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Original Research Article

Antibiotic Resistance Pattern of Uropathogens in Patients with Urinary Tract Infection in a Tertiary Care Center in Central India

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Abstract

Background: It is crucial to educate prescribing physicians about the geographical patterns of antibiotic resistance in this era of shifting trends in antibiotic susceptibility.

Aims and Objectives: Our research aims to characterize the typical uropathogens linked to UTI cases and their pattern of antibiotic susceptibility.

Materials and Methodology: All patients over the age of 18 who were admitted to our medical college with a diagnosis of UTI during the course of a year were included in this retrospective hospital-based study. The case record files for patients were used to obtain information on the causative uropathogens and their antibiotic susceptibility.

Results: Gram-negative organisms made up 86.1% of the 248 significant isolates that caused illness. E. coli was the most frequent uropathogen found (70.8%), followed by Klebsiella spp. (9.2%) and other types. Ampicillin (91%), amoxiclav (66.7%), ceftriaxone (76.5%), and fluoroquinolones (79.1% to 83%), on the other hand, showed strong resistance from E. coli, whereas amikacin, cefoperazone+sulbactam, and meropenem showed low resistance. In our investigation, we found that the isolated uropathogens were more sensitive to vancomycin, linezolid, and carbapenems.

Conclusion: Antibiotic resistance patterns should be continuously monitored because this will only result in more effective prescriptions and a better therapeutic outcome.

Keywords: UTI, Uropathogens, Antibiotic Resistance.

Introduction

One of the frequent illnesses, urinary tract infection (UTI) affects more women than males. Most acute urinary tract infection episodes are accompanied with severe morbidity, and future recurring bouts are also a possibility [1]. It has been noted that 25% of females who experience a first UTI will experience second episode in the same year [2]. The likelihood of a urinary tract infection is influenced by a variety of factors. Recurrences must be avoided by prompt diagnosis and treatment of these risk factors

[3]. Antibiotics are typically used to treat UTIs on an empirical basis without first performing a culture and sensitivity test. This has resulted in the misuse of antibiotics [4]. In order to prevent the evolution of antibiotic-resistant bacterial strains, it is crucial for physicians to recognize their patients' needs and prescribe medicines judiciously. Among uropathogens, there has been a recent change in the pattern of antibiotic resistance [5]. Therefore, it is essential to raise awareness of local uropathogens' susceptibility to antibiotics. However, there aren't many thorough research about the pattern of UTI pathogen antibiotic resistance in India [6].

Aims and Objectives: Our research intends to examine the typical microorganisms linked to UTI cases and their pattern of antibiotic susceptibility.

Materials and Methodology

This study was retrospective and descriptive, conducted in a hospital. All in-patients of either gender over the age of 18 who were admitted to our medical college with a diagnosis of UTI during the course of one year were included in the study. Information was gathered from the patient's case record files, which were obtained from our hospital's medical records department. A proforma sheet that was previously created contained all the pertinent information regarding the type of clinical presentation, demographic distribution, related risk factors, co-morbid conditions, microbiology reports, causative uropathogens, and its pattern of antibiotic resistance.

Statistical Analysis

An excel spreadsheet was used to tabulate the pertinent information from the case record forms, and statistical analysis was conducted. Mean, frequency, and percentage descriptive statistics were used to analyze the data. The results were presented in tables and graphs. Making graphs and tables required the usage of Microsoft Excel.

Results

Gram-negative organisms made up 86.1% of the 248 significant isolates, while gram-positive organisms made up the remaining 11.6% of all infections. In just 2.3% of instances were their fungus isolates. The most common uropathogen found was E. coli, which accounted for 70.8% of the isolates, followed by Klebsiella spp. (9.2%), Enterococcus fecalis (6.2%), and Acinetobacter spp. (3.1%). MRSA (2.3%), Staphylococcus aureus (2.3%), Candida spp (2.3%), Citrobacter freundii (1.5%), Pseudomonas spp (1.5%), and Streptococcus spp (0.8%) were among the other uropathogens. Ampicillin (91%), amoxiclav (66.7%), cephalexin (84.1%), cefuroxime (77.8%), ceftriaxone (76.5%), fluoroquinolones (79.1% to 83%), and cotrimoxazole (64.7%) all demonstrated significant resistance to E. coli. Amikacin (6%), NFT (6.4%), piperacillin + tazobactam (7.8%), cefoperazone + sulbactam (10%), and meropenem (6.5%), however, showed minimal levels of resistance.

The second most frequent uropathogen, Klebsiella spp., had high levels of resistance to NFT (81.8%), ampicillin (100%), cephalexin (100%), cefuroxime (75%), and cefuroxime. Amikacin (83.3%), piperacillin + tazobactam (70%), cefoperazone + sulbactam (91.7%), carbapenems (90.9% to 100%), and tigecycline (100%) were all found to be effective against them.
Table 1 and 2 shows antibiotic resistance pattern of gram-negative and gram-positive bacteria isolated from urine culture

Table 1:

Antimicrobial Agents	E.coli	Acinetobacter spp	Citrobacter freundii	Klebsiella spp	Pseudomonas spp
	R (%)	R (%)	R (%)	R (%)	R (%)
Ampicillin	91.0	100	100	100	100
Amoxicillin-Clavulanic Acid	66.7	75	100	45.5	100
Cephalexin	84.1	100	100	100	100
Cefuroxime	77.8	100	50	75	100
Ceftriaxone	76.5	100	50	72.7	100
Ciprofloxacin	83.0	100	50	50	100
Levofloxacin	79.1	100	50	33.3	100
Cotrimoxazole	64.7	100	100	45.5	100
Gentamicin	50.6	100	50	54.5	50
Amikacin	6.0	100	50	16.7	100
Nitrofurantoin	6.4	100	0.0	81.8	100
Piperacillin + Tazobactam	7.8	50	50	30	0.0
Cefoperazone + Sulbactam	10	50	0.0	8.3	50
Meropenam	6.5	75	0.0	9.1	0.0

Table 2:

Antimicrobial agents	Enterococcus fecalis	Staphylococcus aureus	MRSA	Streptococcus spp
	R (%)	R (%)	R (%)	R (%)
Ampicillin	25	33.3	100	0.0
Amoxicillin-clavulanic acid	14.3	0.0	100	0.0
Cephalexin	100	-	100	0.0
Cefuroxime	100	0.0	100	0.0
Ceftriaxone	100	0.0	100	0.0
Ciprofloxacin	28.6	100	100	0.0
Levofloxacin	28.6	0.0	66.7	0.0
Cotrimoxazole	57.1	0.0	66.7	0.0
Gentamicin	71.4	0.0	0.0	100
Amikacin	62.5	0.0	66.7	100
Nitrofurantoin	12.5	0.0	0.0	0.0
Piperacillin+Tazobactam	0.0	-	-	-
Imipenem	16.7	-	-	-
Meropenem	33.3	-	-	-
Vancomycin	0.0	0.0	0.0	0.0
Linezolid	0.0	0.0	0.0	-
Teicoplanin	0.0	0.0	0.0	-
Azithromycin	-	-	100	0.0

Discussion

E. coli (n = 184) was the most common uropathogen found in our investigation, and this conclusion was consistent with those of other studies. E. coli is the most prevalent uropathogen, as previously mentioned, and it can cause both severe and mild UTI [7]. Klebsiella spp. (n = 24) was the second most frequent uropathogen isolated in our investigation, which is comparable to research done by Beyene *et al.* and Khameneh *et al*. On the other hand, a study in Nepal by Khatri B *et al*. found Enterococcus fecalis to be the second most common uropathogen isolated [8-10]. The discovery of antibiotics has long been regarded as one of the 20th century's greatest wonders. The development of antibiotic resistance, however, is the greatest detrimental side effect of antibiotic use. Our healthcare system faces a threat from antibiotic resistance [11]. Our findings showed that some of the regularly prescribed antimicrobials were frequently resistant among the isolated uropathogens. The most common uropathogen found was E. coli, which exhibited significant resistance to ampicillin (91%), amoxiclav (66.7%), cephalexin (84.1%), cefuroxime (77.8%), ceftriaxone (76.5%), fluoroquinolones (79.1% to 83%), and cotrimoxazole (64.7%). Amikacin (6%), NFT (6.4%), piperacillin + tazobactam (7.8%), cefoperazone + sulbactam (10%), and meropenem (6.5%), however, showed minimal levels of resistance. A study carried out by Mandal *et al*. in South India found a resistance rate similar to our results. In contrast to our findings, a study done in West Nepal found that E. coli isolates had high susceptibilities to cotrimoxazole (77.1%) and ampicillin (72.6%). The second most typical uropathogen found in our study was Klebsiella spp. Ampicillin (100% resistance), cephalexin (100% resistance), cefuroxime (75% resistance), ceftriaxone (72.7%), and NFT (81.8%) all showed high levels of resistance. Amikacin (83.3%), piperacillin + tazobactam (70%), cefoperazone + sulbactam (91.7%), carbapenems (90.9% to 100%), and tigecycline (100%) were all found to be effective against them. In a retrospective investigation by Bahadin *et al*., klebsiella was discovered to be the second most common isolate, and ampicillin resistance of 100% was noted. However, their investigation found better sensitivity to gentamicin (100%), ceftriaxone (86.2%), amoxiclav (82.8%), and ciprofloxacin (72.4%) in contrast to our findings [12-15]. In comparison to our study's results, which were 54.5% and 45.5%, another study carried out in the Southeast region of India demonstrated stronger resistance to gentamicin (83.3%) and cotrimoxazole (82.4%). Ampicillin (100%), amoxiclav (75%), cephalexin (100%), cefuroxime (100%), ceftriaxone (100%), fluoroquinolones (100%), cotrimoxazole (100%), aminoglycosides (100%), NFT (100%) and meropenem (75%), among other antibiotics, showed substantial levels of resistance. According to a study by Akram *et al*., Acinetobacter spp. exhibits high rates of susceptibility to fluoroquinolones (100%) and amikacin (100%) in patients with symptomatic UTIs who visit OPD clinics [16-18]. Their observations couldn't be compared to the findings of our investigation. 1.5% of all isolated uropathogens were Citrobacter freundii. We found that 50% of the samples were resistant to cefuroxime, ceftriaxone, fluoroquinolones, aminoglycosides, and piperacillin + tazobactam, while 100% of the samples were resistant to ampicillin, amoxiclav, cephalexin, and cotrimoxazole. Similar resistance rates to ampicillin (100%), cotrimoxazole (100%), ciprofloxacin (50%), and ceftriaxone (50%), according to Beyene *et al*. A study done in South India found reduced levels of resistance to ampicillin, ceftriaxone, and amikacin. The Citrobacter freundii isolates in our investigation also demonstrated high levels of sensitivity to NFT (100%), cefoperazone+sulbactam (100%), and carbapenems (100%).

Ampicillin, amoxiclav, cephalexin, cefuroxime, ceftriaxone, fluoroquinolones, cotrimoxazole, NFT, and amikacin all showed 100% resistance among pseudomonas species [19-21]. A similar trend of resistance to ampicillin, cotrimoxazole, nitrofurantoin, and cephalexin was shown in research by Farajnia *et al*. Compared to the findings of our investigation, other studies found a lower prevalence of amikacin and ciprofloxacin resistance. 6.2% of all isolates are caused by Enterococcus fecalis. We found significant resistance to gentamicin (71.4%), amikacin (62.5%), cotrimoxazole (57.1%), and cephalosporins (100%). In a study carried out in Iran, resistance to gentamicin and amikacin was found to be less common. In contrast to our findings, Murugan *et al* study found a significant proportion of vancomycin resistance (83.3%). Additionally, a 50% resistance rate to fluoroquinolones was found in their investigation [22]. Fluoroquinolones showed a lower resistance rate of 28.6% in our study, while vancomycin showed a higher susceptibility rate of 100%. All tested medications, with the exception of ciprofloxacin, were shown to be effective against Staphylococcus aureus isolates. In contrast, cotrimoxazole and ceftriaxone showed a reduced susceptibility rate in research by Beyene *et al*. In our investigation, 2.3% of all isolates were MRSA. They were discovered to be extremely susceptible to gentamicin (100%), vancomycin (100%), linezolid (100%), teicoplanin (100%), and NFT (100%). Dalela *et al*. noted comparable vancomycin and linezolid susceptibility rates among MRSA isolates. In our investigation, we found that isolated uropathogens were more sensitive to vancomycin, linezolid, and carbapenems. Their use should be limited moving forward to stop the emergence of antibiotic resistance.

Conclusion

Choosing the right antibiotic is essential in the current climate of antimicrobial resistance. Our work emphasizes how crucial it is to understand the regional patterns of antibiotic resistance and the uropathogens that are to blame. Regular monitoring of the pattern of antibiotic resistance will only result in more effective prescriptions and, thus, a better treatment outcome.

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