Nontypeable *Haemophilus influenzae* as a Cause of Spontaneous Bacterial Peritonitis

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*Haemophilus influenzae* rarely causes spontaneous bacterial peritonitis. We describe a typical case of spontaneous bacterial peritonitis in which the causative organism was identified as nontypeable *H. influenzae*, biotype III. Infection progressed despite the presence of adequate serum bactericidal antibody, probably due to the absence of complement in ascites fluid.

**CASE REPORT**

A 54-year-old former intravenous drug user and alcoholic, known to have chronic hepatitis C infection, presented with 3 days of severe abdominal pain, chills, and fever. He had no symptoms of upper or lower respiratory tract disease. His temperature was 104°F. His skin showed jaundice with spider angiomas. The abdomen was tense and distinctly tender, with peritoneal signs and a fluid wave. His white blood cell count was 8,200 (5% band forms); bilirubin, 2.5 mg/dl; serum glutamic oxalacetic transaminase, 64 units (normal, <45); and albumin, 2.5 mg/dl. His prothrombin and partial thromboplastin times were markedly elevated. Computed tomography showed no pulmonary infiltrates, a shrunken, nodular liver, and a large amount of ascitic fluid. The diagnosis was spontaneous bacterial peritonitis. Because of the abnormal clotting studies, a peritoneal tap was not done. Blood cultures revealed nontypeable *Haemophilus influenzae*, biotype III.

**Bacteriological studies.** The infecting organism grew on chocolate but not blood agar; the colonial appearance and morphology on microscopic examination of a gram-stained specimen were typical for *H. influenzae*. The isolate required X and V factors for growth. On biochemical testing, it was indole and ornithine decarboxylase negative and urease positive. The API NH strip, the 16S rRNA characterization, and traditional biochemicals (done in the Special Pathogens Branch, Centers for Disease Control and Prevention, Atlanta, GA) confirmed the identification of *H. influenzae*, biotype III.

The bactericidal activities of acute- and convalescent-phase sera from the patient were tested against his own isolate, using methods that we have previously described (15). Briefly, the organism was cultivated overnight on chocolate agar at 37°C in an atmosphere containing 5% CO₂. Colonies were removed with a bacteriologic loop and suspended in sterile phosphate-buffered saline to a concentration of about 10^7 CFU per ml. Aliquots were added to brain heart infusion enriched with hemin and NAD to yield about 10^7 CFU per ml in a series of tubes that each contained one of the following: (i) 25% serum from the patient on the day of admission (acute-phase serum), supplemented with 5% fresh rabbit serum to replete complement; (ii) 25% serum obtained from the patient 4 weeks after discharge from the hospital (convalescent-phase serum), supplemented with 5% fresh rabbit serum; (iii) 5% fresh (complement-rich) rabbit serum alone; (iv) 25% acute-phase and (v) 25% convalescent-phase patient serum after heating to 56°C for 20 min to destroy complement; (vi) 25% complement-rich human serum pooled from healthy young adults; or (vii) 25% heat-treated pooled human serum. Samples were incubated at 37°C. Aliquots were removed at hourly intervals for 4 h and diluted serially in phosphate-buffered saline. Ten microliter aliquots were streaked on chocolate agar plates which were then incubated overnight in 5% CO₂. As shown in Fig. 1, the patient’s serum from time of admission exhibited substantial bactericidal activity, and this activity was even greater in convalescence. Rabbit serum alone showed a slight bactericidal effect during the first 2 h of incubation and none thereafter. In contrast, serum from healthy adults was not bactericidal. As expected, heat-treated sera also exhibited no bactericidal activity.

**Discussion.** Spontaneous bacterial peritonitis results from bacterial seeding of preexisting ascitic fluid (5). In adults with cirrhosis, potential sources of the bacteria include the bloodstream, portal venous blood, and lymphatics that drain the bowel. Spontaneous bacterial peritonitis due to *Escherichia coli* is thought to result from an intestinal source, whereas that due to *Streptococcus pneumoniae* has generally been thought to be systemic (5). We (8) recently showed, however, that pneumococcal peritonitis often originates from an intestinal source or, in women, from a genital source.

*Haemophilus influenzae* is a rare cause of spontaneous bacterial peritonitis and has also been assumed to originate from a respiratory source. However, *H. influenzae* has been cultured from feces (13), jejunal fluid (10), and the genital tract (7, 17) of normal persons, as well as from 6% of appendices removed surgically from children with appendicitis (13). Although in most instances, sero- and/or biotyping was not reported, the appendiceal isolates were characterized: 80% were nontypeable, with biotypes II and III predominating. Of course, the

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The assumption that the finding of *H. influenzae* in spontaneous bacterial peritonitis reflects a systemic, rather than an intestinal, origin (19) is probably unfounded. It seems reasonable to consider a gastrointestinal source, especially for a patient who has no evidence for upper or lower respiratory infection.

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**REFERENCES**


17. Salavert, M., A. Oroño, L. Arquitecto, V. Olaso, C. Perez-Belles, and M. Gobernado. 1999. Recurrent spontaneous bacterial peritonitis due to encapsulated microorganisms (*Haemophilus influenzae* and *Streptococcus pneu-
(In Spanish.)
opsonic activity of cirrhotic ascites and nonascitic peritoneal fluid. J. Lab.
21. Stephens, C. G., J. G. Meadows, T. M. Kerkering, S. W. Markowitz, and
R. M. Nisman. 1979. Spontaneous peritonitis due to Hemophilus influenzae
22. Wallace, R. J., Jr., D. M. Musher, E. J. Septimus, J. E. McGowan, Jr., F. J.
Quinones, K. Wiss, P. H. Vance, and P. A. Trier. 1981. Haemophilus influ-
enzae infections in adults: characterization of strains by serotypes, biotypes,
Spontaneous bacterial peritonitis. A review of 28 cases with emphasis on
improved survival and factors influencing prognosis. Am. J. Med. 64:592–
598.