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Ciprofloxacin Resistance in Clinical Isolates of *Pseudomonas aeruginosa* from Italian Patients

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Pseudomonas aeruginosa is an important cause of nosocomial infections, ranking as the foremost pathogen in lower respiratory tract infections, the third most common in surgical wound infections, and the fifth most frequent cause of urinary tract infections.[1]

Acylureido-penicillins, some third generation cephalosporins, aminoglycosides, imipenem, and aztreonam are the drugs of choice in the therapy of *P. aeruginosa* infections, all administered by the parenteral route.[2]

In the first *in vitro* studies, ciprofloxacin showed a broad antibacterial spectrum of action and, particularly, good efficacy against *P. aeruginosa*, as evidenced by minimum inhibitory concentrations (MICs) $\leq$ 0.5 mg/L.[3,4] Because of its activity, oral administration, low toxicity, and good compliance, ciprofloxacin began to be successfully used in the therapy of many infections caused by *P. aeruginosa*.[5,6]

Unfortunately, there have been reports of decreased efficacy of ciprofloxacin against this pathogen: early studies evidenced a rise in MIC values from 0.06 to 0.5 mg/L before treatment to 2 to 8 mg/L during or after therapy.[7-9] Subsequent researchers confirmed these findings.[10,11]

We performed this study to evaluate the frequency of ciprofloxacin resistance in nosocomial strains of *P. aeruginosa* isolated from different body sites of patients in the city of Florence during a 2-year period.

From 1 February 1990 to 31 January 1992 we isolated 505 *P. aeruginosa* strains: 111 from urine cultures containing $\geq$ 100 000 bacteria/ml of a single species, 138 from cultures of skin lesions, 51 from blood cultures, and 205 from cultures of bronchial secretions. Both identification and *in vitro* susceptibility of the isolates were determined by an automated method (VITEK®).

MIC breakpoints for ciprofloxacin were consid-

Table I. Ciprofloxacin resistance in clinical isolates of *Pseudomonas aeruginosa* on the basis of the site of isolation

Body site (no. of isolates)	No. susceptible (%)	No. intermediate (%)	No. resistant (%)
Urinary tract (111)	81 (73.0)	4 (3.6)	26 (23.4)
Skin (138)	110 (79.7)	6 (4.4)	22 (15.9)
Bloodstream (51)	46 (90.2)	1 (2.0)	4 (7.8)
Lower respiratory tract (205)	187 (91.2)	4 (2.0)	14 (6.8)
Total (505)	**424 (84.0)**	**15 (3.0)**	**66 (13.0)**

ered to be ≤ 1 mg/L for susceptibility, 2 mg/L for intermediate susceptibility and ≥ 4 mg/L for resistance. Results are shown in table I.

Our data with regard to the overall ciprofloxacin resistance of *P. aeruginosa*, i.e. 13%, are in agreement with the most recent trends cited in the literature. A decrease in the ciprofloxacin susceptibility of *P. aeruginosa* from 98.6% in 1985/6 to 86.3% in 1989 was noted;[10] in Italy, a similar trend was recently observed, with ciprofloxacin resistance increasing from 3.2% in 1987/8 to 14% in 1992/3.[11] Because of these results, ciprofloxacin may still be considered one of the drugs of choice in the therapy of infections caused by *P. aeruginosa*, and the only effective antipseudomonal oral agent.

In contrast to other authors, who suggested that ciprofloxacin resistance might emerge only infrequently in isolates from the urine,[9,12] we found more resistant strains in the urinary tract than in the other body sites, probably reflecting inadequate dosage or local risk factors (presence of renal calculi, chronicity of infection, complicated anatomical anomalies, urinary catheters, sequestered infection).[13]

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