

## Resistance of *Escherichia Coli* to $\beta$ -Lactams

P. Papaioannidou<sup>1</sup>, V. Hatsiou<sup>2</sup>, E. Fotiadou-Pavlidou<sup>2</sup>, A. Goulas<sup>1</sup>  
and V. Mirtsou-Fidani<sup>1</sup>

<sup>1</sup>Laboratory of Pharmacology, Medical Department, Aristotelian University, Thessaloniki,  
and <sup>2</sup>Laboratory of Microbiology, General Hospital, Kilkis, Greece

### INTRODUCTION

Beta-lactams are the most commonly used antibiotics today. Their low toxicity, their extended spectrum of activity and the development of new orally administered agents make them the antibiotics of first choice for the treatment of most usual infections. *Escherichia coli* is one of the most frequent microorganisms that are isolated from microbial cultures. In fact, it represents the majority of the bacteria isolated from urine cultures. *E. coli* is usually sensitive to most antibiotics. Nevertheless, it is advisable to test antibiotic susceptibility of microbial strains that are isolated from urine cultures and, of course it is necessary to perform antibiograms for strains isolated from other serious infections. The purpose of the present study was to assess susceptibility of *E. coli* clinical strains to a variety of commonly used  $\beta$ -lactam antibiotics.

### MATERIALS AND METHODS

3750 microbial samples, 87% of which were urine cultures, were tested. 638 samples (17%) were found positive after culture. 374 strains of *E. coli* were isolated (66% from outpatient and 34% from internal patient culture samples). The isolated strains of *E. coli* were identified using the API 20 method. The Kirby-Bauer method was used for testing antibiotic susceptibility. The following  $\beta$ -lactam antibiotics were tested: ampicillin/sulbactam, amoxicillin/clavulanic acid, cefaclor, cefuroxime, cefprozil, cefoxitin, cefotaxime, cefepime, loracarbef, imipenem.

### RESULTS

The majority of the examined strains were sensitive to  $\beta$ -lactam antibiotics (resistance higher than 5% was observed only with two antibiotics) but resistance/moderate resistance (higher than 5%) was developed in 7 of the 15 antibiotics tested. The percentage of resistant strains ranged from 0.2% (for cefotaxime) to 5.3% (for cefaclor and cefprozil). The highest percentage of resistant strains was observed with cefaclor (5.3%), cefprozil (5.3%) and loracarbef (4.8%). Moderate resistance was observed in percentages ranging from less than 1% (for imipenem, cefotaxime and cefepime) to 8.5% (for ampicillin/sulbactam). Resistance/moderate resistance was observed in percentages ranging from 1% (for imipenem and cefotaxime) to 12.5% (for ampicillin/sulbactam). The highest percentage of resistance/moderate resistance was observed with ampicillin/sulbactam (12.5%), amoxicillin/clavulanate (10.9%) and cefprozil (10.1%). The percentage of sensitive strains ranged from 99% (for cefotaxime and imipenem) to 87.5% (for ampicillin/sulbactam). Detailed results are presented in Table 1.

### DISCUSSION

*Escherichia coli*, which represents the majority of the bacteria isolated from urine cultures, is usually sensitive to most antibiotics. We decided to study the development of resistance to  $\beta$ -lactams, as the latter - although not the antibiotics of first choice for the treatment of *E. coli* infections - are the most frequently used antibiotics generally.

The percentage of *E. coli* clinical strains that were sensitive to  $\beta$ -lactams was generally good: resistance higher than 5% was observed only with two antibiotics. But resistance/moderate resistance (higher than 5%) was developed with 7 of the 15 antibiotics tested and with three antibiotics the percentage of resistant / moderate resistance was higher than 10%. As it was expected, the best results (susceptibility higher than 98%) were obtained with imipenem and with the third and fourth generation cephalosporins cefotaxime and cefepime and the highest percentage of resistance (susceptibility less than 90%) was observed with the aminopenicillins ampicillin/sulbactam and amoxicillin/clavulanic acid. To our surprise, cefprozil and loracarbef, which are two of the newest orally administered cephalosporins, were proved to be among the antibiotics with the highest resistance, similar to that of cefaclor. This seemed to be rather strange, as resistance develops in course of time and in relation to usage. A thorough search in the Departments of Internal Medicine and Pediatrics revealed that there was an overuse of cefprozil and loracarbef in these Clinics. After our consultation, we hope that this phenomenon will subside soon in future.

#### CONCLUSIONS

The susceptibility of *E. coli* to  $\beta$ -lactam antibiotics was generally good: the highest percentage

of resistance - met with only two antibiotics - was around 5% and the general sensitivity was higher than 87%. It is interesting that cefprozil and loracarbef, which are two of the newest orally administered cephalosporins, are among the antibiotics with the highest resistance, which is due to their overuse.

Table 1  
Resistance and Moderate Resistance of *E. coli* to  $\beta$ -lactams

Antibiotic	Resistance (%)	Moderate Resistance (%)	Resistance/Moderate Resistance (%)
Ampicillin/Sulb.	4.0	8.5	12.5
Amoxicillin/Clav.	3.7	7.2	10.9
Cefaclor	5.3	3.5	8.8
Cefuroxime	2.8	4.7	7.5
Cefprozil	5.3	4.8	10.1
Cefoxitin	4.0	2.1	6.1
Cefotaxime	0.2	0.8	1.0
Cefepime	1.0	0.8	1.8
Loracarbef	4.8	2.4	7.2
Imipenem	0.8	0.2	1.0

#### REFERENCES

1. Davies J.: Inactivation of antibiotics and the dissemination of resistant genes. *Science* 264: 375-378 (1994)
2. Emori T.G., et al. : National Nosocomial Infections Surveillance (NNIS) System: description of surveillance methodology. *Am. J. Infect. Control.* 19: 19-35 (1991)