Community acquired urinary tract infections (CAUTI) with special reference to antibiogram of *Escherichia coli* and *Klebsiella species*

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Abstract

Aim: *Escherichia coli* and *Klebsiella species* are the most important uropathogens. The present study was undertaken to isolate uropathogens causing community acquired urinary tract infections (CAUTIs) and their antibiogram.

Materials and Methods: A total of 755 clean voided mid-stream urine samples were collected and processed. All the specimens were collected from patients attending various OPDs of our hospital. The specimens were cultured and the isolates were identified using standard microbiological techniques. The antibiotic susceptibility was determined by disc diffusion technique. Simple percentage method was used in analyzing data.

Results: From 755 urine specimens, 197 urine specimens yielded significant bacterial growth accounting for 26.09%. Females (75.13%) are more commonly affected than males (24.87%).

E.coli119 (60.40%) was the most frequent organism isolated followed by Klebsiella species(24.87%). Klebsiella species showed high degree of resistance towards the antibiotics tested.

Conclusion: High isolation rate was observed among young females in reproductive age groups. E. coli was the predominant bacteria causing UTI followed by Klebsiella species. Very high resistance rates were observed towards commonly used antibiotics in community.

Keywords: Escherichia coli, Antibiogram, Multi drug resistance.

Introduction

Urinary Tract Infections (UTIs) are among the most common bacterial infections which lead patient to seek medical advice. Approximately ten percent of human population will suffer from UTI at some instant during their life span.[1] Community acquired urinary tract infections are more frequently encountered from rural and semi urban regions.[2] The clinical severity varies widely in UTI.[3] Various microorganisms can cause UTIs, but bacteria are predominantly responsible for causing urinary tract infections.[4]

Bacterial UTIs have been reported in both hospital and community.[5] Among commonly acquired infectious diseases, urinary tract infection is the one which requires antibiotics and special attention. Both men and women may suffer from UTI. However, females develop UTI predominantly. Without complications UTIs in healthy women have an incidence of 50/1000/year. Majority of women will have UTI at least one time during their life span.[6] Most common bacteria causing UTI includes, E. coli, K. pneumonia, P. mirabilis, Ps. aeruginosa, S. aureus, E. faecalis and S. saprophyticus.[7]

Significant contribution was made in the management of UTIs with the discovery of antibiotics. In majority of patients, antimicrobial therapy is initiated before the arrival of culture sensitivity reports which may contribute for drug resistance. Usage of antimicrobial agents extensively resulted in the development of multi drug resistance bacteria, which in recent years has become a major problem.[8]

There is great variation worldwide in the patterns of antimicrobial resistance. The current knowledge of predominant bacterial uropathogens that are highly resistance to multiple antibiotics is of primary importance for the initiation of appropriate antimicrobial drugs and the policy making to overcome antibiotic resistance in UTIs.[9] The antibiogram of community acquired uropathogens has not been studied in detail.[10]. Hence, this study aimed at determining the resistance pattern of common uropathogens which required for initiating empiric antimicrobial therapy.

Materials and Methods

This is a prospective observational study in which 755 midstream urine samples collected in the department of clinical microbiology from patients attending various OPDs of our hospital. All the samples were inoculated on Mac Conkey agar and 5% sheep blood agar (Hi Media, India) with the help of calibrated loop. The culture plates were kept in incubator at 37°C for 18 hours. Patients with urine cultures yielding growth of pathogens $<10^5$ colony forming units/ml were excluded. Uropathogens were further identified by the morphological and biochemical characteristics.[11]

Antimicrobial susceptibility of isolates was tested by the Kirby Bauer disk diffusion method.[12]

Multi antibiotic resistant strains were categorized into MDR (Multiple Drug-Resistant), XDR (Extensively Drug-Resistant) and PDR (Pan drug-resistant) as per Center for Disease prevention and Control. MDR bacteria are defined as resistant to at

least three various classes of antibiotics. XDR bacteria are characterized by their sensitivity to single class of antibiotic and the PDR bacteria are resistant to all classes of antibiotics recommended for treatment.[13,14]

All the data was analysed by simple percentage method.

Quality control: *E. coli* ATCC 25922, *Klebsiella pneumonia*: ATCC 700603

Results

A total of 755 urine specimens collected in the department of clinical microbiology from various outpatient departments over a period of ten months. 197 urine specimens yielded significant bacterial growth accounting for 26.09%. Females (75.13%) are more commonly affected than males (24.87%). Isolation rate was high among females patients who were 22 years and older (n=99). Majority of male patients (n=37) who suffered from UTI were older than 60 years.

Table 1 describes the frequency of different uropathogens isolated from out patients. E.coli (60.40%) was the most commonly isolated organism followed by Klebsiella species (24.87%).

Table 1: Distribution of uropathogens in OPD patients

Isolate	Total Number (%)
Escherichia coli	119(60.40%)
Klebsiella species	48(24.36%)
Enterobacter species	9(4.57%)
Staphylococcus aureus	9(4.57%)
Proteus mirabilis	7(3.55%)
Pseudomonas aeruginosa	2(1.02%)
Coagulase negative staphylococci	2(1.02%)
Provedencia species	1(0.50%)

Both E. coli and Klebsiella sps represented 85.28% of all isolated bacteria. Hence, antibiogram was observed particularly to these two organisms. (Table 2)

Table 2: Antibiotic resistance pattern of E.coli and Klebsiella species

Antibiotic	Escherichia coli	Klebsiella species
Ampicillin	105(88.24%)	45(91.84%)
Amoxiclav	57(47.90%)	29(59.18%)
Trimethoprim/ sulfamethoxazole	99(83.19%)	41(83.67%)
Ciprofloxacin	73(61.34%)	33(67.35%)
Gentamicin	102(85.71%)	30(61.22%)
Amikacin	19(15.97%)	7(14.28%)
Ceftriaxone	58(48.74%)	33(67.35%)
Nitrofurantoin	21(17.65%)	9(18.36%)
Piperacillin/ tazobactam	5(4.20%)	3(6.12%)
Imipenem	1(0.84%)	3(6.12%)

Higher degree of resistance was exhibited by Escherichia coli towards ampicillin(88.24%) followed by gentamicin (85.71%) and Trimethoprim/ sulfamethoxazole(83.19%). Low degree of resistance was exhibited to imipenem(0.84%) followed by Piperacillin/ tazobactam(4.20%), amikacin(15.97%)and nitrofurantoin(17.65%). Very least susceptability was shown by Klebsiella species also. Three isolates of Klebsiella species showed resistance to imipenem whereas only one isolate of E.coli showed resistance. Only four isolates of Klebsiella species were susceptible to ampicillin.

Table 3: Pattern of multi drug resistance in E.coli and Klebsiella species

Isolate	Total Number	MDR (%)	XDR (%)	PDR (%)
Escherichia coli	119	67 (56.30%)	9 (7.56%)	1 (0.84%)
Klebsiella species	49	37 (75.51%)	13 (26.53%)	3 (6.12%)

In our study, 56.30% of E. coli 75.51% of Klebsiella species were MDR strains. Whereas Klebsiella species presented a Extensively Drug-Resistant in 26.53% of the cases compared with only a 7.56% of E. coli. Only one isolate of E.coli presented the PDR to all antimicrobial agents whereas three isolates of Klebsiella species showed resistance to all antimicrobial agents.

Discussion

It is mandatory to know the local prevalence of bacteria and their susceptibility to commonly used antibiotics in community. Due to worldwide disparity in pathogen occurrence and their antibiogram, continuous supervision is needed. In our study, females were more commonly affected than males. Following factors may responsible for higher rate of UTI among females, short urethra and the proximity of the anus to the urethra, due to colonization of urethral resident flora and the vaginal introitus.[15]Majority of males in elderly age group were more commonly developed UTIs. Higher incidence of UTI in elderly males is probably due to advancing age, prostate enlargement and neurogenic bladder.[16]

Most commonly isolated uropathogen in our study was *E. coli*, corresponding to 60.40 % of the cases. These results are compatible with the earlier studies.[17,18] Gram negative bacilli have multiple virulent factors responsible for their adherence to host's uroepithelium. Bacterial colonization in mucosal epithelium takes place with the help of adhesins, pili, fimbriae, and P-1 blood group phenotype receptor.[16]

Resistance to antimicrobial agents usually occurs as a result of drug modification, target alteration, and

decreased drug entry. It could be the inherent characteristic of a bacteria or acquiring resistance genes by means of mutations.[19]

Usually strains isolated from hospitalized patients exhibit antimicrobial resistance, but it is reported increasingly even in community settings. Antibiotic resistance pattern of uropathogens in our study showed the least susceptability rate. E.coli was least susceptible to commonly used antibiotics such as ß lactams, fluoroquinolones and co-trimoxazole. This is in agreement with various studies conducted in Indian communities.[17,18]

Most commonly used antibiotics for treating CA UTIs are quinolones. Excessive usage of these antibiotics led to considerable resistance among uropathogens. In our study, higher rate of resistance was observed against ciprofloxacin by E.coli and Klebsiella species accounting for 61.34% and 67.35% respectively. Few comparable studies demonstrated that ciprofloxacin resistant E. coli were parallely resistant to co-trimaxazole and ampicillin. In some studies, E.coli strains which were resistance to fluoroquinolones also exhibited resistance to ampicillin and co-trimaxazole.[21]

Globally various studies has observed that resistance rates for cotrimoxazole among E.coli with uncomplicated UTI ranges from 11-34%.[22] According to the study conducted by Arslan et al, 36% resistance to cotrimoxazole and 17% resistance to fluoroquinolones in.[23]

In developing countries, the decreased susceptibility to frequently used antimicrobials may due to various reasons such as exposure to suboptimal levels of antimicrobials, exposure to microbes carrying resistant genes, lack of hygiene in clinical environment, usage of antimicrobials in foods/agriculture in addition to that prescriptions not taken for a total duration of therapy, antibiotics for viral infections, antibiotics sold without medical supervision. These factors could contribute to emergency of antibiotic resistance in community.[24]

A majority of E.coli and Klebsiella showed low degree of resistance to imipenem and piperacillin/tazobactum. In a study conducted by Baby et al, all the Gram negative bacilli were found to be susceptible to imipenem and piperacillin/tazobactum. Majority of Gram negative isolates showed good susceptibility to amikacin also.[25]The least resistance may be due to the less common use of these injectable antibiotics in community. Good susceptibility was shown towards nitrofurantoin. Various studies also reported good susceptibility of nitrofurantoin.[26] Hence, nitrofurantoin can be the apt antibiotic for uncomplicated UTI. The drawback of nitrofurantoin is that it cannot be used in complicated urinary tract infections such as pyelonephritis and septicemia.[27]

In our study, isolates of E. coli and Klebsiella species were MDR accounting for 56% and 71.51% respectively. According to Hasan et al, multi drug resistance E.coli was 52.9%.in a tertiary care hospital..[28]As per study conducted by Mathai et al, 8.4% commensal E.coli showed multi drug resistance.[29] However, studies conducted in African countries by Ibrahim et al[30] and Eshetie et al[31]showed 92.2% and 87.4% multi drug resistance E. coli strains respectively.

The antimicrobial susceptibility of Klebsiella species was reported in previous studies [32,33] and varied at the following rates: amoxicillin-clavulanic acid, 0 to 69%; cefotaxime, 43 to 100%; ceftazidime, 40 to 100%; imipenem, 100%; ciprofloxacin, 53 to 100%; nalidixic acid, 51 to 94%; gentamicin, 60 to 100%; amikacin, 100%; trimethoprim-sulfamethoxazole, 0 to 56%; nitrofurantoin, 40 to 78%; tetracycline, 43 to 69%; and fosfomycin, 100%.

The study did not evaluate whether the patients had any comorbidities for UTI, such diabetes mellitus, concurrent sexually transmitted disease or urinary tract structural abnormality. It also did not differentiate between low-risk patients and those who were at a higher risk for UTI due to pregnancy, spinal cord injuries, indwelling catheters, underlying urologic abnormalities or a prior history of UTI. Furthermore the study did not evaluate presence of ESBL producers.

Conclusion

High isolation rate was observed among young females in reproductive age groups. E. coli was the most common causative agent of UTI followed by Klebsiella species. Alarming resistance rates were observed towards commonly used antibiotics in community. Klebsiella species showed more resistance than E.coli. Continuous surveillance of antimicrobial susceptibility pattern helps in initiating the empirical treatment of UTI. Urine culture and sensitivity has to be done before initiating antimicrobial therapy to restrain UTI and its complications.

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