sulfamethoxazole.[11] Treatment with chloramphenicol is not appropriate for otitis media.

I am grateful to the many microbiologists who shared their records and to Helen Kizyma, who assisted in preparing the manuscript. Participating in the study were Dr. Charles A. Janeway Child Health Centre, St. John's (Mr. J. Fleming), the division of laboratories, Department of Health and Social Services, Prince Edward Island, Charlottetown (Dr. J. Craig and S. MacNair), Saint John Regional Hospital (M.E. Crowley), Centre hospitalier universitaire de Sherbrooke (Drs. D. Bourgaux and V.J.H. Marchessault), Centre hospitalier de l'université Laval, Quebec (Dr. P. Déry), Montreal Children's Hospital (Mr. S. Sorger), hôpital Sainte-Justine, Montreal (Dr. J.-R. Lapointe), Children's Hospital of Eastern Ontario, Ottawa (Dr. A.M.R. MacKenzie), Victoria Hospital Corp., London (Dr. E.W.R. Campsall), Health Sciences Centre, Winnipeg (Dr. W.L. Albritton and L. Slaney), University Hospital, Saskatoon (Mr. T. Martin), University of Alberta Hospital, Edmonton (Drs. J. Gilpin, J.L. Brunton and R.P.B. Larke), Edmonton General Hospital (Dr. D.M.K. Williams and Y. Fahli), Charles Camsell General Hospital, Edmonton (Dr. J. Nigrin), Vancouver General Hospital (Dr. J.A. Smith), Children's Hospital, Vancouver (Mrs. S. Damm) and Whitehorse General Hospital (Ms. A. Grauwiler).

References

1. THOMAS WJ, MCREYNOLDS JW, MOCK CR, BAILEY DW: Ampicillin-resistant *Haemophilus influenzae* meningitis. *Lancet* 1974; 1: 313
2. FLEMING PC, MARKOWSKY B: Recent emergence of ampicillin-resistant strains of *H. influenzae* type B and their rapid detection by an iodometric method (abstr). *Can J Public Health* 1975; 66: 40
3. SCHEIFELE DW: Ampicillin-resistant *Haemophilus influenzae* in Canada: nationwide survey of hospital laboratories. *Can Med Assoc J* 1979; 121: 198, 201, 202
4. BRYAN LE: Transferable chloramphenicol and ampicillin resistance in a strain of *Haemophilus influenzae*. *Antimicrob Agents Chemother* 1978; 14: 154–156
5. Canadian Paediatric Society, infectious disease and immunization committee: Ampicillin-resistant strains of Hemophilus influenzae. *Can Med Assoc J* 1975; 113: 222, 227
6. KENNY JF, ISBURG CD, MICHAELS RH: Meningitis due to *Haemophilus influenzae* type b resistant to both ampicillin and chloramphenicol. *Pediatrics* 1980; 66: 14–16
7. KAPLAN SL, MASON EO JR, KVERNLAND SJ, LOISELLE EM, ANDERSON DC, MINTZ AA, FEIGIN RD: Pharmacokinetics and cerebrospinal fluid penetration of moxalactam in children with bacterial meningitis. *J Pediatr* 1981; 98: 152–157
8. CORDERA CS, PEKAREK RS: Treatment of experimental *Haemophilus influenzae* type b meningitis with 1-oxa-β-lactam (LY 127935). *Antimicrob Agents Chemother* 1980; 17: 258–262
9. SCHEIFELE DW, FUSSEL SJ: Ampicillin-resistant *Haemophilus influenzae* colonizing ambulatory children — epidemiology and implications for otitis media therapy. *Am J Dis Child* 1981; 17: 406–409
10. HOWIE VM, PLOUSSARD JH, LESTER RL: Otitis media: a clinical and bacteriological correlation. *Pediatrics* 1970; 45: 29–35
11. MICHAELS RH: Ampicillin-resistant *Haemophilus influenzae* and otitis media. *Am J Dis Child* 1981; 17: 403–405

Legionella longbeachae pneumonia diagnosed by bronchial brushing

S. LAM, MD, FRCP[C]
J.A. SMITH, MD, FRCP[C]
J.D. BURTON, MD, CERT PATH
R.G. EVELYN, MD, FRCP[C]
B. HARPER, B SC
V. HUCKELL, MD, FRCP[C]
E.A. JONES, MD

In the last 5 years a group of gram-negative bacilli have been identified as causative agents in several etiologically obscure infections usually presenting as pneumonias. The best known is *Legionella pneumophila*, of Legionnaires' disease fame. During the short period since its isolation[1] four other *Legionella* species have been implicated in pneumonia in humans: *L. bozemanii*,[2] *L. micdadei*,[3] *L. dumoffii*[2] and *L. longbeachae*.[4] The last was the most recently described, being isolated in 1980 and reported by McKinney and coworkers in June 1981.[4] The geographic distribution of infection due to the various species is not yet known. We describe the clinical and pathological features of a patient with pneumonia from whose bronchial brushing *L. longbeachae* was isolated. This is the first recognized isolation of this organism in Canada.

From the departments of medicine, microbiology and pathology, Vancouver General Hospital, and the University of British Columbia, Vancouver

Reprint requests to: Dr. S. Lam, Department of medicine, Vancouver General Hospital, 855 W 12th Ave., Vancouver, BC V5Z 1M9

Case report

Clinical course

A 69-year-old man presented to the Vancouver General Hospital after 3 days of profound weakness, malaise, sweating and anorexia. He also complained of a mild headache and a cough producing a little white mucoid sputum. The day before admission slurred speech, visual hallucinations and urinary incontinence had developed. He had had western equine encephalitis 10 years before and mild hypertension. Five years earlier his renal function had been found to be normal, with a serum creatinine level of 0.9 mg/dl (80 μmol/l). He was a nonsmoker, had no history of diabetes mellitus and had been working as a security guard.

He was cyanotic and tachypneic, with a temperature of 40°C, a pulse rate of 139 beats/min and a blood pressure of 140/70 mm Hg. He was unresponsive to verbal commands and showed flexion responses to painful stimuli only; the deep tendon reflexes were exaggerated, and the plantar response was equivocal.

Levels of serum constituents were as follows: glucose 310 mg/dl (17.2 mmol/l), lactic dehydrogenase 396 (normally 90 to 210) IU/l, creatine kinase 366 (normally 20 to 120) IU/l, urea nitrogen 62 mg/dl (urea 21.4 mmol/l) and creatinine 2.2 mg/dl (194 μmol/l). Urinalysis showed more than 50 erythrocytes per high power field, and a 24-hour urine collection contained 1.82 g of protein. The blood leukocyte count was 12 × 10⁹/l (55% band forms, 36% neutrophils, 6% monocytes, 2% lymphocytes and 1% metamyelocytes), the platelet count was normal and the prothrombin time was 15.2 (control time 10.5 to 12.5) seconds. Electrocardiography revealed right bundle branch block. The sputum and the endotracheal aspirate contained pus, but no bacteria could be cultured. A chest roentgenogram revealed consolidation of the right upper lobe and a patchy infiltrate in the right middle lobe. The arterial blood gas values while the patient was breathing 5 litres of oxygen per minute were: pH 7.08, carbon dioxide tension (P_{CO_2}) 80 mm Hg and oxygen tension (P_{O_2}) 46 mm Hg.

The patient became hypotensive and oliguric less than 2 hours after admission, so an endotracheal tube was inserted and mechanical ventilation begun. He was resuscitated from shock before a third hour had passed. The cerebrospinal fluid was normal, ruling out meningitis and encephalitis. Therapy with ampicillin and gentamicin was started.

The following morning pneumonia due to *Legionella* was considered. Fibreoptic bronchoscopy and brushing of the right upper lobe were performed with a telescoping double catheter having a distal plug (Meditech, Cooper Scientific Corporation, Watertown, Massachusetts). The bronchial brushing was directly plated on charcoal–yeast extract (CYE) agar plates. The ampicillin was discontinued and erythromycin, 1 g intravenously every 6 hours, substituted.

On the third hospital day, because of progression of the pneumonia and worsening of the arterial hypoxemia (Po_2 82 mm Hg, fractional intake of oxygen 0.9 and positive end-expiratory pressure 5 cm H_2O), a Swan–Ganz catheter was inserted; it revealed pulmonary hypertension and a significant right-to-left shunt. Cefoxitin, 1 g intravenously every 6 hours, was added to the regimen.

On the eighth hospital day the patient's temperature was normal, he was more alert and there was radiologic evidence that the pneumonia had partially resolved. However, his pulmonary hypertension worsened, his tracheobronchial secretions became bloody, and we obtained laboratory evidence of disseminated intravascular coagulation: prolonged prothrombin, partial thromboplastin and thrombin times, a high level of fibrin-split products in the serum (1:160 being the highest dilution yielding the reaction) and a platelet count of only 64×10^9/l.

By the 10th day the infection also involved the left lung, and on the right side a cavity in the upper lobe and pneumothorax had developed. The patient died on the 25th hospital day of severe hypoxemic respiratory failure and sudden cardiac arrest.

Bacteriologic findings

A *Legionella*-like organism was isolated from bronchial secretions on CYE agar after 18 hours of incubation, but there was no growth on blood or chocolate agar incubated at 36°C in air with 5% carbon dioxide. On the CYE plates large runny, mucoid, grey-white colonies appeared. The long, narrow, gram-negative rods were catalase- and gelatinase-positive. Beta-lactamase production was detected by the chromogenic cephalosporin test. The organisms showed in vitro susceptibility to erythromycin, gentamicin, vancomycin and chloramphenicol, and were identified at the Centers for Disease Control in Atlanta, Georgia as *L. longbeachae*, serotype 1 by the direct immunofluorescence technique. The indirect fluorescent antibody titre in serum was 1:256 to this species the day after admission and 1:128 2 days before death. The corresponding titres for *L. pneumophila*, obtained with polyvalent sera, were 1:128 and 1:64.

Autopsy findings

The lungs were very firm and heavy, each weighing approximately 1100 g. The right lung showed fibrinous pleuritis and a pneumatocele between the upper and middle lobes; this space contained old blood and debris, from which *Legionella* and *Proteus mirabilis* were grown. An abscess in the right upper lobe also grew *Proteus*. Microscopically the predominant finding was organizing pneumonia; areas of infarction, a few abscesses and focal areas of acute pneumonia were also present. Dieterle silver-impregnation staining revealed a few bacilli interpreted as *Legionella*, but the overgrowth by *Proteus* had to be considered. There were several microabscesses in the kidneys, but Gram-staining failed to reveal any organisms.

Discussion

While there is an extensive literature on the epidemiologic, clinical and pathological features of *L. pneumophila* infection, less is known about the other species of *Legionella*. This is the first recognized isolation of *L. longbeachae* outside the United States.

Our patient's illness shared features with the sporadic cases of Legionnaires' disease reported by Gregory and associates:[5] severe pneumonia with high fever and multisystem involvement; in this case the central nervous system, kidneys, liver, heart and pancreas were affected. Unusual were the pneumatocele in our patient's lung and the microabscesses in his kidneys. The pneumatocele may have resulted from the positive pressure ventilation.

This case illustrates the importance of bacteriologic studies in establishing the diagnosis. The existence of at least five *Legionella* species and several serotypes within each species limits the sensitivity of available immunologic techniques. Even for the best studied of this group of organisms the sensitivity of direct immunofluorescence examination is only 62% and that of indirect immunofluorescence studies 75%.[6] The sensitivity would be still lower if polyvalent sera were not available. *Legionella* has been cultured from sputum, transtracheal aspirate, blood, lung tissue and pleural fluid, but sputum specimens are usually not considered appropriate because of rapid overgrowth of oral flora on CYE plates. Fibreoptic bronchoscopy and brushing with a telescoping double catheter having a distal plug may be a simple and safe method of obtaining uncontaminated secretions that are suitable for culturing these organisms. Bronchial brushing and direct plating on CYE medium avoids dilution of the specimen by the saline necessary in bronchial washing and transtracheal aspiration. The protected brush catheter has been useful in diagnosing other lower respiratory tract infections.[7,8]

Despite prompt diagnosis and early therapy with erythromycin, cefoxitin and gentamicin — all of which were effective in vitro — our patient died. Although *L. longbeachae* is less susceptible to erythromycin than *L. pneumophila* in vitro, an inhibitory serum concentration of this drug is still achievable.[4] The correlation of in vitro results with clinical response, however, has not yet been established. The course of the disease in our patient illustrates its seriousness and our poor understanding of its pathogenesis. It is probable that many cases caused by even the known species of *Legionella* still escape firm diagnosis.

References

1. MCDADE JE, SHEPARD CC, FRASER DW, TSAI TR, REDUS MA, DOWDLE WR: Legionnaires' disease. Isolation of a bacterium and demonstration of its role in other respiratory diseases. *N Engl J Med* 1977; 297: 1197–1203

2. BRENNER DJ, STEIGERWALT AG, GORMAN GW, WEAVER RE, FEELEY JC, CORDES LG, WILKINSON HW, PATTON C, THOMASON BM, LEWALLENSASSEVILLE KR: Legionella bozemanii sp. nov. and Legionella dumoffii sp. nov. Classification of two additional species of Legionella associated with human pneumonia. *Curr Microbiol* 1980; 4: 111–116

3. HERBERT GA, STEIGERWALT AG, BRENNER DJ: Legionella micdadei species nova. Classification of a third species of Legionella associated with human pneumonia. *Curr Microbiol* 1980; 3: 255–257

4. MCKINNEY RM, PORSCHEN RK, EDELSTEIN PH, BISSETT ML, HARRIS PP, BONDELL SP, STEIGERWALT AG, WEAVER RE, EIN ME, LINDQUIST DS, KOPS RS, BRENNER DJ: *Legionella longbeachae* sp. nova, another etiologic agent of human pneumonia. *Ann Intern Med* 1981; 94: 739–743

5. GREGORY DW, SCHAFFNER W, ALFORD RH, KAISER AB, MCGEE ZA: Sporadic cases of Legionnaires' disease: the expanding clinical spectrum. *Ann Intern Med* 1979; 90: 518–521

6. EDELSTEIN PH, MEYER RD, FINEGOLD SM: Laboratory diagnosis of Legionnaires' disease. *Am Rev Respir Dis* 1981; 121: 317–327

7. WIMBERLEY N, FALING LJ, BARTLETT JG: A fiberoptic bronchoscopy technique to obtain uncontaminated lower airway secretions for bacterial culture. *Am Rev Respir Dis* 1979; 119: 337–343

8. BOYD BW, WIMBERLEY NE, BASS JB JR: A new fiberoptic bronchoscopy technique for diagnosis of pulmonary infections: clinical results in 50 patients (abstr). *Am Rev Respir Dis* 1980; 121 (suppl): 114