Prevalence of bla_{PER-1} in ESBL-producing Clinical Isolates of *Pseudomonas aeruginosa* in the ICUs of Several Iranian Hospitals

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Dear Editor,

Pseudomonas aeruginosa strains are resistant to most first- and second-generation cephalosporins, but these isolates are susceptible to third-generation cephalosporins, such as cefsulodin and ceftazidime, as nontoxic alternatives to aminoglycosides. However, resistance to beta-lactams occurs via plasmid or chromosomal beta-lactamases, which hydrolyze their active ring (1, 2). PER-1 is a class A enzyme that is related to a high level of resistance to cephems, monobactams, and ceftazidime (3, 4). Several previous studies have demonstrated that bla_{PER-1} is widespread in Turkey and has been detected in nearly 50% of extended-spectrum beta-lactamase (ESBL)-positive burn isolates in Iran (5). Previous studies have demonstrated that PER-1-positive isolates had high levels of resistance to penicillin, ceftazidime, and ceftriaxone antibiotics (6, 7). The aim of this study was to detect the prevalence of the bla_{PER-1} gene in several hospitals in the Iranian cities of Tehran, Shiraz, Kermanshah, Ilam, Kerman, and Ahvaz.

A total of 85 clinical isolates of *P. aeruginosa* were collected from patients in the intensive care units (ICUs) of hospitals in Tehran (Motahari and Pediatrics Center), Shiraz (Namazi), Kermanshah (Imam), Ilam (Imam Khomeini), Kerman (Ba Honar), and Ahvaz (Taleghani and Golestan). Antibiotic susceptibility testing was conducted based on the Kirby-Bauer method and according to the Clinical and Laboratory Standards Institute (CLSI 2012) guidelines. *P. aeruginosa* ATCC27853 was used as the control strain. SPSS version 16 and Excel software were used in this study. Student's t-test was used for the analysis of results. P values of < 0.05 (CI = 0.95%) were considered to have statistical significance.

The majority of the isolates came from Tehran and Shiraz, and most were from urine and lung infections. The frequency of isolates among men and women was not significantly different.

While imipenem and meropenem were the most effective drugs, resistance to cefpodoxime was 94.1%. The comparison of the antibiotic susceptibility profiles of ESBL-positive and -negative isolates is shown in Table 1. The ESBL-positive isolates were resistant to the majority of antibiotics tested, especially third-generation cephalosporins. The majority of urine isolates were resistant to all antibiotics, mainly due to the kidney route of drug elimination. The resistance rates to ceftazidime and ceftriaxone were 89% and 88%, respectively. Thirty (35.3%) isolates were ESBL-positive *P. aeruginosa*. The drug resistance of the ESBL-producing isolates to the tested antibiotics was higher than that of the ESBL-negative isolates. The majority of ESBL-positive isolates of *P. aeruginosa* were from urine samples.

Table 1. Differences in Antibiotic Resistance Between ESBL-positive and ESBL-negative Isolates *P. aeruginosa*

Disks/Isolates	ESBL-Positive (%), n = 30	ESBL-Negative (%), n = 55
CPM	96	53
CAZ	89	63
IMI	22	17
MEM	23	18
CIP	89	65
OFX	78	44
TN	82	42
GEN	68	46

Abbreviations: CAZ, ceftazidime; CIP, ciprofloxacin; CPM, cefepime; GEN, gentamicin; IMI, imipenem; MEM, meropenem; OFX, ofloxacin; TN, tobramycin.

The prevalence of bla_{PER-1} was 30% (n = 9) in the ESBL-positive isolates. Among these nine isolates, four, three, and two bla_{PER-1}-positive isolates were from Tehran, Shiraz and Ahvaz, respectively.

The ESBL-positive isolates had a higher rate of drug resistance. The resistance rates to ceftazidime and ceftriaxone were 63% and 64%, respectively. Urine isolates harbored a significantly higher rate of the bla_{PER-1} gene among the different clinical sites. Furthermore, the isolates with resistance to all of the third-generation cephalosporins harbored a higher prevalence of the bla_{PER-1} beta-lactamase. Data on the prevalence of the bla_{PER-1} gene in the Middle East are limited. In Japoni's survey, in Shiraz, ESBLs were detected in only three (4.3%) isolates (8). In a previous study, the prevalence of bla_{VEB-1} was 40% in these isolates (9).

Approximately one-third of the isolates in the present study were ESBL-positive. The cities of Tehran, Shiraz, and Ahvaz demonstrated more ESBL isolates of *P. aeruginosa*, and the isolates from these cities amplified bla_{PER-1}. Moreover, nearly one-third of the ESBL producers amplified the bla_{PER-1} gene.

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Footnotes

Authors' Contribution: Abdolmajid Ghasemian and Farshad Nojoomi designed and guided the study, with the help of other authors.

Conflicts of Interest: There are no conflicts of interest to declare.

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