Findings that shed new light on the possible pathogenesis of a disease or an adverse effect

Nontuberculous mycobacterial hypersensitivity pneumonitis related to a home shower: treatment and secondary prevention

Paul E. Hankwitz,¹ Joseph Steven Cervia,^{2,3} Charles F. Thomas,⁴ Jordan N Fink,⁵ Ted Marras,⁶ Rade Tomic⁷

¹Department of Medicine, Medical College of Wisconsin, Milwaukee, Wisconsin, USA;

²North Shore University Hospital, Albert Einstein College of Medicine, Manhasset, New York, USA;

³Medical Department, Pall Corporation, Port Washington, New York, USA;

⁴Department of Medicine, Mayo Clinic College of Medicine, Rochester, Minnesota, USA;

⁵Pediatrics Department, Childrens Hosp of Wisconsin, Milwaukee, Wisconsin, USA;

⁶Respirology Department, University Health Network and Mount Sinai Hospital, Toronto, Canada;

⁷Department of Medicine (Pulmonary and Critical Care Medicine), Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Correspondence to Dr Joseph Steven Cervia, cervia@lii.edu

Summary

A 57-year-old physician with increasing dyspnoea and hypoxaemia had a high-resolution CT scan of the chest, which disclosed diffuse pulmonary ground glass opacities, more pronounced in the upper lobes with minimal mediastinal lymphadenopathy. Transbronchial biopsy of the right middle and lower lobes was performed, demonstrating varying degrees of well circumscribed organising granulomatous pneumonitis thought to be most consistent with hypersensitivity to nontuberculous mycobacteria. Cultures of water obtained from the patient's home shower were positive for *Mycobacterium avium* complex. The patient began substituting baths for showers, experiencing some gradual improvement of his symptoms. Subsequently, he installed point-of-use 0.2 micron membrane filters on his shower, and resumed regular showering after installation with continued symptomatic improvement. CT scans at 3 and 18 months revealed improvement and resolution, respectively. Four years later, he continues to shower in filtered home shower water and remains clinically well.

BACKGROUND

Causative exposures to inciting agents of hypersensitivity pneumonitis are increasingly being reported in the home environment.¹ In particular, *Mycobacterium avium* complex (MAC) has been recovered from hot and cold water in showers and from showerheads,² with infection and hypersensitivity pneumonitis reported previously in association with routine use of household shower and bath water.^{3,4} The distinctive features of the currently reported case are its resolution without antimycobacterial therapy, and the remarkable lack of recurrence with continued showering in source water over a 4 year follow-up period with point-of-use 0.2 micron water filtration. These observations are particularly noteworthy as there is no standard approach to the treatment of this disorder.

CASE PRESENTATION

A 57-year-old physician was admitted with increasing dyspnoea and chest discomfort.

He had been well until 4 months prior to admission, when as director of a ventilatory care unit, he used a pulse oximeter that he had been calibrating to check his oxygen saturation. He noted that it was 89% at rest and declined into the 70s% upon ambulation. Shortly thereafter, he noted progressive exertional dyspnoea becoming profound over the 9 days prior to admission. He denied fever, chills, cough, orthopnea, paroxysmal nocturnal dyspnoea, or any other specific complaints. Despite a previous history

of paroxysmal atrial fibrillation and hypertension, he had been well-controlled and in sinus rhythm on flecainide and atenolol.

Upon arrival in the emergency department, he was noted to be in atrial fibrillation with a rate of 184/min. After treatment with intravenous labetalol 5 mg and diltiazem 20 mg, his heart rate was reduced to 80–90/min with atrial flutter. Upon examination, his temperature was 98° F, pulse was 82/min, respirations were 20/min, blood pressure was 133/65; and, room air arterial blood gas: pH=7.46, pCO₂=35, pO₂=56, HCO₃=24, Sat.=90%. Remarkable findings included soft rales audible diffusely in both lungs, without wheezing. There was no digital clubbing, cyanosis, or edema.

INVESTIGATIONS

Laboratory findings included: white blood cell=10.4 K/μl, erythrocyte sedimentation rate=4 mm/h, creatine kinase=185 U/l, troponin=0 ng/ml. A chest radiograph revealed mildly hypoventilated, but clear lung fields. ECG disclosed atrial flutter with variable A-V block and a ventricular rate of 71/min. Intravenous dofetilide was begun with return to sinus rhythm. A high-resolution CT scan of the chest was performed, which disclosed diffuse pulmonary ground glass opacities, more pronounced in the upper lobes (figure 1), with minimal mediastinal lymphadenopathy. A contrast angiographic study showed no evidence of pulmonary embolism. Pulmonary function testing sug-

Figure 1 High resolution CT scan of the chest, which disclosed diffuse pulmonary ground glass opacities, more pronounced in the upper lobes. There was also minimal mediastinal lymphadenopathy.

Figure 2 Histopathology of transbronchial biopsy of the right middle and lower lobes, which demonstrated varying degrees of well circumscribed organising granulomatous pneumonitis most consistent with hypersensitivity to nontuberculous mycobacteria, NTM ('hot tub lung').

gested mild restriction with no significant response to bronchodilator.

DIFFERENTIAL DIAGNOSIS

Differential diagnostic possibilities considered were hypersensitivity pneumonitis, idiopathic interstitial pneumonitis, or a diffuse infiltrative reaction to flecainide. As flecainide had been discontinued, the patient and his physicians elected to maintain a period of watchful waiting following hospital discharge. One month later, since his dyspnoea had not improved, transbronchial biopsy of the right middle and lower lobes was performed, demonstrating well circumscribed organising granulomatous pneumonitis (figure 2) most consistent with hypersensitivity to nontuberculous mycobacteria (NTM). Grocott's methenamine silver and auramine-rhodamine stains, and all cultures were negative.

OUTCOME AND FOLLOW-UP

Cultures of water obtained from the patient's home shower were positive for NTM. The patient began substituting baths for showers, experiencing some gradual improvement of symptoms. Subsequently, he installed point-of-use 0.2 micron pore size membrane filters on his shower (Pall Medical, Port Washington, New York, USA). Following filter installation, he resumed regular showering with continued symptomatic improvement. CT scans at 3 and 18 months revealed improvement and resolution, respectively. Four years later, he continues to shower in filtered home water and remains clinically well.

DISCUSSION

It has long been recognised that aerosolised water contaminants can cause febrile respiratory illness and hypersensitivity pneumonitis,⁵ MAC infections and illness characterised by features such as fever, cough, dyspnoea and hypoxia in immunocompetent children and adults have been reported, most often in association with hot tub exposure.^{6–9} Radiographic features of 'hot tub lung' on high-resolution CT include the appearance of centrilobular nodules of ground glass attenuation, resembling subacute hypersensitivity pneumonitis.^{10 11} Thus, it has been debated whether this entity should be treated as an infection or a hypersensitivity reaction.¹² Indeed, whereas, granulomata are seen on tissue biopsies, acid fast organisms are infrequently demonstrated;⁸ and, while continuing exposure to hot tub water results in ongoing, progressive respiratory difficulty, discontinuation of exposure without antimicrobial therapy leads to prompt improvement in symptoms, pulmonary function and radiographic abnormalities, suggesting a hypersensitivity pneumonitis.^{7 13–16}

Causative exposures to inciting agents of hypersensitivity pneumonitis are increasingly being reported in the home environment.¹ In particular, MAC has been recovered from hot and cold water in showers and from showerheads,² with infection and hypersensitivity pneumonitis reported previously in association with routine use of household shower and bath water.^{3 4} The distinctive features of the currently reported case are its resolution without antimycobacterial therapy, and the remarkable lack of recurrence with continued showering in source water over a 4 year follow-up period with point-of-use 0.2 micron

filtration. These observations are particularly noteworthy as there is no standard approach to the treatment of this disorder; and, although the literature describes clinical improvement with mere avoidance of source water exposure, continued exposure after source decontamination and cleansing has been deemed inappropriate, as MAC may persist in plumbing even after repeated decontamination and cleansing.¹⁷

Learning points

- ▶ Aerosolised water contaminants, including NTM can cause febrile respiratory illness and hypersensitivity pneumonitis.
- ▶ MAC infections and illness, characterised by features such as fever, cough, dyspnoea and hypoxia in immunocompetent children and adults have been reported, most often in association with hot tub exposure.
- ▶ Radiographic features of 'hot tub lung' on high-resolution CT include the appearance of centrilobular nodules of ground glass attenuation, resembling subacute hypersensitivity pneumonitis; and whereas, granulomata are seen on tissue biopsies, acid fast organisms are infrequently demonstrated.
- ▶ While continuing exposure to hot tub water results in ongoing, progressive respiratory difficulty, discontinuation of exposure without antimicrobial therapy leads to prompt improvement in symptoms, pulmonary function and radiographic abnormalities.
- ▶ MAC has been recovered from hot and cold water in showers and from showerheads, with infection and hypersensitivity pneumonitis reported in association with routine use of household shower and bath water, a risk which may be effectively mitigated with point-of-use 0.2 micron water filtration.

Acknowledgements The authors gratefully acknowledge Dr Anna-Luise Katzenstein, SUNY Upstate Medical Center, Syracuse, New York for her expert review of the pathology slides in this case report.

Competing interests Dr Cervia is employed as Medical Director for Pall Medical, which manufactured the filters used in this report.

Patient consent Obtained.

REFERENCES

1. Hanak V, Golbin JM, Ryu JH. Causes and presenting features in 85 consecutive patients with hypersensitivity pneumonitis. *Mayo Clin Proc* 2007;**82**:812–6.
2. Falkinham JO. The changing pattern of nontuberculous mycobacterial disease. *Can J Infect Dis* 2003;**14**:281–6.
3. Marras TK, Wallace RJ Jr, Koth LL, et al. Hypersensitivity pneumonitis reaction to *Mycobacterium avium* in household water. *Chest* 2005;**127**:664–71.
4. Falkinham JO 3rd, Iseman MD, de Haas P, et al. *Mycobacterium avium* in a shower linked to pulmonary disease. *J Water Health* 2008;**6**:209–13.
5. Rose CS. Water-related lung diseases. *Occup Med* 1992;**7**:271–86.
6. Kahana LM, Kay JM, Yakus MA, et al. *Mycobacterium avium* complex infection in an immunocompetent young adult related to hot tub exposure. *Chest* 1997;**111**:242–5.
7. Embil J, Warren P, Yakus M, et al. Pulmonary illness associated with exposure to *Mycobacterium-avium* complex in hot tub water. Hypersensitivity pneumonitis or infection? *Chest* 1997;**111**:813–6.
8. Khoor A, Leslie KO, Tazelaar HD, et al. Diffuse pulmonary disease caused by nontuberculous mycobacteria in immunocompetent people (hot tub lung). *Am J Clin Pathol* 2001;**115**:755–62.

9. **Mangione EJ**, Huitt G, Lenaway D, *et al.* Nontuberculous mycobacterial disease following hot tub exposure. *Emerging Infect Dis* 2001;**7**:1039–42.
10. **Lynch DA**, Rose CS, Way D, *et al.* Hypersensitivity pneumonitis: sensitivity of high-resolution CT in a population-based study. *AJR Am J Roentgenol* 1992;**159**:469–72.
11. **Pham RV**, Vydareny KH, Gal AA. High-resolution computed tomography appearance of pulmonary Mycobacterium avium complex infection after exposure to hot tub: case of hot-tub lung. *J Thorac Imaging* 2003;**18**:48–52.
12. **Aksamit TR**. Hot tub lung: infection, inflammation, or both? *Semin Respir Infect* 2003;**18**:33–9.
13. **Rickman OB**, Ryu JH, Fidler ME, *et al.* Hypersensitivity pneumonitis associated with Mycobacterium avium complex and hot tub use. *Mayo Clin Proc* 2002;**77**:1233–7.
14. **Cappelluti E**, Fraire AE, Schaefer OP. A case of “hot tub lung” due to Mycobacterium avium complex in an immunocompetent host. *Arch Intern Med* 2003;**163**:845–8.
15. **Hartman TE**, Jensen E, Tazelaar HD, *et al.* CT findings of granulomatous pneumonitis secondary to Mycobacterium avium-intracellulare inhalation: “hot tub lung”. *AJR Am J Roentgenol* 2007;**188**:1050–3.
16. **Verma G**, Jamieson F, Chedore P, *et al.* Hot tub lung mimicking classic acute and chronic hypersensitivity pneumonitis: two case reports. *Can Respir J* 2007;**14**:354–6.
17. **Sood A**, Sreedhar R, Kulkarni P, *et al.* Hypersensitivity pneumonitis-like granulomatous lung disease with nontuberculous mycobacteria from exposure to hot water aerosols. *Environ Health Perspect* 2007;**115**:262–6.

This pdf has been created automatically from the final edited text and images.

Copyright 2011 BMJ Publishing Group. All rights reserved. For permission to reuse any of this content visit <http://group.bmj.com/group/rights-licensing/permissions>.
BMJ Case Report Fellows may re-use this article for personal use and teaching without any further permission.

Please cite this article as follows (you will need to access the article online to obtain the date of publication).

Hankwitz PE, Cervia JS, Thomas CF, Fink JN, Marras T, Tomic R. Nontuberculous mycobacterial hypersensitivity pneumonitis related to a home shower: treatment and secondary prevention. *BMJ Case Reports* 2011;10.1136/bcr.06.2011.4360, date of publication

Become a Fellow of BMJ Case Reports today and you can:

- Submit as many cases as you like
- Enjoy fast sympathetic peer review and rapid publication of accepted articles
- Access all the published articles
- Re-use any of the published material for personal use and teaching without further permission

For information on Institutional Fellowships contact consortiasales@bmjgroup.com

Visit casereports.bmj.com for more articles like this and to become a Fellow