Legionella pneumophila: probable transmission from a contaminated respiratory device

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Clinical record

A 77-year-old man, who lived alone but with good social support, presented to his general practitioner with a 1 day history of fever and productive cough, with a background of increasing shortness of breath during the previous 2 weeks. He was prescribed a course of amoxycillin but did not commence treatment until the following day. After 3 days of antibiotic treatment he was admitted to his local hospital with persistent fever and cough. On examination he had left lower lobe consolidation, decreased oxygen saturation (SpO_2) and an increased respiratory rate. A chest x-ray revealed increased opacity in the left lower lobe consistent with a pneumonia. Arterial blood gas analysis found his SpO_2 to be 75.4% with a pH of 7.25. The case had a white cell count of 18.3 x 10^9 cells/L with 95.6% neutrophils and 2.4% lymphocytes. His creatinine was elevated (127 μmol/L), as were his fasting glucose (10.2 mmol/L) and liver function tests (alanine transaminase 105 U/L, aspartate aminotransferase 145 U/L). He was diagnosed with community-acquired pneumonia and treated with broad spectrum antibiotics and non-invasive ventilation. Multiplex polymerase chain reaction testing of a throat swab did not detect *Bordetella pertussis, Mycoplasma pneumoniae,* or any respiratory viruses. Three sets of sputum cultures were negative, however ,the patient was already on antibiotics when these were collected. A urinary antigen immunochromatographic assay (BinaxNOW® *Legionella* Urinary Antigen Card, Alere, Maine, USA) confirmed the patient had *Legionella pneumophila* serogroup 1 (LP1). He died of respiratory failure 4 days after admission.

The patient's medical history included obstructive sleep apnoea syndrome, bronchiectasis, and interstitial lung disease. These respiratory conditions were diagnosed in 2007 following a sleep study, lung function testing, and computed tomography scans. He was a non-smoker who only occasionally consumed alcohol. He had no history of cardiac illness. He had used a continuous positive airway pressure (CPAP) machine (ResMed S8 Autoset Spirit™ ANZ Limited edition system with an integrated HumidAire 3i™ humidifier) for 4 years for the management of his obstructive sleep apnoea.

A public health investigation was commenced within 1 hour of receipt of the positive LP1 result. The investigation identified numerous locations visited by the patient during the 10-day incubation period of his illness. Air conditioning cooling towers identified at, or in the vicinity of, these locations were investigated. Environmental samples taken from these towers did not reveal the presence of any LP1. Environmental health officers visited the case's house and found the CPAP machine in a poorly maintained state (Figures 1 and 2). The device was retrieved and swabs of the internal chamber, filter, and mouth piece were positive for LP1. All environmental samples were tested using the Australian Standard Method AS/NZS 3896:2008. This method isolates *Legionella* species by the spread plate technique, with further characterisation using rapid latex slide agglutination.

Figure 1: Respiratory device retrieved from case with biofilm on the internal filter

Figure 2: Respiratory device retrieved from case with biofilm on the face mask

The user manual for the CPAP machine recommends daily cleaning of the mask, with the tubing air dried between uses. Both the mask and tubing should be cleaned weekly with detergent. The humidifier user manual has guidelines for the daily and weekly cleaning of the water chamber. Neither the CPAP or humidifier device manuals explain the importance of, or reasons for, cleaning and maintenance.

Discussion

The acquisition of *Legionella* infection has previously been associated with the use of respiratory equipment.[1–3] A case of humidifier-acquired legionellosis had not been reported in detail in the literature since 1991.[1] A short report in 2013 highlighted the potential association between the use of CPAP devices and 2 non-fatal cases of legionellosis, though in neither of the cases discussed was evidence provided of contamination of the CPAP devices.[3] Without prominent reporting of cases in the literature, the importance of respiratory devices as potential reservoirs of *Legionella* species may not be fully appreciated by a new generation of medical practitioners and respiratory physicians. Furthermore, the majority of previous reports on the risk of these devices described equipment that is now outdated. With modern advances in medical technology it may be wrongly assumed that bacterial colonisation of respiratory devices is no longer a risk. Clearly however, modern respiratory devices remain a potential reservoir of *Legionella* bacteria. It is important, therefore, to highlight this fatality and reaffirm that respiratory devices are a potential reservoir of LP1 and other pathogens, and may be implicated in the acquisition of Legionnaire's disease. This is particularly important for patients with underlying respiratory illnesses.

A respiratory specimen could not be collected, so confirmation of the diagnosis of LP1 by culture was not possible. Furthermore, immunochromatographic urinary antigen testing has been shown to produce false positive results.[4,5] While the sensitivity of the immunochromatographic assay used is estimated at 74%–79%,[4,6] the specificity of the test is estimated as 99.1%.[5] This case also meets the Australian case definition for legionellosis, which is that a confirmed case requires the detection of *Legionella* urinary antigen with clinical evidence, such as fever or pneumonia.[7]

Medical practitioners must ensure their respiratory patients who are advised to use CPAP devices are taught the importance of good device maintenance. Patients need to fully appreciate the potential risks associated with not adhering to the cleaning instructions provided in the instruction manual. A position paper released by the Australian Sleep Association in 2009 states that patients should be provided with device information, including cleaning and safety.[8] This is particularly important for patients living in the community, including those who may have strong social supports. Individual or group education sessions on the use of CPAP devices have been shown to improve compliance with treatment.[9,10] These sessions, which might be conducted by respiratory therapists, provide an opportunity to discuss device maintenance issues. Instruction manuals have detailed information on the process of cleaning and maintaining the device's components, however these instructions read more as a guide to ensuring the longevity of the device components and manufacturer warranty, rather than mentioning health implications of poor maintenance. Ideally, important information on the reasons for cleaning respiratory devices should be included in instruction manuals and highlighted by medical practitioners during any discussions about use of the device. Finally, the inclusion of the patient's social supports in these discussions will raise the profile of, and reinforce, the importance of regular cleaning to ensure that contamination of respiratory devices is avoided.

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