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Antibiotic and Antiseptic resistance of *Pseudomonas aeruginosa* Isolated from Hospitalized Patients and Hospital Environments I. a comparative study(การดื้อต่อยาปฏิชีวนะและยามาเชื้อใส่...

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ORIGINAL ARTICLE

Antibiotic and Antiseptic resistance of *Pseudomonas aeruginosa* Isolated from Hospitalized Patients and Hospital Environments I. a comparative study

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ABSTRACT

A total of 300 and 205 isolates of *Pseudomonas aeruginosa* from hospitalized patients and hospital environments, respectively, were studied for their resistance to three antibiotics, i.e., carbenilin, moxalactam and tobramycin, and three antiseptics, i.e., hydrogen peroxide, iodine tincture and thimerosal tincture, by disc diffusion method. It was found that 39.67, 7.99, 39.67, 6.33, 8.67 and 1.00% of *P. aeruginosa* isolated from hospitalized patients were resistant to carbenicillin, moxalactam, tobramycin, hydrogen peroxide, iodine tincture and thimerosal tincture, respectively, while 26.34, 1.47, 16.59, 0, 9.27 and 0% of those isolated from hospital environments were resistant to such antimicrobial agents, respectively. Moreover, isolates from hospitalized patients were demonstrated to be resistant to multiple drugs, whereas those from hospital environments were mostly resistant to one or two drugs. (Th. J. Pharm. Sci. 1985 10 : 1-7)

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INTRODUCTION

Pseudomonas aeruginosa is a ubiquitous microorganism that rarely causes infection in healthy individuals but frequently becomes major cause of infections in patients with depressed immunity. Such infections often result in septic death. Acquisition of pseudomonas infections is probably via food, water, common objects or person-to-person contact.

Infections with *P. aeruginosa* are difficult to treat because they do not respond well or uniformly to generally used antimicrobial chemotherapeutic agents. Recently, many valuable antipseudomonal drugs have been found. However resistant strains of *P. aeruginosa* to these drugs have subsequently appeared. Resistance of this bacterium to several commercial disinfectants/antiseptics have also been reported (1,2,3,4). Since *P. aeruginosa* can survive in the hospital environments under natural conditions (5,6), and is now a common cause of hospital-acquired infections. It is, therefore, interesting to see whether there is any difference in drug resistance of *Pseudomonas* isolated from hospitalized patients and hospital environments. In this study, three antipseudomonal antibiotics, namely, carbenicillin, moxalactam and tobramycin; and three antiseptics which were previously tested to be effective to *P. aeruginosa* (3,4), namely, hydrogen peroxide, iodine tincture and thimerosal tincture were employed.

MATERIALS AND METHODS

Microorganisms :

Three-hundred clinical isolates of *P. aeruginosa* tested were taken from skin lesions of the hospitalized patients situated in different wards of Ramathibodi, Rajavithi and Pramongkutklao Hospitals, Bangkok. The environmental isolates were those isolated from floors of different wards and samples of the water drainage in these three hospitals, 205 isolates were studied, *P. aeruginosa* ATCC 27853 was used as the control strain.

Antimicrobial sensitivity test :

Antibiotic and antiseptic sensitivities were carried out by disc diffusion method. All disc diffusion tests were performed according to the procedure described by Bauer et al. (7). The concentrations and sources of antibiotics employed were as follows : 100- μ g carbenicillin discs, Beecham Pharmaceuticals; 30- μ g moxalactam and 10- μ g tobramycin discs, Eli Lilly & Co. For antiseptics, all were supplied by Thai Government Pharmaceutical Organization. These included 3, 2.5 and 0.1% W/V of hydrogen peroxide, iodine tincture and thimerosal tincture, respectively. Before testing, 0.01 ml. of each antiseptic was pipetted onto a 5.8 mm. in diameter and 0.35 mm. thick filter paper disc.

Determination of antimicrobial resistance :

Antibiotic resistance was determined with zone diameter interpretive standards described in NCCLS (8). As stated, inhibition zone diameter breakpoints for *P. aeruginosa* versus carbenicillin were 13 mm. or less for assigning resistance (R), $R \leq 14$ mm. for moxalactam and $R \leq 12$ mm. for tobramycin. Resistance to antiseptics was determined according to Ungsurungsie and Charoensiri (4). No inhibition zone appearance was interpreted as the resistance.

RESULTS

Frequency of antimicrobial resistance of *P. aeruginosa*

The frequency of antibiotic and antiseptic resistance of *P. aeruginosa* isolated from hospitalized patients and hospital environments is shown in Table 1. Among 300 clinical isolates tested, 39.67, 7.99 and 39.67% were resistant to carbenicillin, moxalactam and tobramycin, respectively, while among 205 environmental isolates tested the frequencies of resistance to these antibiotics were 26.34, 1.47 and 16.59%, respectively. Also more isolates from hospitalized patients than from hospital environments were resistant to antiseptics. As shown in Table 1. percentages of resistant clinical isolates to hydrogen peroxide, iodine tincture and thimerosal tincture were 6.33, 8.67 and 1.00, respectively, For environmental isolates of *P. aeruginosa*, 9.27% were resistant to iodine tincture, but none was resistant to hydrogen peroxide and thimerosal tincture.

Table 1. Frequency of antibiotic and antiseptic resistance of *P. aeruginosa* isolated from hospitalized patients and hospital environments

Determination ^a	Hospitalized patients (300 isolates)		Hospital environments (205 isolates)	
	No. of resistant isolates	% of isolates	No. of resistant isolates	% of isolates
Antibiotics				
Cb	119	39.67	54	26.34
Mx	24	7.99	3	1.47
Tb	119	39.67	34	16.59
Antiseptics				
Hp	19	6.33	0	0
Io	26	8.67	19	9.27
Th	3	1.00	0	0

^a) Cb, Carbenicillin; Mx, moxalactam; Tb, tobramycin; Hp, hydrogen peroxide; Io, iodine tincture; Th, thimerosal tincture

Patterns of antimicrobial resistance of *P. aeruginosa*

When patterns of antibiotic and antiseptic resistance of *P. aeruginosa* were analysed, more multiple drug resistant isolates from hospitalized patients than from hospital environments were demonstrated. Table 2. reveals that 34.33% of clinical isolates and 16.59% of environmental isolates of *P. aeruginosa* were multiple drug resistant, respectively.

Table 2 Patterns of antibiotic and antiseptic resistance of *P. aeruginosa* isolated from hospitalized patients and hospital environments.

Type of resistance ^a	Hospitalized patients (300 isolates)		Hospital environments (205 isolates)	
	No. of isolates (%)	Isolation frequency among tested isolates (%)	No. of isolates (%)	Isolation frequency among tested isolates (%)
<u>Sensitive</u>	131 (43.67)	131 (43.67)	130 (63.41)	130 (63.41)
<u>Single resistance</u>		66 (22.00)		41 (20.00)
Cb	18 (6.00)		23 (11.20)	
Mx	1 (0.33)		0	
Tb	30 (10.00)		5 (2.45)	
Hp	7 (2.34)		0	
Io	10 (3.33)		13 (6.35)	
<u>Double resistance</u>		74 (24.67)		33 (16.10)
Cb, Mx	6 (2.00)		2 (0.98)	
Cb, Tb	63 (21.00)		26 (12.68)	
Cb, Io	3 (1.00)		2 (0.98)	
Tb, Io	0		3 (1.46)	
Hp, Io	2 (0.67)		0	
<u>Triple resistance</u>		21 (7.00)		1 (0.49)
Cb, Mx, Tb	13 (4.33)		0	
Cb, Mx, Io	1 (0.33)		1 (0.49)	
Cb, Tb, Hp	4 (1.34)		0	
Cb, Tb, Io	2 (0.67)		0	
Cb, Tb, Th	1 (0.33)		0	
<u>Quadruple resistance</u>		7 (2.33)		0
Cb, Mx, Tb, Io	1 (0.33)		0	
Cb, Mx, Hp, Io	2 (0.67)		0	
Cb, Tb, Hp, Io	3 (1.00)		0	
Cb, Tb, Io, Th	1 (0.33)		0	
<u>Quintuple resistance</u>		1 (0.33)		0
Cb, Tb, Hp, Io, Th	1 (0.33)		0	

^{a)} Cb, carbenicillin; Mx, moxalactam; To, tobramycin; Hp, hydrogen peroxide; Io, iodine tincture; Th, thimerosal tincture

DISCUSSION

The results of this study could be summarized as follows: numbers of antibiotic and antiseptic resistant, and multiple drug resistant isolates of *P. aeruginosa* were shown higher from hospitalized patients than from hospital environments. These observations were likely to support the hypothesis that resistant strains occur more often and would also be associated with multiple drug resistance in a/an condition/environment where the antimicrobial compounds are frequently employed. As for antibiotics, they are administered into the body or as for antiseptics, they are applied onto a body rather than inanimate objects.

Among three individual antibiotics study, it was found that both clinical and environmental isolates of *Pseudomonas* were mostly sensitive to moxalactam. This might be because moxalactam is the latest antipseudomonal antibiotic marketed when comparing with the other two, the emergence of the resistant strains to this antibiotic is, so, not well developed. By broth dilution method, Preheim *et al.* (9) demonstrated that resistance of *P. aeruginosa* induced to β -lactam was likely to be associated with increasing resistance to aminoglycosides. In present investigation, however, revealed the development of moxalactam produced cross-resistance to carbenicillin but not to tobramycin, although in some of our isolates, the emergence of resistance to carbenicillin was accompanied with the resistance to tobramycin.

In terms of antiseptics more isolates of *P. aeruginosa* were resistant to iodine tincture than to the other two antiseptics tested. It was probable that the former is more commonly used in hospitals. Since iodine preparations are not only applied for skin disinfection but also for other purposes, such as disinfection of water, disinfection of air and sanitization of food utensils, it was, therefore, possible to explain why our results appeared that the proportion of iodine tincture resistant isolates was about the same for hospitalized patients and hospital environments.

Because our experimental studies only revealed more antibiotic and antiseptic resistant isolates from hospitalized patients than from hospital environments, further investigations on what conditions or factors in human body that may influence such higher frequency of resistance are needed.

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การดื้อยาปฏิชีวนะและยามาเชื้อใส่แผลของเชื้อ *Pseudomonas aeruginosa* ที่แยกจากผู้ป่วย และสิ่งแวดล้อมในโรงพยาบาล 1. การศึกษาเปรียบเทียบ

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บทคัดย่อ

เชื้อ *Pseudomonas aeruginosa* จำนวน 300 และ 205 ตัวอย่างที่ได้จากผู้ป่วยและสิ่งแวดล้อมในโรงพยาบาล ตามลำดับ ได้ทำการศึกษาถึงผลการดื้อของเชื้อต่อยาปฏิชีวนะ 3 ชนิด คือ คาร์เบนซิลลิน มอกซาแลคแทม และ โทบรามัยซิน รวมทั้งยามาเชื้อใส่แผลอีก 3 ชนิด คือ ไฮโดรเจนเปอร์ออกไซด์ ทิงเจอร์ไอโอดีน และทิงเจอร์ไธเมอโรซาล โดยวิธี disc diffusion พบว่า เชื้อ *P. aeruginosa* แยกจากผู้ป่วยในโรงพยาบาลมีจำนวน 39.67, 7.99, 39.67, 6.33, 8.67 และ 1.00% ที่ดื้อต่อคาร์เบนซิลลิน มอกซาแลคแทม โทบรามัยซิน ไฮโดรเจนเปอร์ออกไซด์ ทิงเจอร์ไอโอดีน และทิงเจอร์ไธเมอโรซาล ตามลำดับ ขณะที่เชื้อซึ่งแยกได้จากสิ่งแวดล้อมในโรงพยาบาลที่ดื้อยาต้านจุลชีพดังกล่าวนี้มีจำนวน 26.34, 1.47, 16.59, 0, 9.27 และ 0% ตามลำดับ นอกจากนี้ยังพบว่าเชื้อจากผู้ป่วยมีความดื้อต่อยาหลายชนิด ขณะที่เชื้อจากสิ่งแวดล้อมดื้อต่อยาเพียงหนึ่งหรือสองชนิดเท่านั้น (ไทยเภสัชสาร 2528 10 : 1-7)

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