

Hot Tub Legionellosis

Legionnaires' Disease and Pontiac Fever After a Point-Source Exposure to *Legionella pneumophila*

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L*egionella pneumophila* is associated with outbreaks of either Pontiac fever, a self-limited influenzalike condition without pneumonia, or Legionnaires' disease, a severe pneumonic disease affecting elderly or immunocompromised individuals. An outbreak of both Legionnaires' disease and Pontiac fever after a point-source exposure to *L pneumophila* was studied. Our observations demonstrated the spectrum of illness that *L pneumophila* may cause and emphasized the importance of host factors in affecting the expression of infection.

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In January 1991, six undergraduate students experienced febrile illnesses while vacationing at a Vermont resort. In this report, we describe this outbreak and the clinical course of the index patient, who had Legionnaires' disease.

REPORT OF A CASE

A 21-year-old man with well-controlled insulin-dependent diabetes mellitus presented to The Johns Hopkins Hospital, Baltimore, Md, on January 19, 1991. While vacationing at a ski resort with five other college students, he had had an acute onset of high fever, myalgias, and pleuritic chest pain.

His temperature was 38.6°C, his heart rate was 90 beats per minute, and his respiratory rate was 32/min. Fine inspiratory crackles and egophony were noted in the right, posterior lung fields. A chest roentgenogram showed an interstitial infiltrate in the right lower lobe. Laboratory analysis showed the following values: white blood cells, $14.0 \times 10^9/L$, with 0.36 band forms, 0.44 segmented neutrophils, 0.07 lymphocytes, 0.10 monocytes, and 0.03 eosinophils; aspartate aminotransferase, 97 U/L;

and alanine aminotransferase, 50 U/L. Arterial blood gas values while the patient was breathing room air were as follows: pH, 7.45; PaO₂, 61 mm Hg; and PaCO₂, 26 mm Hg.

The patient was treated with oxygen, doxycycline, and cefuroxime. His condition steadily improved; he was discharged on hospital day 7 and was fully recovered by day 24. Cultures of blood, sputum, urine, throat (*Mycoplasma* and *Chlamydia*), and nasopharyngeal aspirate (influenza A and B) materials were all negative. Sputum samples were negative on *Legionella*-specific direct fluorescence and culture. Assays of paired serum samples (drawn on admission and 6 weeks later) were negative for antibodies to influenza A and B; parainfluenza I, II, and III; *Coxiella*; *Mycoplasma*; and *Chlamydia*, but positive by immunofluorescent antibody assay and enzyme immunoassay for *L pneumophila* (Table, patient 1). After serologic confirmation of this case of Legionnaires' disease, the five contacts with whom he had been vacationing were identified individually, interviewed, and serologically examined.

On January 15, 1991, the six students had come from separate homes to a Vermont ski resort. Seventy-two hours after arrival, two students became ill. Within

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Serologic Analysis of Six Students With Legionnaires'

Patient	Acute IFA ^a Titer	Convalescent IFA ^a Titer	Acute EIA [†]	Convalescent EIA [†]
1‡	1:64	1:256	0.47	1.2
2	1:64	1:256	0.00	2.57
3	...	1:256	...	2.70
4	...	1:64	...	1.2
5	...	1:256	...	2.0
6	...	1:64	...	2.5

^aImmunofluorescent antibody (IFA) titer was considered significant if there was a fourfold titer rise or a convalescent titer of 1:128 or greater.

[†]Enzyme immunoassay (EIA) was considered significant if 1.0 or more.

[‡]Index case.

24 hours of the onset of their symptoms, all six students experienced an influenzalike illness consisting of fever, headache, myalgias, and cough. Five of the students had chest pain. Each student, except the index patient, recovered within 6 days. Three were seen by physicians and given nonpneumonic diagnoses. Four students received antibiotics; one received erythromycin, one took amoxicillin, and two took an unnamed antibiotic. Two had normal chest roentgenograms. In Vermont, the students had stayed in a private, three-bedroom condominium and used three separate bathrooms and showers. Each student reported daily use of a private, whirlpool-type hot tub. However, after detailed questioning, no other exposure previously associated with *L pneumophila* was reported.

Convalescent serum samples were obtained from all students, and acute serum samples were available from the index patient and one student who had had serum stored the previous year for another investigation. *Legionella* serologic testing was performed with the use of pooled serogroup antigens by enzyme immunoassay (*Legionella*-STAT, Bio-whitaker, Walkerville, Md) and by immunofluorescent antibody assay, as previously described.¹ All demonstrated serologic evidence of infection with *L pneumophila* by enzyme immunoassay (Table). Seroconversion was defined as a fourfold or greater rise in titer, which occurred in the two

cases in which paired serum samples were available. Unpaired convalescent reciprocal titers of 64 or more were detected by immunofluorescent antibody assay in the other four cases, in a laboratory where 95% of community-obtained control specimens had titers less than 1:64. When the hot tub was recognized as the only shared exposure for a possible source of *L pneumophila*, we asked to evaluate it. However, before sampling, the tub had been halogenated and emptied. No other persons had used this private hot tub during the winter of 1991.

COMMENT

While *L pneumophila* is associated with point-source outbreaks of either Pontiac fever or Legionnaires' disease, these two forms of infection are generally considered to be clinically and epidemiologically distinct.^{2,3} The basis for the marked difference in the expression of disease is unknown. However, differences in bacterial strains, inoculum size, and host response have been proposed. In this outbreak, illnesses consistent with both Pontiac fever and Legionnaires' disease were observed. While the index patient, who was ill for 3 weeks, developed severe pneumonia and hypoxemia, the five other students described self-limited febrile illnesses without pneumonia and recovered in 3 to 6 days.

By the criteria developed for the Philadelphia (Pa) American Legion

outbreak, only the index patient had Legionnaires' disease. Similarly, in the American Legion epidemic, while 182 delegates met the clinical criteria for Legionnaires' disease, 98 persons had mild respiratory illnesses consistent with Pontiac fever.⁴ Unfortunately, no properly timed serum pairs were available for these individuals. Similarly, in the Stafford outbreak of Legionnaires' disease, a proportion of the seropositive staff had "influenza-like" illnesses but not pneumonia.⁵ In addition, both Legionnaires' disease and Pontiac fever have previously been reported after a common-source exposure.⁶ In the Philadelphia report, the investigators were primarily concerned with clearly defining cases of Legionnaires' disease and, therefore, did not include those with mild respiratory illnesses. Therefore, the Pontiac fever-like presentation of *L pneumophila* infection may not have been recognized in this and subsequent outbreaks of Legionnaires' disease.

In this outbreak, the case of Legionnaires' disease occurred in the only student with an underlying disease, type I diabetes mellitus, a condition with a clinically recognizable deficiency of cellular immunity. Similarly, other studies have demonstrated an increased incidence of Legionnaires' disease in humans after organ transplantation and in corticosteroid-treated rats.^{7,8} While much of the pathogenesis of infection with *L pneumophila* remains unknown, these observations emphasize the importance of the host's immune defense in affecting the expression of infection with this intracellular pathogen.

The source of *L pneumophila* in this outbreak was most likely the hot tub. *Legionella pneumophila* recovered from whirlpool-type spas has been associated with other outbreaks of Pontiac fever and Legionnaires' disease.^{9,10} Furthermore, in this outbreak, no other common exposure was detected. Before medical consultation, recognition of the hot tub as the likely source of the students' illnesses led to prompt

disinfection of the tub before cultures could be taken. Our inability to recover the organism limits the confidence with which the tub can be implicated as the source of *L pneumophila*. However, the striking coincidence within 24 hours of six infections in six persons, all of whom later had serologic evidence of *L pneumophila* infection, and the seroconversion of the two students with paired samples is strong evidence of a point source outbreak of legionellosis. The clinical contrast of symptoms in the index patient and the other students emphasizes that *L pneumophila* can cause a spectrum of illness, which is likely influenced by the immune status of the host.

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