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Original Article

Ghost in opera: Are *Legionella* bacteria really rare pathogens for hospital plumbing?

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ABSTRACT

Objectives: The aim of this study was to evaluate the presence of *Legionella species (spp.)* in our hospital and to identify patients who were possibly affected by the current plumping system.

Materials and methods: *Legionella spp.* swap antigen test showed positivity from plumbing in two patients' room between June 2016 and December 2016. All patients were retrospectively checked whether they were infected or not. The symptoms of Legionnaires' disease (LD) were asked and urine antigen test was performed. Possible transmission pathways were investigated and discussed. The main source of bacteria and possible routes of transmission were identified.

Results: A total of 40 patients were suspected of being infected with LD. A total of 34 (34/40, 85%) patients were reached. During the evaluation, five (5/34, 14%) patients (3 males, 2 females; mean age: 68±2.6 years; range, 58 to 64 years) showed a clinical picture resembling LD. Chronic obstructive pulmonary disease and chronic renal failure were the most common comorbid diseases. Urinary antigen positivity was demonstrated in only two (2/5, 40%) patients. Antibiotic treatment was started after clinical presentation of fever in all patients. Two patients with a positive antigen test had a history of severe respiratory failure requiring hospitalization. Mortality was seen in none of the patients. *Legionella spp.* was detected in the hospital water storage tank.

Conclusion: On-site analysis is important for every facility, as bacterial contamination of hospital plumbing by *Legionella spp.* is a rare condition.

Keywords: Hospital plumbing, hospital-acquired infection, *Legionella* species.

Legionella bacteria are aerobic, Gram-negative, and intracellular pathogens and important causes of community-acquired and nosocomial pneumonia.[1] *Legionella* infections can be acquired sporadically or during outbreaks. They are typically transmitted via inhalation aerosols from contaminated water or soil.[2] *Legionella species (spp.)* naturally exist in lakes and rivers. The two most common syndromes associated with *Legionella* infection are Legionnaires' disease (LD), which refers to pneumonia caused by *Legionella spp.* and pontiac fever, which is an acute, self-limited febrile illness that is typically acquired during outbreaks. *Legionella* bacteria are typically transmitted to humans via inhalation of aerosols derived from water or soil.[1] Legionnaires' disease is a mild lower respiratory tract infection. It is uncommon, but vital in certain risk groups and sometimes dangerous. The annual incidence in Europe was 1/100,000 between 2006 and 2010 and mortality rate was 6.6%.[2] Incubation period is 15 days and, while *Legionella spp.* do not mostly pose risks in healthy individuals, specific groups have a risk in terms of LD. According to the Centers for Disease Control and Prevention (CDC), risk groups for LD has been defined as follows; elderly (particularly 50 years and older), smokers, patients with chronic lung

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disease (chronic obstructive pulmonary disease [COPD], emphysema, etc.), immunocompromised patients (cancer, diabetes, renal failure, etc.), and those receiving immunosuppressive agents (drugs used after organ transplantation, chemotherapy drugs, etc.).[3] In general, individuals develop LD by inhaling aerosolized *Legionella* from contaminated water or aspirating potable contaminated water.[4]

Legionella spp. mainly reside in the bodies of water such as lakes, streams, and artificial water reservoirs. Contamination of water sources with *Legionella* is enough to cause human infection. The prevalence of LD in patients with nosocomial pneumonia is linked to presence and concentration of bacteria in the water supply of the facility.[5]

Prevention and control of LD in Turkey is governed by the Ministry of Health Guidelines.[6] The national guideline includes many concepts which are in common with other international guidelines, such as giving importance to the correct construction and maintenance of water systems, the use of disinfection methods and environmental investigations, and the creation of risk assessments for the exposure to *Legionella spp.* In the present study, we aimed to evaluate the presence of *Legionella spp.* in our hospital and to identify patients who were possibly affected by the current plumping system.

MATERIALS AND METHODS

This outbreak analysis study was conducted at Onsekiz Mart University Training and Research Hospital, Department of Infectious Diseases and Clinical Microbiology between between June 2016 and December 2016. Our hospital is a training and research hospital with a 600-bed capacity. The infection control team reported *Legionella spp.* swap antigen test positivity from the tap and shower head in two patients' room during routine controls. The Infection Control Committee evaluated this concern. With reference to the Legionnaires' Disease Field Control Guide of the Ministry of Health of Republic of Turkey, all patients were retrospectively checked for whether they became infected or not. The symptoms of LD were questioned including fever, shortness of breath, nausea, vomiting, and diarrhea and urine antigen test *(Legionella pneumophila Sg 1)* was performed after the incubation period. The scenario of possible transmission pathways was investigated and discussed. Different assumptions were hypothesized for the main source of bacteria. These assumptions were hypothetically focused on how the bacterium was transmitted to the hospital, in particular.

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 20.0 software (IBM Corp.,

Table 1. Characteristics of patients

	Numerical distribution (n=5)	
Patient's characteristics	n	Mean±SD
Mean age		68±2.6
Sex		
Male	3	
Female	2	
Comorbidity (risk factor for LD)		
- COPD	4	
- Emphysema	1	
- Cardiac failure	1	
- CRF	3	
- Diabetes	1	
- Cancer (lung)	1	
- Immunosuppressive treatment	1	
Mean total treatment day		14±1.0
Complications (respiratory failure)	2	

SD: Standard deviation; LD: Legionnaires' disease; COPD: Chronic obstructive pulmonary disease.

Armonk, NY, USA). Descriptive data were expressed in mean ± standard deviation (SD), median (min-max) or number and frequency, where applicable.

RESULTS

A total of 40 patients were found to probably have been infected. Of these, 34 (34/40, 85%) patients were reached. During the evaluation, five (5/34, 14%) patients (3 males, 2 females; mean age: 68±2.6 years; range, 58 to 64 years) showed a clinical picture resembling LD. Demographic data of the patients are summarized in Table 1.

Most common comorbid diseases were COPD and chronic renal failure (CRF). Urinary antigen positivity was demonstrated in only two (2/5, 40%) of these patients. antibiotic treatment was started in all patients after the clinical presentation of fever. Two patients with a positive antigen test had a history of severe respiratory failure requiring hospitalization in this period. Mortality was observed in none of the patients. Scenarios of possible contamination of bacterium to hospital plumbing were examined and it was reached to the detail that the hospital water tank was filled by the municipal fire department intermittently. The same bacteria were shown from the tank sediment and from the outlet. The water tank was drained, and the sediment removed and internal cleaning was performed. Hydrogen peroxide application was applied as a cost-effective method for hospital water decontamination. After decontamination, the control antigen screening was made from the shower and tap in the rooms where the bacteria showed positivity and *Legionella spp.* were eradicated.

DISCUSSION

Inhalation of contaminated aerosols, including *Legionella spp.*, cause LD and the main source of contamination is water. The main route of infection is aspiration of contaminated water for hospital-acquired LD.[7] However, as a matter of fact, sometimes clinicians need to search ghost in opera, such as in our study. Although the apparent source of *Legionella spp.* was plumbing in our study, the real source was contamination of hospital water reservoir. Since it is not a common situation to filling the tank by fire departments, on-site analysis is important.

Comorbidity factors of LD has been defined in several studies and guidelines.[3,8,9] Similar to the literature, our patients also had COPD, emphysema, cardiac failure, CRF, diabetes, cancer (lung), and were receiving immunosuppressive treatment. The mean age and sex distribution is also consistent with the literature.[3,8,9] On the other hand, the complication rate of our patients was higher than the reported literature (40% *vs.* 6.6%, respectively).[8,9] This can be attributed to the fact that we analyzed the situation as an epidemic and conduct a detailed epidemic investigation and, in previous studies, this approach might have been overlooked.

The laboratory tests used in the diagnosis of LD can be divided into two main groups as supportive and confirmatory. Supportive laboratory tests are usually used with positive clinical signs. These tests are direct fluorescence antibody test in respiratory secretions or in lung tissue, indirect fluorescence with a double serum sample antibody (IFA) or enzyme-linked immunosorbent assay (ELISA) against *Legionella spp. (Legionella pneumophila Sg 1)* antibody titers showing ≥4-fold increase, IFA or ELISA in a single serum sample against *Legionella spp.* titer ≥1/256, and detection of *Legionella spp.*-specific nucleic acids in respiratory secretions or in lung tissue or in sterile body fluid. In our study, we were unable to perform these tests, as once we detected the condition, acute LD already recovered. Confirmatory tests are usually used, if one of the above tests is positive. In addition, isolation of *Legionella* bacteria from sputum, lung tissue, pleural fluid or other clinical specimens, detection of specific antigen in urine for *Legionella pneumophila Sg 1*, ≥4-fold increase in the antibody titers in serum-specific IFA or ELISA for *Legionella pneumophila Sg 1* from double serum sample makes the definitive diagnosis. In our study, we preferred using the *Legionella* antigen urine test due to its precise diagnostic advantage as recommended in the current guidelines.[6,8]

In conclusion, *Legionella spp.* can settle in erosion areas of plumbing and hide, leading to hospital infections. Regular control is, therefore, required.

Declaration of conflicting interests

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