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Research Article

Antimicrobial Resistance of Urinary *Escherichia coli* Isolates

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Abstract

Purpose: *To investigate the antimicrobial resistance rate of 110 E. coli strains, isolated from UTIs in Etlik Lokman Hekim Hospital, Etlik, Ankara, Turkey.*
Methods: *API-20E System (bioMerieux, France) was used to identify E. coli isolates. Antimicrobial susceptibility testing was conducted on Mueller-Hinton Agar plates (Merck, Germany) using agar disc diffusion method and the results were expressed as susceptible or resistant according to the criteria recommended by the Clinical and Laboratory Standarts Institute (CLSI).*
Results: *The resistance rates detected were 56 % to ampicillin, 24 % to ampicillin sulbactam, 9 % to gentamicin, 15 % to ciprofloxacin, 36 % to trimethoprim sulfamethoxazole, 12 % to cefazolin, and 7 % to cefuroxime. All isolates tested were susceptible to fosfomycin and nitrofurantoin.*
Conclusion: *When the high resistance rates in Turkey are taken into consideration, antimicrobial agent usage policies and empirical therapies should be based on antimicrobial resistance surveillance studies.*

Keywords: *Urinary tract infections, Escherichia coli, Antimicrobial resistance*

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INTRODUCTION

The increasing prevalence of antibiotic resistance is a major health problem worldwide. The World Health Organization (WHO) and the European Commision (EC) have recognized the importance of studying the emergence and determinants of resistance and the need for strategies for its control [1].

Urinary tract infection (UTI) is a common community-acquired bacterial disease which frequently affects female outpatients. *Escherichia coli*, the most common member of the family Enterobacteriaceae, accounts for 75 - 90 % of all UTIs in both inpatients and outpatients [2]. Increasing rates of resistance among bacterial uropathogens has caused growing concern in both developed and developing countries. A rise in bacterial resistance to antibiotics complicates treatment of infections. In general, up to 95 % of cases with severe symptoms are treated without bacteriological investigation. Also, appropriate antibiotic treatment may vary according to the patient's age, sex and the infecting agent [2,3].

In this study, the objective was to investigate the antimicrobial resistance rates of 110 *E. coli* strains, isolated from the urine cultures of patients with UTI in Etlik Lokman Hekim Hospital, Etlik, Ankara, Turkey.

EXPERIMENTAL

Bacterial strains

A total of 110 *E.coli* strains isolated from urine cultures processed between September 2008 and April 2009 in Etlik Lokman Hekim Hospital, Etlik, Ankara, Turkey were included in the study. Identification of bacterial strain was performed by classical identification methods and API 20 E System (bioMerieux, France).

Antimicrobial susceptibility testing

Antimicrobial susceptibility testing was conducted on Mueller Hinton Agar (MHA) plates (Merck, Germany) by agar disc diffusion method. Each strain was inoculated in Mueller Hinton Broth (Merck, Germany), and after 24 h of incubation at 37 ºC, they were streaked using sterile swabs on MHA plates. The plates were kept at room temperature for 10 min and then the standard antimicrobial discs were placed on the inoculated MHA plates and incubated for 24 h at 37 ºC. The following standard antimicrobial discs were tested: ampicillin, ampicillin sulbactam, gentamicin, ciprofloxacin, nitrofurantoin, trimethoprim sulfamethoxazole, cefazolin, fosfomycin and cefuroxime. The results were expressed as susceptible or resistant according to the criteria recommended by CLSI guidelines [4].

Statistical analysis

Statistical analysis for probability was carried out with Minitab 14.0 program that incorporates 2P application [Minitab Inc., USA]. Z-Test was employed to determine the existence of significant differences between data ($p \leq 0.05$).

RESULTS

Resistance of urinary isolates to antimicrobials is shown in Tables 1 and 2. The resistance rates detected were 56% to ampicillin, 24% to ampicillin sulbactam, 9% to gentamicin, 15% to ciprofloxacin, 36% to trimethoprim sulfamethoxazole, 12% to cefazolin, 7% to cefuroxime. All isolates tested were susceptible to fosfomycin and nitrofurantoin. The difference observed between the resistance to ampicillin and trimethoprim/sulfamethoxazole were statistic-cally significant ($p \leq 0.05$) but there was no statistically significant difference in resistance between the following: ampicillin sulbactam/ ciprofloxacin and cefazolin; ciprofloxacin/ cefazolin, gentamicin and cefuroxime; cefazolin/gentamicin and cefuroxime;

Table 1: Resistance of urinary *E.coli* isolates to antimicrobials (%).

Bacteria	AMP	SAM	GM	CIP	TMP-SXT	CZ	CXM	FOS	NIT
E. coli	56	24	9	15	36	12	7	0	0

***AMP** = ampicillin; **SAM** = ampicillin sulbactam; **GM** = gentamicin; **CIP** = ciprofloxacin; **FOS** = fosfomycin; **TMP-SXT** = trimethoprim sulfametoxazole; **CZ** = cefazolin; **CXM** = cefuroxime; **NIT** = nitrofurantoin*

Table 2: Resistance of urinary *E.coli* isolates to antimicrobials in Turkey (%)

Studies	Rate of resistance (%)								
	AMP	SAM	GM	CIP	TMP-SXT	CZ	CXM	FOS	NIT
Köse et al [3] (Rize)	-	-	10	8	53	-	-	-	-
Arıkan Akan [10] (Ankara)2001/2002	67.7/ 68.8	-	-	26.1/ 33.1	51/ 44	-	-	-	-
Göker et al [11] (İstanbul)	71	48	-	-	-	-	-	0	3
Çetin et al [12] (Isparta)	79	63.2	6.6	-	-	-	21.9	-	-
Sayın Kutlu and Kutlu [8] (Didim)	-	-	26.7	14.2	37.5	37.5	-	-	25
Yıldırım et al [13] (Düzce)	-	-	-	10.8	48.8	-	-	-	-
Kalem et al [14] (Konya)	78.1	48.3	27.5	37.6	55.6	-	30.3	-	15.2

***AMP** = ampicillin; **SAM** = ampicillin sulbactam; **GM** = gentamicin; **CIP** = ciprofloxacin; **FOS** = fosfomycin; **TMP-SXT** = trimethoprim sulfametoxazole; **CZ** = cefazolin; **CXM** = cefuroxime; **NIT** = nitrofurantoin; - = unapplied in the study*

Table 3: *p* values of antimicrobials ($p \leq 0,05$ values are significant)

	TMP-SXT	SAM	CIP	CZ	GM	CXM	NIT	FOS
AMP	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000
TMP-SXT		0.038	0.000	0.000	0.000	0.000	0.000	0.000
SAM			0.124	0.020	0.003	0.001	0.000	0.000
CIP				0.431	0.148	0.054	0.000	0.000
CZ					0.508	0.250	0.000	0.000
GM						0.623	0.001	0.001
CXM							0.007	0.007
NIT								1.000

***AMP** = ampicillin; **SAM** = ampicillin sulbactam; **GM** = gentamicin; **CIP** = ciprofloxacin; **FOS** = fosfomycin; **TMP-SXT** = trimethoprim sulfametoxazole; **CZ** = cefazolin; **CXM** = cefuroxime; **NIT** = nitrofurantoin*

gentamicin/cefuroxime, cefuroxime/fosfomycin, nitrofurantoin and nitrofurantoin/fosfomycin ($p > 0.05$) (Table 3).

DISCUSSION

The antimicrobial resistance of bacteria is a problem of global concern. There is a correlation between antibiotic use and subsequent resistance [5]. Antibacterial consumption is increasing in many countries around the world, and it is increasingly recognized as the main reason for the emergence of resistance [6].

The majority of UTIs are treated empirically especially in developing countries where patients often can not afford to consult a physician or to conduct laboratory analysis [2]. The high prevalence of antimicrobial resistance among UTI *E. coli* isolates emphasizes the necessity to review empirical therapies [7]. Empirical therapy should be based on local antimicrobial resistance monitoring in order to prevent increase in resistance to drugs used in the treatment of UTIs [8]. A North American UTI Collaborative Alliance study determined the susceptibility of antibiotics commonly used for the treatment of UTIs, to *E. coli* urinary isolates obtained from outpatients in various geographic regions in the USA and Canada. Overall, resistance to ampicillin was 37.7%, followed by trimethoprim/sulfamethoxazole 21.3%, nitrofurantoin 1.1% and ciprofloxacin 5.5% [9]. The resistance rates (except for nitrofurantoin) found in our study were higher than those in the North American study.

In a study conducted in Senegal, the resistance rates reported were: trimethoprim/sulfamethoxazole 67.8%; and ampicillin 73.6% [2]. These resistance rates were higher than those obtained in the present work. The higher values found in these other studies can be explained by widespread, frequent and uncontrolled use of antimicrobials.

The resistance rates found in studies performed in Turkey are given in Table 2. In one of them, Arıkan Akan [10], which compared resistance rates between 2001 and 2002, the results indicate that empirical treatment should be avoided and that antimicrobial chemotherapy should be based on the result of *in vitro* antimicrobial susceptibility tests [10].

The increasing resistance of ampicillin and trimethoprim sulfamethoxazole to *E. coli* has been reported in other studies from Turkey and other countries [15-19]. They were higher than the rates reported in our study. This could be attributed to the different antimicrobial agent use policies of the various centers involved in the studies, more frequent use of antimicrobials by the patients and easier access to antimicrobials without prescription. On the basis of our findings, antimicrobials such as ampicillin and trimethoprim/sulfamethoxazole should no longer be recommended for initial empirical therapies for UTIs. Furthermore, as result of the high resistance rates, trimethoprim/sulfamethoxazole, ampicillin and ampicillin sulbactam do not seem to be appropriate for the empirical treatment of community-acquired UTIs.

Gentamicin, ciprofloxacin, cefazolin and cefuroxime may be considered as alternative therapies but before such a decision, the antimicrobial susceptibilities of the pathogens causing the UTIs should be investigated and necessary precautions taken against resistance development. Fosfomycin and nitrofurantoin were found to be the most effective antimicrobials. As a result, nitrofurantoin and fosfomycin are recommended for empirical therapy of UTIs.

Since the susceptibility of uropathogenic E.coli strains to antimicrobials has been gradually increasing, it is imperative that prior to deciding on antimicrobial therapy, the antimicrobial susceptibilities of the pathogens causing the UTI should be investigated in order to minimise resistance development.

CONCLUSION

It is hereby recommended that in view of the high resistance rates to antimicrobial agents used in UTI therapy in Turkey, antimicrobial agent usage policies, especially empirical therapies, should be based on antimicrobial resistance surveillance studies.

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