

Original Research Article

Prevalence and Antibiotic Susceptibility Pattern of *E. coli* Isolated from Urinary Tract Infection in Patients with Renal Failure Disease and Renal Transplant Recipients

Mohammad Aghazadeh¹, Soyar Sari², Mohammadreza Nahaie¹, Seyed Sadraddin Rasi Hashemi³ and Samaneh Mehri^{1*}

¹Department of Bacteriology and Virology, School of Medicine; ²Department of molecular and cellular science, Faculty of advanced sciences technology, Pharmaceutical sciences branch, Islamic Azad University, Tehran, Iran; ³Chronic Kidney Disease Research Center, Tabriz University of Medical Sciences, IR Iran M

*For correspondence: **Email:** mehri.samaneh@gmail.com; **Tel/Fax:** +982144652354

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Abstract

Purpose: To determine the common uropathogens found in patients with urinary tract infections and to assess their antibiotic susceptibility patterns.

Methods: The prevalence and antibiotic susceptibility pattern of *E. coli* in urinary tract infection in-patients with renal failure disease and renal transplant recipients (group 1) and in outpatients (group 2), admitted in/attending Imam Reza Hospital in Tabriz, Iran, were determined. Isolates were analyzed by standard methods, and antimicrobial susceptibility testing was performed by Kirby-Bauer disc diffusion method.

Results: A total of 136 *E. coli* strains from 81 females and 55 males were examined. The high level of antibiotic susceptibility for group 1 was cefuroxime/ceftazidime (100 %) and nitrofurantoin (81.63 %), respectively; and for group 2, it was ampicillin (95.83 %) and nitrofurantoin (93.75 %), respectively.

Conclusion: The most important finding of this study is that a considerable proportion of the studied *E. coli* isolates are resistant to the antibiotics tested, except nitrofurantoin. This finding is useful for clinicians to determine appropriate empirical antimicrobial treatment in similar cases and would also help health authorities to formulate antibiotic prescription policies.

Keywords: Urinary tract infection, Antibiotic susceptibility pattern, Uropathogens, Renal failure, Renal transplant, *Escherichia coli*

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INTRODUCTION

Escherichia coli (*E. coli*) is one of the most important causes of community-acquired and nosocomial infections. This organism is therefore of clinical importance and can be isolated from various clinical specimens [1]. Urinary tract infections (UTIs), including cystitis and pyelonephritis, are the most common infectious diseases in childhood. *E. coli* accounts for as

much as 90 % of the community-acquired and 50 % of the nosocomial UTIs [2,3].

Knowledge of antimicrobial resistance pattern in *E. coli*, the predominant pathogen associated with urinary tract infection is important as a guide in selecting empirical antimicrobial therapy. Microbial infections are one of the major problems militating against successful organ transplantation and can cause high morbidity and mortality among transplant recipients. Infections

in renal transplant recipients account for 26 % of hospitalization days annually and 40 % of overall mortalities [4]. Although UTI is one of the most common bacterial diseases in children, its diagnosis is often delayed due to obscure clinical findings. In pediatric patients, acute pyelonephritis may be associated with high morbidity and long-term complications like renal scarring, hypertension, and chronic renal failure [5-7].

Gram-negative enteric bacilli, especially *E. coli* and *Klebsiella* spp., are the leading pathogens, though *Enterococcus* spp., yeasts, and *Staphylococcus* spp. have recently emerged as prominent agents [5]. Worldwide, 150 million people are diagnosed with UTI each year, costing the global economy in excess of US\$ 6 billion [8]. In the United States, surveys have estimated an incidence of 8 million UTI episodes per year [9]. A study from Turkey showed that 17.8 % of all visits were patients with UTI at primary care settings [10].

The predominance of Gram-negative species, usually Enterobacteriaceae and, particularly, *Escherichia coli*, remained the principal pathogens causing UTI, accounting for 75 – 90 % of all urinary tract infections in both inpatients and outpatients [11]. The *in vitro* susceptibility of *E. coli* urinary isolates to the most common antimicrobial agents used for the treatment of patients with UTI varies considerably in different parts of the world [12-14]. Antibiotics are usually given empirically before laboratory results from urine culture are available. To optimize the use of empirical antibiotic therapy for UTI, it is important for clinicians to be aware of the etiological agents and susceptibility patterns of UTI pathogens in their populations. Hence, various centers consider the results of urine culture previously obtained from their microbiology laboratory in selecting empirical antibiotic treatment for UTI [15].

The aim of this study was to investigate microbial species isolated from patients with UTI and evaluate *E. coli* prevalence and antibiotic susceptibility pattern in patients with renal failure disease and renal transplant recipients hospitalized in Imam Reza Hospital, Tabriz, Iran.

EXPERIMENTAL

Specimen collection

Urinary specimens were obtained from renal failure transplant and failure patients and outpatients. For each patient, age, sex, collection

date, prescribed antibiotic and hospitalization period was registered.

Ten ml of midstream clean urine specimens were collected in sterile containers and transported to the laboratory in minimum time for analysis and culturing on appropriate bacteriologic media [16].

Macroscopic and microscopic examination

For macroscopic examination color and appearance of collected urine samples was observed and reported accordingly.

In microscopic examination, centrifuging at 300 rpm for 10 min, preparation of wet mount smear and gram stain was done for directly examination.

Urine culturing and bacterial identification

Urine specimen was used for culturing on sheep blood and MacConkey agar plates by calibrated loop of 1 μ L and incubated at 37 °C for 24 h. Specimens with more than 10⁵ colony forming unit (CFU) per ml were considered as positive samples.

All isolates were identified morphologically and biochemically by standard laboratory procedures (Baird D. Staphylococcus).

Antibiogram test

Antimicrobial susceptibility test was performed according to "Kirby & Bauer" method on Mueller-Hinton agar medium [17]. The agents used for antibiotic susceptibility testing of isolates are amikacin, ampicillin, cefixime, ceftazidime, ceftriaxone, cefuroxime, chloramphenicol, ciprofloxacin, cotrimaxazole, imipenem, nalidixic acid, nitrofurantoin, ofloxacin, tetracycline and trimethoprim. *E. coli* (ATCC 25922) was used as standard control strains.

Statistical analysis

Data collected in this study were evaluated by one-way analysis of variance (ANOVA) using SPSS 19. Differences at $p \leq 0.05$ were considered significant.

RESULTS

A total of 136 urinary specimens from different patients were obtained from 68 renal transplant and failure patients and 68 outpatients hospitalized in Tabriz Emam Reza hospital.

They were 55 males (40.44 %) and 81 females (59.55 %) with different ages from 9 to 75. Out of 136 bacterial isolates from the patients, the rate of *E. coli* (98, 72.05 %) isolation was highest, as shown in Table 1.

Table 2 depicts the antibiotic susceptibility data for all the *E. coli* isolates in renal transplant and failure patients (group 1) and outpatients (group 2).

The antibiotic susceptibility pattern for *E. coli* isolated from group 1 showed the highest resistance to cefuroxime and ceftazidime (100 %) followed by ceftriaxone (97.9 %) and ciprofloxacin (95 %), while group 2 showed the highest resistance to ampicillin (95.83 %) followed by cefuroxime (91.66 %) and ceftazidime (89.58 %). In order of efficacy nitrofurantoin was the most effective in groups 1 and 2 with 81.63 % and 93.75 %, respectively (Table 2).

DISCUSSION

This study shows the prevalence and antibiotic susceptibility pattern of *E. coli* isolated from urinary tract infection in patients with renal failure

disease and renal transplant recipients at Imam Reza hospital in Tabriz, Iran.

Antimicrobial resistance is a growing problem and a cause of great concern throughout the world [18]. Approximately 1 in 3 women will require antimicrobial treatment for a UTI before age 24, and 40 % to 50 % of women will suffer from UTI during their lifetime [19]. In the last decades, the number of reports about appearance of bacteria with antibiotic resistance has increased all over the world [20]. This study, like others, shows clearly that there are significant geographic differences in the susceptibility of commonly used antimicrobials against UTIs [21]. Knowledge of antimicrobial resistance trends among isolates of uropathogens is essential to provide clinically appropriate and cost-effective therapy. Guidelines for the empirical treatment of patients with UTI suggest it is important to consider local resistance patterns of commonly isolated pathogens in selecting the antibiotic agents. This study provides an update on *E. coli*, the main cause of UTI in outpatients. Ampicillin or amoxicillin were once standard therapy for UTI, but resistance of *E. coli* to ampicillin has been on the increase in most regions of the world [22-24].

Table 1: Frequency of isolates in studied population

Microorganism	Renal failure and transplant patients		Outpatients	
	No.	%	No.	%
<i>E. coli</i>	49	72.05	46	67.64
<i>Staphylococcus aureus</i>	5	7.35	3	4.41
<i>Serratia</i>	1	1.47	1	1.47
<i>Enterococcus</i>	3	4.41	4	5.88
<i>Klebsiella</i>	5	7.35	4	5.88
<i>Pseudomonas</i>	5	7.35	7	10.29
<i>Staphylococcus epidermidis</i>	0	0	3	4.41

Table 2: Antibiotic sensitivity pattern of *E. coli* isolates

Antibiotic	Code	Disk (µg)	Group 1		Group 2	
			Resistant (%)	Sensitive (%)	Resistant (%)	Sensitive (%)
Ampicillin	AP	10	87.75	12.24	95.83	4.16
Cotrimaxazole	TS	25	81.63	18.36	60.41	39.58
Tetracycline	T	30	85.71	14.28	54.16	45.83
Nalidixic Acid	NA	30	89.79	10.2	85.41	14.58
Cefuroxime	CXM	30	100	0	91.66	8.3
Ceftriaxone	CRO	30	97.9	2.04	64.58	35.41
Imipenem	IMI	10	20.4	79.59	10.41	89.58
Nitrofurantoin	NI	300	18.36	81.63	6.25	93.75
Amikacin	AK	30	32.65	67.34	25	75
Chloramphenicol	C	30	36.73	63.26	8.3	87.5
Cefixime	CFM	5	85.71	14.28	66.66	33.33
Ceftazidime	CAZ	30	100	0	89.58	10.41
Ciprofloxacin	CIP	5	95	4.08	27.08	72.91
Trimethoprim	TM	5	85.71	14.28	81.25	18.75
Ofloxacin	OFX	30	81.63	18.36	79.16	20.83

The present study demonstrated that the prevalence of ampicillin resistance was 87.75 and 95.83 % for renal failure and transplant patients and outpatients, respectively.

A urine specimen for culture obtained before the initiation of antimicrobial therapy confirms the diagnosis of UTI. The choice of antibiotics depends upon the causative organism and its local expected antibiotic susceptibility pattern. Comparisons of the findings of the present study with those of other recent similar studies indicate similarity.

Findings in this study are similar to those of previous studies for USA [21] and Iran [25]. Reports from developed and developing nations such as Turkey, Senegal, Brazil, Slovenia, Southern India and Australia are also consistent with the present findings [11,26-28].

The lack of sufficient data about bacterial resistance to the antimicrobial agents in developing countries, including Iran, may be responsible for the increasing emergence of multiple-drug resistance (MDR) [29].

CONCLUSION

Findings from this study demonstrate that nitrofurantoin and imipenem can be used as first- and second-line empirical treatments of pathogenic *E. coli* in Tabriz, Iran. However, this recommendation also requires careful and extensive monitoring at healthcare centers to avoid increase in resistance in these bacterial agents.

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