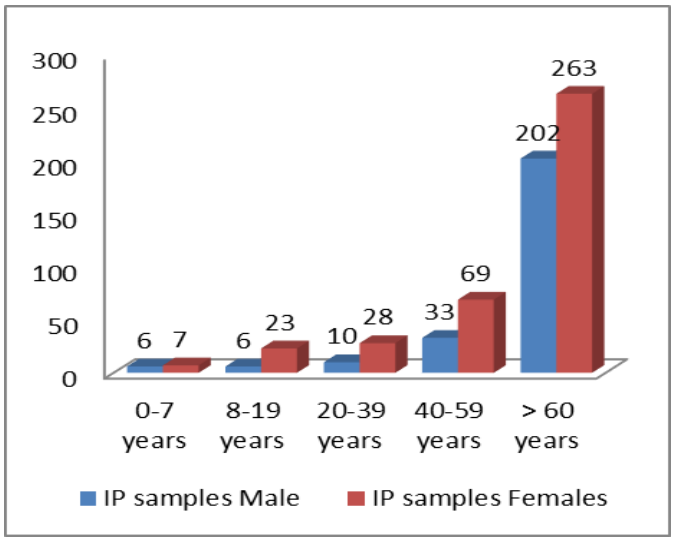
Prevention and Control (ECDC) isolates were termed multi-drug resistance (MDR) if it exhibited non-susceptibility to at least one agent in three or more antimicrobial categories.[11] The data was analysed using Microsoft excel 2019 and statistical package for the social sciences (SPSS) 16.

Results

Among the 3000 urine samples processed1097 samples showed significant bacteriuria. 363(33 %) were from males and 734 (67 %) were from females.



Graph 1: Age wise distribution of OP samples



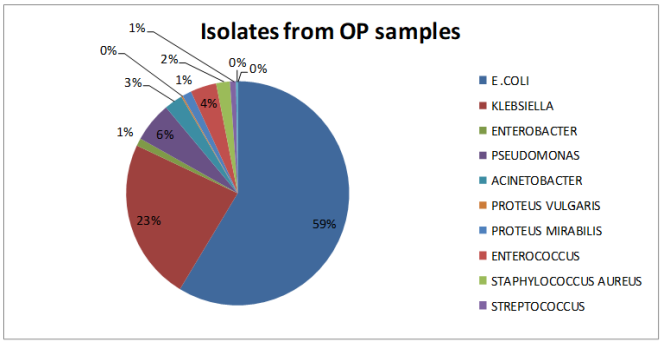
Graph 2: Age wise distribution of IP samples

Table 1: Age and Sex -wise Distribution of samples

Age distribution	OP samples		IP samples	
	Male	Female	Male	Females
0-7 years	8	12	6	7
8-19 years	4	23	6	23
20-39 years	3	46	10	28
40-59 years	17	96	33	69
> 60 years	74	167	202	263
Total (1097)	106	344	257	390
	450		647	

The study population was further divided based on age into 0-7, 8-19, 20-39, 40-59, and >60 years. Age wise distribution of positive culture was 33 (14 males and 19 females) for 0-7, 56 (10 males and 46 females) for 8-19, 87(13 males and 74 females) for 20-39, 215 (50 males and 165 females) for 40- 60, 706 (276 males and 430 females) for >60 year.

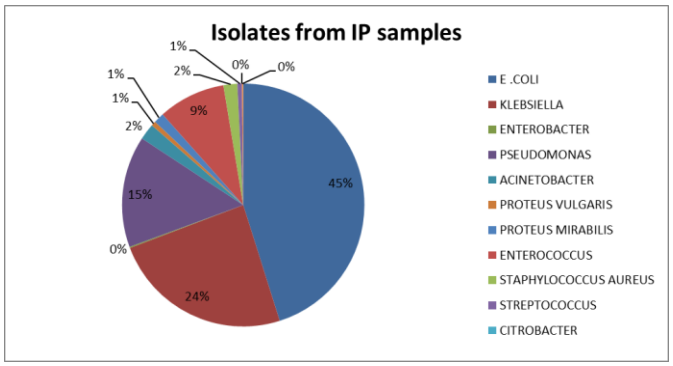
41 % (n=450) of the 1097 positive cultures were from the outpatient unit and 59 % (n=647) were from inpatient units. 76.4 % (n=344) of samples were from females and 23.6 % (n=106) were from males in the outpatient unit. In inpatient units, 60 % (n=390) of the samples were from females and 40 % (n=257) were from males.



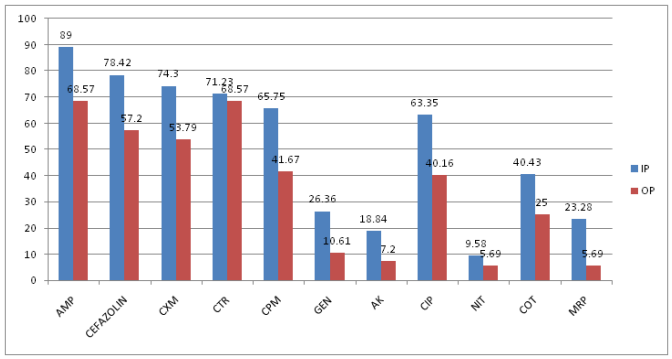
Graph 3: Isolates from OP samples

The predominant isolate was E. coli (50.6%) followed by Klebsiella sp. (23.7%), Pseudomonas 11.12 % ,Enterococcus sp. (7 %), Staphylococcus sp. (1.9 %), and other non-fermenters (4.2 %) . 59 % of total isolates in the present study is from inpatients and the rest is from out patients. In both the groups, E. coli stands as the commonest isolate, which constitutes 58.6 % of the outpatient and 45.13 % of inpatient isolates respectively. (Fig. 3, 4).

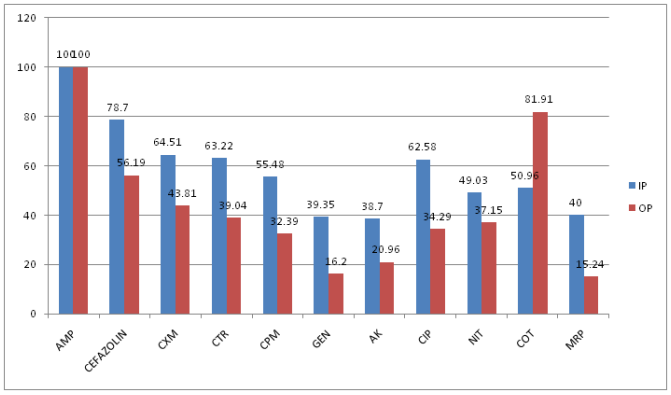
It was observed that the percentage of Escherichia coli and isolates were higher in OP when compared to IP. Conversely, the percentage of Klebsiellapneumoniae isolates within IP was slightly higher than in the OP unit.



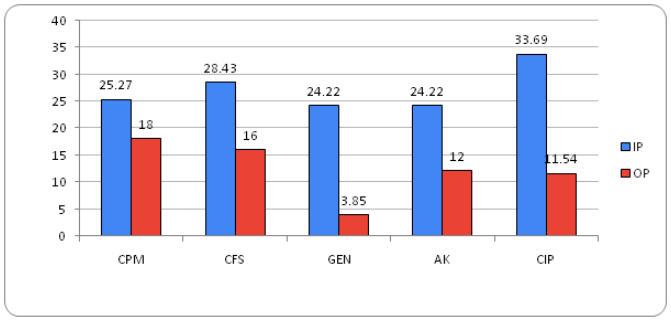
Graph 4: Isolates from IP samples



Graph 5: Antibiotic resistance pattern of E. coli



Graph 6: Antibiotic resistance pattern of Klebsiella pneumonia



Graph 7: Antibiotic resistance pattern of Pseudomonas aeruginosa

Pseudomonas species and Citrobacter species showed 100% sensitivity to Amikacin, Imipenem, and Piperacillin/tazobactam.Pseudomonas aeruginosa showed a relatively lesser resistance towards the flouroquinolones than E.coli and Klebsiella.(Fig 7) Escalation in the drug resistance among the gram negative bacteria was observed against the 3rd generation cephalosporins and quinolones, as has been shown in [Fig- 5 and 6].Monotherapy with Amikacinand imipenem demonstrated statistically significant susceptibility patterns and these were found to be effective against a majority of the isolates.

For all common organisms from both outpatients and hospitalized patients, Carbapenems, Nitrofurantoin and Amikacin are found to be least resistant followed by Piperacillin- tazobactam and. For E. coli, Nitrofurantoin resistance is 94.3 % and 90 % respectively, in

outpatients and inpatients and for Amikacin it is 92.8 % and 88%.

Among the gram positive isolates, Ampicillin resistance is observed in 56 % of Enterococcus isolates and Vancomycin resistance in 2 %. Of the Staphylococcal isolates, totally 6 isolates are MRSA.

Discussion

The changing trends in the aetio-pathogenesis of UTIs and the emerging resistance to the antimicrobial agents are a matter of concern worldwide. Even with the adequate precautions, preventive measures and the advances in therapy, UTIs still remain the commonest infections, both in the hospitalized patients and in the out patients. This may be due to the advancing age, prolonged hospitalization, increase in the immune-compromised hosts, inadequate personal and environmental hygiene, functional or anatomical abnormalities, instrumentation (catheters), co morbidities [12]. The irrational, indiscriminate and inadequate the usage of antimicrobials has further contributed to the emergence of resistant strains, leading to increase in the morbidity and mortality in the developing countries.

The analysis of the age-wise data, as has been shown in [Table1 / Fig-1,2] , portrayed an increased prevalence in the 61-80 years age group (64.33%), which was at par with the findings of similar studies which were done by Manjunath G N et al., [13], Akram et al., [14] and Barate D L et al., [15]. The increased vulnerability in the geriatric population maybe due to their age related physiological and immunological changes and other co morbidities.

The present study provided an outlook on the prevalence and the antibiogram of the uropathogens which were isolated in Kozhikode part of north Kerala. E.coli (50.60%) was the predominant organism which was isolated, followed by Klebsiellapneumoniae (24 %), which was in comprehension with the findings of similar studies which were by Manjunath et al., [13]Supriya et al.,[16],S Baby Padmini et al., [17]PallaviKhanna et al., [18] and Oladeinde B.H et al.,[19]as has been shown in [Fig- 3,4].

The rate of the isolation was higher in females (66.86%), thus revealing the increased susceptibility of females to UTIs than males (33.14%), as has been shown in [Fig- 1,2]., which was in concordance with the findings of similar studies which were done by Manjunath et al.,[13]Barate D L et al., [15]Oladeinde B.H et al., [19] and Khadri et al.,[20]. Females are more prone to develop UTIs, probably due to their characteristic anatomical and physiological changes - short urethra, its proximity to the anus, urethral trauma during intercourse, dilatation of the urethra and the stasis of urine during pregnancy[19].

The antimicrobial resistance among uropathogens is one of the barricades that might interfere with an effective treatment. This study depicted the anti microbial susceptibility patterns among the gram negative bacteria which were isolated, as has been shown in [Table/Fig-5,6]. These are of the organisms which belonged to the Enterobacteriaceae family, which showed heavy resistance towards amoxyclav (79.6%), a majority of the flouroquinolones [ciprofloxacin (63.5%) and norfloxacin (71.6%) and the cephalosporins [cefuroxime (74.3%) and ceftriaxone (71.2%)], which was in accordance with the findings of the studies which were done by Manjunath G N et al[13], Khadri et al., [11], Akram et al., [14] and Barate D L et al., [15].

The reason for this might be the irrational and the prophylactic usage and the easy availability and the over the counter sale of the antimicrobials without a proper prescription and an appropriate dosing schedule. A notable observation was that a majority of the isolates

showed a higher sensitivity pattern towards imipenem, piperacillin/tazobactam, and amikacin Nitrofurantoin, with a resistance of 1.9%, was found to be an effective cure against the E.coli which induced UTIs.

Klebsiella pneumonia showed an increased resistance to amoxyclav and cefuroxime and a decreased resistance to ciprofloxacin and norfloxacin as compared to E.coli. However, it showed an increased resistance towards nitrofurantoin. Pseudomonas aeruginosa showed an increased resistance towards the 3rd generation cephalosporins and a decreased resistance towards the flouroquinolones. Imipenem, piperacillin/ tazobactam and cefoperazone/sulbactam with 100% sensitivity and amikacin with 75.5% sensitivity, were found to be the most effective drugs for the therapy of UTIs, as has been shown in Fig 7.

Conclusion

Before prescribing an empirical anti microbial therapy, clinicians must have an indepth knowledge of the predisposing factors,the aetiology, the cultural positivity and the continued evaluation of the susceptibility patterns of the uropathogens to the traditional as well as the new antimicrobials . This will avoid irrational drug usage and to ascertain the optimal prophylactic therapy.

The escalation of drug resistance among the uropathogens poses a global threat. The wide spread availability and the usage of penicillins and cotrimoxazole has led to the development of resistant strains, even the flouroquinolones and the cephalosporins are getting exceedingly affected day by day.

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