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Unexpected Isolation of *Bordetella pertussis* from a Blood Culture

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***Bordetella pertussis* was isolated from a culture of blood from a 31-year-old man with Wegener's granulomatosis. The organism was detected with the BACTEC 9240 system after 6 days of incubation and was confirmed as *B. pertussis* by the Centers for Disease Control and Prevention. To our knowledge, this is the first published report of the recovery of *B. pertussis* from blood.**

Bordetella pertussis is a fastidious gram-negative coccobacillus that causes the classical disease whooping cough (3). The organism is acquired by droplet infection and may be spread from person to person by this route. Upon infection, *B. pertussis* preferentially attaches to the ciliated epithelium of the upper respiratory tract, where the organism grows and elaborates a variety of virulence factors, including pertussis toxin, adenylate cyclase, tracheal cytotoxin, a heat-labile dermonecrotic toxin, and lipopolysaccharide (3, 5). These virulence factors are believed to play key roles in the pathogenesis of clinical pertussis. The laboratory diagnosis of pertussis depends upon culture and isolation of the organisms from nasopharyngeal swabs collected early in the course of the disease (15). While direct fluorescent-antibody (DFA) detection of the organisms is helpful, negative DFA results do not rule out a diagnosis of pertussis and culture for the organism is necessary (6, 9). Recovery of *B. pertussis* in culture is compromised by the fastidious nature of the organism, its susceptibility to toxic materials, and impurities in routine culture media. The addition of potato-derived starch (Bordet-Gengou agar) or activated charcoal (Regan-Lowe agar), along with horse or sheep blood, is necessary to neutralize these inhibitory substances (6, 11, 12, 14, 16, 18). Because of these inherent difficulties with the culture and recovery of *B. pertussis*, recent research in this area has focused on the detection of the organism or its components directly in nasopharyngeal specimens by immunologic or molecular techniques, including enzyme immunoassays, cytotoxicity assays, dot blot techniques, or PCR (3, 4, 7, 8, 10).

B. pertussis is not recognized as an intrinsically invasive organism in that the clinical manifestations of pertussis presumably are due to the systemic effects of the toxins that are produced by the organism locally and that are absorbed systemically (2, 5). In this case presentation, we report the recovery of *B. pertussis* from a culture of blood from a compromised host. To our knowledge, this is the first and only report of the isolation of this organism from blood.

The patient was a 31-year-old Hispanic male who came to the hospital emergency room with complaints of progressive shortness of breath, intermittent fever with chills, wheezing, and a nonproductive cough. Initially, the patient complained of dyspnea on exertion that gradually worsened. The patient denied chest pain, hemoptysis, sore throat, abdominal pain, nausea, vomiting, and diarrhea. The patient's past medical history was significant for Wegener's granulomatosis (diagnosed in 1987), asthma, hypertension, chronic renal insufficiency, nephrolithiasis (with lithotripsies performed in 1985 and 1987), and bilateral hydronephrosis. The patient smoked one-half pack of cigarettes per day for an undisclosed duration, denied alcohol and drug abuse, and had no known food or drug allergies. He previously had been treated with prednisone (15 mg/day), the antianginal drug nifedipine (30 mg/day), and cyclophosphamide (50 mg twice a day), but he had not been taking any medication for the last 9 months.

On physical examination, the patient was alert and oriented but in moderate respiratory distress. His blood pressure was 160/110 mm Hg, his heart rate was 130 beats per min, his respiratory rate was 30/min, and his temperature was 98.2°F (36.8°C). The conjunctivae were pink, while the sclera were icteric. The neck was soft and supple with mild elevation of the jugular venous pressure; no oropharyngeal erythma or lymphadenopathy was noted. Cardiac examination revealed S1 and S2 heart sounds, increased regular rate and sinus rhythm, and no audible murmurs. There was an upper right posterior chest scar, which was the entry site for a previous lung biopsy. Chest auscultation revealed diffuse bilateral wheezing along with fair air entry and dry crackles primarily in the left lung fields. The abdomen was soft and nontender, with active bowel sounds and no hepatosplenomegaly. There was no clubbing, cyanosis, or edema in the extremities. Pertinent laboratory data on admission included the following: blood urea nitrogen (BUN), 103 mg/dl; creatinine, 15.2 mg/dl; sodium, 142 mmol/liter; potassium, 4.7 mmol/liter; chloride, 103 mmol/liter; bicarbonate, 15 meq/liter; arterial blood gas pH, 7.25; partial CO_2 pressure, 35 mm Hg; partial O_2 pressure, 189 mm Hg; hemoglobin, 8.6 g/dl; hematocrit, 24.5%; leukocyte count 23,200/mm^3 (polymorphonuclear cells, 82%; lymphocytes, 13.5%; monocytes, 3.9%); mean corpuscular volume, 87 fl; and platelet count, 376,000/mm^3. Electrocardiographic studies showed sinus tachycardia with left ventricular hypertrophy and strain as well as nonspecific ST-T wave changes. Chest radiography revealed right lower lung infiltrates, the absence of cardiomegaly, a cavitary bleb in the right middle lobe, and sutures from a previous surgery in the right upper lobe.

On admission, albuterol treatment with oxygen supplementation was started to alleviate respiratory distress and to prevent bronchospasm. A sample of blood for culture was

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drawn, and the patient was begun on ceftizoxime and erythromycin. That night, the patient decompensated and required intubation because of severe respiratory acidosis. Gentamicin was added to the antibiotic regimen because of leukocytosis, and methylprednisolone and cyclophosphamide were also administered for treatment of the Wegener's granulomatosis. Slow rehydration was given because of renel insufficiency, as reflected in the BUN and creatinine levels. Renal ultrasound showed bilateral renal hydronephrosis (right greater than left). The patient underwent dialysis once as per a nephrology service consultation. The patient's condition gradually deteriorated until he experienced cardiopulmonary arrest and died on the third hospital day. Permission for autopsy was not obtained.

The single blood specimen collected for culture was inoculated into BACTEC Plus aerobic/F medium and BACTEC standard anaerobic F medium (Becton Dickinson Diagnostic Instrument Systems, Sparks, Md.). The bottles were placed into the BACTEC 9240 continuous-monitor blood culture system. On the sixth day of the 7-day incubation period routinely used for blood cultures in the laboratory, growth was detected by the BACTEC instrument in the aerobic bottle only. On Gram staining, very small pale-staining gram-negative coccobacilli were noted. The blood culture bottle was subcultured onto sheep blood agar, chocolate agar, and MacConkey agar (MicroDiagnostics, Lombard, Ill.), which were incubated at 35°C in a 5 to 7% CO_2 atmosphere according to the routine laboratory protocol. No growth was noted on these plates after 48 h. Because of the failure of the organism to grow on routine media, the aerobic blood culture broth was subcultured onto buffered charcoal-yeast extract (BCYE) agar in addition to sheep blood and chocolate agar media. After incubation in a candle jar at 35°C, small colonies were noted to be growing on the BCYE medium after 48 h. The organism failed to grow on subculture of a sample from the anaerobic blood culture bottle to the same sets of media. By repeated subculture of the growth from the BCYE plate onto additional BCYE agar plates and onto the routine media, good growth of the isolate eventually was obtained on both blood and chocolate agar media, but not on MacConkey agar, after incubation for 48 h at 35°C in a candle extinction jar. The organism was oxidase positive and catalase positive and did not produce urease or reduce nitrate to nitrite. No growth was detected on Kligler iron agar slants or tryptic soy agar plates supplemented with X and V factors. No growth occurred when media were incubated under anaerobic or microaerophilic conditions. The organism was negative when tested with a DFA reagent for *Legionella pneumophila* serotypes 1 to 14 (Genetic Systems Corp., Chaska, Minn.). The organism was subcultured onto a BCYE agar slant and was sent to the Illinois Department of Public Health Division of Laboratories (Chicago) for identification. The state reference laboratory forwarded the isolate to the Centers for Disease Control and Prevention (Atlanta, Ga.). The Centers for Disease Control and Prevention reported the organism as *B. pertussis*, with 4 + fluorescence by the direct immunofluorescence procedure.

Studies on the epidemiology of *B. pertussis* during the 1980s have shown an actual increase in the incidence of reported cases of pertussis; these increases were most pronounced among adolescents and adults (2). Atypical respiratory tract infections in previously immunized adults may represent pertussis disease that is ameliorated or modified in its clinical presentation by low or waning levels of protective antibodies (2). Since our patient died some time before the identity of the isolate was confirmed, an immunization history for pertussis was not obtained and serum from the patient was not available to determine the titer of anti-*B. pertussis* antibodies. *B. pertussis* has also been recovered incidentally from respiratory tract specimens obtained from patients with AIDS (17). The patient in this case report was not tested for the presence of human immunodeficiency virus type 1 or 2 infection. However, he was a compromised host because of Wegener's granulomatosis, which is believed to be an autoimmune condition that is associated with chronic pneumonia and the development of pulmonary nodules and cavitary lung lesions of a noninfectious etiology (1). Because of this condition, he was being treated with methylprednisolone and cyclophosphamide, which are anti-inflammatory agents that are also immunosuppressive. After the blood for culture was collected, the patient was started on ceftizoxime and erythromycin, the latter of which has demonstrated activity against *B. pertussis* (13). Although our isolate did not grow in microdilution antimicrobial susceptibility panels (Pasco, Detroit, Mich.) with Mueller-Hinton broth supplemented with laked horse blood or Fildes enrichment, very large zones of growth inhibition were observed around standard erythromycin (zone, 38 mm), ceftizoxime (zone, 32 mm), and gentamicin (zone, 30 mm) diffusion disks after 48 h of growth on Mueller-Hinton agar containing 5% sheep blood (MicroDiagnostics, Lombard, Ill.). It is difficult to ascertain how this organism made its way into the bloodstream and whether the presence of this organism contributed to the relatively rapid downward clinical course and eventual demise of the patient.

The recovery of *B. pertussis* from the single blood culture collected from this patient was indeed unexpected. The pale staining appearance and the coccobacillary morphology of the organisms observed on Gram staining suggested that the organism could have been a *Brucella* spp. or *Franciscella* spp. However, failure of the organism to grow on routine agar media after the BACTEC system detected growth made *Brucella* spp. a less likely possibility since, in our experience, these organisms grow well, albeit slowly, on routine blood and chocolate agars. *B. pertussis* is also known to be very susceptible to inhibition by toxic materials in swabs and in components of bacteriologic media (3, 16). The presence of resins for the inactivation of antimicrobial agents and other inhibitory materials in the BACTEC Plus aerobic/F blood culture bottle may also have helped in the recovery of this organism by adsorbing or inactivating inhibitory substances. It is interesting to speculate whether the formulations of blood culture media and/or the detection systems used in the past were of sufficient sensitivity to recovery this fastidious bacterium from blood cultures of infected individuals. A Medline literature search of reports published between January 1966 and March 1994 failed to yield any published reports of this organism in blood cultures from either adults or children. Therefore, we believe the present case study is the first report of the recovery of *B. pertussis* from cultures of blood to appear in the medical literature.

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