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Aminoglycoside-Resistant *Aeromonas hydrophila* as Part of a Polymicrobial Infection following a Traumatic Fall into Freshwater[▽]

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Amikacin is a first-line treatment for *Aeromonas* infection due to high efficacy. There are few reports of aminoglycoside-resistant *Aeromonas* spp. We report a soft tissue infection containing multiple pathogens, including a strain of *Aeromonas hydrophila* resistant to amikacin, tobramycin, and multiple cephalosporins.

CASE REPORT

A 35-year-old man presented to the emergency department of our academic tertiary care facility after suffering a right posterior leg laceration. He was walking on a wooden dock over the Chattahoochee River in Georgia when the structure collapsed beneath him. A wooden shard or a metal pipe underneath the dock lacerated his leg before he fell into the river, and the wound was exposed to water. Shortly after the fall, a physician friend cleaned the wound with povidone-iodine and sutured the laceration closed. He also received a tetanus booster and cephalexin at a local hospital. Past medical and surgical histories were unremarkable.

One day after the accident, the patient presented to the emergency department with rapidly advancing erythema, low-grade fevers, nausea, severe right leg pain, and purulent malodorous drainage from the wound. On presentation, his temperature was 38.0°C, blood pressure was 137/74 mm Hg, heart rate was 105 beats per minute, and respiratory rate was 20 breaths per minute. There was an 8-cm laceration to the right popliteal fossa, repaired with a nylon suture. Cellulitis extended approximately 10 cm proximally and distally to the wound. Laboratory values were remarkable for a white blood cell count of 22,500 cells/μl (93% granulocytes).

Fluid was obtained from the wound, and a Gram stain of the fluid revealed many Gram-negative rods. Aerobic and anaerobic cultures were conducted using standard microbiologic procedures. Species identification and antibiotic susceptibility tests were conducted using the MicroScan WalkAway Plus system (Siemens Healthcare Diagnostics, Deerfield, IL). The wound culture subsequently grew many colonies of *Escherichia coli*, few colonies of *Enterococcus* species, few colonies of alpha-hemolytic *Streptococcus* species, few colonies of *Clostridium perfringens*, and 2 strains (many colonies isolates each) of *Aeromonas hydrophila* (species identification later confirmed by conventional biochemical and cell wall fatty acid analysis at the Georgia Public Heath Laboratory). The *E. coli* and *Enterococcus* isolates were sensitive to all antibiotics tested. Strain 1 of *Aeromonas* was resistant to ampicillin and tetracycline. Strain 2 was resistant to the same antibiotics as strain 1. In addition, strain 2 was resistant to amikacin, aztreonam, cefepime, cefoxitin, ceftazidime, ceftriaxone, cefotaxime, ertapenem, gentamicin, and tobramycin (Table 1). Per the microbiology laboratory's policy, susceptibilities were not ascertained for the *C. perfringens* and alpha-hemolytic *Streptococcus* species; however, these bacteria are generally susceptible to the empirical antibiotic regimen selected for our patient, vancomycin and piperacillin-tazobactam.

Due to the rapidly advancing cellulitis, the patient was taken emergently to the operating room for surgical debridement of the wound. Deep tissue cultures obtained in the operating room grew the same pathogens as the cultures obtained in the emergency department. When preliminary culture results the following day suggested possible *Aeromonas* infection, empirical treatment with vancomycin and piperacillin-tazobactam was supplemented with amikacin and levofloxacin. On hospital day 2, due to advancing cellulitis and purulent drainage from the wound despite intensive antibiotic therapy, a second surgical debridement was performed. Cultures of specimens from this surgery revealed only oxidase-positive Gram-negative rods, implicating *Aeromonas* as the primary pathogen in this infection. Due to the confirmed susceptibilities of the *Aeromonas* species (Table 1), the patient's antibiotic regimen was narrowed to vancomycin and piperacillin-tazobactam.

The patient's wound improved rapidly over the next 5 days, and a split-thickness skin graft was placed. After the grafting, the patient was discharged on oral levofloxacin and amoxicillin-clavulanate and has fully recovered.

Aeromonas hydrophila is a Gram-negative, oxidase-positive bacillus that is a common freshwater and food-borne pathogen that can cause enterocolitis, bacteremia, meningitis, and soft tissue infections (3, 4). Here we report a polymicrobial soft tissue infection after a traumatic laceration and freshwater exposure that included two strains of *A. hydrophila*. We believe that *Aeromonas* played a major role in this patient's disease process, since it was most numerous on the Gram stain and the

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TABLE 1. Antibiotic susceptibilities of the *Aeromonas hydrophila* strains[a]

Strain[b]	MIC (μg/ml)[c]																
	AMP	TZP	FOX	CAZ	CTX	CRO	FEP	IPM	ETP	ATM	GEN	AMK	TOB	CIP	TET	CHL	POB
Aero1	**>16**	≤16	≤8	≤1	≤2	≤8	≤8	≤4	≤2	≤8	≤4	≤16	≤4	≤1	**>8**	ND	ND
Aero2	**>16**	≤16	**16**	**>16**	**>32**	**32**	**>16**	≤4	**>4**	**>16**	**8**	**>32**	**>8**	≤1	**>8**	ND	ND
ATCC 7966	**>256**	2	4	<0.5	<0.5	<0.5	<0.5	0.5	ND	<0.5	2	4	4	<0.5	0.5	<0.5	2
MB443	**>256**	**>256**	**>256**	**>256**	**>256**	**>256**	**32**	**32**	ND	<0.5	2	8	**16**	**8**	**>256**	2	16

[a] Antibiotic susceptibilities of the two *Aeromonas hydrophila* strains recovered in this study, the completely sequenced prototype strain ATCC 7966 (12), and the VIM metallo-β-lactamase-producing strain MB443 (7).

[b] Aero1 and Aero2, *Aeromonas hydrophila* strains 1 and 2 from this study. MIC data for ATCC 7966 and MB443 are reprinted with permission from Libisch et al. (7).

[c] Boldface indicates resistance according to current Clinical and Laboratory Standards Institute guidelines (2). AMP, ampicillin; TZP, piperacillin-tazobactam; FOX, cefoxitin; CAZ, ceftazidime; CTX, cefotaxime; CRO, ceftriaxone; FEP, cefepime; IPM, imipenem; ETP, ertapenem; ATM, aztreonam; GEN, gentamicin; AMK, amikacin; TOB, tobramycin; CIP, ciprofloxacin; TET, tetracycline; CHL, chloramphenicol; POB, polymyxin B; ND, not determined.

only bacterium cultured from specimens taken during repeated surgical debridements. One of the strains of *Aeromonas* exhibited an unusual resistance to amikacin and tobramycin as well as aztreonam, ertapenem, ceftazidime, and cefepime.

Heretofore, reports of aminoglycoside resistance in *Aeromonas* species have been very limited. We are aware of only four strains of demonstrated aminoglycoside-resistant *Aeromonas hydrophila* in the literature: one strain resistant to gentamicin and amikacin but susceptible to tobramycin, isolated at the Massachusetts General Hospital in the mid-1970s (9), and three strains of amikacin-resistant *A. hydrophila* from a survey conducted in Taiwan in 1996 (5). In 2008, Libisch et al. first reported a VIM metallo-β-lactamase-producing *Aeromonas hydrophila* strain with extensive resistance to beta-lactams and carbapenems but not aminoglycosides (7). To our knowledge, our report is the first to present a clinical description of an *A. hydrophila* infection with resistance to both aminoglycosides and expanded-spectrum cephalosporins.

Known antimicrobial resistance patterns can affect the choice of empirical antibiotic regimens used to treat specific infections. A 1996 study of antibiotic susceptibility in clinical isolates of *Aeromonas* in Taiwan (5) concluded that certain cephalosporins (moxalactam, ceftazidime, and cefepime), amikacin, aztreonam, imipenem, and quinolones were reasonable choices for empirical treatment. A 2009 study of *Aeromonas* in France recommended that a cephalosporin or a quinolone be prescribed along with an aminoglycoside in cases of severe infection (6). We believe that the reported emerging resistance of *Aeromonas* to quinolones (1, 10) and carbapenems (7, 11), as well as aztreonam, cephalosporins, and aminoglycosides (this report), might influence physicians to employ polytherapy for empirical treatment of severe *Aeromonas hydrophila* infections. However, comprehensive studies are needed to examine broader trends in *Aeromonas* antibiotic resistance.

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