Antimicrobial Susceptibility Profile of Pseudomonas aeruginosa Isolates in Egypt

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Purpose: Pseudomonas aeruginosa is a leading cause of nosocomial respiratory tract, urinary tract and skin infections. Data are sparse on the antimicrobial resistance of P. aeruginosa in Egypt. We sought to detect and compare the antimicrobial susceptibility of P. aeruginosa isolates from respiratory tract, urinary tract and skin infections at 3 Egyptian hospitals.
Materials and Methods: Minimum inhibitory concentrations of antibiotics were determined by the agar dilution method.
Results: P. aeruginosa respiratory tract infections isolates were 100% resistant to ampicillin, ampicillin/sulbactam, amoxicillin, amoxicillin/clavulanate and chloramphenicol, highly resistant to cefuroxime (89%), tetracycline (89%) and azithromycin (84%), and susceptible to norfloxacin (89%), amikacin (84%) and meropenem (68%). P. aeruginosa urinary tract infection isolates were 100% resistant to ampicillin, amoxicillin, chloramphenicol, cefuroxime and tetracycline, highly resistant to amoxicillin/clavulanate (95%), azithromycin (95%), cefalexin (91%) and ampicillin/sulbactam (82%), and susceptible to amikacin (82%), meropenem (73%) and norfloxacin (64%). P. aeruginosa skin infection isolates were 100% resistant to ampicillin and amoxicillin, highly resistant to tetracycline (95%), amoxicillin/clavulanate (95%), cefalexin (87%) and azithromycin (84%), and susceptible to amikacin (87%), norfloxacin (71%) and meropenem (68%). The anti-pseudomonal effect of antibiotics varied among different infection sites only for ampicillin/sulbactam, cefoperazone or chloramphenicol but not with the other tested antibiotics.
Conclusions: Norfloxacin and amikacin could be used for initial therapy for P. aeruginosa mediated respiratory tract infections. Amikacin, meropenem and norfloxacin could be used for P. aeruginosa mediated urinary tract and skin infections. Such studies are essential to determine the current guidelines for empirical therapy regimens, which vary by location, and help with the establishment of effective infection control measures.

Key Words: urinary tract infections; drug resistance, microbial; Pseudomonas aeruginosa; cross infection; infection control

Pseudomonas aeruginosa is one of the main causes of nosocomial infections. As an opportunistic human pathogen, P. aeruginosa is a frequent cause of RTIs, UTIs and SIs, especially in patients in intensive care units.[1] Physicians must use empirical antibiotic treatment initially for Pseudomonas infections. However, such treatment can be targeted if clinicians establish the nature of a particular Pseudomonas infection and know the susceptibility patterns of Pseudomonas at the hospitals where they work. Susceptibility testing should be done when patients are seriously ill, do not respond to therapy or require prolonged therapy. It is also important when there are sparse data available on a particular microorganism, or when the organism is frequently resistant, as in the case of P. aeruginosa.[2] Thus, it is essential to perform periodic surveys of the susceptibility patterns of clinical isolates of P. aeruginosa to develop rational antimicrobial therapy recommendations.

The control of these nosocomial P. aeruginosa infections necessitates the detection of susceptibility pattern of clinical isolates from different infection sites to different classes of antibiotics. Data on antimicrobial resistance in Egypt are sparse, especially for P. aeruginosa strains. Thus, we sought to detect the antimicrobial susceptibility of clinical P. aeruginosa isolates from RTIs, UTIs and SIs at hospitals in Egypt. Moreover, the antimicrobial susceptibility of P. aeruginosa isolates from different infection sites to antibiotics was compared to determine whether the anti-pseudomonal effect of antibiotics varies among different infection sites.

MATERIALS AND METHODS

Sample Collection

A total of 100 urine samples from patients with UTI, 170 from patients with SI (wound, abscess and burn exudates) and 130 from patients with RTI (sputum and purulent ear discharge) were collected at Minia University Hospital, Minia General Hospital and Minia Chest Hospital in Egypt. All samples were examined for P. aeruginosa by standard procedures and by polymerase chain reaction, as described previously.[3,4] Thus, nonduplicated isolates (1 isolate per patient) positive for P. aeruginosa were included in susceptibility and MIC testing, including 22 positive isolates from UTI, 19 from RTI and 38 from SI. Nosocomial infection by P. aeruginosa was defined as infection with the typical signs and symptoms of P. aeruginosa infection, provided that P.

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Study received ethical approval from the hospital management boards, and the Egyptian Ministry of Health and Population.
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TABLE 1. *MICs of different antibiotics against P. aeruginosa RTI isolates*

Antibiotic	Breakpoint* (mg/l)	No. Isolates With MIC (mg/l)											
		1	2	4	8	16	32	64	128	256	512	1,024	Greater Than 1,024
Ampicillin	8	0	0	0	0	0	0	0	0	2	7	8	2
Ampicillin/sulbactam	8	0	0	0	0	0	0	3	6	8	1	1	0
Amoxicillin	8	0	0	0	0	0	0	0	0	3	2	8	6
Amoxicillin/clavulanate	8	0	0	0	0	0	0	3	1	8	6	1	0
Cefalexin	16	0	0	0	0	2	2	0	6	0	1	8	0
Cefuroxime	16	0	0	0	0	1	2	0	2	3	2	8	1
Cefoperazone	16	0	0	0	2	6	8	1	2	0	0	0	0
Cefotaxime	8	0	0	0	1	7	4	3	2	2	0	0	0
Ceftriaxone	8	0	0	0	3	5	4	2	3	2	0	0	0
Cefepime	8	0	0	4	6	4	3	1	1	0	0	0	0
Meropenem	4	8	3	2	3	2	0	1	0	0	0	0	0
Chloramphenicol	8	0	0	0	0	0	0	2	0	2	5	8	2
Tetracycline	4	0	0	0	2	2	3	5	6	0	1	0	0
Gentamicin	4	0	1	2	6	6	2	2	0	0	0	0	0
Amikacin	16	0	2	6	5	3	1	2	0	0	0	0	0
Ciprofloxacin	1	8	7	3	1	0	0	0	0	0	0	0	0
Levofloxacin	2	1	12	5	0	0	0	1	0	0	0	0	0
Norfloxacin	4	4	10	3	0	2	0	0	0	0	0	0	0
Ofloxacin	2	9	7	2	1	0	0	0	0	0	0	0	0
Azithromycin	4	0	2	1	1	2	3	5	2	3	0	0	0

* According to 1997 NCCLS guidelines.

aeruginosa was isolated from the clinical sample as a unique pathogen.[5] A nosocomial infection was defined according to Centers for Disease Control and Prevention definitions.[6] Ethical approval to perform the study was obtained from the management boards of the hospitals, and the Egyptian Ministry of Health and Population.

Antibiotics

The antibiotics used in this study were ampicillin, ampicillin/sulbactam, amoxicillin, amoxicillin/clavulanic acid, cephalexin, cefuroxime, cefotaxime, cefoperazone, ceftriaxone, cefepime, meropenem, gentamicin, amikacin, chloramphenicol, tetracycline, ciprofloxacin, levofloxacin, ofloxacin, norfloxacin and azithromycin.

Determination of MIC

The MIC for each antibiotic was determined on Mueller-Hinton agar by the agar dilution method according to 1997 NCCLS guidelines. Overnight cultures of P. aeruginosa on Mueller-Hinton broth were diluted to an initial cell density of 10^7 cfu/ml with fresh Mueller-Hinton broth. Inoculums of 10^5 cfu per spot were applied to the surface of dry Mueller-Hinton agar plates containing graded concentrations (1 to 1,024 mg/l) of the respective antibiotics. Plates were incubated at 37C for 20 to 24 hours and the MIC was calculated. Spots with the lowest concentrations of antibiotic that showed no growth were defined as the MIC. The susceptibility percent of each antimicrobial agent used was calculated by dividing the number of susceptible isolates by the total number of tested isolates.

Statistics

The significance of differences between resistance patterns of P. aeruginosa isolates from different infection sites was determined using the chi-square test. All p values were

TABLE 2. *Antibiotic susceptibility of 19 P. aeruginosa RTI isolates*

Antibiotic	No. Susceptible (%)	No. Intermediate (%)	No. Resistant (%)	MIC_{90}
Ampicillin	0 (0)	0 (0)	19 (100)	Greater than 1,024
Ampicillin/sulbactam	0 (0)	0 (0)	19 (100)	512
Amoxicillin	0 (0)	0 (0)	19 (100)	Greater than 1,024
Amoxicillin/clavulanate	0 (0)	0 (0)	19 (100)	512
Cefalexin	2 (11)	2 (11)	15 (78)	1,024
Cefuroxime	0 (0)	2 (11)	17 (89)	1,024
Cefoperazone	8 (42)	8 (42)	3 (16)	128
Cefotaxime	1 (5)	7 (37)	11 (58)	256
Ceftriaxone	3 (16)	5 (26)	11 (58)	256
Cefepime	10 (53)	4 (21)	5 (26)	64
Meropenem	13 (68)	3 (16)	3 (16)	16
Chloramphenicol	0 (0)	0 (0)	19 (100)	Greater than 1,024
Tetracycline	0 (0)	2 (11)	17 (89)	128
Gentamicin	3 (16)	6 (32)	10 (52)	64
Amikacin	16 (84)	1 (5)	2 (11)	64
Ciprofloxacin	8 (42)	7 (37)	4 (21)	4
Levofloxacin	1 (5)	12 (63)	6 (32)	4
Norfloxacin	17 (89)	0 (0)	2 (11)	16
Ofloxacin	9 (47)	7 (37)	3 (16)	4
Azithromycin	2 (11)	1 (5)	16 (84)	256

Percents in proportion to the total of 19 P. aeruginosa RTI isolates.