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Determination of antibiotic resistance of *E. coli* isolated from urine culture samples

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Abstract

The high use of antibiotics causes the increasing trend of microbial resistance, followed by the limitation of treatment options, the complexity of the treatment, and the increase in the cost of the healthcare system. In this study, we examined antibiotic resistance of *E. coli* isolated from urine culture samples in Shahid Sadoughi Hospital, Yazd. This cross-sectional study was conducted on urine cultures related to patients hospitalized in different wards of Shahid Sadoughi Hospital in Yazd in 2021. Antibiotic resistance to *E. coli* isolates was investigated in 395 cultures, and the data was analyzed using SPSS software (version 26). The highest antibiotic resistance of *E. coli* was to ampicillin. Resistance to gentamicin was the highest in the surgery ward and the lowest resistance was observed in the women's ward. Also, the resistance to cefepime was the highest in the surgery ward and the lowest resistance rate was related to the emergency ward. The results of the present study showed the high antibiotic resistance of Ecoli isolates in hospitalized patients with urinary tract infection, especially in the population of men and elderly people.

Keywords: *E. coli*, Antibiotic resistance, Urine culture.

INTRODUCTION

Urinary tract infection (UTI) is one of the most common causes of outpatient visits to medical centers, as well as the most common type of hospital infection and the second cause of death due to such infections [1-3]. Although agents such as viruses, fungi and parasites are capable of causing urinary tract infections, these infections are usually caused by bacteria. The most common etiological agents of urinary tract infection are *Enterobacteriaceae* bacteria such as *Escherichia coli* and *Klebsiella* [4].

The basis of appropriate treatment for urinary tract infections is choosing the proper antibiotic with high efficiency and effectiveness. Today, the problem of antibiotic resistance among pathogenic bacteria has become a serious problem, and the prevalence of microbial resistance, especially gram-negative bacteria resistance, is still considered one of the main obstacles to definitive treatment of infectious diseases [5].

Determining the pattern of antibiotic resistance related to common pathogenic bacteria, especially *Escherichia coli*, is important to guide experimental and specific treatments against these bacteria [6,7]. Thus, this study was conducted to evaluate antibiotic resistance of *E.coli* isolates associated with urine cultures in Shahid Sadoughi Hospital, Yazd.

MATERIALS AND METHODS

This cross-sectional study was conducted after approval by the ethics committee on all urine samples of inpatients referred to the laboratory of Shahid Sadoughi Hospital in Yazd, Iran in 2021. The method of determining the number of samples was census.

In this investigation, the urine sample was collected using the clean midstream method and then it was cultured in blood agar and EMB media using a standard loop and placed in a 37 C° incubator for 24 h. To determine the type of bacteria, a slide was prepared, and after determining the morphology, differential media such as TSI, Simon Citrate, SIM, VP-MR, and Urea were used to identify gram-negative bacilli.

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Also, various biochemical tests such as catalase, sensitivity to bacitracin, coagulase, oxidase, etc. were used to determine gram-positive bacteria.

In this study, the antibiotic sensitivity of *E. coli* isolates was evaluated by the disc diffusion method on Mueller Hinton agar and the halo of non-growth was examined based on the recommendation of the National Committee for Clinical Laboratory Standards (NCCLS).

The antibiotic discs included cotrimoxazole (30 µg), gentamicin (10 µg), imipenem (10 µg), piperacillin (10 µg), amikacin (30 µg), cephalothin (30 µg), ceftazidime (30 µg), nitrofurantoin (30 µg), ciprofloxacin (5 µg), cefazolin (30 µg), cefixime (5 µg), azithromycin (15 µg), cefotaxime (30 µg) and ceftriaxone (30 µg).

Data analysis was done by SPSS (version 22).

RESULTS

This study was conducted on 395 cases of positive *E. coli* urine cultures related to patients with UTI admitted to the wards of Shahid Sadoughi Hospital in Yazd.

The age mean of the patients was 40.7 ± 28 years, the minimum age was one month and the maximum age was 96 years.

Out of 395 patients, 84 patients (21.3%) were men and 311 patients (78.7%) were women.

Most patients with UTIs were over 60 years old with 117 cases (29.6%) (Table 1).

Table 1: Patients with UTIs according to age

Age (year)	Number	Percentage (%)
< 1	38	9.6
1-20	72	18.2
21-40	92	23.3
41-60	76	19.2
> 60	117	29.6
Total	395	100

The highest antibiotic resistance was to ampicillin (83.8%) (Table 2).

Table 2: Antibiotic resistance percentage of *E. coli* isolates

Antibiotic	Resistance rate (%)
Ampicillin	83.8
Cefazolin	68.4
Cotrimoxazole	65.1
Cefotaxime	63.3
Ceftriaxone	61.3
Ceftazidime	58.5
Ciprofloxacin	46.1
Cefepime	40
Gentamicin	21.8
Levofloxacin	15.9
Meropenem	12.7
Amikacin	4.3
Nitrofurantoin	3.3
Imipenem	3

The percentage of resistance to cefazolin, ceftazidime, gentamicin, cefepime, ciprofloxacin and amikacin was significantly higher in men than in women (Table 3).

Table 3: Antibiotic resistance percentage based on gender

Antibiotic	Antibiotic resistance percentage (%)		P value
	Male	**Female**	
Ampicillin	88.6	82.1	0.228
Cefazolin	77.4	65.9	0.045
Cefotaxime	71.4	61.5	0.093
Ceftazidime	67.9	55.9	0.049
Ceftriaxone	70.2	58.8	0.057
Cotrimoxazole	72.6	63	0.102
Gentamicin	34.5	18.3	0.001
Cefepime	54.8	31.6	0.002
Ciprofloxacin	57.1	43.1	0.022
Levofloxacin	21.7	14.5	0.111
Meropenem	20.2	10.6	0.019
Nitrofurantoin	6	2.6	0.123
Amikacin	8.3	2.3	0.040
Imipenem	6	2.3	0.079

The resistance to gentamicin was the highest in the surgery ward and significantly the lowest in the women's ward (Table 4).

DISCUSSION

In the current study, the highest resistance was to ampicillin. The rate of resistance to gentamicin was significantly higher in men. The resistance to gentamicin was the lowest in the women's ward and the highest resistance was related to the surgery ward.

In a study conducted in Spain, E. coli isolates had significant rates of resistance to antibiotics including nalidixic acid, ciprofloxacin, and gentamicin, respectively [8].

A study used The Surveillance Network to analyze in vitro antibiotic resistance information from Escherichia coli isolates isolated from urine samples of U.S. outpatients during 2000-2010. Ciprofloxacin exhibited the biggest enhancement in *E. coli* resistance, while nitrofurantoin indicated the least rate of change [9].

In another study, Escherichia coli urine isolates from patients who visited the emergency room at a tertiary care hospital in Germany were evaluated to identify patient danger agents for resistance to antibiotics and antibiotic resistance patterns. Resistance amounts of UTI in indicative cases were: cotrimoxazole (15%), ciprofloxacin (almost 11%), and finally amoxicillin/clavulanic acid (almost 6%) [10].

Escherichia coli antibiotic resistance was examined in human urine samples from patients with UTIs at a Hospital in Lahore, Pakistan. Very high levels of resistance were found to augmentin and gentamicin, while imipenem and tazocin showed the lowest levels of resistance among bacteria [11].

CONCLUSION

In this study, imipenem, nitrofurantoin and amikacin were the treatment options with minimal resistance, but it is necessary to conduct future studies with a larger number of samples to prevent the spread of resistance to the treatment.

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Table 4: Antibiotic resistance percentage based on wards

Antibiotic	Ward (%)								P value
	Pediatric	**Emergency**	**Neurology**	**Internal**	**Women**	**Heart**	**Infectious Diseases**	**Surgery**	
Ampicillin	88.1	84.2	100	82.4	76.5	90	88.6	83.3	0.196
Cefazolin	65.5	73.7	68.4	76.9	55.9	80	74.3	77.8	0.062
Cefotaxime	60.2	78.9	63.2	70.4	51.5	80	65.7	77.8	0.057
Ceftazidime	58.3	63.2	57.9	64.8	45.1	80	62.9	72.2	0.071
Ceftriaxone	59.5	73.3	63.2	68.5	48	80	62.9	72.2	0.057
Cotrimoxazole	65.5	57.9	68.4	70.4	55.9	70	65.7	83.3	0.298
Gentamicin	14.3	26.3	26.3	31.5	8.8	30	28.6	44.4	0.000
Cefepime	36.1	21.1	47.4	49.1	28.4	60	45.7	61.1	0.009
Ciprofloxacin	31	57.9	47.4	60.2	31.4	60	60	66.7	0.000
Levofloxacin	9.6	31.6	10.5	26.9	12.7	10	5.7	11.1	0.006
Meropenem	16.7	15.8	26.3	12.1	8.8	20	2.9	16.7	0.203
Nitrofurantoin	6	0	0	4.6	0	20	0	5.6	0.014
Amikacin	4.8	5.3	0	5.6	1	0	5.7	16.7	0.123
Imipenem	2.4	0	0	4.6	2	10	2.9	5.6	0.699

Conflicts of interest

None declared.

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