Short Communication

Microbial Contamination of Suction Tubes Attached to Suction Instruments and Preventive Methods

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SUMMARY: We investigated the microbial contamination of suction tubes attached to wall-type suction instruments. Microbial contamination of suction tubes used for endoscopy or sputum suction in hospital wards was examined before and after their disinfection. In addition, disinfection and washing methods for suction tubes were evaluated. Suction tubes (n = 33) before disinfection were contaminated with 10^7–10^8 colony-forming units (cfu)/tube. The main contaminants were Pseudomonas aeruginosa, Acinetobacter baumannii, and Stenotrophomonas maltophilia. The suction tubes were disinfected with sodium hypochlorite (n = 11) or hot water (n = 11), or by an automatic tube cleaner (n = 11). After 2-h immersion in 0.1% (1,000 ppm) sodium hypochlorite, 10^5–10^7 cfu/tube of bacteria were detected in all 11 tubes examined. After washing in hot running water (65°C), 10^5–10^6 cfu/tube were detected in 3 of the 11 examined tubes. The bacteria detected in the suction tubes after disinfection with sodium hypochlorite or hot water were P. aeruginosa, A. baumannii, and S. maltophilia. On the other hand, after washing with warm water (40°C) using the automatic tube cleaner, contamination was found to be <20 cfu/tube (lower detection limit, 20 cfu/tube) in all 11 tubes examined. These results suggest the usefulness of washing with automatic tube cleaners.

In hospitals in Japan, the suction of body fluids such as sputum or blood is performed daily using wall-type suction instruments in wards and outpatient clinics such as endoscopy rooms. These wall-mounted suction instruments are connected to a suction tube. The suction instruments are used for procedures such as sputum suction, endoscopy using a suction tube connected to a gastrofibroscope, and bronchoalveolar lavage (BAL) using a suction tube connected to a bronchofibroscope. In sputum suction and suction in gastrofibroscope, the sucked body fluid (such as sputum and saliva) flows from the patient’s side toward the suction tube (suction instruments). However, in BAL, regurgitation from the suction tube side toward the bronchofibroscope or bronchoalveolar lavage fluid (BALF) sometimes occurs (1); indeed, we experienced such regurgitation several times during BAL. BAL using suction tubes that are contaminated or that have not been disinfected therefore risks contaminating the patient and/or BALF, which may induce nosocomial infection (2,3). Additionally, when suction tubes are washed or disininfected in a sink in the ward or outpatient clinic, water drops containing patients’ body fluids and microorganisms may splash on health care workers, who then run the risk of exposure and infection (4–6). Thus, it is essential to use disposable (single-use) suction tubes or to wash or disinfect suction tubes for each patient. However, to the best of our knowledge, there are currently no guidelines (or recommendations) regarding washing/disinfection methods for suction tubes as non-critical instruments, nor are there clinical data on the relationship between the microbial contamination of suction tubes and their disinfection methods. The purpose of the present study was to evaluate microbial contamination and methods of disinfection of suction tubes.

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We investigated the microbial contamination of suction tubes connected to wall-type suction instruments (Central Uni Co., Tokyo, Japan), and evaluated their disinfection/washing methods. Microbial contamination in a total of 33 suction tubes used for endoscopy or sputum suction in wards was compared before and after disinfection/washing. The tubes were disinfected with sodium hypochlorite (n = 11) or hot water (n = 11), or washed using an automatic tube cleaner (n = 11). We used one suction tube per patient. All suction tubes were 3 m in length and 4 mm in internal diameter, and were made of high-purity latex (Deluxe type latex tubing; Central Uni).

For disinfection with sodium hypochlorite, the suction tubes were washed after use under running water, immersed in 0.1% (1,000 ppm) sodium hypochlorite for 2 h (Fig. 1A), and air-dried in the ward or endoscopy room.

For disinfection with hot water, the suction tubes were washed under running water and then immersed in an enzyme detergent (Biotect®55; Sakura Seiki Co., Tokyo, Japan) at 40°C for 30 min. Subsequently, hot water (65°C) was run through the suction tubes for 5 min (Fig. 1B). In addition, the tubes were flushed with 20 mL of 80% (v/v) ethanol for disinfection (Yoshida Pharmaceutical Co., Tokyo, Japan) using a syringe, and air-dried in the ward.

For washing with the automatic tube cleaner, the suction tubes were washed using the cleaner in the central supply room, flushed with 20 mL of 80% (v/v) ethanol for disinfection, and dried using an automatic drier at 70°C for 2 h. This automatic tube cleaner automatically performs a cleaning process consisting of washing with an enzyme detergent, washing without a detergent, rinsing, and drying (Fig. 1C; Automatic Tube Cleaner MU-72 K; Sharp System Product Co., Tokyo, Japan). Warm water at 40°C, the temperature at which the optimal effects of the enzyme detergent can be expected, was used in the automatic tube cleaner.

Microorganisms in suction tubes after use and after disinfection.
organisms, 10-fold serial dilutions of the samples with sterile saline were incubated in Trypticase® Soy Agar II with 5% sheep blood (Nippon Becton Dickinson, Co., Tokyo, Japan) at 37°C for 24–48 h. Microorganisms were identified by gram staining, morphological examination, the oxidation-fermentation (OF) test, the cytochrome-oxidase test, a test using a kit for the identification of glucose non-fermentative rods (ID Test • ENF-18®; Nissui Pharmaceutical, Co., Tokyo, Japan),

Test staining, morphological examination, the oxidation-fermentation (OF) test, the cytochrome-oxidase test, a test using a kit for the identification of glucose non-fermentative rods (ID Test • ENF-18®; Nissui Pharmaceutical, Co., Tokyo, Japan),

Table 1. Microbial contamination inside suction tubes before disinfection with sodium hypochlorite solution, disinfection with hot water, or washing with automatic tube cleaner

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Colony (cfu/tube)</th>
<th>Contaminant</th>
<th>Sample no.</th>
<th>Colony (cfu/tube)</th>
<th>Contaminant</th>
<th>Sample no.</th>
<th>Colony (cfu/tube)</th>
<th>Contaminant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$2.4 \times 10^3$</td>
<td>Escherichia coli</td>
<td>1</td>
<td>$5.5 \times 10^3$</td>
<td>Acinetobacter baumannii</td>
<td>1</td>
<td>$3.0 \times 10^6$</td>
<td>Acinetobacter baumannii</td>
</tr>
<tr>
<td>2</td>
<td>$2.7 \times 10^3$</td>
<td>Klebsiella oxytoca</td>
<td>2</td>
<td>$3.0 \times 10^3$</td>
<td>Stenotrophomonas maltophilia</td>
<td>2</td>
<td>$3.0 \times 10^6$</td>
<td>Stenotrophomonas maltophilia</td>
</tr>
<tr>
<td>3</td>
<td>$8.0 \times 10^3$</td>
<td>Pseudomonas aeruginosa</td>
<td>3</td>
<td>$2.5 \times 10^3$</td>
<td>Acinetobacter baumannii</td>
<td>3</td>
<td>$2.6 \times 10^7$</td>
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</tr>
<tr>
<td>4</td>
<td>$2.8 \times 10^3$</td>
<td>Acinetobacter baumannii</td>
<td>4</td>
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<tr>
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<td>$3.5 \times 10^3$</td>
<td>Acinetobacter baumannii</td>
<td>5</td>
<td>$3.0 \times 10^3$</td>
<td>Pseudomonas aeruginosa</td>
<td>5</td>
<td>$3.0 \times 10^6$</td>
<td>Pseudomonas aeruginosa</td>
</tr>
<tr>
<td>6</td>
<td>$1.4 \times 10^4$</td>
<td>Stenotrophomonas maltophilia</td>
<td>6</td>
<td>$3.0 \times 10^3$</td>
<td>Acinetobacter baumannii</td>
<td>6</td>
<td>$1.0 \times 10^6$</td>
<td>Acinetobacter baumannii</td>
</tr>
<tr>
<td>7</td>
<td>$1.0 \times 10^4$</td>
<td>Pseudomonas putida</td>
<td>7</td>
<td>$3.0 \times 10^3$</td>
<td>Stenotrophomonas maltophilia</td>
<td>7</td>
<td>$4.8 \times 10^3$</td>
<td>Pseudomonas aeruginosa</td>
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<tr>
<td>8</td>
<td>$2.3 \times 10^4$</td>
<td>Acinetobacter baumannii</td>
<td>8</td>
<td>$3.0 \times 10^3$</td>
<td>Pseudomonas aeruginosa</td>
<td>8</td>
<td>$5.0 \times 10^5$</td>
<td>Acinetobacter baumannii</td>
</tr>
<tr>
<td>9</td>
<td>$1.2 \times 10^4$</td>
<td>Pseudomonas putida</td>
<td>9</td>
<td>$3.0 \times 10^3$</td>
<td>Stenotrophomonas maltophilia</td>
<td>9</td>
<td>$6.6 \times 10^6$</td>
<td>Pseudomonas aeruginosa</td>
</tr>
<tr>
<td>10</td>
<td>$6.5 \times 10^4$</td>
<td>Stenotrophomonas maltophilia</td>
<td>10</td>
<td>$3.0 \times 10^3$</td>
<td>Acinetobacter baumannii</td>
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<td>$7.8 \times 10^6$</td>
<td>Acinetobacter baumannii</td>
</tr>
<tr>
<td>11</td>
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<td>Chryseobacterium meningosepticum</td>
<td>11</td>
<td>$3.0 \times 10^3$</td>
<td>Pseudomonas aeruginosa</td>
<td>11</td>
<td>$3.6 \times 10^6$</td>
<td>Pseudomonas aeruginosa</td>
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</table>
or a test using a kit for the identification of glucose fermentative rods (ID Test \* ENF-20\*; Nissui Pharmaceutical).

An interview survey was performed regarding suction tubes used in 18 institutions (including our hospital) in Yamaguchi Prefecture regarding the use or nonuse of disposable tubes, disinfection and automatic cleaners. Three institutions reported that disposable tubes were used, in 2 (including our hospital), disinfection was performed by immersion in sodium hypochlorite; and in 2, automatic tube cleaners were used. In the other remaining 11 institutions, tubes were reused without disinfection.

Table 1 shows the results of microbial contamination in suction tubes after disinfection by any of the 3 methods under consideration. Suction tubes before disinfection with sodium hypochlorite solution or hot water were contaminated with $10^2$–$10^6$ colony-forming units (cfu)/tube, and the main contaminants were *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, and *Stenotrophomonas maltophilia*. Table 2 shows the results of microbial contamination in suction tubes after disinfection by any of the 3 methods under consideration. Bacteria were detected in all 11 examined tubes after 2-h immersion in 0.1% (1,000 ppm) sodium hypochlorite solution, and in 3 of 11 tubes after washing in hot running water. Contamination after disinfection was $10^3$–$10^5$ cfu/tube, and the contaminants detected in the tubes were glucose non-fermentative Gram-negative rods such as *P. aeruginosa*, *A. baumannii*, *Sphingomonas paucimobilis*, and *S. maltophilia*. Contamination was <20 cfu/tube (lower detection limit, 20 cfu/tube) in all 11 examined tubes after washing using the automatic tube cleaner.

After disinfection by immersion in sodium hypochlorite solution or washing in hot running water, 14 (63.6%) of the 22 tubes examined were contaminated with $10^3$–$10^7$ cfu/tube. In the case of immersion in sodium hypochlorite solution, this inadequate disinfection may be due to the insides of the tubes not being fully immersed in the solution because of the long thin tube structure (>3 m), which inhibits the removal or dilution of organic matter and microorganisms in the tubes. Indeed, in one suction tube after disinfection by immersion in sodium hypochlorite solution, a mass of body fluid was discovered (Fig. 2). On the other hand, all 11 tubes disinfected by an automatic tube cleaner were contaminated with

![Fig. 2. A mass of body fluid discovered in a suction tube after disinfection with sodium hypochlorite solution.](image)
<20 cfu/tube, showing accurate disinfection effects. Automatic cleaners can reduce microorganisms and organic matter inside suction tubes by a mean of 4 log (99.9%) (7). Therefore, the observed disinfection effects may be due to the effective removal of microorganisms and organic matter attached to suction tubes by the automatic cleaner. The disinfection and sterilization of medical equipment are indispensable as anti-infection measures in hospitals. To ensure appropriate disinfection/sterilization, the removal of contaminants from medical instruments is essential (8). In England and the United States, disinfection using automatic cleaners is widely performed. However, in Japan, disinfection is generally performed with disinfectants rather than automatic cleaners (9,10). Disinfectants are much more toxic than antibiotics and have various influences on the human body. The inappropriate use of disinfectants not only leads to inadequate effects but may also cause side effects due to residues. There have been reports of cases of chemical burns, shock, and protocolitis due to residual disinfectants resulting from inadequate rinsing (11–14). The use of automatic cleaners is a useful disinfection method that has marked disinfection effects without causing side effects due to residual toxicity (15).

The present status survey of 18 institutions revealed 3 institutions (16%) using disposable tubes and 2 (11%) (including our hospital) where disinfection is performed by immersion in sodium hypochlorite in the ward or outpatient clinic. When moist/respiratory tract medical instruments such as suction tubes are disinfected in the ward or outpatient clinic, medial workers or sinks may be contaminated by water droplets from suction tubes, which may cause occupational infection (16–18). On the other hand, washing with automatic tube cleaners not only provides superior decontamination/washing effects than disinfection methods performed in the ward or outpatient clinic, but is also desirable in terms of the prevention of occupational contamination of medical workers (19,20). Therefore, we strongly recommend the use of disposable suction tubes or disinfection using automatic tube cleaners.

REFERENCES


