

Pseudomonas aeruginosa Isolation in Intensive Care Units at Siriraj Hospital: Prevalence and Antimicrobial Susceptibility

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Abstract

Pharyngeal colonization with *P. aeruginosa* were found in 12/82 (14.6%) and 16/147 (10.2%) cases admitted to the respiratory care unit (RCU) and the traumatic intensive care unit (TICU), respectively, at Siriraj Hospital during August 1997-February 1998. *P. aeruginosa* was also isolated from 9.2 percent and 9.5 percent of sinks located in the RCU and TICU, respectively. The antimicrobial susceptibility of all *P. aeruginosa* isolates from various sources revealed that most isolates were susceptible to six antimicrobials or more. The susceptibility patterns of these *P. aeruginosa* were compared to those of 73 pathogenic *P. aeruginosa* isolated from sputa of patients admitted in general wards at Siriraj Hospital during the same study period and were found to be similar. Two interesting results emerged from this study. Firstly, the pharyngeal colonization of *P. aeruginosa* occurred in all patients who were receiving antimicrobial with the exception of one case. Secondly, susceptibility patterns of the isolates from cases (about 50% of cases receiving antimicrobials) who were on single drug was not different from those isolated from another half who were on combined antimicrobial regimens. Antimicrobials commonly used were 2nd, 3rd generation cephalosporins and aminoglycosides, mostly amikacin. It was also found that 63.3-73.3 percent of *P. aeruginosa* that colonized in the hosts, were still susceptible to antimicrobial agents being administered to them. (*J Infect Dis Antimicrob Agents* 2000;17:87-91.)

INTRODUCTION

Pseudomonas aeruginosa (*P. aeruginosa*) is one of the major causes of hospital-acquired (nosocomial) infection. This organism has the unique ability to infect all body system especially the respiratory tract which *P. aeruginosa* is the major leading cause of

infection.^{1,2} The data from the National Nosocomial Infections Surveillance (NNIS),³ has shown that the most frequent pathogen isolated from nosocomial infections in the intensive care units (ICUs) during the 38 years of study (1950-1988) was *P. aeruginosa*. Most of these patients have defective immune system

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Received for publication: January 25, 2000.

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Keywords: *Pseudomonas aeruginosa*, pharyngeal colonization, ICU intensive care unit

and are prone to have nosocomial infection. At present, an increase in the incidence of *P. aeruginosa* infections in the hospital in Thailand as well as in the other countries all over the world is an important health problem.

We therefore would like to determine the occurrence of *P. aeruginosa* colonization in patients and environment from the respiratory care unit (RCU), traumatic intensive care unit (TICU) at Siriraj Hospital and compare their susceptibility patterns to those of pathogenic *P. aeruginosa* isolated from sputum obtained from patients admitted in general wards. We also determined the relatedness between the occurrence and susceptibility patterns of *P. aeruginosa* and the antimicrobials being used in the same hosts.

MATERIALS AND METHODS

The prevalence of pharyngeal colonization and antimicrobial susceptibility of *P. aeruginosa* isolated from patients admitted to the respiratory care unit (RCU) and the traumatic intensive care unit (TICU) at Siriraj Hospital were studied during August 1997-February 1998. Throat swab cultures were obtained once a week at the beginning of the admission until discharge from the units. Contamination of sinks located in these units with *P. aeruginosa* was studied by swab cultures and specimens were collected once a week throughout the study period. The specimen collection was done at Siriraj Hospital, Mahidol University during the consecutive 6 months.

Patients

Throat swabs were collected on the first day of the patients' admission in the respiratory care unit (RCU) and the traumatic intensive care unit (TICU). They were subsequently collected once a week until *P. aeruginosa* was isolated or the patients were moved out of the units. A total of 385 throat swabs samples were collected and cultured.

Sputa of patients from other general wards were also included. True sputum was screened based on criteria of true sputum recommended by Gohn et al.⁴ A total of 73 isolates from true sputa were obtained.

Sinks

Cotton swabs were used to collect samples from five sinks in the RCU and seven sinks in the TICU on the same day as the throat swab collection

was performed. A total of 120 swabs from the RCU and 168 swabs in the TICU were collected.

Culture and identification

All the samples were plated on 5 percent blood tryptic soy agar (Difco, USA) and Muller-Hinton medium (Difco, USA) and incubated at 37°C for 48 hours. Each of the *P. aeruginosa* suspected colonies were picked and identified according to the procedure described in the Manual of Clinical Microbiology.⁵

Antimicrobial Susceptibility Test

All the isolates included *P. aeruginosa* ATCC 27853 were tested by disk diffusion method^{6,7} against 8 antimicrobial agents: piperacillin 100 µg, ceftazidime 30 µg, cefoperazone/sulbactam 30 µg, imipenem 10 µg, gentamicin 10 µg, amikacin 30 µg, netilmicin 30 µg and ciprofloxacin 5 µg.

RESULTS

The isolation rates of *P. aeruginosa* from the patients and sinks were shown in Table 1. *P. aeruginosa* colonization was found in 14.6 and 10.2 percent of the patients, and 9.2 and 9.5 percent of samples from the sinks located in the RCU and TICU, respectively.

Table 1. Isolation rates of *P. aeruginosa* in the patients and sinks in the intensive care units.

Site of isolation	RCU	TICU
Throat swab (+ve culture/total cases)	12/82 (14.6%)	15/147 (10.2%)
- on respirator	5/32 (15.6%)	15/147 (10.2%)
- without respirator	7/50 (14.0%)	0/147 (0%)
Sinks (+ve culture/total specimens)	6/120 (9.2%)	16/168 (9.5%)

RCU, respiratory care unit; TICU, traumatic intensive care unit

The antimicrobial susceptibility of 128 *P. aeruginosa* isolates was shown in Table 2. All isolates from the colonized patients and the sinks in both RCU and TICU exhibited similar susceptibility patterns to the antimicrobial agents tested.

As shown in Table 3, two main groups of antimicrobial agents were administered to the patients; the beta lactams: 2nd and 3rd generations cephalosporins and the aminoglycosides. There was

no difference of the types of antimicrobial agents administered in the RCU and TICU patients who had *P. aeruginosa* colonization in their throats. All patients except one case received antimicrobial agents prior to the isolation of *P. aeruginosa*.

During the antimicrobial administration, *P. aeruginosa* isolated from 63.6 percent and 73.3 percent of the *P. aeruginosa*-positive RCU and TICU patients respectively, were still susceptible to antimicrobial(s) being used in that case.

DISCUSSION

Our study revealed rather low rates of pharyngeal colonization with *P. aeruginosa* among patients hospitalized in the two intensive care units during the

study period. Only 10-14 percent of the patients harbored the organism in the throat. The low colonization rate can not be attributed to sample collection and culture method since *P. aeruginosa* is one of the microorganism that can be easily cultivated and sample was collected once a week until the patients were discharged from the units.

The pharyngeal colonization with *P. aeruginosa* was not induced by the use of respirators. Though the colonization rate seemed to be higher in the patients with underlying chronic illnesses, it did not reach statistical significance. Other explanation may be that other bacteria such as enterobacteria may be a predominant microorganism that colonized in the throat or *P. aeruginosa* colonization was inhibited by the

Table 2. Antimicrobial susceptibility of *P. aeruginosa* against 8 antimicrobial agents.

Antimicrobial agents	Admission units				
	RCU*		TICU*		Other wards*
	T (n=12)	S (n=11)	T (n=16)	S (n=16)	
Piperacillin	10 (83.3)	9 (81.8)	14 (87.5)	11 (68.8)	57 (78.1)
Ceftazidime	11 (91.7)	9 (81.8)	13 (81.3)	14 (87.5)	59 (80.8)
Cefoperazone/sulbactam	9 (75.0)	8 (72.7)	12 (75.0)	14 (87.5)	43 (58.9)
Imipenem	10 (83.3)	11 (100)	12 (75.0)	13 (81.3)	63 (86.3)
Gentamicin	11 (91.7)	10 (90.9)	14 (87.5)	9 (56.3)	60 (82.2)
Amikacin	11 (91.7)	10 (90.9)	15 (93.8)	14 (87.5)	58 (79.5)
Netilmicin	11 (91.7)	10 (90.9)	13 (81.3)	14 (87.5)	66 (90.4)
Ciprofloxacin	10 (83.3)	10 (90.9)	13 (81.25)	16 (100)	62 (84.9)

RCU, respiratory care unit; TICU, traumatic intensive care unit

T = throat, S = sink, * n = total strains tested, number of strains susceptible to the antimicrobial tested, number in the blanket indicates percentage of susceptibility.

Table 3. Antimicrobial administration and the occurrence of *P. aeruginosa* in the patients.

Antimicrobial agents	RCU (%)	TICU (%)
Used within 7 days prior to the occurrence of <i>P. aeruginosa</i>	11/12 (92)	15/15 (100)
Type of antimicrobial administered		
- Beta lactam		
Cephalosporins (2 nd & 3 rd generations)	9/11 (82)	11/15 (73)
Penicillins	4/11 (36)	4/15 (27)
- Aminoglycoside	3/11 (27)	6/15 (40)
Number of antimicrobial administered		
- Single drug	5/11 (45)	7/15 (47)
- Combined drug	6/11 (54)	8/15 (53)

RCU, respiratory care unit; TICU, traumatic intensive care unit

concomitant use of antimicrobials. However, the latter explanation was not confirmed by our finding in this study that *P. aeruginosa* was often susceptible to the antimicrobials being used as discussed below.

Our study could not indicate that common moist area in the intensive care units such as washing basins (sinks) was the important source of dissemination of *P. aeruginosa* to the patients in both intensive care units although some sinks were frequently contaminated with *P. aeruginosa*. The isolation rate was only 9.2-9.5 percents. We could not point out whether the *P. aeruginosa* isolated from the patients from different wards and from the sinks were the same strain or not. Even though, the antibiograms of these isolates had been worked out (unpublished data) they were not related when the patterns were matched for the isolates from the patient and sink in the same ward. Thus, to further prove the source and transmission of the organism requires other study particularly DNA typing of each isolate.

The antimicrobial susceptibility test was performed against three groups of the antimicrobial agents namely cephalosporins, aminoglycosides and quinolone that have been recommended for the treatment of *P. aeruginosa* infections.⁸ The susceptibility patterns of the isolates from different sources were not different from those of the 73 isolates obtained from the sputa of the patients with respiratory tract infections who were admitted in general wards. In addition, most isolates showed comparable high percentage and pattern of susceptibility. Thus the isolates in the intensive care units posed no threat to higher mortality due to antimicrobial-resistant *P. aeruginosa* since antimicrobial selection for treatment of *P. aeruginosa* infection would be the same, especially if the colonized strains were the ones that would subsequently infected the patients. Our finding was in accordance to the results obtained from previous studies.^{7,9}

It was interesting that *P. aeruginosa* that colonized in a large number of patients were *in vitro* susceptible to the antimicrobial agents being used in that case. This indicated the failure of the agents to prevent the throat colonization with *P. aeruginosa* in the patients. Beta-lactams and aminoglycosides were common antimicrobial agents administered in both ICU patients and may have poor penetration into pharyngeal mucosa. The use of single or combined antimicrobial agents had no different effect on the occur-

rence of *P. aeruginosa* in the patients.

Thus, *P. aeruginosa* is one of the most common gram-negative bacteria that causes hospital-acquired infection. Periodic examination of source is often needed, particularly in the respiratory intensive care unit where most of the patients have to stay for a long time in the hospital. The longer they stay, the more risk to acquire nosocomial infection could happen. Though our study failed to confirm the benefit of short course surveillance, it may be related to the full implementation of the precaution measures that are currently operated in the intensive care units.

In conclusion, pharyngeal colonization with *P. aeruginosa* is still prevalent in both ICU patients despite of the fact that the isolates were *in vitro* susceptible to antimicrobial agents being administered at the time of isolation. At the same time, we were unable to show that *P. aeruginosa* colonization in both ICU patients is the consequence of self inoculation from self gastrointestinal tract or cross transmission from other patients or the sink. Further study such as strain typing is necessary to discover whether the source of transmission is from the environment or not.

ACKNOWLEDGEMENT

The authors were grateful to all participants involved in our study including the medical personnel in RCU and TICU, staffs of Center for Nosocomial Infection Control Siriraj Hospital. This study was partially funded by Faculty of Pharmaceutical Sciences Research Fund, Chulalongkorn University.

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