Eradication of contaminating Mycobacterium chelonae from bronchofibrescopes and an automated bronchoscope disinfection machine

K. Takigawa*, J. Fujita‡§, K. Negayama‡, S. Terada‡, Y. Yamaji‡, K. Kawanishi‡ and J. Takahara†

*Takamatsu National Hospital, ‡First Department of Internal Medicine and §Clinical Laboratory, Kagawa Medical School, Kagawa, Japan

The results of a follow-up study concerning the decontamination of Mycobacterium chelonae subspecies abscessus from the bronchofibrescopes and the automated bronchoscope disinfection machine are described in this paper. After modification of the methods for disinfecting the bronchofibrescopes (adding a disinfection procedure with 70% alcohol before using the automated bronchoscope disinfection machine, increasing glutaraldehyde concentration to 3%, and changing the glutaraldehyde solution once a week), and the automated bronchoscope disinfection machine (recirculating used disinfectant), M. chelonae has not been detected from either the bronchofibrescopes or the automated bronchoscope disinfection machine (examined every 6 months for 4 yr by microscopy and cultures). Moreover, no M. chelonae has been clinically detected from bronchial washings for 4 yr.

Introduction

Previous episodes of contamination of bronchofibrescopes with environmental mycobacteria have been reported (1–3). In addition, contamination of the automated bronchoscope disinfection machine with Mycobacterium chelonae subspecies abscessus has been reported recently (4–7). The presence of non-tuberculous mycobacteria in water supplies is well recognized (8), and as the rinsing water comes from the main supply, it is important to exclude environmental sources of atypical mycobacteria before assigning an aetiological role to isolates obtained from bronchofibrescopic examination. Five years ago, a pseudoepidemic of M. chelonae was experienced by the authors, due to contaminated bronchofibrescopes and an automatic endoscope washing machine (4). This report describes the results of the follow-up study concerning decontamination of the bronchofibrescopes and the automated bronchoscope disinfection machine.

Materials and Methods

PSEUDEPIDEMIC (4)

Kagawa Medical School is a 633-bed hospital in which 300 bronchoscopies are performed annually. Between May 1988 and September 1989, acid-fast mycobacteria were detected in bronchial washings from 19 patients at this hospital. Among the 19 strains of acid-fast mycobacteria, three were identified as Mycobacterium avium intracellulare, one as Mycobacterium tuberculosis, and the other 15 as M. chelonae. Based on these cases, it was suspected that the bronchofibrescopes or automated bronchoscope disinfection machines were contaminated with acid-fast mycobacteria. An environmental survey was performed three times (18 January, 15 March and 19 April 1989) (Table 1). All bronchoscopes (Olympus type BF 1T10, BF 20, BF P20, BF 10 and BF 6C) used in the Kagawa Medical School Hospital and an automated bronchoscope disinfection machine (Olympus EW-10) were investigated for contamination. All the bronchofibrescopes were investigated after disinfection by the usual method. From the upper suction valve hole, endoscopes were brushed with a sterilized exclusive brush, and samples were collected from the lower suction hole by washing with 20 ml of sterilized 0.9% NaCl solution. In the case of
The automated bronchoscope disinfection machine, 20 ml (each) of the water for washing (tap water stored in a tank), waste water, detergent, and disinfectant (glutaraldehyde) were sampled. Each sample (20 ml) was centrifuged at 3000 rpm for 20 min at room temperature, and the deposit was smeared and stained using the Ziehl-Neelsen method. All the bronchofibrescopes were found to be contaminated with *M. chelonae*. In addition, the water for washing (tap water stored in a tank), waste water, detergent, and disinfectant (glutaraldehyde) from the automated bronchoscope disinfection machine were also contaminated with *M. chelonae*. Although patients had no roentgenologic abnormalities consistent with mycobacterial infection, four patients were administered anti-mycobacterial therapy for a short period of time. In these patients with suspected contaminated samples by *M. chelonae*, no evidence of invasive *M. chelonae* disease was detected during a 4-yr follow-up period after bronchofibrescopic examination.

Cleansing and disinfection of bronchofibrescopes

The routine cleansing and disinfection procedures for bronchofibrescopes before the pseudoepidemic were as follows: the bronchofibrosecope was immersed in warm tap water with neutral detergent and washed with gauze swabs. Suction valves were dismantled and cleaned separately. The bronchofibrosecope was subsequently washed and disinfected in an automated bronchoscope disinfection machine. This consisted of washing with tap water supplied from a tank and neutral detergent for 7 min, disinfection with 2.25% glutaraldehyde for 30 min and air feeding for 2 min. The glutaraldehyde solution was changed every 2 weeks. These disinfected bronchofibrescopes were kept under U.V. radiation. After the experience of the pseudoepidemic, 70% methanol was instilled into the channels of bronchofibrescopes before they were placed in the automated bronchoscope disinfection machine, as in solution of this concentration,
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**Fig. 1** (b).

![Diagram of automated bronchoscope disinfection machine](image)

In the original washing method, tap water was introduced into the water tank, the two pumps and the washing nozzle. Using this method (previously recommended by the manufacturer), the water tank, connecting tubing and parts were never disinfected. After the experience of a pseudoepidemic due to *M. chelonae*, the method was changed to one that disinfected the whole system of the automated bronchoscope disinfection machine. Simply, at the time of changing the glutaraldehyde solution, the water from the drainage tube was connected to the tube for tap water supply. By this method, the water tank, the two pumps and the washing nozzle were disinfected by the circulating used glutaraldehyde solution. Arrows represent pathways of disinfectant.

*Fig. 1* Structure of an automated bronchoscope disinfection machine. (a) In the original washing method, tap water was introduced into the water tank, the two pumps and the washing nozzle. Using this method (previously recommended by the manufacturer), the water tank, connecting tubing and parts were never disinfected. (b) After the experience of a pseudoepidemic due to *M. chelonae*, the method was changed to one that disinfected the whole system of the automated bronchoscope disinfection machine. Simply, at the time of changing the glutaraldehyde solution, the water from the drainage tube was connected to the tube for tap water supply. By this method, the water tank, the two pumps and the washing nozzle were disinfected by the circulating used glutaraldehyde solution. Arrows represent pathways of disinfectant.

*M. chelonae* is sterilized within 30 s (4). In addition, 3% glutaraldehyde was used instead of 2.25%. Furthermore, the glutaraldehyde solution was changed every week.

**DISINFECTION OF THE AUTOMATED BRONCHOSCOPE DISINFECTION MACHINE**

Previously, the automated bronchoscope disinfection machine was washed by introducing tap water through the water tank, the two pumps and the washing nozzle. In this washing method (previously recommended by the manufacturer), the water tank, connecting tubing and parts were never disinfected (Fig. 1a). After the experience of the pseudoepidemic due to *M. chelonae*, the washing method was changed to one that disinfected the whole system of the automated bronchoscope disinfection machine. Simply, at the time of changing the glutaraldehyde solution, the drainage tube was connected to the tube for tap water supply, and used disinfectant was recirculated for 60 min. Using this method, the old glutaraldehyde solution circulated around the water tank, the two pumps, and the washing nozzle and disinfected all these parts. (Fig. 1b)

**SAMPLE COLLECTION AND INCUBATION**

To re-evaluate contamination of the bronchosopes and the automated bronchoscope disinfection machine, samples were collected. The methods used to investigate the bronchosopes and washing
Table 1 Contamination of Mycobacterium chelonae

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<td>Disinfectant (glutaraldehyde)</td>
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+, M. chelonae positive; –, M. chelonae negative; C, Contamination of other bacteria; ND, Not done.

machine for contamination and culture procedures were the same as the methods used during the pseudo-epidemic. Sample collection was performed every 6 months for 4 yr.

After modification of the methods for disinfecting the bronchofibrescopes (adding the disinfection procedure with 70% alcohol before using the automated bronchoscope disinfection machine, increasing glutaraldehyde concentration to 3% and changing the glutaraldehyde solution once a week) and the automated bronchoscope disinfection machine (recirculation of used disinfectant), M. chelonae has not been detected from either the bronchofibrescopes or the automated bronchoscope disinfection machine for 4 yr. Moreover, no M. chelonae has been detected from bronchial washings for 4 yr.

Discussion

Two potential problems may arise if contamination of bronchial washing or bronchoalveolar lavage fluid by mycobacteria occurs during bronchofibrescopic examination. Firstly, false-positive results may be obtained, both in direct microscopy and in culture for acid- and alcohol-fast bacilli. This may lead to unnecessary, potentially toxic antituberculosis therapy. In our experience of a pseudo-epidemic, four patients without clinical evidence of mycobacterial infection were administered antimycobacterial therapy. Secondly, immunocompromised patients may develop respiratory infection due to the contaminating mycobacteria during bronchofibrescopic examination. In our experience of a pseudo-epidemic (4), no patient developed M. chelonae infection during a 3-yr follow-up period; however, Pappas et al. reported (1) that among 72 patients undergoing bronchofibrescopy from whom M. chelonae were isolated, two immunocompromised patients developed M. chelonae infection and nine patients were transiently colonized.

Several important points have been highlighted by the episodes of contamination of automated bronchoscope disinfection machines. Firstly, the problem of contaminations of bronchofibrescopes and automated bronchoscope disinfection machines is probably under-recognized. Many hospital water systems may be contaminated, but unless the contamination is serious enough to be detected on direct staining for mycobacteria, recognition usually depends on special culture methods used only when looking for atypical organisms. Secondly, the culture method for atypical mycobacteria may be important. In our previous study, M. chelonae was cultured from two patients using a new culture method, without NaOH treatment and using incubation at 28°C. NaOH treatment that kills ordinary bacteria may also kill M. chelonae (4). Thirdly, glutaraldehyde disinfection may not be effective for certain mycobacteria at the exposure time currently recommended for M. tuberculosis. Wenger et al. reported (9) that since these bacteria are often resistant to many standard disinfectants, the use of a rapidly tuberculocidal disinfectant, e.g. 2% glutaraldehyde for at least 30 min, is appropriate. However, because the concentration of glutaraldehyde may decrease with time, 3% glutaraldehyde is currently used by the authors. Finally, a very large series of isolates has been shown to be associated with a damaged endoscope (1):
however, most hospitals do not have regular servicing or maintenance of instruments, as these procedures are time-consuming and expensive.

*M. chelonae* was eventually eradicated from the bronchofibrescope and the automated bronchoscope disinfection machine after the methods of cleansing and disinfection were changed. Some important points were highlighted by our experience. Firstly, the water tank inside the automated bronchoscope disinfection machine was never disinfected by the previous washing method which was previously recommended by the manufacturer. Secondly, disinfection of the washing tank can be accomplished by a simple method of recirculating the used disinfectant (3% glutaraldehyde) from the drainage tube to the water tank inside the automated bronchoscope disinfection machine, by connecting the drainage tube to the tube for tap water supply. There are no occupational hazards of increasing glutaraldehyde to 3%. Gubler et al. also suggested the importance of disinfecting the water tank in an automated bronchoscope disinfection machine, and used a 10% succinic dialdehyde/dimethoxytetrafurane solution (Gigasept) (6). However, recirculating used disinfectant is simpler and less expensive. The washing machine manufacturers have changed their recommendations for disinfection with regard to the results of this study.

In conclusion, the possibility of contamination of the automated bronchoscope disinfection machine by atypical mycobacteria should be considered. By modification of the method for disinfection, contaminated mycobacteria were eventually eradicated from the bronchofibrescopes and the automated bronchoscope disinfection machine.

References