In Vitro Susceptibilities of Aeromonas hydrophila, Aeromonas sobria, and Aeromonas caviae to 22 Antimicrobial Agents

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MICs of 22 antimicrobial agents for 60 strains of three Aeromonas species were determined by a microdilution method. The newer cephalosporins such as moxalactam, cefotaxime, and cefoperazone, the aminoglycosides, and chloramphenicol, tetracycline, nitrofurantoin, and trimethoprim-sulfamethoxazole inhibited most of the strains studied. Within the genus, A. hydrophila was more resistant than either A. caviae or A. sobria to the antibiotics tested.

Aeromonas hydrophila, a ubiquitous waterborne organism, has been implicated in a variety of clinical infections including gastroenteritis, cellulitis, and bacteremia in immunocompromised or cirrhotic individuals (4). Although the genus is well-defined, the exact number of distinct species making up the motile Aeromonas group (often referred to as the A. hydrophila complex) remains unknown. Recent numerical taxonomy and DNA-DNA reassociation studies suggest that at least three species of Aeromonas, namely, A. hydrophila, A. sobria, and A. caviae, should be recognized (13, 14). The relevance of this proposal is supported by further clinical and microbiologic studies showing that all three species can be recovered from human infections (8). In addition, several studies suggest that the majority of A. hydrophila and A. sobria strains recovered from gastroenteritis are enterotoxigenic (1, 2, 15). Invasive potential among the three aeromonal species as judged by their frequency of recovery from blood, their 50% lethal dose for mice and fish, and their exoenzymatic activity also appears to differ substantially (3, 5, 9).

Previous antimicrobial susceptibility studies of Aeromonas were performed with isolates collectively designated A. hydrophila (6, 7, 12). Since newer taxonomy criteria have enabled the correlation of different Aeromonas species with distinct infectious processes and virulence potential, the species-associated antibiotic susceptibility patterns may serve as important therapeutic and diagnostic guidelines. In this regard we studied the antimicrobial susceptibility of the three Aeromonas species.

Sixty Aeromonas strains of human origin were tested in this study, and their respective sources of isolation are listed in Table 1. Of these strains, 39 were recovered in the New York City area, 14 were obtained from the gastrointestinal contents of children in Thailand and were kindly provided by P. Echeverria, and 7 from various clinical sources were submitted by T. Overman. Clinical information was available on 19 of the New York City isolates. Three patients (two with Aeromonas bacteremia and one with Aeromonas gastroenteritis) were receiving antimicrobial therapy either simultaneously or just before the isolation of their respective strains. All isolates were recovered in mixed culture with the exception of two bacteremic strains and one isolate recovered in pure culture from a patient with Aeromonas wound infection. The clinical significance of these 19 isolates was determined by previously defined criteria (8), and the results were as follows: primary or secondary pathogen (n = 15, 79%), colonization (n = 1, 5%), and undetermined significance (n = 3, 16%). Species of the isolates were determined by a modification of the original criteria of Popoff and Véron as previously described (9). MICs were determined by a microdilution method in modified Eugon (cation supplementation for aminoglycosides and thymidine phosphorlyase supplementation for trimethoprim-sulfamethoxazole) broth (Uniscept MIC Plus; Analytab Products, Plainview, N.Y.) with an inoculum of approximately 10⁶ CFU/ml.

Results of testing 20 isolates of each species against each of 22 antimicrobial agents are listed in Table 2. Breakpoints for susceptible, intermediate, and resistant categories were determined by tentative NCCLS standards with the susceptible category used in discussing percent susceptible (11). All Aeromonas spp. studied were susceptible to gentamicin, amikacin, chloramphenicol, trimethoprim-sulfamethoxazole, tetracycline, and nitrofurantoin and uniformly resistant to methicillin, erythromycin, clindamycin, and vancomycin. For 7 of 60 Aeromonas isolates, the MIC of tobramycin was >8 µg/ml. With beta-lactam antibiotics, all three species were resistant to penicillin, ampicillin, and carbenicillin: 50% of all strains tested, however, were susceptible to piperacillin and mezlocillin. The third-generation cephalosporins moxalactam, cefotaxime, and cefoperazone were uniformly active against the 60 isolates, with MICs ranging from 2 to 64 µg/ml. Second-generation cephalosporins (cefoxitin and cefamandole) inhibited approximately 50% of the 60 strains tested.

Of the three species tested, A. hydrophila was more resistant to the penicillins and cephalosporins than either A.

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<th>TABLE 1. Sources of Aeromonas isolates used in this study</th>
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<td><strong>Source of isolation</strong></td>
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<td>Stool</td>
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cavæ or A. sobria. Ninety percent of A. cavæ and A. sobria strains were inhibited at levels of 16 and 64 μg of piperacillin per ml, respectively, while 256 μg of piperacillin per ml was required to inhibit 90% of the A. hydrophila strains (MIC90). Similarly, a higher concentration of cefamandole (≥32 μg/ml) was required to inhibit 90% of the A. hydrophila isolates as compared with A. cavæ (16 μg/ml) or A. sobria (<2 μg/ml). Greater than 32 μg of cefoxitin per ml was required to inhibit 90% of the A. hydrophila isolates as compared with A. cavæ (8 μg/ml) or A. sobria (<2 μg/ml). A unimodal distribution of strains was reflected in the higher MIC90 of these antibiotics for A. hydrophila.

The most striking difference among the species was seen in susceptibility to cephalothin. There were 4 of 20 A. hydrophila strains and only 1 of 20 A. cavæ isolates that were susceptible to 8 μg of cephalothin per ml. In contrast, for 13 of 20 A. sobria strains the MIC was <2 μg/ml, and for one additional strain the MIC of this antibiotic was 4 μg/ml (P < 0.005). Although this observation requires further investigation, cephalothin susceptibility may prove to be a useful marker for A. sobria.

Recently, McNicol and colleagues (10) reported that 57% of the environmental Aeromonas isolates recovered in Bangladesh were resistant to multiple antibiotics including tetracycline and that the resistance appeared to be plasmid mediated. In addition, high-level resistance to chloramphenicol was also noted. Similar resistance patterns have been observed in Aeromonas isolates recovered from the Chesapeake Bay. In our study, no antibiograms similar to those described above were noted because all clinical isolates were susceptible to both drugs. These differences may be related to the source or species of Aeromonas recovered, the method of isolation, the frequency of use of certain antimicrobial agents in a specific geographic area, or to other unknown factors.

Comparative antibiograms of taxonomically defined
Aeromonas species reveal that most isolates are susceptible to a wide range of antibiotics, excluding beta-lactam agents and those normally active against gram-positive bacteria. As judged by MIC, higher levels of resistance to various antibiotics were observed especially among A. hydrophila strains when compared with either A. sobria or A. caviae. Taken together, these data suggest that identification of Aeromonas isolates to the species level may have important implications in the selection of definitive species-oriented therapy.

LITERATURE CITED