JOURNAL OF CLINICAL MICROBIOLOGY, Jan. 1992, p. 211–213
0095-1137/92/010211-03$02.00/0
Copyright © 1992, American Society for Microbiology
Vol. 30, No. 1

NOTES

Capnocytophaga canimorsus Septicemia Caused by a Dog Bite in a Hairy Cell Leukemia Patient

JOHN A. NDON

Department of Health Sciences, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201

Received 5 August 1991/Accepted 10 October 1991

Fatal septicemia developed in a splenectomized patient with hairy cell leukemia following a dog bite. *Capnocytophaga canimorsus*, a slowly growing gram-negative bacillus, was isolated from the patient's blood. Although a rare complication of dog bites in the normal population, this bacterium should be suspected and promptly treated in immunologically compromised dog bite victims. Furthermore, immunocompromised patients should be made aware of the dangers of dog ownership.

Capnocytophaga canimorsus, formerly called dysgonic fermenter 2 (DF-2), was first described by Butler and colleagues (6) in 1977. It is a gram-negative, filamentous, non-spore-forming, facultative aerobe. This bacterium has been implicated in a broad spectrum of disorders including septicemia, meningitis, and endocarditis following dog bites (3, 5, 6, 11, 14, 16, 19, 21) or recent contact with dogs (22). Splenectomy, alcoholism, and chronic lung disorder (6, 8, 11) have been reported to be significant risk factors. The purpose of this report is to describe a fatal case of fulminant septicemia caused by this unusual microorganism in a patient with hairy cell leukemia (HCL).

A 50-year-old man was diagnosed with HCL in 1980. Therapeutic splenectomy was performed in 1984 because of leukopenia and thrombocytopenia. The patient had remained in relatively good health until May 1990, when he was bitten by the family dog. Three days later he was admitted to the hospital, complaining of fever and diarrhea. Laboratory studies upon admission disclosed the following hematological values: hemoglobin, 13.7 g/dl; hematocrit, 40.0%; leukocyte count, 11.3×10^9/liter, with 2% segmented neutrophils and 98% mononuclear cells (about 88% of the mononuclear cells with characteristics of hairy cells). There were 20 nucleated erythrocytes per 100 leukocytes and many Howell-Jolly bodies in the erythrocytes. In addition, numerous elongated, filamentous-appearing bacteria were seen on the peripheral blood smear (Fig. 1). Platelet count was 250×10^9/liter. A specimen of arterial blood drawn while the patient was receiving an unrecorded mixture of oxygen disclosed that the partial pressure of oxygen (PaO_2) was 58 mm of Hg, partial pressure of carbon dioxide ($PaCO_2$) was 28 mm of Hg, and pH was 7.12. Potassium was 4.1 meq/liter, sodium was 135 meq/liter, chloride was 99 meq/liter, CO_2 was 15 meq/liter, and blood urea nitrogen was 25 mg/dliter. A blood sample was also drawn for microbiological studies at the time of admission. The patient was presumed septic and was promptly treated with intravenous penicillin G at 12 million units per day. Nevertheless, his condition deteriorated and he expired 12 h after admission. Autopsy showed microscopic infarcts of the kidneys and adrenal glands. Gram-negative rods were isolated from the blood in both Bactec 6A aerobic broth and Bactec 6B prereduced, enriched tryptic soy broth. The organism grew on subculture within 48 h on chocolate agar, chocolate Mueller-Hinton agar, and heart infusion agar with 5% rabbit blood in candle jar extinction. There was no growth on MacConkey agar. The organism was oxidase- and catalase-positive but negative for indole, citrate, urease, and nitrate reduction. Disk diffusion tests for antibiotic susceptibility were performed on Mueller-Hinton chocolate agar, and disks were incubated at 35°C in 10% carbon dioxide. The organism was susceptible to penicillin, ampicillin, clindamycin, cephalothin, chloramphenicol, and erythromycin but was resistant to gentamicin, kanamycin, and trimethoprim-sulfamethoxazole. A sample of the bacteria recovered from the patient's blood was sent to the Special Bacteriology Reference Laboratory in the Meningitis and Special Pathogen Branch at the Centers for Disease Control (CDC), Atlanta, Ga., and was identified as *C. canimorsus* (formerly CDC group DF-2). A detailed description of *C. canimorsus* was reported by Brenner et al. (5).

The incidence and seriousness of animal bites is not fully appreciated by the public because little is written about animal bites except for occasional sensational descriptions of fatal or especially serious attacks in news media. Of the estimated one to two million animal bites each year in the United States, 84% are by dogs, 10% are by cats, 4% are by rodents, and the remainder are by other species (2, 20). Even though rabies has been the primary reason for investigating animal bite cases, the injuries caused by animal bites may lead to dangerous bacterial infections such as pasteurellosis and tetanus (12, 20). About 1.6 to 16% of bite wounds inflicted by dogs become infected (25). *Pasteurella multocida* is frequently isolated from such wounds (10, 12). Occasionally, CDC groups EF-4, M-5, II-j, and DF-2 (10) are also isolated. Indeed, our patient was infected by *C. canimorsus*, formerly called DF-2.

Butler and coworkers (6) presented data suggesting that dogs and possibly other animals serve as natural reservoirs of *C. canimorsus*. Bailie and colleagues (1) substantiated Butler's suggestion that this gram-negative rod may be part of the normal canine mouth flora on the basis of their ability to cultivate this bacterium from the oral cavities of 4 of 50 dogs. Martone and coworkers (19) have also been able to isolate the bacterium from a dog which was implicated in the transmission of the infection. The incidence of infection by

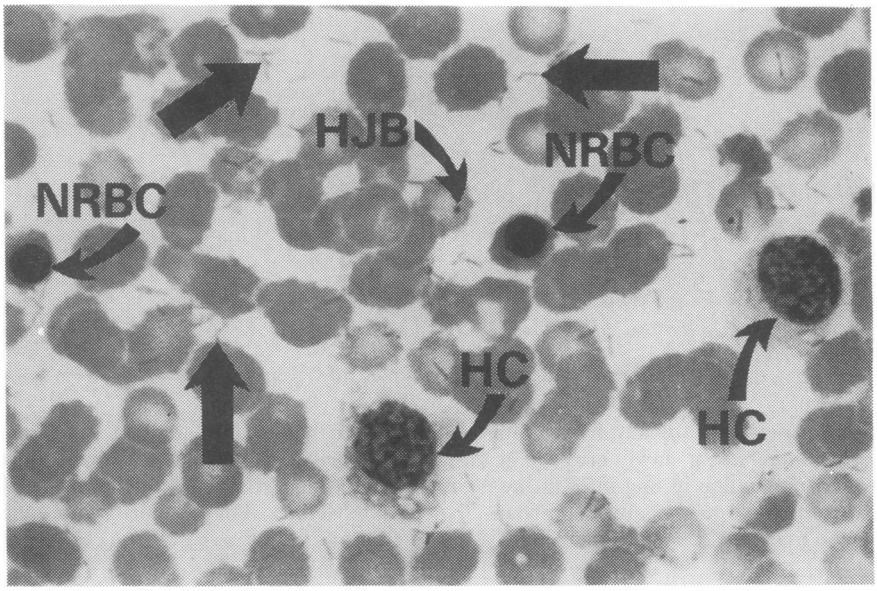

FIG. 1. Peripheral blood smear from a patient with HCL 3 days after a dog bite. Note the presence of abnormal mononuclear cells with ill defined cytoplasmic projections (hairy cells [HC]) and numerous elongated, filamentous-appearing bacteria (large arrows). Also present are nucleated erythrocytes (NRBC) and a Howell-Jolly body (HJB). Wright's stain was used. Magnification, ×1,000.

this microorganism in the general population is unknown. Although *C. canimorsus* has been reported to be the cause of fatal septicemia and meningitis in humans following dog bites or close contact with dogs, the spectrum and frequency of illness caused by the microorganism are probably greater than what has been reported because of the susceptibility of the microorganism to penicillin and the widespread use of this drug after dog bites to combat *P. multocida* (12).

This patient suffered from HCL. HCL is a low-grade lymphoproliferative disorder of B-cell origin characterized by the presence of abnormal mononuclear cells with irregular cytoplasmic projections in the blood (Fig. 1), bone marrow, and other tissues. Its reported frequency is 2 to 5% of all leukemias. The major hematologic manifestation of HCL is pancytopenia, which is a result of two simultaneous problems, hypersplenism secondary to splenic infiltration and bone marrow hypofunction secondary to the bone marrow cell replacement by malignant cells (7). The pancytopenia in these patients is often severe, producing symptoms of anemia, frequent infections, ease of bruising, unusual bleeding, or any combination of these (13). Since hypersplenism contributes to thrombocytopenia, an obvious therapeutic maneuver for symptomatic patients is removal of the spleen (15). Survival of patients with HCL is significantly longer following splenectomy (15). However, it is generally acknowledged that splenectomy, apart from the reason for which it is performed, leads to an increased risk of overwhelming sepsis (17). Moreover, the risk seems to be higher in patients splenectomized for malignant blood disease than for those who have undergone splenectomy for trauma (6, 14). The basis for the association of splenectomy to septicemia is not well understood, but it is thought to revolve around the important role of the spleen in filtering foreign particles from the bloodstream and synthesizing specific antibodies and its involvement in modulation of the alternate complement pathway (17).

Although there are numerous infections associated with HCL (4, 13, 18, 24), I am unaware of any case of *C. canimorsus*. The increased risk for septicemia in the patient described in this article could be due to several factors. The most important was splenectomy, which led to increased risk of septicemia due to impaired clearance of intravascular unopsonized bacteria, low synthesis of specific antibodies, and possible abnormalities of the alternate complement pathway (17). Second, severe monocytopenia and impaired monocytic function, either from intrinsic defect or from lack of chemotactic factors needed for attracting monocytes to sites of inflammation, or the presence of serum inactivators of chemotactic factors, which is a common finding in patients with HCL (9, 23, 26), may have played a role in the aggressive nature of the fatal septicemia in this patient. Third, poor cooperation between neutrophils and the mononuclear cells, which is also a common finding in patients with HCL (26), may also have contributed to the increased susceptibility of this patient to infection.

In conclusion, I report this case of fatal *C. canimorsus* to emphasize that the epidemiologic features of a dog bite coupled with a preexisting condition of splenectomy should alert physicians to suspect this unusual bacterium. Furthermore, since this bacterium grows slowly, laboratories should also be alerted to its potential presence since it otherwise would be either discarded as a contaminant or misidentified. Finally, physicians should inform patients with splenectomy or other immunocompromising conditions that dog ownership or animal contact are important risk factors for *C. canimorsus* infection.

I thank H. Nyien and G. Wawrzyniak for assisting in preparing the manuscript, R. E. Weaver (Centers for Disease Control, Atlanta, Ga.) for identifying the organism, and W. B. Wehrenberg for editorial help.

REFERENCES

1. **Bailie, W. E., E. C. Stowe, and A. M. Schmitt.** 1978. Aerobic bacterial flora of oral and nasal fluids of canines with reference to bacteria associated with bites. J. Clin. Microbiol. **7**:223–231.
2. **Berzon, D. R., R. E. Farber, J. Gordon, and E. B. Kelley.** 1972.

Animal bites in a large city—a report on Baltimore, Maryland. Am. J. Public Health **62**:422–426.
3. **Bobo, R. A., and E. J. Newton.** 1976. A previously undescribed gram-negative bacillus causing septicemia and meningitis. Am. J. Clin. Pathol. **65**:564–569.
4. **Bouza, E., C. Burgaleta, and D. W. Golde.** 1978. Infections in hairy-cell leukemia. Blood **51**:851–859.
5. **Brenner, D. J., D. G. Hollis, G. R. Fanning, and R. E. Weaver.** 1989. *Capnocytophaga canimorsus* sp. nov. (formerly CDC group DF-2), a cause of septicemia following dog bite, and *C. cynodegmi* sp. nov., a cause of localized wound infection following dog bite. J. Clin. Microbiol. **27**:231–235.
6. **Butler, T., R. E. Weaver, T. K. V. Ramani, C. T. Uyeda, R. A. Bobo, J. S. Ryu, and R. B. Kohler.** 1977. Unidentified gram-negative rod infection: a new disease of man. Ann. Intern. Med. **86**:1–5.
7. **Catovsky, D.** 1977. Hairy-cell leukaemia and prolymphocytic leukaemia. Clin. Haematol. **6**:245–268.
8. **Cheek, W.** 1979. An odd link between dog bites, splenectomy. JAMA **241**:225–226.
9. **Dalal, B. I., and L. A. Fitzpatrick.** 1991. Hairy cell leukemia: an update. Lab. Med. **22**:31–36.
10. **Dees, S. B., J. Powell, C. W. Moss, D. G. Hollis, and R. E. Weaver.** 1981. Cellular fatty acid composition of organisms frequently associated with human infections resulting from dog bites: *Pasteurella multocida* and groups EF-4, IIj, M-5, and DF-2. J. Clin. Microbiol. **14**:612–616.
11. **Findling, J. W., G. P. Pohlmann, and H. D. Rose.** 1980. Fulminant gram-negative bacillemia (DF-2) following a dog bite in an asplenic woman. Am. J. Med. **68**:154–156.
12. **Francis, D. P., M. A. Holmes, and G. Brandon.** 1975. *Pasteurella multocida* infections after animal bites and scratches. JAMA **233**:42–45.
13. **Golomb, H. M., D. Catovsky, and D. W. Golde.** 1978. Hairy cell leukemia: a clinical review based on 71 cases. Ann. Intern. Med. **89**:677–683.
14. **Hicklin, H., A. Verghese, and S. Alvarez.** 1987. Dysgonic fermenter 2 septicemia. Rev. Infect. Dis. **9**:884–890.
15. **Jansen, J., and J. Hermans.** 1981. Splenectomy in hairy cell leukemia: a retrospective multicenter analysis. Cancer **47**:2066–2076.
16. **Kalb, R., M. H. Kaplan, M. J. Tenenbaum, G. R. Joachim, and S. Samuels.** 1985. Cutaneous infection at dog bite wounds associated with fulminant DF-2 septicemia. Am. J. Med. **78**: 687–690.
17. **Likhite, V. V.** 1976. Immunological impairment and susceptibility to infection after splenectomy. JAMA **236**:1376–1377.
18. **Manes, J. L., and O. M. Blair.** 1976. Disseminated *Mycobacterium kansasii* infection complicating hairy cell leukemia. JAMA **236**:1878–1879.
19. **Martone, W. J., R. W. Zuehl, G. E. Minson, and W. M. Scheld.** 1980. Postsplenectomy sepsis with DF-2: report of a case with isolation of the organism from the patient's dog. Ann. Intern. Med. **93**:457–459.
20. **Moore, R. M., R. B. Zehmer, J. I. Moulthrop, and R. L. Parker.** 1977. Surveillance of animal-bite cases in the United States, 1971–1972. Arch. Environ. Health **32**:267–270.
21. **Schlossberg, D.** 1979. Septicemia caused by DF-2. J. Clin. Microbiol. **9**:297–298.
22. **Schoen, R. T., D. Wohlgelernter, G. E. Barden, and T. J. Swartz.** 1980. Infection with CDC group DF-2 gram-negative rod. Arch. Intern. Med. **140**:657–658.
23. **Seshadri, R. S., E. J. Brown, and A. Zipursky.** 1976. Leukemic reticuloendotheliosis: a failure of monocyte production. N. Engl. J. Med. **295**:181–184.
24. **Weinstein, R. A., H. M. Golomb, G. Grumet, E. Gelmann, and G. P. Schechter.** 1981. Hairy cell leukemia: association with disseminated atypical mycobacterial infection. Cancer **48**:380–383.
25. **Winkler, W. G.** 1977. Human death induced by dog bites, United States, 1974–75. Public Health Rep. **92**:425–429.
26. **Yam, L. T., A. A. Chaudhry, and A. J. Janckila.** 1977. Impaired marrow granulocyte reserve and leukocyte mobilization in leukemic reticuloendotheliosis. Ann. Intern. Med. **87**:444–446.