Antibiotic Susceptibility Pattern of Isolates in Urinary Tract Infection in a Tertiary Care Hospital

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Abstract
Urinary tract infection is the commonest infection with high morbidity. In almost all cases of UTI, empirical antimicrobial treatment initiates before the laboratory results of urine culture are available; thus antibiotic resistance may increase in uropathogens due to frequent use of antibiotics. The study is carried out in the Department of Microbiology, Govt. Medical College, Jammu for a period of one year to know the etiological agents of UTIs and their antibiograms. Escherichia coli is the commonest isolate. The most effective antibiotic for E. coli in this study observed is Piperacillin-Tazobactam, Imipenem followed by Nitrofurantoin. This study provides valuable laboratory data to monitor the status of antimicrobial resistance among uropathogens and to improve treatment recommendations in a specific geographical region.

Key Words
Urinary Tact infection, Escherichia Coli

Introduction
Urinary tract infections (UTIs) are one of the most common bacterial infections in humans both in the community and hospital setting. It is the commonest bacterial infectious disease in community practice with a high rate of morbidity and financial cost. It has been estimated that 150 million people were infected with UTI per annum worldwide which costing global economy more than 6 billion US dollars.

UTI is a broad term that encompasses asymptomatic bacteriuria and symptomatic infection with microbial invasion and inflammation of the urinary tract. While up to 90% of the patients with UTIs complain of urinary tract symptoms, one third or more of the patients with these symptoms do not have bacteriuria. In almost all cases of UTI, empirical antimicrobial treatment initiates before the laboratory results of urine culture are available; thus antibiotic resistance may increase in uropathogens due to frequent use of antibiotics. Increasing resistance in bacterial pathogens is of world-wide concern. The prevalence of antimicrobial resistance in patients with UTI is increasing and can vary according to geographical and regional location.

For this reason, knowledge of the etiological agents of UTIs and their antimicrobial resistance patterns in specific geographical locations may aid clinicians in choosing the appropriate antimicrobial empirical treatments.

Study Area
The study was carried out in the Department of Microbiology, Govt. Medical College, Jammu (J&K), India. The urine samples were collected from the OPDs (outpatient departments) and indoor patients of the hospital. The duration of the study was one year.

Study Population
The urine samples of 1644 patients, were received...
during the above mentioned period. The age of patients included in the study ranged from 1 to 60 years.

**Sample Collection**

Clean catch midstream urine was collected from each patient into a 20mL calibrated sterile screw-capped universal container which was distributed to the patients. The specimens were labelled, transported to the laboratory, and analyzed within 6 hours. In each container boric acid (0.2mg) was added to prevent the growth of bacteria in urine samples. All patients were well instructed on how to collect sample aseptically prior to sample collection to avoid contaminations from urethra. The study was conducted after due ethical approval which was subjected to the hospital administrations.

**Sample Processing**

A calibrated loop method was used for the isolation of bacterial pathogens from urinary samples. A sterile 4.0mm platinum wired calibrated loop was used which delivered 0.001mL of urine. A loopful urine sample was plated on UTI Chrome agar and MacConkey agar (Hi Media Laboratories, Mumbai, India). The inoculated plates were incubated at 37°C for 24h. The number of isolated bacterial colonies was multiplied by 1000 for the estimation of bacterial load/mL of the urine sample. A specimen was considered positive for UTI if an organism was cultured at a concentration of 105cfu/mL or when an organism was cultured at a concentration of 104cfu/mL and >5 pus cells per high-power field were observed on microscopic examination of the urine. [6]

**Identification and Maintenance of Pure Bacterial Isolates**

Identification of bacterial isolates was done on the basis of their cultural and biochemical characteristics. Gram negative bacteria were identified by the standard biochemical tests [7] and Gram positive microorganisms were identified with the corresponding laboratory tests: catalase, coagulase, and mannitol test for Staphylococcus aureus. [8]

**Antibiotic Susceptibility Testing**

Isolates were tested for antimicrobial susceptibility testing by the standard Kirby Bauer’s disc diffusion method.[9] Standard inoculums adjusted to 0.5 McFarland was swabbed on Mueller Hinton agar and was allowed to soak for 2 to 5 minutes. After that antibiotic disks were placed on the surface of media and pressed gently. Mueller Hinton agar plates were then incubated at 37°C for 24h. After 24h the inhibition zones were measured and interpreted by the recommendations of clinical and laboratory standards.[10] The following standard antibiotic discs were used for the isolates, ofloxacin (OFL), tobramycin (TOB), amikacin (AMK), gentamycin (GET), ceftazidime (CTZ), ceftriaxone (CFX), imipenem (IMP), nitrofurantoin (NTF), linezolid(LNZ), and co-trimoxazole (COT). Standard strains of E. coli (ATCC 25922), S. aureus (ATCC 25923), and P. aeruginosa (ATCC 27853) were used routinely in this study as control.

**Results**

We received and examined 1,644 urine specimens during the study period. The total number of urine samples that showed significant growth was 300 (18.2 %). Of these, 182 (83.3%) were from outpatients and 118 (16.6%) from inpatient. These results indicated that the prevalence of UTI was higher in female patients than in males as 180 (60%) samples from females and 120 (40%) from males showed significant bacteriuria.

The highest susceptible age group of patients to UTI was <40 years (32.33%) followed by 20-30 years (24%), 30-40 years (22.3%), 50-60years (10.66%) and 10-20 years (7.3%), and Comparatively, however, more cases of UTI were observed in females than in males in all age groups. The highest prevalence of UTI in females was found in the age group of 20-30 years (90.69%); however in males the highest susceptible age group to UTI was >40 years (71.15%).

Escherichia coli was found the dominant bacteria among all isolated uropathogens with the prevalence rate of 60%. The second most prevalent isolate was Staphylococcus aureus (14%) followed by budding yeast (7.3%), Klebsiella pneumoniae (6.6%) Enterococcus (4.6%), Citrobacter (2.6%), Proteus spp. (2.6%) and Pseudomonas aeruginosa (2%). Antibiotic susceptibility patterns were observed for Escherichia coli

**Discussion**

This study provides valuable data to compare and monitor the status of antimicrobial resistance among uropathogens to improve efficient empirical treatment. Increasing antimicrobial resistance has been documented globally. [11] The prevalence of UTI was found to be 18.2% in this study and this rate of prevalence is lower than in the other study which accounts for 25.6% [12] in India; however, the prevalence rate of UTI in our study correlates with the study done in Aligarh 17.19%. [13]

Our study showed a high prevalence of UTI in females than in males which correlates with other findings which revealed that the frequency of UTI is greater in females
**Fig. 1** Showing sex distribution of study population

**Fig. 2** Showing Age wise distribution of study population

**Fig. 3** Showing Type of Pathogens
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Fig. 4 Showing that isolates were highly susceptible to Piperacillin-Tazobactam and Imipenem. Antibiotic susceptibility pattern of Staphylococcus aureus

Fig. 5 Showing that isolates were sensitive to linezolid and nitrofurantoin

as compared to males. \(^{[14]}\) The reason behind this high prevalence of UTI in females is due to close proximity of the urethral meatus to the anus, shorter urethra, sexual intercourse, incontinence, and bad toilet. \(^{[13]}\)

The occurrence of UTI recorded among the elderly (\( \geq 48\) years, 63.51%) compared to young age patients (26-37 years, 58.11%; 15-25 years, 54.55%) and middle-age patients (37-47 years, 39.19%) in this study differs from the other study done in Kuwait \(^{[16]}\) in which the highest incidence of UTI was recorded among the age group 20 to 50 years (63.4 and 74.7%, resp.) and lowest among the age group \( \geq 50\) years (13.3 and 10.3%, resp.). However, our results agree with the study done in Japan with a 20-year period in which a trend of increasing complicated UTI was reported in elderly patients. \(^{[17]}\) In our study it was found that the elderly males (\( \geq 48\) years) had a higher incidence of UTI (71.15%) when compared with the elderly females (45.45%). This finding is similar to a study conducted at a tertiary care hospital in Jaipur, Rajasthan, India. \(^{[18]}\) The main cause behind this increasing incidence of UTI with advancing age in males is due to prostate enlargement and neurogenic bladder. \(^{[19]}\) This factor is also reported by other authors whose studies showed that the prostate disease in males is responsible for the increase in incidence of UTI and decrease in female: male ratio in patients above 50 years. \(^{[20]}\)
Females of the age group 26-36 years were found more susceptible (90.69%) to UTI followed by 15-25 years (82.93%), 37-47 years (58.82%), and ≥48 years (45.45%). These findings correlate with other reports which showed that females are more prone to UTIs than males during adolescence and adulthood. The factors of this increasing incidence of UTI in young age females are associated with high sexual activity, recent use of a diaphragm with spermicide, and a history of recurrent UTIs.

In this study, the Gram negative bacilli constituted 90.32% of the total bacterial isolates while Gram positive cocci constituted 9.68%. Escherichia coli (42.58%) was found the most prevalent gram negative bacteria in the positive urine samples of UTI. This result is consistent with reports from other studies. Other isolated bacteria from UTI cases in this study were K. pneumoniae (18.71%), P. aeruginosa (12.90%), S. aureus (9.68%), Proteus spp. (9.03%), and Enterobacter spp. (7.10%). Higher incidence of gram negative bacteria, related to Enterobacteriaceae, in causing UTI has many factors which are responsible for their attachment to the uroepithelium. In addition, they are able to colonize in the urogenital mucosa with adhesins, pili, fimbriae, and P-1 blood group phenotype receptor.

In females of all age categories, E. coli is the most frequently isolated uropathogen which correlates with other studies but not with others which found that E. coli causes most male UTIs, followed by other Enterobacteriaceae and Enterococci whereas Proteus mirabilis was more frequently isolated in the younger female patients of UTI and K. pneumoniae in the elderly patients. The most effective antibiotic for E. coli in this study observed was Piperacillin-Tazobactam, Imipenem followed by Nitrofurantoin. This is similar to recent studies in India. The antimicrobial susceptibility pattern of E. coli varies widely by region. High efficacy of Nitrofurantoin followed by Cotrimaxazole and Tetracycline both was observed against Klebsiella in this study. Similar trends were reported by Kothari et al. The alarming finding in this study is the resistance to third-generation cephalosporin; the highest resistance was seen against CTZ (71.61%) followed by CTX (67.74%) among all uropathogens. This is an indication that many of the organisms are ESBL producers. The other possible explanation behind this situation is that the III generation cephalosporin has been in use for a long period and must have been abused and over time organisms have developed resistant mechanisms due to changing their mode of action. The inappropriate usage of wide spectrum antibiotics, insufficient hygiene, immunosuppression, and a prolonged stay in the hospital are some other major etiological factors that elevate the chances of MDR infections.

Imipenem used in this study were found to be the most sensitive drug against all isolated uropathogens. A study done in King Fahd Hospital, Saudi Arabia showed that imipenem was 91.71% sensitive against extended spectrum beta-lactamase producing E. coli. The present study revealed that Linezolid and Nitrofurantoin were highly effective for Staphylococcus aureus. 60% of the isolates were sensitive to gentamycin. High susceptibility to aminoglycosides was also obvious in the study by Adedeji et al., in Yola. The emergence and spread of resistance can be reduced through appropriate or careful use of antimicrobial drugs and increasing awareness among the population to the hazards of inappropriate antimicrobial use through public health education campaign.

Conclusions

Surveillance programs of antimicrobial drug resistance are necessary both locally and nationally. Antimicrobial susceptibility surveys from various hospitals allow comparisons between resistance rates at the national level. This information will directly affect selection of empiric therapy for UTI. Regular monitoring is required to establish reliable information about susceptibility pattern of urinary pathogens for optimal empirical therapy of patients with UTIs. We suggest that empirical antibiotic selection should be based on the knowledge of local prevalence of bacterial organisms and antibiotic sensitivities rather than on universal guidelines. This study provides valuable laboratory data to monitor the status of antimicrobial resistance among uropathogens and to improve treatment recommendations in a specific geographical region.

References


