Hot Tub–Associated Necrotizing Pneumonia due to *Pseudomonas aeruginosa*

Christopher J. Crnich, Barbara Gordon, and David Andes
Department of Medicine and Section of Infectious Diseases, University of Wisconsin Hospital and Clinics, Madison

We describe a case of severe necrotizing pneumonia due to community-acquired *Pseudomonas aeruginosa*. Cultures of fluid obtained from the filter of the patient’s hot tub grew the same *P. aeruginosa* strain as that grown from culture of the patient’s sputum. Centers for Disease Control and Prevention guidelines should be strictly followed for hot tub maintenance to prevent *P. aeruginosa* overgrowth: the range of free chlorine levels in the water should be kept at 1–3 mg/L, and the pH should be kept at 7.2–7.8.

*Pseudomonas aeruginosa* is a common cause of nosocomial respiratory tract, urinary tract, and bloodstream infections but remains a rare cause of community-acquired infection despite its environmental ubiquity. Herein we report a case of severe necrotizing pneumonia due to community-acquired *P. aeruginosa*.

**Case report.** A 40-year-old man with a history of tobacco use presented to the emergency room after experiencing several days of fevers, chills, and a cough producing blood and rust-colored sputum. Physical examination revealed a temperature of 37.3°C and tachypnea (respiratory rate, 24 breaths/min). Chest examination revealed decreased breath sounds in the upper lung fields bilaterally that were especially notable at the right apex. There were no rales noted, and there was no evidence of egophony or increased tactile fremitus. The findings of the physical examination were otherwise unremarkable. Laboratory abnormalities included leukocytosis (WBC count, 17,900 cells/µL) with a left shift (83% neutrophils), a platelet count of 623,000 cells/µL, and a serum sodium level of 127 mEq/L, and the pH should be kept at 7.2–7.8.

The patient’s family brought us the hot tub filter because they were concerned that others would become ill. Cultures of fluid from the filter were positive for a *P. aeruginosa* strain as that grown from culture of the patient’s sputum, and restriction endonuclease analysis revealed the same antimicrobial susceptibility as that of the species grown from culture of the patient’s sputum, and restriction endonuclease analysis revealed the same susceptibility as that of the species grown from culture of the patient’s sputum, and restriction endonuclease analysis revealed the same susceptibility as that of the species grown from culture of the patient’s sputum, and restriction endonuclease analysis revealed the same susceptibility as that of the species grown from culture of the patient’s sputum, and restriction endonuclease analysis revealed the same susceptibility as that of the species grown from culture of the patient’s sputum, and restriction.
Figure 1. Chest radiograph of the patient at admission to the hospital, revealing a right apical cavitary lesion and left upper-lobe scarring.

Figure 2. PFGE patterns of *Pseudomonas aeruginosa* isolates: Lanes 2 and 3, isolates from the patient’s hot tub filter; lanes 4–6, isolates from the patient’s sputum; lanes 1 and 8, λ ladder; lane 7, control strain of *P. aeruginosa*.

A few types of community-acquired pseudomonal infections, ranging from minor to serious, have been well described in the literature, including green nail syndrome, toe-web infection, hot tub-associated folliculitis, whirlpool-associated urinary tract infection, otitis externa, pedal osteomyelitis after puncture wounds, and right-side endocarditis in injection drug users [2]. In contrast, community-acquired pneumonia due to *P. aeruginosa* is rare.

Community-acquired *P. aeruginosa* pneumonia in patients without characteristic risk factors has been the subject of only a few case reports published since the 1970s [4–14]. Although some of these cases were attributable to an identifiable source, such as a home humidifier [9] or a home whirlpool spa [8], most cases had no identifiable environmental source of infection [4–7, 10–14]. Our case adds to this small list of com-
communuty-acquired cases of *P. aeruginosa* pneumonia and is, we believe, the first in which molecular subtyping techniques were used to definitively confirm that a patient’s infection derived from an environmental source.

By use of molecular subtyping techniques, we were able to show conclusively that our patient had acquired the *P. aeruginosa* strain that caused his infection from his hot tub. Several factors put the patient at risk for pneumonia, most notably alcoholism and underlying structural lung disease. One recent prospective trial reported that *P. aeruginosa* was recovered from 5% of patients presenting with severe community-acquired pneumonia, and that alcoholism was an independent risk factor for severe pneumonia [15].

Review of the CT scan performed for our patient at admission to the hospital confirmed the presence of underlying bul- lous emphysema, although there was no evidence of bronchi-ectasis in any of the images. Although the latter form of structural lung disease has clearly been associated with a risk for colonization or infection with *P. aeruginosa*, we are not aware of literature demonstrating a similar association with emphysema or chronic bronchitis.

Studies performed in the 1980s, amid rapidly increasing reports of whirlpool-associated folliculitis, documented the heavy growth of *P. aeruginosa* in health spa and personal-use hot tubs [16]. On the basis of these reports, the Centers for Disease Control and Prevention published guidelines that specifically recommended that free chlorine levels in the water of public hot tubs be kept at 1–3 mg/L and the pH be kept at 7.2–7.8 to prevent *P. aeruginosa* overgrowth [17].

Most studies of whirlpool-associated folliculitis have shown inadequate free chlorine levels (<1.0 mg/L) in the water that was the source of infection. Free chlorine levels dissipate rapidly in the warm temperatures (>40°C) and turbulent waters of hot tubs, and it has been shown that an elevated water pH (>7.6) is associated with a reduced antibacterial effect of halogens [18]. Studies suggest that *P. aeruginosa* can multiply to levels of 10^7 to 10^10 organisms/mL if the free chlorine level is allowed to drop to <1 mg/L or if the pH is allowed to rise to >7.8 for even as short a time as 24 h [18]. Therefore, it is necessary to monitor these levels on a frequent basis, in order to make the adjustments necessary to maintain the appropriate level of disinfection, and to change the water regularly, especially after heavy use.

Despite the severity of *P. aeruginosa* pneumonia, empirical therapy for community-acquired infections cannot be recommended because of its rarity. However, this case demonstrates that recognition of potential environmental exposures is important for early diagnosis of and therapy for pneumonia of unusual etiology.

References