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Meningitis Due to *Aeromonas hydrophila*

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A case of meningitis caused by *Aeromonas hydrophila* is reported. The infection complicated an otherwise successful frontotemporal craniotomy. Survey of the literature revealed that human infections due to this organism are relatively uncommon, and its causal relationship in meningitis has not been previously reported. *A. hydrophila* is known to cause bacteremia in patients under treatment with immunosuppresive agents. We report meningitis with bacteremia, caused by this organism, in an immunologically competent host.

Aeromonas hydrophila inhabits freshwater and is known to cause red leg disease in frog, septicemia and stomatitis in snakes, and infections in freshwater fish (4, 13, 19). Human infections due to members of the genus *Aeromonas* are considered rare, but these organisms have been isolated from a number of human sources. Although Miles and Halnan (18) were the first to isolate aeromonads from feces of a patient with chronic colitis, they did not establish any causal relationship. Since then these organisms have been isolated from patients with diarrhea, severe gastroenteritis, metastatic myositis, cellulitis, gangrene, peritonitis, osteomyelitis, pneumonitis, bronchopneumonia, carcinoma of the ovaries and uterus, and have been recovered from throat, sputum, tracheal aspirate, urine, blood, ascitic fluid, pleural fluid, pus, bile gallbladder, placenta, wounds, and abscesses (2, 3, 5-9, 12, 14, 16, 17, 20, 22, 23).

Although aeromonads have been isolated from the above sources, they have never been shown to be associated with meningitis. To our knowledge, this is the first documented report of isolation of *A. hydrophila* from a patient with clinical signs of meningitis.

CASE REPORT

A 37-year-old white man was admitted to the emergency room of Ben Taub General Hospital in a comatose state secondary to head trauma with no superficial lacerations. Physical examination revealed dilated and fixed pupils and a left hemiparesis. Cerebral angiogram demonstrated a large right-sided subdural hematoma. The patient was immediately taken to the operating room where 1.5- to 2-cm-thick blood clots in the right subdural space were evacuated by a frontotemporal craniotomy. The patient tolerated the procedure well and was sent to the recovery room in satisfactory condition. There was temporary improvement in the mental status of the patient until postoperative day 4, when a fever of 103 F (39.4 C), mental confusion, and nuchal rigidity developed. Examination of the operative wound showed no signs of infection. A lumbar puncture was performed with opening and closing pressures of 600 and 245 mm water, respectively. The spinal fluid had a hematocrit of 4% with a glucose concentration of 40 mg/ml. Spinal fluid and blood were obtained for microbiological analysis, and gentamicin, 100 mg every 6 h, and carbenicillin, 5 g every 4 h, were administered intravenously. Both the spinal fluid and blood cultures grew *A. hydrophila*, which was susceptible to gentamicin and chloramphenicol but resistant to carbenicillin.

At this time carbenicillin therapy was discontinued, and treatment with chloramphenicol, 1 g every 6 h, was initiated to obtain a better level of the antibiotic in the spinal fluid. In addition, gentamicin, 5 mg, was administered intrathecally once a day for 5 days and then 10 mg every other day over a 6-day period. Subsequent spinal fluid cultures were sterile. During the 2-week course of chemotherapy, there was improvement in mental status, an increase in spinal fluid glucose level from 35 to 81 mg/ml, and a decrease in spinal fluid leukocyte count, from 225 to 24 cells. The patient remained afebrile after treatment with antibiotics was discontinued, and he was discharged on hospital day 18.

MICROBIOLOGICAL STUDIES

For routine examination, the spinal fluid was inoculated onto sheep blood (5%) and MacConkey agar plates, and cystine Trypticase agar (CTA) slants. Blood (10 ml) was inoculated into 100-ml brain-heart infusion (BHI), with 0.1% agar, in a 250-ml prescription bottle. Chocolate agar, blood agar, and BHI bottle, with lossened cap, were kept in a CO_2 incubator; MacConkey agar and CTA slant were kept in a regular incubator. Incubation temperature during all studies, cultural as well as biochemi-

cal, was 35 C. All the above media were positive for bacterial growth within 24 h. BHI and CTA were subcultured on sheep blood and MacConkey agar plates and incubated for the isolation of the organism. All media grew the same organism, which upon microscopy examination appeared as a gram-negative, nonsporulating, short to elongated bacillus occurring singly and in pairs. Colonies on blood agar at 24 h were 1 to 2 mm in diameter, round, opaque, grayish-white, smooth, convex, moist, and beta-hemolytic. MacConkey agar grew non-lactose-fermenting colonies in 24 h. The isolate was indophenol oxidase positive with a freshly prepared 1% aqueous solution of *N*, *N*-dimethyl-*p*-phenylenediamine monohydrochloride.

Biochemical studies were performed in tubes by use of Baltimore Biological Laboratory or Difco standard media and reagents. The results are shown in Table 1.

On the basis of these morphological, cultural, and biochemical characteristics, the isolate was identified as *A. hydrophila*. Antimicrobial susceptibility was tested according to the method of Bauer et al. (1) with Mueller-Hinton agar plates. The bacterium was susceptible to chloramphenicol, colistin, gentamicin, kanamycin, and tetracycline, and resistant to ampicillin, carbenicillin, cephalothin, and penicillin.

Other clinical material, such as urine, sputum, and feces, were cultured on sheep blood (5%) and MacConkey agar plates. None of the specimens yielded growth of *A. hydrophila* at 35 C in 48 h.

TABLE 1. *Biochemical characteristics of the isolate*

Test	Result
Glucose	Acid and gas
Galactose	Acid
Maltose	Acid
Mannose	Acid
Sucrose	Acid
Mannitol	Acid
Lactose	Acid
Raffinose	Negative
Rhamnose	Negative
Salicin	Negative
Adonitol	Negative
Xylose	Negative
Motility	Positive
Citrate utilization	Positive
Malonate utilization	Positive
Voges-Proskauer	Positive
Aesculin hydrolysis	Positive
Indole	Positive
Indophenol oxidase	Positive
Arginine dihydrolase	Positive
Lysine decarboxylase	Negative
Ornithine decarboxylase	Negative
Urease	Negative
Methyl red	Negative
Hydrogen sulfide	Negative

DISCUSSION

The clinical history of this case shows that meningitis developed 4 days after a successful frontotemporal craniotomy. Although the patient's blood culture was positive for *A. hydrophila* and his spinal fluid hematocrit was 4%, a low concentration of spinal fluid glucose, along with classical signs of high fever, mental confusion, and nuchal rigidity, strongly indicated primary meningitis. Isolation of *A. hydrophila* and subsequent disappearance of the organism from spinal fluid after chemotherapy, accompanied by a decrease in leukocyte count and an increase in glucose level, established *A. hydrophila* as the causative agent of meningitis.

A. hydrophila has been implicated in bacteremias in patients with acute myelogenous leukemia, acute lymphatic leukemia, and hepatobiliary disease (9–11, 15, 21). It is believed that treatment of neoplastic disease and administration of antileukemic agents, such as corticosteroids, alkylating agents, folic acid inhibitors, and periwinkle compounds, depress the bone marrow and impair the immunological response of the patient to infection. These drugs are often toxic to the gastrointestinal mucosa and can result in ulceration and increased permeability in a debilitated person with a depressed immune response and an impaired reticuloendothelial system. The damage allows entrance into the portal system of bacteria such as aeromonads that are rarely pathogenic but that can cause bacteremia once they have entered the blood stream. Our case was different in that there was bacteremia due to *A. hydrophila* in a patient who was not immunologically compromised. Since *A. hydrophila* was isolated from the spinal fluid after a craniotomy, we believe that the bacteremia was secondary to a "spillover" from meningitis.

Investigations as to the source of this meningeal infection suggest that *A. hydrophila* was probably introduced during the surgical procedure, because the patient did not have any open wounds or superficial lacerations. *A. hydrophila* did not grow from other clinical material, and none of the other patients in the unit had this bacterium in their clinical specimens.

We reiterate the suggestion made by De Fronzo et al. (10) that the indophenol oxidase test should be routinely performed on all gram-negative facultative bacilli in the diagnostic microbiology laboratory to establish the fre-

quency with which organisms like *Aeromonas* cause human infection.

LITERATURE CITED

1. **Bauer, A. W., W. M. M., Kirby, J. C. Sherris, and M. Turck.** 1966. Antibiotic susceptibility testing by a standardized single disk method. Am. J. Clin. Pathol. 45:493-496.
2. **Beer, H.** 1963. Zur Diagnostik gramnegativer, aerober Stäbchen. Pathol. Microbiol. 26:607-634.
3. **Bulger, R. J., and J. C. Sherris.** 1948. The clinical significance of *Aeromonas hydrophila:* report of two cases. Arch. Intern. Med. 118:562-654.
4. **Camin, J. H.** 1948. Mite transmission of hemorrhagic septicemia in snakes. J. Parasitol. 34:345-354.
5. **Caselitz, F-H., A. Hoffman, and R. Martinez-Silva.** 1958. Unbeschriebener Keim der Familie Pseudomonadaceae als Infektionserreger. Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. 1 Orig. 170:564-570.
6. **Caselitz, F-H., and R. Günther.** 1960. Weitere Beiträge zum Genus *Aeromonas*. Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. 1 Orig. 178:15-24.
7. **Caselitz, F-H., and W. Maass.** 1962. Aeromonastämme als Krankheitserreger, ihre Empfindlichkeit gegenüber Antibiotika und Sulfonamiden. Dsch. Med. Wochenschr. 87:198-200.
8. **Conn, H. O.** 1964. Spontaneous peritonitis and bacteremia in Laennec's cirrhosis caused by enteric organisms. Ann. Intern. Med. 60:568-580.
9. **Dean, H. M., and R. M. Post.** 1967. Fatal infection with *Aeromonas hydrophila* in a patient with myelogenous leukemia. Ann. Intern. Med. 66:1177-1179.
10. **DeFronzo, R. A., G. F. Murray, and W. C. Maddrey.** 1973. Aeromonas septicemia from hepatobiliary disease. Am. J. Dig. Dis. 18:323-331.
11. **Giffird, R. R. M., D. W. Lambe, Jr., S. D. McElreath, and W. R. Vogler.** 1972. Septicemia due to *Aeromonas* hydrophila and Mima polymorpha in a patient with myelogenous leukemia. Am. J. Med. Sci. 263:157-162.
12. **Gilardi, G. L., E. Bottone, and M. Birnbaum.** 1970. Unusual fermentative, gram negative bacilli isolated from clinical specimens. II. Characterization of Aeromonas species. Appl. Microbiol. 20:156-159.
13. **Heuschmann-Brunner, G.** 1965. Ein Beitrag zur Erregerfrage der Infektiosen Bauchwassersucht des Karpfens, p. 41-49. *In* Der Fisch in Wissenschaft und Praxis. Festschrift, herausgegeben anlässlich des 50-jahrigen Bestehens der teichwirtshaftlichen Abteilung Weilenbach der Bayerischen Biologischen Versuchsanstalt (Demoll-Hofer-Institut), Munchen.
14. **Hill, K. R., F-H Caselitz, and L. M. Moody.** 1954. A case of acute, metastatic myositis caused by a new organism in the family Pseudomonadaceae. West Indian Med. J. 3:9-11.
15. **Ketover, B. P., L. S. Young, and D. Armstrong.** 1973. Septicemia due to *Aeromonas hydrophila*. Clinical and immunological aspects. J. Infect. Dis. 127:284-290.
16. **Lopez, J. F., J. Quesada, and A. Saied.** 1968. Bacteremia and osteomyelitis due to Aeromonas hydrophila. A complication during the treatment of acute leukemia. Am. J. Clin. Pathol. 50:587-591.
17. **McCracken, A. W., and R. Barkley.** 1972. Isolation of Aeromonas species from clinical sources. J. Clin. Pathol. 25:970-975.
18. **Miles, A. A., and E. T. Halnan.** 1937. A new species of microorganism (*Proteus melanovogenes*) causing black rot in eggs. J. Hyg. 37:79-97.
19. **Page, L. A.** 1961. Experimental ulcerative stomatitis in King snakes. Cornell Vet. 51:258-266.
20. **Pauchova, V. and A. Fukalova.** 1968. Occurrence of *Aeromonas hydrophila* and *Aeromonas shigelloides* in feces. Zentrabl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. 1 Orig. 206:202-216.
21. **Pearson, T. A., C. A. Mitchell, and W. T. Hughes.** 1972. *Aeromonas hydrophila* septicemia. Am. J. Dis. Child. 123:579-582.
22. **Rosner, R.** 1964. Aeromonas hydrophila as the etiologic agent in a case of severe gastroenteritis. Am. J. Clin. Pathol. 42:402-404.
23. **von Gravenitz, A., and A. H. Mensch.** 1968. The genus Aeromonas in human bacteriology. Report of 30 cases and review of the literature. N. Engl. J. Med. 278:245-249.