Epidemiological Tracing of *Pseudomonas aeruginosa*: Antibiogram and Serotyping

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The spread of a particular strain of *Pseudomonas aeruginosa* through a pediatric burn unit was monitored using serological typing and antibiotic susceptibility data.

Infections due to *Pseudomonas aeruginosa* continue to be a problem in some hospitals. Laboratories may need to establish and maintain methods by which the spread of specific strains of epidemic bacteria in the hospital can be documented. Currently, procedures used for epidemiological tracing of *P. aeruginosa* include phage susceptibility (4), pyocin production and/or pyocin susceptibility (9), serotyping (5), or a combination of these methods (1, 3). The use of biochemical markers for *P. aeruginosa* have not been successful and generally cannot be correlated with any of the above-mentioned techniques (8).

In certain situations, an antibiogram might be the only practical means by which a small laboratory can attempt to compare the relatedness of strains with otherwise identical biochemical characteristics (2). This report describes the use of antibiograms supplemented with serological typing in tracing the spread of a particular strain of *P. aeruginosa* among burned children.

The patient population consisted of male and female children ranging in age from 1 to 14 years of age who were admitted for intensive care of second- and third-degree burns. *P. aeruginosa* was isolated and identified by methods previously described (6, 7). Environmental samples consisted of culturing sink drains, basins, and toilets with moistened swabs. Antibiograms were routinely determined by the Kirby-Bauer agar disk-diffusion test. Minimal inhibitory concentrations were determined in Trypticase soy glucose broth (BBL) for gentamicin and carbenicillin. Serotyping was done with seven antisera prepared by Parke-Davis and Co., Detroit, Mich. (courtesy of G. C. Cole) and was done by their instructions. Cultures were streaked on Mueller-Hinton agar (BBL) and incubated at 30 C for 18 h. Heavy suspensions of cells were prepared in 0.5 ml of saline, and agglutination was determined by the slide test.

Initial recognition of a *P. aeruginosa* strain resistant to both gentamicin and carbenicillin occurred in January 1973 and had not been detected in the burn unit prior to this time. The strain was first isolated on 19 January 1973 from the burns and rectal swab of a 4-year-old girl who received a 15% third-degree burn on 3 January 1973. The patient had not received antibiotics prior to admission. The gentamicin-carbenicillin-resistant strains agglutinated strongly with Parke-Davis immunotype 1 antiserum and were designated as *P. aeruginosa* strain A. Gentamicin and carbenicillin minimal inhibitory concentrations for all isolates of strain A were >250 μg/ml. The strain was isolated eventually from 19 of 51 acutely burned children and was particularly common in urine specimens (Table 1). Seven patients had urine counts >10⁵/ml, but urine specimens obtained from these patients by bladder aspiration were sterile. All other isolates of *P. aeruginosa* formed a heterogenous group called group B, were susceptible to gentamicin and carbenicillin, and varied in susceptibility to sulfonamides and kanamycin (Table 2). The group B strains represented a mixture of “O” groups consisting of immunotypes 1 (38%), 2 (32%), 3 (18%), and 7 (12%).

Despite the potential threat which strain A represented had it caused septicemia, no such systemic infections occurred. Strain A was isolated from children at a much lower rate than the group B strains (Fig. 1) over a period of 8 months. Strain A could be differentiated from other strains by the combination of serotyping

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TABLE 1. Distribution and types of Pseudomonas aeruginosa strains isolated from 19 burned children

| Source            | No. of isolates |
|-------------------|-----------------|
|                   | Strain A | Group B |
| Burn wounds       | 9 (5) 40   | 80 (10) |
| Urine             | 24 (13)   | 0       |
| Rectal            | 15 (7)    | 45 (14) |
| Intravenous catheter | 2 (2)   | 9 (5)   |
| Foley catheter    | 1 (1)     | 3 (2)   |
| Blood             | 0         | 6 (2)   |
| Miscellaneous     | 1 (1)     | 7 (5)   |

* Total of 51 acute patients were admitted during the study.
* Total number of isolates = 52.
* Total number of isolates = 150.
* Number in parenthesis denotes individual patients from whom strain A and group B were isolated.
Group B was isolated from 17 of the 19 patients from whom strain A was isolated.

TABLE 2. Antibiotic susceptibility patterns of Pseudomonas aeruginosa strains isolated from burned children

| Antimicrobial agent | Strain A (52 isolates), immunotype 1 | Group B (150 isolates), immunotypes 1,2,3,7 |
|---------------------|-------------------------------------|---------------------------------------------|
| Polymyxin B, 300a   | S*                                  | S                                           |
| Nalidixic acid, 30  | R R                                 | R R                                         |
| Colistin, 10        | S S                                 | S S                                         |
| Gentamicin, 10      | R R                                 | R R                                         |
| Carbenicillin, 50   | R R                                 | R R                                         |
| Nitrofuradantin, 300| R R                                 | R R                                         |
| Sulfisoxazole, 1000 | R V                                 | R V                                         |
| Chloramphenicol, 30 | R S                                 | R S                                         |
| Streptomycin, 10    | R R                                 | R R                                         |
| Tetracycline, 30    | R R                                 | R R                                         |
| Neomycin, 30        | R R                                 | R R                                         |
| Kanamycin, 30       | R V                                 | R V                                         |
| Cephalothin, 30     | R R                                 | R R                                         |
| Ampicillin, 10      | R R                                 | R R                                         |
| Sulfadiazine, 1000  | R V                                 | R V                                         |

* Units (micrograms) of compound per disk.
* S, Susceptible; R, resistant; V, Variable (S or R).

and antibiograms. Six of the 19 patients from whom strain A was isolated each had one episode of P. aeruginosa septicemia but by a different strain. One of the blood isolates was immunotype 1 and the other five were immunotype 2; however, all six strains were susceptible to gentamicin and carbenicillin.

Environmental sampling revealed that strain A was also present on the toilet seats in rooms occupied by patients colonized with this strain. Presumably the toilet seats were contaminated by the patients. Some of the urine specimens containing the organism may have represented environmental rather than urethral isolates.

Although more sophisticated methods can be used to trace P. aeruginosa strains in the hospital, our study shows that the antibiogram is particularly useful when a strain has an unusual susceptibility pattern. Since we had encountered no strains with both gentamicin and carbenicillin resistance, the appearance of many isolates with this dual resistance suggested an outbreak of urinary tract colonization by this strain. Since all the resistant isolates were the same immunotype, this explanation was further substantiated. However, the combination of antibiograms and immunotype was less useful in differentiating the strains called group B.

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