Case report

Exposure to potting soils and compost material as potential sources of Legionella pneumophilia in Australia

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ABSTRACT

Legionnaires' disease is a form of atypical community-acquired pneumonia usually caused by *Legionella pneumophilia, which is* typically associated with exposure to tower cooling or water systems. In Australia, Legionnaires' disease is more commonly caused by *Legionella longbaechae,* which is typically associated with exposure to soil or compost materials, and the presence of *Legionella pneumophilia* is less recognized. We report a sporadic case of Legionnaires' disease caused by *Legionella pneumophilia* serogroup 1 that was contracted following exposure to potting mix and topsoil.

1. Background

Legionnaires' disease is an uncommon cause of community acquired pneumonia and it is associated with high morbidity and mortality. Pneumonia following exposure to potting mix is typically associated with *Legionella longbaechae (L. longbaechae)*. Transmission of *Legionella pneumophilia* (*L. pneumophilia)* is commonly associated with exposure to water sources, but rarely related to soil or potting mix exposure. Recent literature had reported strains of *L. pneumophilia* being isolated and transmitted from potting mix and soil to humans causing pneumonia.

2. Case presentation

This case highlights the *possibility* of acquiring Legionnaires' disease from exposure to potting soils and seeks to alert clinicians to assess for compost and soil exposure when managing patients with community-acquired pneumonia.

An 84-year-old gentleman presented with a 3-day history of fevers, non-productive cough, mild headache and delirium. His previous medical history included hypertension, hypercholesterolemia, atrial fibrillation and hearing impairment. He was living at home in a semi-rural area of New South Wales with his partner and was fully independent in his activities of daily living. He was an ex-smoker having ceased smoking in his thirties. He had worked as a plumber with minor asbestos exposure.

On presentation, he was febrile to 39.6° and his pulse oximetry was 94% on room air with a respiratory rate of 18. Physical examination revealed inspiratory crackles in the left upper zone. He was cardiovascularly stable.

Ten days prior to developing symptoms, the patient was working in his outdoor backyard garden shovelling approximately 500 kg of topsoil and home compost. The patient was also exposed to two 25 kg bags of commercial potting mix that were stored in his garden shed. In the process of preparing and working with soil and compost materials, the patient did not practice strict infection control measures, including wearing of masks, frequent handwashing and opening bags of commercial potting mix in well ventilated areas. The patient also had no recent sick contacts, no overseas travel, no contact with air-conditioning units or cooling towers and no exposure to birds.

3. Investigations

His white blood cell count was 14.6×10^9/L (neutrophil count 12.3×10^9/L, lymphocyte count 1.0×10^9/L) and his C-reactive protein level was 210 mg/L. He also suffered from acute on chronic kidney injury with a creatinine level of 131 micromol/L (Table 1). His liver function tests were unremarkable. A chest radiograph showed consolidation in the left upper lobe (Fig. 1). His initial diagnosis was lobar community-acquired pneumonia, and as per local antimicrobial guidelines he was empirically treated with intravenous benzylpenicillin and oral doxycycline.

The patient tested positive for *L. pneumophilia* 1 antigen in his urine sample *with* urinary antigen enzyme immunoassay, and his antibiotic regimen was changed to dual therapy with azithromycin 500mg once

Table 1
Pathology results.

Pathology Test	14/12/18	17/12/18	21/12/18	Reference Range
White Cell Count	14.6	12.7	10.2	$4–11 \times 10^9$/L
Neutrophil Count	12.3	10.9	7.8	$2–8 \times 10^9$/L
C Reactive Protein	210	332	86	<5.0mg/L
Creatinine	131	212	128	60 - 110 μmol/L
Estimated Glomerular Filtration Rate	131	24	44	>60 mL/min/1.73 m^2
Haemoglobin	119			130–180 g/L
Sodium	132	135	138	135–145 mmol/L
Potassium	4.2		3.9	3.5–5.2 mmol/L

daily and ciprofloxacin 500mg twice daily for 48 hours, followed by monotherapy with azithromycin 500mg once daily.

Nasopharyngeal swabs for polymerase chain reaction (PCR) testing confirmed *L. pneumophilia* infection. Both acute and follow-up convalescent serologies were negative for *L. pneumophilia* and *L. longbeachae*.

Sampling and analysis of suspected contaminated home soil was not feasible as this was a single isolated case and no home soil was available for sampling. The patient denied having any exposure to ponds, fountains and other sources of stagnant water at home. A notification was made to the local public health unit and because this was an isolated case, no further investigation or contact tracing was necessary as there were no other outbreaks of Legionnaires' disease at the time of presentation. Thorough review of the clinical presentation strongly suggests that there were no other sources that the patient could have acquired the infection except for his recent exposure to home soil and potting mix.

4. Differential diagnosis

In an elderly man presenting with fevers, rigours, cough and raised white cell count, raised C-reactive protein level and left upper lobe consolidation, our provisional diagnosis was that of a community-acquired pneumonia. Treatment is based on antibiotic guidelines and altered as diagnostic tests result became available or according to progression of illness.

5. Management

The patient had a CURB-65 score of 4 on initial presentation, he was hypoxic and delirious. He had evidence of a lobar pneumonia and commenced on intravenous benzylpenicillin and oral doxycycline. *L. pneumophilia* 1 antigen was detected in his urine within 12 hours after initial testing, and 12 hours after commencement of initial treatment, his antibiotics were changed to oral azithromycin 500mg once daily and oral ciprofloxacin 500mg twice daily for 48 hours, followed by monotherapy on defervescence with oral azithromycin 500mg once daily.

6. Outcome

Resolution of fevers, delirium and clinical defervescence occurred 48 hours after commencement of antibiotic therapy, and he was discharged home after day 8 of his admission with resolution of his acute kidney injury. He underwent a gradual but complete recovery after receiving a total of 14 days of oral azithromycin.

On outpatient follow up approximately 6 weeks later, the patient had made a full clinical recovery. Examination was unremarkable, respiratory examination was normal and breath sounds were vesicular with no added sounds. A follow-up chest radiograph performed 9 weeks after onset of symptoms demonstrated improving residual left upper lobe consolidation.

7. Discussion

7.1. Epidemiology and transmission

Legionella is a facultative intracellular parasite that invades and replicates in environmental amoebae. It is a human pathogen and aspiration into airway and lung tissues causes Legionnaires' disease. *L. pneumophilia* was first identified following an outbreak of pneumonia

Fig. 1. Chest X-ray on admission demonstrated left upper lobe consolidation.

amongst attendees at an American legion convention in Philadelphia in 1976 [1]. Symptoms typically arise 2–10 days after exposure, but can range from 1 to 19 days, with a median of 6–7 days post-exposure. Immunosuppressed individuals may take 10 days or longer to develop symptoms [1,2]. The principal reservoir for this pathogen is water; therefore, contaminated sources typically include air-conditioning cooling towers, humidifiers, fountains and plumbing networks [3].

Exposure and handling of potting soils have typically been associated with *L. longbeachae* infection [4–6]. *L. longbaechae* was found to be the predominant legionella species (73%) isolated from 45 potting soil samples in one Australian study [7]. However, one other study had reported *L. pneumophilia* as the predominant species other than serogroup I in composted plant materials [8].

L. pneumophilia is usually associated with exposure to contaminated water towers and air conditioning systems [1,9]. In Australia, the presence of *L. pneumophilia* in soil is not widely appreciated, but it has been reported.

In 2005, a case of Legionnaires' disease was reported in a middle-aged man was admitted to hospital for community acquired pneumonia, 2 weeks after he commenced on a new employment which involved potting plants at a local nursery. The patient tested positive for *L. pneumophilia* serotype 1 in urine and sputum samples. Soil samples collected from the potting area in his workplace also tested positive for *L. pneumophilia serotype 1* [10].

Detection of different strains of *L pneumophilia* in soil or compost materials has been reported in various parts of the world. The soil contamination rate in UK compost is 62.5%, which is significantly higher than the rest of Europe including Greece (27.3%) and Switzerland (45.7%) [5]. Casati and his colleagues [11] reported that *L. pneumophilia* accounted for 90% of all reported cases of soil contamination in Europe [3], which is significantly higher that potting soil samples in Switzerland (Lp 1–15, 19.6%), Japan (Lp 2–14, 4.2%) and Australia (Lp 1–14, 13.3%). This may relate to differences in the diagnostic techniques used.

7.2. Diagnosis of Legionnaires' disease

L. pneumophilia serotype 1 (Lp1) accounts for almost 85–90% of all cases of Legionnaires' disease [12]. There are several investigations that are useful in the diagnosis of legionella species (Table 2). The urinary antigen test detects soluble legionella antigen in urine specimens, which is easy to perform, and results are available within 15 minutes. It has a sensitivity of 70–100% and specificity of 94–100% [13,14]. However it is limited to the reliable detection of Lp1. The *Biotest* urine antigen EIA is a broader spectrum assay that detects a wider spectrum of legionella species other than Lp1, but it is less reliable that *BINAX* urine antigen test in detection of Lp1 [15]. There has only been one case of false positive result using the *Binax* legionella urine antigen test reported in the literature [16]. The urine antigen test can remain positive for days to weeks in patients with confirmed Legionnaires' disease.

Serological testing has limited value in day-to-day clinical practice. As seroconversion may take up to a few weeks, repeat convalescent serology 3–4 weeks after onset of symptoms is required, and a four-fold increase in anti-body titer is required to establish a diagnosis, thus posing significant limitations on clinical decision-making. Serological testing is also unable to detect all species of legionella and cross-reactive antibody formation from non-Legionella bacteria (Pseudomonas,

Mycobacteria, Bacteroides spp, and Campylobacter spp) makes it difficult to determine the significance of a positive serology [17].

Detection of legionella DNA with PCR-based nucleic acid amplification technique based on lower respiratory tract samples enables rapid diagnosis of Legionnaires' disease, with a turnaround time of less than 4 hours. It has greater sensitivity of 80–100% when compared to culture, based on testing of samples from the lower respiratory tract; therefore, it is the best modality of diagnostic testing for patients who can produce a sputum sample for analysis [17].

Sputum culture has 100% specificity in ruling in Legionnaires' disease, but it takes 3–5 days to obtain a positive result as it requires special media and technical expertise to achieve successful culturing of any legionella organism, hence is it not widely available. More importantly, less than half of patients with Legionnaires' disease are able to produce a sputum sample, hence adding on to the challenge of obtaining a diagnosis. Sputum samples obtained via bronchoscopy are more likely to yield positive results than expectorated sputum samples [17].

7.3. Treatment

Since most cases of Legionnaires' disease are community-acquired, current clinical guidelines suggest empirical treatment with antibiotics that covers most legionella species, such as macrolides, fluoroquinones or tetracyclines.

The 2007 Infectious Disease Society of America (IDSA) guidelines suggest azithromycin or fluoroquinones (such as moxifloxacin or levofloxacin) are preferred antibiotics for targeted therapy as these agents are bactericidal, able to penetrable into lung tissues and are they active against all species of legionella bacteria that are known human pathogens [18].

The optimal duration of therapy to maximise therapeutic efficacy has not been firmly determined, as the total duration of therapy depends on severity of illness and patient's response to treatment. The 2003 IDSA guidelines recommend 10–21 days of antibiotic therapy depending of severity of illness and host response to treatment. In the 2007 IDSA guidelines, it recommends at least 5 days of antibiotic therapy for patients with community-acquired pneumonia. In the recently published 2019 IDSA guidelines, however no recommendation was made on the optimal duration of therapy specifically for legionella pneumonia [19].

Clinical guidelines from the British Thoracic Society and the National Institute for Health and Care Excellence UK have no specific recommendations of optimal duration of antibiotic therapy for legionella pneumonia.

Patients receiving 7–14 days of various antibiotics for legionella pneumonia have been associated with cure rates of 90–100%, including azithromycin, clarithromycin, roxithromycin and levofloxacin [20]. Two studies have suggested that a short course of 3–5 days of oral azithromycin resulted in 100% cure rates [21,22]. However, for our patient, such short duration of antibiotic therapy is not favoured as he suffered from severe pneumonia with slow clinical response to antibiotic treatment on a background of multiple chronic co-morbidities.

8. Summary

This case report aims to highlight the possibility that different strains of *L. pneumophilia* can be transmitted after exposure to potting mix, compost materials or soil products. This underscores the importance of maintaining strict infection control measures including handwashing, usage of masks and opening bags of commercially prepared potting mix in well ventilated areas. In patients presenting with community-acquired pneumonia, recent exposure to soil, compost and potting mix materials should be confirmed even if pneumonia is due *L. pneumophilia*. Clinicians should also be mindful that diagnosis via serological testing for antibodies against legionella species is neither a reliable or timely indicator of disease, as underlying medical co-morbidities and immunosuppression may delay or suppress an appropriate increase in

Table 2
Comparison of various diagnostic modalities [17,19].

Test	Sensitivity	Specificity	Turn-around time
Urine antigen test	70–90%	99%	<1 hour
Polymerase Chain Reaction (PCR)	80–100%	>90%	<4 hours
Sputum Culture	10–80%	100%	3–7 days
Serology	60–80	>65%	3–10 weeks

antibody titers resulting in false negative results. Therefore, relying on microbiological culture and PCR methods is imperative for a definitive and timely diagnosis of Legionnaires' disease [23]. [bib23].

Patient consent

Informed consent was obtained for dis-closure of the patient's medical information in a non-identifiable manner.

Declaration of competing interest

The authors declare no conflict of interests.

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