

Aeromonas infection from river and playa lake waters in West Texas and southeastern New Mexico

Robert C. Kimbrough MD, Richard E. Winn MD, Randall M. Jeter PhD,
William J. Warren PhD, Jennifer R. Huddleston PhD, John C. Zak PhD

ABSTRACT

Trauma occurring in direct contact with freshwater bodies may result in wounds contaminated with a variety of microorganisms. Bacteria belonging to the genus *Aeromonas* have been recovered from these types of infections. We report two cases of *Aeromonas hydrophila* infections occurring from freshwater-contaminated wounds. One of these infections was acquired from a river in southeastern New Mexico; the other was from an urban playa lake in West Texas. The latter case prompted an ecological study of the seasonal occurrence of *Aeromonas spp.* and the incidence of resistance to antimicrobial agents in two of these local lakes. Recent scientific and medical literature data show that *Aeromonas* should be considered as a possible agent of infection in immunocompetent hosts from water exposure, even if the water is a running river or a seemingly unpolluted (“clean”) freshwater lake.

Key words: *Aeromonas*, water borne infection, playa lakes

INTRODUCTION

Members of the bacterial genus *Aeromonas* are known to infect wounds that occur in contact with either polluted or unpolluted (“clean”) freshwater.^{1–3} We report a scalp-wound infection and a unique bloodstream infection occurring in two patients exposed to freshwater sources in West Texas and southeastern New Mexico, respectively. *Aeromonas* infection in the former patient led to a year-long study of the seasonal occurrence and incidence of resistance to antimicrobial agents among *Aeromonas* isolates from two urban playa lakes within the city limits of Lubbock, TX.⁴

In addition, we surveyed the recent (1998–2011) scientific and medical literature for reports of *Aeromonas* infections and summarize pertinent information.

CASE REPORTS

Case 1. A 32-year-old white woman sustained a blast injury and 60% body burn in a natural gas pipeline explosion while camping beside the Pecos River near Carlsbad, NM (Figure 1). She dove into the river to quench the fire. She was admitted to the burn ICU in critical condition. She was febrile at the time of admission and became septic. On the second day of hospitalization, her blood cultures grew *Aeromonas hydrophila*. Her wounds did not grow this organism, nor did bronchial washings. The large-line intravenous

Corresponding author: Richard Winn, MD
Contact Information: Richard.winn@tuhsc.edu
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(IV) device, which was placed at the scene while she was still wet from the river, also grew *A. hydrophila*. She was treated with appropriate antibiotics, but died after 30 days due to burn trauma and inhalation injury.

Case 2. A 26-year-old Hispanic man lacerated his scalp while swimming in a local playa lake in Lubbock, TX (Figure 1). The wound was initially closed and subgaleal infections ensued. He developed massive facial and neck edema and required intubation. He required incision and drainage twice. *A. hydrophila* was recovered in pure culture. The patient was treated with appropriate antibiotics and discharged after 10 days of antibiotic therapy. He was followed for a one-year period with his face and scalp returning to normal.

MATERIALS AND METHODS

All clinical specimens were collected by cotton-tipped swabs, suction catheters, or standard blood culture techniques. They were processed for species identification and antimicrobial sensitivities in the hospital clinical microbiology laboratory at Texas Tech University Health Sciences Center by using a replicator device of standard manufacture with reagents and equipment from the same company (Dade MicroScan™, Dade Behring, Inc., 1584 Enterprise Blvd., West Sacramento, CA 95691). The playa-lake study procedures have been described previously.⁴

PERTINENT LITERATURE REVIEW

Genus definition. The genus *Aeromonas* consists of Gram-negative, rod-shaped bacteria that are generally motile by means of single polar flagella. They are facultative anaerobes.^{5,6}

Organism distribution. *Aeromonads* are ubiquitous in aquatic environments and have been isolated from fresh and brackish water^{7,8}, urban wastewater⁹, aquatic sediments⁴, and soils that have been recently irrigated or flooded.¹⁰ They have also been found in drinking water supplies, perhaps because they can form biofilms that are resistant to chlorination.¹¹ *Aeromonads* have been detected in bottled natural mineral waters¹² and in various foodstuffs, including raw fish and shellfish, poultry, meat products, milk, and fresh vegetables.^{13,14} *Aeromonas* is also found in association with a growing list of invertebrate and vertebrate animals, including molluscs (snails and mussels)^{15,16}, annelids (leeches)¹⁷⁻¹⁹, crustaceans (shrimp)²⁰, insects (mosquitoes)²¹, fishes²², amphibians (frogs)²³, reptiles (snakes and crocodiles)^{24,25}, birds²⁶, and mammals²⁷. In some cases, the *aeromonads* form part of the host animal's normal microbial flora; in others, they act as invading parasites that can cause potentially lethal infections.

Disease associations. *Aeromonas* species cause diseases in several poikilothermic animals, including fish, frogs, and other amphibians (primarily



Figure 1. Geographical locations of the sites where the *Aeromonas* infections in these cases occurred

A. hydrophila).^{28,29} Several *Aeromonas* species also act as pathogens in humans.^{30,31} *Aeromonas hydrophila* is the most frequently isolated species in cases of human infection. *A. caviae* and *A. veronii* biovar *sobria* are also commonly isolated.³² Other less frequently isolated human pathogens are *A. veronii* biovar *veronii*, *A. jandaei*, and *A. schubertii*.³³ A single case of infection by *A. popoffii* has been reported.³⁴

Traditionally *Aeromonas* has been described as an opportunistic pathogen, but more recent reports in the medical literature of *Aeromonas* infections in healthy, immunocompetent adults suggest that, in some cases, *Aeromonas* may be regarded as a primary pathogen as well. Gastroenteritis is the most commonly reported clinical illness associated with *Aeromonas* infection, which typically manifests as acute, watery diarrhea.³⁵ Although this condition is usually self-limiting in otherwise healthy individuals, the symptoms can be more severe in children, the elderly, and immunocompromised patients.³⁶⁻⁴¹ Severe cholera-like or dysenteric diarrheal diseases occur more rarely.³² The association between *Aeromonas* and diarrheal symptoms has recently been questioned.⁴² *Aeromonas* has also been recovered from fecal samples taken from healthy, asymptomatic individuals. The bowel carriage rate is generally considered to be about 3–5% in temperate regions⁴³ but higher in tropical areas. One study found a carriage rate as high as 27% in a Thai population of 51 healthy adults.⁴⁴ Thus, the human gastrointestinal tract may serve as a reservoir for potentially pathogenic *Aeromonas* strains. Iatrogenic *Aeromonas* infections have been associated with medicinal leech therapy due to a specific host-microbe symbiosis with *A. veronii*.¹⁸

Routes of infection. The principal routes by which *Aeromonas* enters the human body are the gastrointestinal tract (by ingestion of contaminated food or water) and wounds to the skin surface (cuts, scratches, punctures, and burns) from water exposure. The latter infections are usually self-limiting, but on occasion, entry of *Aeromonas* into the bloodstream can result in life-threatening septicemia. Other apparent routes of infection include the respiratory tract (inhalation leading to pneumonia or

other types of pulmonary infections), urinary tract, and ocular infections.³³ *Aeromonas* infections have also resulted from the treatment of surgical incisions with medicinal leeches, which appear to form a stable host-symbiont association with *A. veronii* in the leech digestive tract.⁴⁵⁻⁴⁷

Disease consequences. Wound (skin and soft-tissue) infections are the second most common type of infections caused by *Aeromonas* species. These infections are generally self-limiting in immunocompetent individuals but can become life-threatening if septicemia develops, especially in immunocompromised individuals. Among 305 survivors of the December 2004 tsunami in southern Thailand who were treated for skin and soft-tissue infections, 145 of 641 (22.6%) bacterial isolates from the pus and/or wound cultures were identified as *Aeromonas*, including 104 *A. hydrophila* and 41 *A. veronii* biovar *sobria*.⁴⁸

Antibiotic resistance. Many clinical isolates of *Aeromonas* have a high-level resistance to β -lactam antibiotics and first-generation cephalosporins in vitro. Unbiased surveys of both clinical and environmental strains typically show that the prevalence of ampicillin resistance is 70–90%.⁴⁹⁻⁵¹ Several different *Aeromonas* clinical isolates have been analyzed in detail and found to produce two or three chromosomally encoded β -lactamases with overlapping substrate specificities.^{52,53} Occasionally, strains have also been isolated that carry plasmid-borne β -lactamase genes.^{52,54} Resistances to other antimicrobial drugs and antibiotics have been reported. For example, a recent study in India of 21 *A. hydrophila* isolates from children with acute diarrhea found a high prevalence of resistance to several antibiotics, including bacitracin (95.2%), novobiocin (95.2%), vancomycin (90.5%), cefazoline (85.7%), methicillin (85.7%), kanamycin (81%), rifampicin (76.2%), erythromycin (71.4%), tetracycline (71.4%), and nalidixic acid (62%).⁵⁵ Resistances found among 138 environmental aeromonads isolated from two European rivers included nalidixic acid (59%), tetracycline (14%), fosfomycin (8%), tobramycin and cotrimoxazole (7%), cefotaxime (4%), chloramphenicol (2%), and gentamicin (1%).⁵⁶ In another study, 217 clinical

and non-clinical *Aeromonas* isolates were resistant to various antimicrobials, including clindamycin (100%), vancomycin (100%), erythromycin (69.27%), cefazoline (57.34%), sulfamethoxazole (35.78%), rifampicin (21.56%), and tetracycline (9.63%).⁵⁷ These results support the idea that a correlation exists between the prevalence of antibiotic resistance among aeromonads and the source of their isolation. Resistance to tetracyclines has been associated with plasmid-encoded genes^{51,58,59}, and sulfonamide/trimethoprim drug resistance has been associated with integrons⁶⁰, confirming that *Aeromonas* is quite capable of acquiring antimicrobial resistance determinants from other groups of bacteria by lateral gene transfer. Quinolones and second- and third-generation cephalosporins are generally considered to be the most effective antimicrobial agents against aeromonads in current clinical settings.

RESULTS AND DISCUSSION

The *A. hydrophila* recovered from the blood stream of Case 1 was resistant to ampicillin, ampicillin/sulbactam, cefazolin, cefoxitin, and imipenem. This organism originated from the Pecos River, a different water source than for Case 2 and the playa lake study.⁴ The *A. hydrophila* from the wound infection of Case 2 was resistant only to ampicillin. An *A. hydrophila* with similar biotyping and antibiotic sensitivities was recovered from the lake where the accident occurred.

Case 1 is representative of the many types of *Aeromonas* infections from freshwater exposure that have been reported previously.⁶¹⁻⁶⁴ However, this patient was not immunosuppressed or ill prior to the acute burn injury.⁶⁵ The early onset of the bacteremia and the lack of *Aeromonas* recovered from specimens other than the blood and the IV line tip led us to surmise that river water contaminated the IV line at the time of emergency placement. In contrast to the organism recovered from Case 1, the *Aeromonas* isolate from Case 2 was susceptible to multiple antimicrobial agents consistent with results obtained with the *Aeromonas* isolates from the two urban playa lakes.⁴

In summary, we report a case with bacteremia

from an IV line placed under emergent circumstances in skin contaminated with river water and a case with a scalp wound from a laceration sustained in a local playa lake. Both infections occurred in immunocompetent individuals who acquired the *A. hydrophila* infections subsequent to trauma accompanied by direct exposure to freshwater environments. The infection contributed to a fatal outcome in the former patient, whereas the latter patient recovered completely. Infections due to *Aeromonas* species from freshwater sources have been previously reported.⁶⁶ Most serious infections affect immunocompromised hosts. *Aeromonas* should be considered as a possible agent of infection from water exposure even if the water is a running river or a small, seemingly “clean” freshwater playa lake and should be considered in wounds with exposure to these waters in immunocompetent hosts.

Author Affiliation: Robert C. Kimbrough (deceased) and Richard E. Winn are in the Department of Internal Medicine, Division of Infectious Disease, Texas Tech University Health Sciences Center, Lubbock, TX. Randall M. Jeter, William J. Warren, Jennifer R. Huddleston, John C. Zak are in the Department of Biological Sciences, Texas Tech University, Lubbock, TX.

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