JOURNAL OF CLINICAL MICROBIOLOGY, Jan. 1995, p. 202–204 Vol. 33, No. 1
0095-1137/95/$04.00+0

Pasteurella multocida Septicemia and Subsequent *Pasteurella dagmatis* Septicemia in a Diabetic Patient

CAROL JO T. FAJFAR-WHETSTONE, LISA COLEMAN, DIANA R. BIGGS, AND BARRY C. FOX*

Carle Clinic Association, Urbana, Illinois 61801

Received 19 July 1994/Returned for modification 1 August 1994/Accepted 29 September 1994

***Pasteurella* species may cause zoonotic infections of humans. Serious systemic infections with these organisms are unusual, but they may occur in individuals with predisposing underlying illnesses. Occurrences of bacteremia due to *P. multocida* are infrequent, and *P. dagmatis* bacteremia is even rarer. We report independent occurrences of *P. multocida* and *P. dagmatis* septicemia in the same diabetic patient after contact with two pet dogs. We review the history of *Pasteurella* species and discuss the biochemical and clinical features of its association with zoonosis.**

Pasteurella species exist as normal upper respiratory and gastrointestinal flora of dogs, cats, and other domestic and wild animals (1, 5, 13, 21). These organisms are known to be widespread veterinary pathogens (6, 10, 13) and are being recognized as important human zoonotic pathogens (6, 11–13).

Pasteur first isolated the causative agent of fowl cholera, *P. multocida*, in 1880 (19). Thereafter, bacteria with the same growth characteristics were implicated in hemorrhagic septicemia of cattle, in swine plague, and in rabbit septicemia (13). Isolates from all sources with common biochemical and morphological features were grouped together as "*P. septica*" in 1929 and *P. multocida* in 1939 (24). It was not until 1930 that *P. multocida* infection was associated with a cat bite (14).

Reclassification of the members of the genus *Pasteurella* in 1985 (15) resulted in the description of at least 11 species, including *P. multocida* (which comprises three subspecies) and *P. dagmatis* (previously known as *Pasteurella* "gas" and *Pasteurella* new species 1). Four further *Pasteurella* species have more recently been described (22), and biochemical studies have been conducted to relate strains recovered from humans with infections to the described taxa of the *Pasteurella* genus (9).

Human infections caused by *Pasteurella* species are rare but have been reported with increasing frequency over the last few decades (6, 11–13). Life-threatening systemic disease is distinctly uncommon in otherwise healthy persons and usually occurs in patients with chronic predisposing illnesses (23). The spectrum of associated human disease usually involves animal contact (zoonosis), although infections can occur without this association (6). Our case study illustrates that infection with either *P. multocida* or *P. dagmatis* can result from casual contact with household pets and does not require a specific animal bite or scratch trauma. We also review the biochemical and cultural characteristics of these two closely related organisms, the spectrum of associated human disease, and appropriate antibiotic therapy.

Case report. A 51-year-old white male was admitted to the hospital for a 2-day history of fever, chills, and episodes of myalgia. One day prior to admission he noticed increased swelling and erythema of his left leg. The patient had a long-standing history of diabetes and also suffered a frostbite injury to his left foot in 1988. His left great toe had developed a blister from a shoe, and the blister had broken. His long-haired dachshund had attempted to nurse his wound by licking his toe.

On physical examination the patient was febrile to 39.4°C and was hypotensive with a blood pressure of 90/60 mm of mercury. The left leg showed a moderate cellulitis extending from the left great toe to the proximal margin of his knee. A Gram stain from the blister fluid showed no leukocytes and no organisms. Because of the severity of the cellulitis and hemodynamic compromise, the patient was treated with imipenem. Blood cultures were positive for *P. multocida*. The patient's antibiotic treatment was switched to ampicillin, and the patient made an uneventful recovery.

One year later, the patient was hospitalized for fever and chills. The same left great toe had developed a callus, and his Yorkshire terrier had been nibbling on the callus. On physical examination the patient was febrile but not hemodynamically unstable. On the basis of a prior history of *Pasteurella* sepsis or possible streptococcal cellulitis, the patient was treated with high doses of penicillin. Blood cultures were subsequently positive for *P. dagmatis*. With continued penicillin therapy, the patient made an uneventful recovery.

Discussion. The pathogenesis of human *P. multocida* infections has been divided into three groups based on the etiology of the infection (6, 13, 24). The most common consists of local infections following animal trauma (13). Most wounds occur on exposed areas of the body and result from cat and dog bites and scratches (6, 24). Infections generally become symptomatic within 24 h of animal contact, with the appearance of erythema, warmth, tenderness, and purulent discharge (6, 24). The most common complication is abscess formation and tenosynovitis (24). Although the majority of infections remain localized to the areas of penetration, serious systemic infection may develop with the presence of underlying chronic diseases (6, 13).

The second group of *P. multocida* infections includes those associated with atraumatic animal exposure in patients who had only casual exposure to farm animals or household pets (6). The most common site of infection in these cases is the respiratory tract, in patients with underlying chronic respiratory diseases (6, 13, 24). *P. multocida* can survive in soil for up to 21 days and has been isolated from water (13). Respiratory infections result from airborne or vector contact with the organism (6). *P. multocida* may exist as part of the flora of the upper respiratory tract, lying dormant until trauma, infection,

* Corresponding author. Mailing address: Carle Clinic Association, 602 W. University Ave., Urbana, IL 61801.

or some other disruption of the host's immune system provides the opportunity for secondary infection (13).

The third group of *P. multocida* infections includes those cases not associated with animal exposure which result in a variety of systemic infections, including bacteremia, meningitis, brain abscesses, spontaneous bacterial peritonitis, or intraabdominal abscesses (6, 13, 24). Even when evidence for animal exposure is lacking, it is still believed that an animal reservoir is the major source of *P. multocida* infections. It is unknown whether the organism can be transmitted from animal secretions, urine, or feces (6).

Only about half of the patients with systemic disease have given histories of animal contact (13). *P. multocida* may act as an opportunistic pathogen causing bacteremia in patients with underlying respiratory tract abnormalities or liver dysfunction, meningitis in the very young or elderly, or septic arthritis in damaged tissue (24). There is evidence suggesting that the upper respiratory tract is the source of *P. multocida* in systemically infected patients, since it is occasionally present as a commensal of upper respiratory flora, and person-to-person spread may occur (6, 13).

Positive blood cultures from this patient were detected with a Bactec NR-660 (Becton Dickinson, Cockeysville, Md.). The aerobic blood bottles became positive after 24 h, with the anaerobic bottle positive after 48 h of incubation. The Gram stain revealed small, gram-negative coccobacilli. *Pasteurella* organisms frequently show marked bipolar Gram staining. Blood, chocolate, CDC, and MacConkey agar plates were inoculated with blood. After 24 h of incubation in 5% CO_2, small, gray, translucent, nonhemolytic colonies which had a musty odor were observed on the plates, with no growth detected on MacConkey agar.

In the first infection, the organism was found to be indole, catalase, and oxidase positive. The Vitek database (bioMerieux Vitek, Inc., Hazelwood, Mo.) was employed to identify the organism, which resulted in an implicit identification of *P. multocida*. *P. multocida* is further found to reduce nitrates to nitrites, is H_2S positive and urea negative, and produces acid in glucose and sucrose and generally in mannitol, xylose and sorbitol (13). Lactose, maltose, salicin, and adonitol are generally not fermented.

In the second infection, the Vitek database was unsuccessful in identifying the organism. The API 20E system (bioMerieux Vitek, Inc.) and RAP NF Plus system (Innovative Diagnostic Systems, Inc., Norcross, Ga.) were both unable to identify the organism as well; therefore, standard biochemical tests (2) (i.e., catalase reaction, citrate reaction, indole-nitrate broth, motility test, oxidation-fermentation medium, oxidase test, triple sugar iron agar-lead acetate paper, and urea agar) were performed. These standard tests yielded reactions consistent with the presence of *P. multocida*, but the urea slant was positive, indicating that the organism was *P. dagmatis*. The identity was confirmed by the State of Illinois Department of Public Health Laboratory as *Pasteurella* new species 1 (*Pasteurella* "gas"), i.e., *P. dagmatis*. Most commercially available identification systems are not useful for differentiating *P. multocida* from *P. dagmatis*, since *P. dagmatis* is not in the existing database. It is interesting that an excellent identification of *P. multocida* would have been obtained with the API 20E system in this case had the result of the urease test been negative. The colony morphologies of the two *Pasteurella* species are sufficiently similar that further biochemical tests are necessary for identification and differentiation. One must also consider the possibility of a mixed infection with these two organisms (25); thus, it is recommended that more than one colony be checked for urease activity to avoid overlooking the presence of urease-negative *P. multocida.*

Penicillin is the drug of choice for *P. multocida* infections, with the organisms being inhibited by concentrations of 0.19 to 0.39 μg/ml (7, 18, 20). Chloramphenicol, tetracycline, ampicillin, and carbenicillin are alternative drug therapies in cases of penicillin allergy (4, 8). *P. multocida* is generally susceptible to the extended- and broad-spectrum cephalosporins (4), oral cephalosporins. Semisynthetic penicillins and erythromycin are poor choices for treatment or prophylaxis of *P. multocida* infections (4). *P. multocida* is also resistant to vancomycin and clindamycin (18), and rare penicillin-resistant strains have been reported (16, 18); thus, susceptibility testing of isolates is recommended.

Penicillin is a good choice in cases of animal bite prophylaxis, since its spectrum includes both *P. multocida* and *P. dagmatis*, streptococci, and most canine mouth anaerobes. Amoxicillin-clavulanic acid (Augmentin; Smith-Kline-Beecham) is an alternative drug with a broader antimicrobial spectrum.

There is scant literature regarding the drug sensitivity patterns of *P. dagmatis*, but our studies indicate that the MIC patterns are relatively consistent with those of *P. multocida*. The penicillin MIC we obtained for *P. dagmatis* was 0.06 μg/ml by microtiter broth dilution susceptibility testing (Microscan; Baxter, West Sacramento, Calif.).

Animal contact clearly was the source of *P. multocida* and *P. dagmatis* infection in our case study, and the patient had a preexisting chronic medical illness. Both diabetes mellitus (17) and corticosteroid therapy (3), which are associated with impaired inflammatory response, can cause a predilection for *P. multocida* infection. *Pasteurella* septicemia should be suspected in immunocompromised patients with a history of direct animal exposure, and appropriate antimicrobial therapy should be instituted.

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