



Isolation of *Aeromonas hydrophila* in children with diarrhea

Ho-Jung Juan¹, Ren-Bin Tang¹, Tzee-Chung Wu¹, Kwok-Woon Yu²

¹Departments of Pediatrics and ²Pathology and Laboratory Medicine, Taipei Veterans General Hospital, and National Yang Ming University, Taipei, Taiwan, ROC

Received: June 8, 1999 Revised: February 22, 2000 Accepted: March 4, 2000

Aeromonas species are gram-negative bacilli that lead to a wide spectrum of infectious diseases in human. In the present study, these bacilli were reviewed to assess their significance as enteric pathogens in this area. During the years of 1994 to 1998, the clinical microbiology laboratory received 2150 stool specimens of children with diarrhea. Medical charts of patients who had positive culture for *Aeromonas hydrophila* were reviewed. *A. hydrophila* were isolated from 50 (2.3%) of 2150 children with diarrhea. Most patients were outpatients with ages ranging from 5 months to 16 years old (mean age 3.5 years). The male to female ratio was 0.85:1. All patients suffered from watery or loose diarrhea, some with blood-tinged stool. Whether or not they received medication, all patients had uneventful recoveries. The results of antibiotic susceptibility testing revealed that all strains were not susceptible to ampicillin. In summary, *A. hydrophila* may be considered as a causative agent of gastrointestinal illness in children.

Key words: *Aeromonas hydrophila*, children, diarrhea

Aeromonas species are gram-negative bacilli with positive catalase and oxidase reactions and are distributed worldwide. They can cause diseases in aquatic animals, but they are also associated with a wide spectrum of infectious diseases in humans.

Human infections caused by *Aeromonas* species include acute gastrointestinal illness [1-3]; soft tissue infections [1,4]; sepsis, frequently in association with malignancies and cirrhosis [1-6]; and other miscellaneous infections, including pneumonia, meningitis, endocarditis, septic arthritis and osteomyelitis [1,2,6-8]. *Aeromonas* can also be isolated from the stools of asymptomatic individuals [1].

Despite its clinical significance in diarrhea, the organism is not commonly sought in routine stool cultures, and few clinical evaluations have been done. Evidence of isolation of *Aeromonas hydrophila* has been reported in Taiwan [9-11], and acute diarrhea associated with *Aeromonas* species in fecal samples has been reported in this area [9-12]. In the present study, we undertook a retrospective study of patients with diarrhea to determine the isolation rate and clinical significance of *A. hydrophila*.

Materials and Methods

During the 4-year period from 1994 to 1998, the clinical

microbiology laboratory at Taipei Veterans General Hospital, received 2150 stool specimens of children. Repeated isolation of enteric pathogens from multiple samples during an episode of diarrhea was recorded as a simple isolation. Medical charts of patients who had positive cultures for *A. hydrophila* were reviewed for symptoms, signs, duration of illness, treatment and outcome.

All stool specimens were processed for bacterial enteric pathogens by inoculating the specimens on sheep blood agar (BAP) and MacConkey agar. Screening for *A. hydrophila* was done either by the use of a dry slide (oxidase) from Difco laboratory (Detroit, MI, USA) or by spot-checking nonlactose fermenting colonies from MacConkey agar plates or beta-hemolytic colonies from BAP for oxidase positivity. Antibiotic susceptibility tests were performed by a modified Kirby-Bauer method using a BBL Sensi-Disc test (Becton Dickinson and Company, Cockeysville, MA, USA). *E. coli* ATCC 25922 as a quality control strain.

Results

Enteric bacterial pathogens were isolated from 308 (14.3%) of the 2150 specimens of patients with gastrointestinal symptoms. *Salmonella* species were isolated from 250 (11.6%) children with diarrhea, followed by *Aeromonas*, *Yersinia* and *Shigella*. *A. hydrophila* accounted for 50 (2.3%) of the cases. *A. hydrophila* was the sole bacterial enteropathogen in 46 of these children; the other four also suffered from

Corresponding author: Dr. Ren-Bin Tang, Department of Pediatrics, Taipei Veterans General Hospital, No. 201, Sec 2, Shih-Pai Road, Taipei, 112, Taiwan, ROC.

Table 1. Clinical features of 50 children with *Aeromonas hydrophila* diarrhea

Feature	No. of patients (%)
Fever 38-39°C	13 (26)
> 39°C	9 (18)
Abdominal pain	6 (12)
Vomiting	7 (14)
Diarrhea 2-7 days	38 (76)
> 8 days	12 (24)
Blood-tinged stool	13 (26)

Salmonella infection. *A. hydrophila* were isolated most frequently during the late summer, with 15 (30%) and 12 (24%) cases in September and August respectively. The male-to-female ratio was 0.85:1. The age distribution was 12% younger than 1 year old, 48% between 1 and 3 years old, 26% between 4 and 6 years old, and 14.9% older than 6 years old. Most of the patients were out-patients.

The most common symptoms were watery diarrhea (100%), followed by fever (44%), blood-tinged stool (26%), vomiting (14%), and abdominal pain (12%) (Table 1). Only five patients received trimethoprim-sulfamethoxazole during the course of illness. All patients, whether or not they received drug therapy, had uneventful recoveries. The results of antibiotic susceptibility testing are listed in table 2. All strains were not susceptible to ampicillin. Most strains were sensitive to aminoglycosides, chloramphenicol and third generation cephalosporins.

Discussion

Diarrhea is one of the most common gastrointestinal

Table 2. *In vitro* susceptibilities of 50 isolates of *Aeromonas hydrophila*

Antimicrobial agent	Susceptible (%)
Ampicillin	0
Aztreonam	49 (98)
Cefazolin	13 (26)
Cefonicid	31 (62)
Cefoperazone	50 (100)
Ceftriaxone	50 (100)
Cefotaxime	50 (100)
Ceftazidime	50 (100)
Moxalactam	50 (100)
Chloramphenicol	45 (90)
Gentamicin	50 (100)
Amikacin	50 (100)
Tobramycin	48 (96)
Tetracycline	39 (78)
Ticarcillin or sulbenicillin	12 (24)
Trimethoprim/sulfamethoxazole	39 (78)

illnesses, accounting for several billion cases annually throughout the world, with 10 to 15 million deaths in the developing countries of Asia, Africa, and Latin America [13]. The most common etiological agent is *Salmonella*, followed by *Shigella*, *Campylobacter*, *Giardia*, and *Entamoeba histolytica*. Other pathogens, such as *A. hydrophila*, *Campylobacter* and *Yersinia*, have been reported as enteric pathogens identified in groups of children with diarrhea in this area [9,12,14, 15].

Aeromonas species are found worldwide and are potential pathogens of the gastrointestinal tract. Aeromonads that have been isolated suggest that the *Aeromonas* species, like *E. coli*, may cause disease and that many strains are probably not pathogenic. *A. hydrophila* is most commonly associated with human disease, although *Aeromonas sobria* and *Aeromonas caviae* also cause human illnesses. *A. hydrophila* usually causes acute gastroenteritis. In Asia and Africa, *Aeromonas* species cause a cholera-like illness, often due to production of enterotoxin.

In this study, *A. hydrophila* was isolated in only 50 of the 2150 stool specimens of patients with gastrointestinal symptoms. In our institution, this constituted 2.3% of the children with diarrhea. Controls were not available in this report. Prevalence rates for this organism range from 1.1% in the USA and Brazil to 10% in Australia [16-18]. In a study of etiology of childhood diarrhea in Beijing, members of the *A. hydrophila* group were isolated with equal frequency from both patients and controls [19]. These differences in results might be related to geographic locations, seasonal variation and identification techniques.

Aeromonas are infrequently recognized, treatable causes of infectious diarrhea. They are present only rarely in the gut of normal individuals. Thus, when they are found in the stools of patients with gastrointestinal disease, they should not be ignored. They grow well on routine bacteriological media (e.g. MacConkey or sheep blood agar) but may not be distinguishable from *Enterobacteriaceae*, normal stool flora, unless an oxidase test is performed. Under an oxidase test, *Aeromonas* give a positive reaction.

Although many cases of diarrhea due to *Aeromonas* species are mild and self-resolving, there are times when the clinical course is severe and protracted. *Aeromonas* are susceptible to a number of antibiotics [20-22]. Most strains are sensitive to aminoglycosides, chloramphenicol, and third generation cephalosporins. None of these *A. hydrophila* is sensitive to ampicillin. In this study, about 22% of *A. hydrophila* were resistant to tetracycline and trimethoprim-sulfamethoxazole.

Aeromonas species were most often isolated in late summer.

In summary, *A. hydrophila* may be considered as a causative agent of gastrointestinal illness in children.

References

1. McGowan JE, Del Rio C Jr. Other gram-negative bacilli. In: Mandell GL, Douglas RG Jr, Bennett JE, eds. Principles and Practice of Infectious Diseases. 3rd ed. New York: Churchill Livingstone, 1990:1782-93.
2. Davis WA II, Kane JG, Garagusi VF. Human *Aeromonas* infections: a review of the literature and a case report of endocarditis. *Medicine* 1978;57:267-77.
3. Holmberg SD, Schell WL, Fanning GR, Wachsmuth IK, Blake PA, Brenner DJ, Farmer JJ. *Aeromonas* intestinal infections in the United States. *Ann Intern Med* 1986;105:683-9.
4. Harris RL, Fainsein V, Elting L, Hopfer RL, Bodey GP. Bacteremia caused by *Aeromonas* species in hospitalized cancer patients. *Rev Infect Dis* 1985;7:314-20.
5. Ketover BP, Young LS, Armstrong D. Septicemia due to *Aeromonas hydrophila*: clinical and immunologic aspects. *J Infect Dis* 1973;127:284-90.
6. Scott EG, Russell CM, Noell KT, Sproul AE. *Aeromonas hydrophila* sepsis in a previously healthy man. *JAMA* 1978;239:1742.
7. Karam GH, Ackley AM, Dismukes WE. Post-traumatic *Aeromonas hydrophila* osteomyelitis. *Arch Intern Med* 1983;143:2073-4.
8. Chmel H, Armstrong D. Acute arthritis caused by *Aeromonas hydrophila*: clinical and therapeutic aspects. *Arthritis Rheum* 1976;19:169-72.
9. Lien SL, Tang RB, Wang HC, Tsai WC. Frequencies of occurrence of the diarrhea-causing pathogenic bacteria in patients of the pediatric out-patient department. *Chin Med J (Taipei)* 1984;33:331-40.
10. Tsai WC, Lee CH, Ju YC. Comparative study of the biotype, hemolysin-producing capability and antibiogram of the aquatic and the clinical strains of *Aeromonas hydrophila*. *Chin J Microbiol Immunol* 1986;19:124-35.
11. Lin SY, Jou MY. Wound infection due to *Aeromonas hydrophila*: a case report. *J Infect Dis Soc ROC* 1995;6:151-4.
12. Lin SP, Chyou SC, Huang FY, Lee HC, Wu WH, Yang DI. *Aeromonas*-associated diarrheal disease. *Acta Paed Sin* 1986;27:216-22.
13. Mitchell JE, Skelton MM. Diarrheal infections. *Am Fam Phys* 1988;37:195-207.
14. Tang RB, Hsieh KS, Hwang B. *Campylobacter jejuni* enteritis in children. *Chin J Microbiol Immunol* 1984;17:226-32.
15. Tang RB, Wang HC, Law SL, Hwang B. Isolation of *Yersinia enterocolitica* in diarrheal children. *Acta Paediatr Sin* 1985;26:298-302.
16. Burk V, Gracey M, Robinson J, Peck D, Beaman J, Bundell C. The microbiology of childhood gastroenteritis: *Aeromonas* species and other infective agents. *J Infect Dis* 1983;148:68-74.
17. Altwegg M, Johl M. Isolation frequency of *Aeromonas* species in relation to patient age. *Eur J Clin Microbiol* 1987;6:55-6.
18. Hazen TC, Fliermans CB, Hirsch RB, Esch GW. Prevalence and distribution of *Aeromonas hydrophila* in the United States. *Appl Environ Microbiol* 1978;36:731-8.
19. Kain KC, Barteluk RL, Kelly MT, Xin H, Hua GD, Yuan G, Proctor EM, Nyrene S, Stiver HG. Etiology of childhood diarrhea in Beijing, China. *J Clin Microbiol* 1991;29:90-5.
20. San Joaquin VH, Scribner RK, Pickett DA. Antimicrobial susceptibility of *Aeromonas* species isolated from patients with diarrhea. *Antimicrob Agents Chemother* 1986;30:794-5.
21. Ko WC, Chuang YC. *Aeromonas* bacteremia: review of 59 episodes. *Clin Infect Dis* 1995;20:1298-304.
22. Ko WC, Yu KW, Liu CY, Huang CT, Leu HS, Chuang YC. Increasing antibiotic resistance in clinical isolates of *Aeromonas* strains in Taiwan. *Antimicrob Agents Chemother* 1996;40:1260-2.