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Pulmonary *Mycobacterium avium* Infection in an Immunocompetent Young Adult Related to Use of Home Bath with a Circulating Water System

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Unsuitable management of bath water occasionally causes waterborne infectious diseases, such as legionellosis and infections due to non-tuberculosis mycobacteria. (The draft guideline is available with the full text of this article at http://www.cdc.gov/ncidod/hip/enviro/env_guide_draft.pdf)(1).

A 21-year-old female student (patient A) was referred to the corresponding author in May 2000, with a routine chest radiograph revealing left lobe shadowing, and with mild fever and a productive cough that had continued since March. She was a nonsmoker. She had a history of *Mycoplasma pneumoniae* infection at 12 years of age. At hospitalization, a tuberculin skin test was negative (0 × 0 induration with 9 × 8 mm of redness), and a test for HIV antibody was also negative. The lungs were clear with no crackles or wheezes. Routine laboratory tests disclosed no abnormalities.

A chest radiograph revealed left lower lobe consolidation (Fig. 1a). A CT scan revealed an infiltration with thickened wall of left B9 (Fig. 1b). Her sputum smear was acid-fast bacilli (AFB) negative. However, by diagnostic tests based on polymerase chain reaction (PCR) (COBAS AMPLICOR™ MTB, *M. avium* and *M. intracellulare* tests: Roche Diagnostics, Branchburg, N.J., USA), the sputum was positive for *M. avium*. It was, however, negative for *M. tuberculosis* and *M. intracellulare*. The bronchial aspirates were AFB and *M. avium* complex (MAC) culture positive. Four drug chemotherapy consisting of clarithromycin, rifampin, streptomycin, and ethambutol was started immediately. The MAC isolate was resistant to rifampin (MIC: >50 μg/ml), streptomycin (MIC: >20 μg/ml), and ethambutol (MIC: >5 μg/ml), but relatively sensitive to clarithromycin (MIC: 4 μg/ml). After 3 months of treatment, she became asymptomatic, and her chest radiograph and CT scan improved.

The patient and her family used a bath with a circulating and filtering water system in their home. The bath water was found MAC culture positive. PCR-based diagnosis revealed that the MACs both from the bath water and the patient were *M. avium*. To determine whether these isolates were derived from a clone, chromosomal DNA's derived from these two isolates and two more *M. avium* clinical isolates not associated with the present case were analyzed by pulsed-field gel electrophoresis (PFGE) (CHEF Mapper™: Bio-Rad Laboratories, Hercules, Calif., USA) of *Ase*I digests (Fig. 2), IS*1245* restriction fragment length polymorphism (RFLP) typing (2) (Fig. 3a), IS*1311* RFLP typing (3) (Fig. 3b), and typing based on length polymorphism of ribosomal DNA spacer regions between repetitive IS*1245* and IS*1311* (LPRS) (4) (Fig. 4).

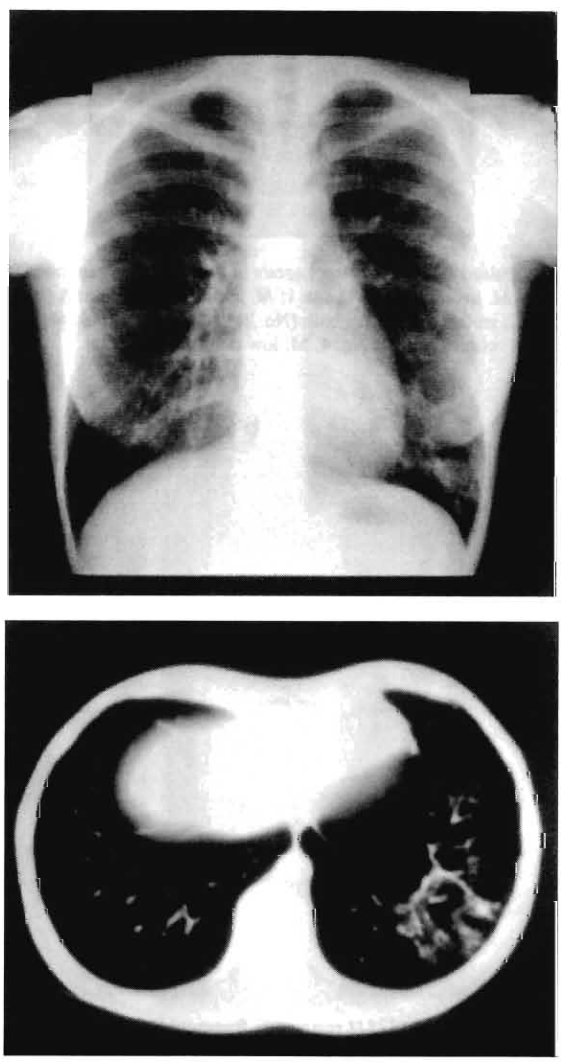

Fig. 1. Chest radiograph (a) and chest CT scan (b) before therapy.

The PFGE pattern of the lung specimen from patient A (No. 1) and that of the bath water-derived specimen (No. 2) were

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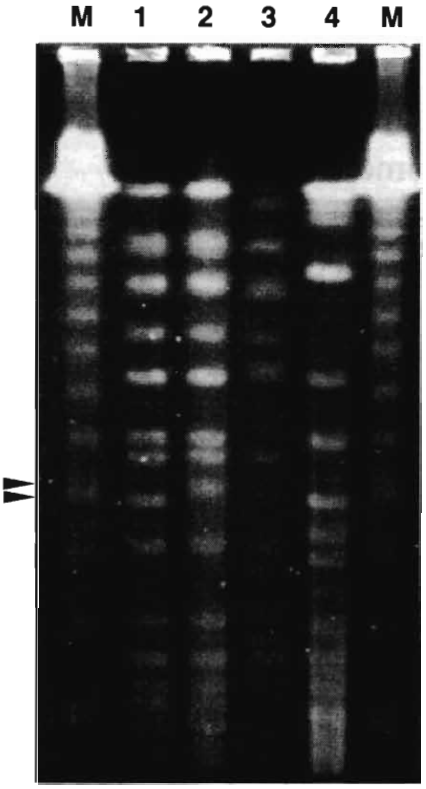

Fig. 2. Pulsed-field gel electrophoresis of *Ase*I-digested genomic DNA from *M. avium* isolates. Lane 1: *M. avium* from patient A (No. 1), lane 2: isolate from water bath (No. 2), lane 3: clinical isolate No. 3, lane 4: clinical isolate No. 4, M: low range PFG marker.

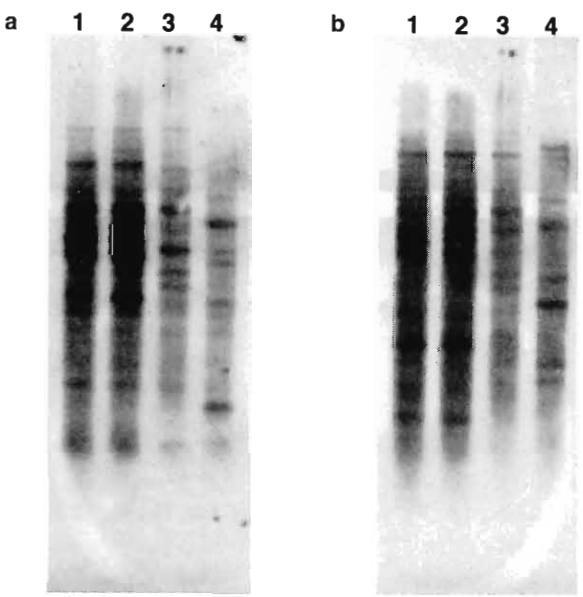

Fig. 3. IS*1245* and IS*1311* restriction fragment length polymorphism (RFLP) typing. *Pvu*II-digested genomic DNA was analyzed by Southern blot hybridization with peroxydase-labeled DNA probe for IS*1245* (a) and IS*1311* (b). Lane 1: *M. avium* from patient A (No. 1), lane 2: isolate from water bath (No. 2), lane 3: clinical isolate No. 3, lane 4: clinical isolate No. 4.

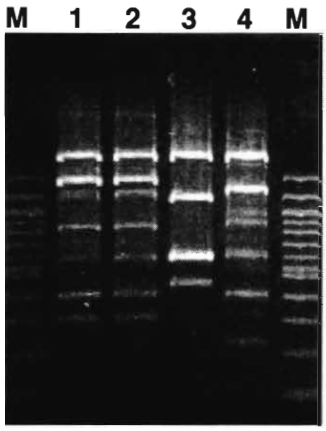

Fig. 4. Typing of *M. avium* isolates by PCR. Genomic sequences located between IS*1245* and IS*1311* were amplified using PCR. Lane 1: *M. avium* from patient A (No. 1), lane 2: isolate from water bath (No. 2), lane 3: clinical isolate No. 3, lane 4: clinical isolate No. 4, M: DNA markers consisting 100-bp ladders.

identical except for one band differenence in size (indicated by an arrow in Fig. 2). Meanwhile, other two clinical isolates (Nos. 3 and 4) were entirely different from isolates Nos. 1 and 2 in PEGE pattern. The patterns obtained by IS*1245* RFLP, IS*1311* RFLP and LPRS were identical for the patient A's isolate and the bath water-derived isolate (Figs. 3 and 4). Isolates Nos. 3 and 4 showed entirely different patterns from isolate Nos. 1 and 2 in all the assays (Figs. 3 and 4). The data indicated that the *M. avium* isolate from patient A and that from bath water were of the same clone. Probably, patient A acquired the *M. avium* infection from the bath water. It remains unknown why only patient A, but not other family members, contracted the disease.

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