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Resistance phenotypes and susceptibility of contemporary Serratia isolates in a university hospital in Crete, Greece

George Samonis[1], Konstantinos Vardakas[2], Sofia Maraki*[3], Petroula Stamouli[4], Victoria Eirini Mavromanolaki[5], Diamantis Kofteridis[6], Matthew E. Falagas[2]

[1]*University Hospital of Heraklion; Internal Medicine-Infectious Diseases*

[2]*Alfa Institute of Biomedical Sciences (Aibs)*

[3]*University Hospital of Heraklion; Department of Clinical Microbiology*

[4]*National Technical University of Athens; Department of Applied Mathematics and Physics*

[5]*University of Crete Medical School*

[6]*University Hospital of Heraklion; Internal Medicine - Infectious Diseases Unit*

Background: *Serratia* spp. account for a significant proportion of Gram negative infections in intensive care unit (ICU) and, to a lesser extent, non-ICU patients, but also an increasingly recognized cause of community-acquired infections. The emergence of multi-drug resistant (MDR) strains intensified the interest in *Serratia* spp. infections. In this study we sought to evaluate the activity of several antibiotics against clinical isolates of *Serratia* spp., resistance rates in time and phenotypic mechanisms of resistance.

Material/methods: *Serratia* spp. isolated from outpatients and inpatients at the University Hospital of Heraklion, Crete, Greece during a six year period (2010-2015) were included in the study. Non-duplicate isolates from intensive care unit (ICU) and non-ICU patients were studied using automated systems (Advanced Expert System in conjunction with the VITEK 2). Phenotypic confirmatory tests were applied for detection of extended-spectrum beta-lactamases (ESBLs), AmpCs and carbapenemases.

Results: A total of 378 *Serratia* spp. isolates were analyzed. *S. marcescens* (88.3%) was the predominant species; *S. liquefaciens* (22), *S. fonticola* (12), *S. rubidaea* (5), *S. odorifera* (2) and *S. plymuthica* (1) were the remaining isolates. Bronchial secretions (105, 27.8%) was the commonest cultured specimen, followed by ophthalmic secretions (63, 16.7%), pus (61, 16.1%), and urine (57, 15.1%). Fluoroquinolones (97.9%), carbapenems (97.4%) and fosfomycin (97.4%) were the most active followed by amikacin (95.5%), piperacillin/tazobactam (94.7%), and trimethoprim/sulfamethoxazole (94.4%). MDR strains were less susceptible to a number of antibiotics (table 1). The activity of 3rd and 4th generation cephalosporins was 87%-88.6%. *S. marcescens* were less susceptible than non-marcescens species to cephalosporins, carbapenems, aztreonam, gentamicin, and tigecycline and more susceptible to fluoroquinolones. Changes in the susceptibility rate were observed within years depending on the distribution of MDR strains, without specific trend towards decreasing susceptibility. ESBL (7.9%, 29/30 MDR, all resistant to aztreonam and cephalosporins), carbapenemase (2.9%, 7 KPC and 4 MBL), AmpC (2.1%) and aminoglycoside modifying enzyme (10.6%, AAC(3)-II in 24 isolates) production were the commonest resistant phenotypes.

Conclusions: Susceptibility of *Serratia* spp. varied during the study period without evidence of a continuous decline.

Table 1. Susceptibility and MICs for selected antibiotics for susceptible, MDR and XDR *Serratia* spp. isolated from clinical specimens during the period 2010-2015 in the University Hospital of Heraklion, Crete, Greece.

	S, N=189				MDR, N=186				XDR, N=3		*p* value
Antibiotic	% susceptible	MIC RANGE (mg/L)	MIC_{50} (mg/L)	MIC_{90} (mg/L)	% susceptible	MIC RANGE (mg/L)	MIC_{50} (mg/L)	MIC_{90} (mg/L)	% susceptible	MIC RANGE (mg/L)	S vs MDR
piperacillin/ tazobactam	100	<4 - 16	≤4	<4	90.9	≤4 - >128	≤4	16	0.0	64 - >128	<0,01
cefoxitin	67.2	≤4 - >64	8	16	23.7	≤4 - >64	16	>64	0.0	>64	<0,01
ceftriaxone	100	≤1	≤1	≤1	75.3	≤1 - >64	≤1	16	0.0	16 - >64	<0,01
imipenem	100	≤0,25 - 1	1	1	95.7	≤0,25 - >16	1	1	0.0	4 - >16	0,129
aztreonam	100	≤1	≤1	≤1	74.7	≤1 - >64	≤1	16	0.0	16 - >16	<0,001
ciprofloxacin	100	≤0,25 - 1	≤0,25	≤0,25	96.8	≤0,25 - >4	≤0,25	≤0,25	33.3	1 - >4	0,66
amikacin	100	≤1 - 4	2	2	92.5	≤2 - >64	≤2	16	0.0	32 - >64	<0,01
gentamicin	100	≤1	≤1	≤1	82.8	≤1 - >16	≤1	>16	66.7	2 - >16	0,01
tigecycline	99.5	≤0,5 - 4	1	2	76.3	≤0,5 - >8	2	4	0.0	>8	<0,01
trimethoprim/ sulfamethoxazole	99.5	≤2 - >4	≤2	≤2	89.8	≤2 - >4	≤2	≤2	66.7	≤2 - >4	0,49
fosfomycin	98.4	4 - >1024	16	48	96.2	4 - 512	16	48	100	4 - 16	0,98

Abbreviations: S susceptible, MDR multi-drug resistant, XDR extensively drug resistant, MIC minimum inhibitory concentration