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Distribution of bacteria isolated from urine cultures and resistance pattern of *Escherichia coli* strains in community-acquired urinary tract infections

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ABSTRACT

Aims: Urinary tract infections are one of the most common among community-acquired infections. *Escherichia coli* (*E. coli*) is the most common cause of community-acquired urinary tract infections. In our study, we aimed to determine the correct empirical treatment by determining the resistance profile of *E. coli* strains isolated from urine cultures in our hospital, thus both establishing an effective treatment and preventing the development of resistance.

Methods: Urine cultures of 3145 patients with urinary tract infection symptoms who applied to the infection and clinical microbiology outpatient clinic of our hospital between January 2019 and December 2019 were analyzed retrospectively. Patients with a history of catheter, a history of urinary operations, a history of hospitalization in the last 15 days, contamination in their cultures, and patients under the age of 18 were excluded from the study, and 422 urine cultures with growth were included in the study.

Results: The mean age of the patients included in the study was 49.8±14.7 years, and the gender distribution consisted of 301 females (71.3%) and 121 males (28.7%). *E. coli* was isolated in 313 (77.6%) of these cultures. The antibiotic with the highest resistance rate was trimethoprim-sulfametoxazole (34.8%), while the antibiotics with the lowest resistance rates were fosfomycin and imipenem (0.6%).

Conclusions: Considering that the resistance profiles of microorganisms are different from each other on the basis of country, region, and city, revealing regional resistance patterns can make an important contribution to both establishing effective treatment and preventing the development of antibiotic resistance.

Keywords: Resistance, community acquired, urinary tract infection

INTRODUCTION

Urinary tract infections (UTIs) include infections that target various components of the urinary system, including the urethra, bladder, ureters, and kidneys.[1] Urinary tract infections are one of the most common bacterial infections that can affect individuals of all age groups worldwide and pose a serious burden on both individuals and public health systems.[2,3] While this burden is associated with significant morbidity and mortality for individuals, it is related to health expenditures, loss of productivity, and reduced quality of life in the health system.[4]

"Community-acquired UTIs" (CA-UTIs) is an idiom encountered in daily life, acquired outside of healthcare settings, as well as reflecting the complex relationships between individual behavior, microbial exposure, and local health practices.[2,5] Therefore, the epidemiology of CA-UTIs varies from region to region, depending on sociodemographic factors, health infrastructure, and antibiotic prescribing habits of physicians.[6]

Agents causing CA-UTIs include a spectrum of different bacterial species, particularly *Escherichia coli* (*E. coli*), *Klebsiella pneumoniae*, *Proteus mirabilis*, and *Enterococcus faecalis*. Again, the distribution of these bacterial species may differ in different geographic regions, populations, and healthcare settings.[7] Therefore, revealing the common bacterial species that cause CA-UTIs in different geographical areas and determining the resistance profiles of these bacteria have a very important place in establishing the correct antibiotic regimens. This, in turn, is expected to increase the success of treatment while reducing the risk of antibiotic resistance

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development.[8,9] Apart from geographical differences, the existence of different resistance profiles, even in different health institutions, is of great importance in the creation of targeted treatments in the microenvironment and the formation of the right health policies.[10]

In this study, we aimed to reveal the prevalence of CA-UTIs admitted to our hospital, which is a health center that caters to a wide area in the Eastern Anatolia Region of Turkey, and the antimicrobial resistance of the dominant pathogen causing these infections. In this way, with its distribution and resistance profile, it might facilitate the selection of antibiotics that can be preferred primarily in empirical treatment in our province while contributing to the prevention of antimicrobial resistance formation.

METHODS

This study was planned as a retrospective study and carried out with the permission of Van Training and Research Hospital Clinical Researches Ethics Committee (Date:11.03.2021, Decision No: 2021-06). All procedures were carried out in accordance with the ethical rules and principles of the Declaration of Helsinki.

In the study, 3145 urine culture samples taken from patients who applied to the infectious diseases and clinical microbiology outpatient clinics of Van Training and Research Hospital between January 2019 and December 2019 and had urinary tract infection findings were retrospectively analyzed. Samples of patients with a history of catheterization, a history of urological operation, a history of hospitalization in the last 15 days, contamination in their culture, and those under the age of 18 were excluded from the study. Age and gender of the patients, microorganisms isolated from urine cultures, and their resistance profiles were recorded.

Midstream urines of 422 patients included in the study were seeded with sterile loop on 5% sheep blood agar and eosin methylene blue (EMB) agar (bioMerioux, France). It was incubated for 24 hours in a 36°C oven in a 5-10% CO_2 environment. One or two types of growths ≥105 cfu/ml or single type ≥104 cfu/ml were taken into consideration as pure culture. Identification, MIC values determination, and antibiograms were made with BACT / ALERT 3D and PHOENIX 100 device. Antibiotic susceptibility tests were performed on the samples with growth detected by the agar disc diffusion method in accordance with the recommendations of the Clinical Laboratory Standards Institute (CLSI).[11]

RESULTS

The mean age of the patients included in the study was 49.8±14.7 years, and the gender distribution consisted of 301 females (71.3%) and 121 males (28.7%).

In our study, growth was detected in 422 of the 3145 samples. Two microorganisms were isolated in 12 of these samples.

A total of 434 microorganisms were isolated in 422 patients. *E. coli* and *Klebsiella* spp. in five samples, *E. coli* and *Pseudomonas* spp. in two samples, *E. coli* and *Enterococcus* spp. in two samples, *E. coli* and *Streptococcus agalactia* in two samples, and *Enterococcus* spp. and *Staphylococcus* spp. in one sample were isolated together.

The causative agent was determined as *E. coli* in 313 (77.6%) in the microorganism isolated cultures. The distribution of isolated pathogens is given in Table 1.

Table 1. Distribution of microorganisms isolated from urine cultures, n (%)

Uropathogen	n	%
E. coli	313	72.1
Other Gr (-)		
Klebsiella spp.	56	12.9
Pseudomonas spp.	7	1.6
Proteus spp.	5	1.2
Enterobacter cloacae	7	1.6
Staphylococcus spp.	11	2.5
Enterococcus spp.	22	5.1
Streptococcus agalactia	13	3
Total	434	100

E. coli: *Escherichia coli*, Spp: Species pulural

In the evaluation of the *E. coli* resistance profile, the antibiotics to which it was most sensitive were fosfomycin (0.6%) and imipenem (0.6%), while trimethoprim-sulfamethoxazole (TMP-SMX) (34.8%) had the highest resistance rate. The resistance profile of *E. coli* is shown in Table 2.

Table 2. Antibiotic resistance rates of *E. coli* strains isolated from urine cultures, n (%)

Antibiotic Name	Resistance (n)	Resistance (%)
Ampicillin-sulbactam	109	34.8
Ciprofloxacin	97	31
TMP-SMX	113	36.1
Cefuroxime aksetil	69	22
Ceftriaxone	59	18.8
Fosfomycin	2	0.6
Nitrofurantoin	12	3.8
Amikacin	23	7.3
Piperacillin-tazobactam	4	1.3
Imipenem	2	0.6

TMP-SMX: Trimethoprim-sulfamethoxazole

DISCUSSION

Our research assesses the frequency of antibiotic resistance observed in urine cultures caused by *E. coli* isolates within the local population, and it offers

recommendations for outpatient treatment guidance for individuals diagnosed with community-acquired urinary tract infections. Our results indicate that *E. coli* was the predominant strain found in urine samples, comprising 72.1% of all isolates. Similarly, in publications from both our country and abroad, it is observed that the most frequently isolated agent in urine cultures is *E. coli*. Its prevalence varies from region to region, ranging between 54.8% and 81%.[9]

In our study, the majority of cultures were from female participants (71.3%), and published studies have shown that women frequently experience urinary tract infections. This situation is thought to be related to the physiological and anatomical characteristics of women.[12-15]

The antimicrobial susceptibilities of causative pathogens in urinary tract infections can vary based on regions, patients' accompanying diseases and medications, environmental factors, and the inappropriate and widespread use of antibiotics over the years. Therefore, it is necessary to determine region-specific microorganisms and their antimicrobial susceptibilities. Among the tested antibiotics, the highest resistance rates were recorded for TMP-SMX (36.1%), followed by ampicillin-sulbactam (34.8%) and ciprofloxacin (31%).[16]

In the empirical antibiotic treatment of urinary tract infections, quinolones, cephalosporins, fosfomycin, aminoglycosides, and TMP-SMX are generally preferred. In the context of empirical treatment for community-acquired UTIs, the recommended options include nitrofurantoin and fosfomycin, but fluoroquinolones and TMP-SMX are not advised.[17,18]

Quinolones are effective against many uropathogens and are considered among the first-choice drugs for treating urinary tract infections due to their high rates of bacteriological and clinical improvement.[19] Due to the widespread use of quinolones, an increase in quinolone resistance in community-acquired *E. coli* strains has been reported.[20] And in our country, reported quinolone resistance has reached a rate of 40-45%.[21,22] In our study, quinolone resistance was found to be 31%, indicating that it is not suitable for empirical treatment.

Various studies have reported that TMP-SMX resistance in community-acquired *E. coli* strains in our country ranges from 60%.[21,23,24] In our study, TMP-SMX resistance in community-acquired *E. coli* was determined to be 36.1%, which is consistent with the literature. As a result, empirical treatment with TMP-SMX is not recommended for patients under surveillance in our region.

Fosfomycin and nitrofurantoin are the effective antimicrobial agents in vitro against *E. coli*, even in cases of multi-drug resistant (MDR) isolates, among outpatients with community-acquired *E. coli*. The oral single-dose administration of fosfomycin has started to gain significance in the treatment of urinary tract infections caused by *E. coli* due to its ability to reach high concentrations in the urine and low resistance rates.[25] Additionally, studies conducted in our country have reported nitrofurantoin resistance for *E. coli* among outpatient patients to be below 10%.[24,26]

In our study, resistance rates were determined to be 0.6% for fosfomycin and 3.8% for nitrofurantoin, similar to previous studies.[15,21,24] Due to their significant efficacy against *E. coli* and low resistance rates, fosfomycin and nitrofurantoin are recommended as the antibiotic treatments for community-acquired *E. coli* urinary tract infections.

Antibiotic resistance is associated with increased morbidity, mortality, and healthcare expenses. Therefore, understanding local resistance patterns will help prevent inappropriate antibiotic usage and mitigate the risks of antibiotic side effects.

There are certain limitations in our study. The retrospective nature of our data might have led to data loss in determining patient-related risk factors. Conducting our study within a one-year timeframe may have resulted in a lack of assessment regarding resistance trends over the years. In accordance with the literature, patients with a history of urinary surgery and hospitalization in the last 15 days were excluded from the study. However, it may take longer than 15 days for the flora structure of patients with these stories to recover. This may create a bias in evaluating the optimal flora and determining the appropriate antibiotic. The scope of our conclusions is limited because this study was conducted at a single center. With its extensive population size, our study contributes to national data by collecting regional information.

CONCLUSION

Resistance to antibiotics used in the past years in the treatment of CA-UTIs is increasing dramatically. In addition, in CA-UTIs, empirical antibiotic therapy is usually started without waiting for urine culture results. Therefore, knowing the regional resistance pattern is of vital importance for the development of rational drug policies, especially for effective treatment and prevention of resistance development. According to our study, when the antibiotic resistance pattern in our region is evaluated, fosfomycin and nitrofurantoin can be considered at the forefront of empirical treatment among oral treatment options.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Van Training and Research Hospital Clinical Researches Ethics Committee (Date:11.03.2021, Decision No: 2021-06).

Informed consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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