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Microbial Contamination of Suction Tubes Attached to Suction Instrument and Its Preventive Methods

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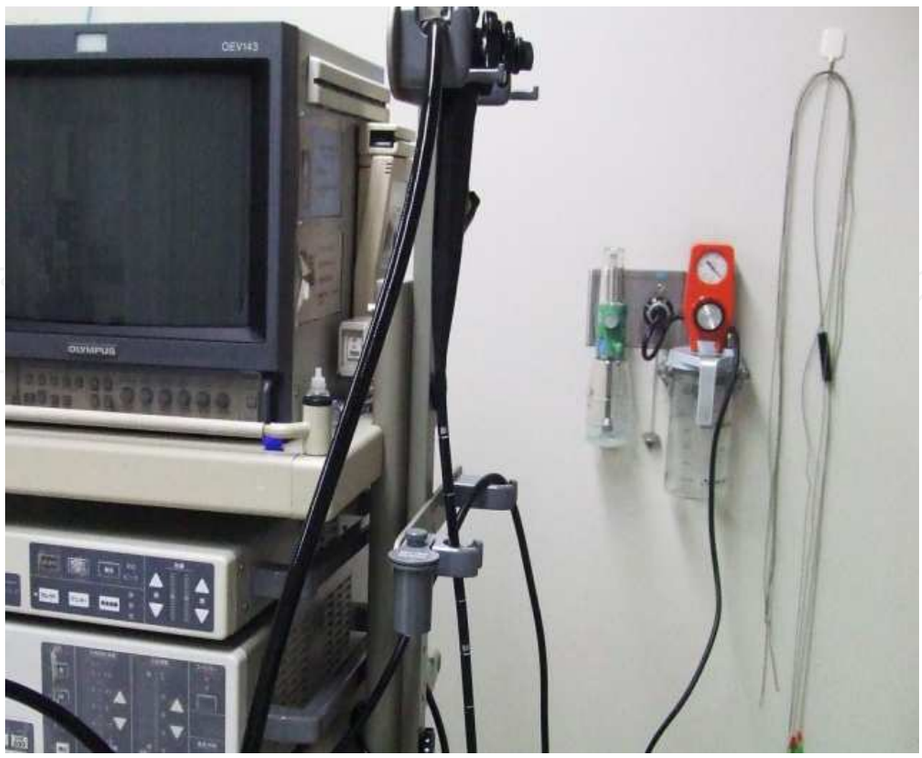
1. Introduction

We investigated the microbial contamination of suction tubes attached to wall-type suction instrument. Microbial contamination of suction tubes used for endoscopy or sputum suction in 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 10^2-10^8 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 using an automatic tube cleaner (N=11). After 2-hour immersion in 0.1% (1,000 ppm) sodium hypochlorite, 10^3-10^7cfu/tube of bacteria were detected in all 11 tubes examined. After washing in hot running water (65°C), 10^3-10^7cfu / tube were detected in 3 of 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, the contamination were < 20 cfu / tube (lower detection limit: 20 cfu / tube) in all 11 tubes examined. These results suggest the usefulness of washing using the automatic tube cleaners.

2. Background

In hospitals in Japan, the suction of body fluid such as sputum or blood is performed daily using wall-type suction instrument in wards and outpatient clinics such as endoscopy rooms (**Fig.1-a,2-b**). Wall-mounted suction instrument are used being connected to a suction tube. Suction instruments are used for procedures such as sputum suction, endoscopy using a suction tube connected to a gastrofiberscope, and bronchoalveolar lavage (BAL) using a suction tube connected to a bronchofiberscope. In sputum suction and suction in gastrofiberscopy, sucked body fluid (such as sputum and saliva) flows from the patient's



a)

b)

Fig. 1.

side toward the suction tube (suction instruments). However, in BAL, regurgitation from the suction tube side toward the bronchofiberscope or bronchoalveolar lavage fluid (BALF) sometimes occurs (1). Indeed, we experienced regurgitation from the suction tube side toward the BALF side several times during BAL. BAL using suction tubes that are contaminated or have not been disinfected runs the risk of the contamination of patients and BALF, which may induce nosocomial infection (2, 3). When suction tubes are washed or disinfected in sink such as the ward or outpatient clinic, water drops containing patients' body fluid and microorganism's splash on health care workers, which runs the risk of exposure and infection (4-6). The use of disposable (single-use) suction tubes or washing/disinfection of suction tubes in each patient is necessary. However, at present, there are no guidelines (or recommendation) regarding the washing/disinfection methods for suction tubes as non-critical instruments. In addition, there are no clinical data on the relationship between the microbial contamination of suction tubes and their disinfection methods. Therefore, we evaluated microbial contamination of suction tubes and methods for their disinfection.

3. Methods

We investigated the microbial contamination of suction tubes that are used, being 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. Tubes were disinfected with sodium hypochlorite (N=11) or hot water (N=11), or washed using an automatic tube cleaner (N=11). Per one patient, we used one suction tube. The suction tube is 3m in length, 4mm in internal diameter and made of high-purity latex (Deluxe type latex tubing: Central Uni Co., Tokyo, Japan). The washing methods using sodium hypochlorite, hot water, or an automatic tube cleaner are as follows.

Disinfection with sodium hypochlorite solution: Suction tubes after use were washed under running water, immersed in 0.1% (1,000 ppm) sodium hypochlorite for 2 hours (**Fig.2-a**), and dried naturally in the ward or endoscopy room.

Disinfection with hot water: Suction tubes were washed under running water and immersed in an enzyme detergent (Biotect®55, Sakura Seiki Co.,Tokyo, Japan) at 40°C for 30 minutes. Subsequently, hot water (65°C) was run into the suction tubes for 5 minutes (**Fig.2-b**). 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 dried naturally in the ward.

Washing using an automatic tube cleaner: Suction tubes were washed using an automatic tube 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 hours. This automatic tube cleaner automatically performs the cleaning process consisting of washing with an enzyme detergent, washing without a detergent, rinsing, and drying (**Fig.2-c**: Automatic tube cleaner MU-72 K: Sharp System Product Co.,Tokyo, Japan). Warm water at 40°C, with which the optimal effects of the enzyme detergent can be expected, was used for the automatic tube cleaner.

A) B)

C)

A: Disinfection by sodium hypochlorite solution
Suction tubes after use were washed under running tap water, immersed in 0.1% (1,000 ppm) sodium hypochlorite for 2 hours.
B: Disinfection with hot water
Suction tubes were washed under running tap water and immersed in an enzyme detergent at 40°C for 30 minutes. Subsequently, hot water (65°C) was run into the suction tubes for 5 minutes.
C: Washing with an automatic tube cleaner
This automatic tube cleaner automatically performs the cleaning process consisting of washing with an enzyme detergent, washing without a detergent, rinsing, and drying.

Fig. 2. Immersion in sodium hypochlorite (a), washing under running hot water (b) and washing with an automatic tube cleaner (c)

4. Results

Table 1 shows the results of microbial contamination in suction tubes before disinfection with immersion in sodium hypochlorite solution, washing with hot water, and washing

with an automatic tube cleaner. Suction tubes before disinfection with sodium hypochlorite solution or hot water were contaminated with 10^3-10^8 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 immersion in sodium hypochlorite solution, those after washing by hot running water, and those after washing with warm water using an automatic tube cleaner. Bacteria were detected in all 11 examined tubes after 2-hour immersion in 0.1% (1,000 ppm) sodium hypochlorite solution and 3 of 11 after washing in hot running water. The contaminant after disinfection was 10^3-10^8 cfu/tube, and the contaminants detected in the suction tubes were glucose non-fermentative gram-negative rods such as *P. aeruginosa*, *A. baumannii*, *Sphingomonas paucimobilis*, and *Stenotrophomonas maltophilia*. The contaminant 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. The main contaminants were glucose non-fermentative gram-negative rods such as *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, and *Stenotrophomonas maltophilia*.

5. Discussion

This inadequate disinfection may be because the inside of the tubes was not immersed in sodium hypochlorite solution due to the thin long tube structure (≥ 3 m), and organic matter and microorganisms in the tubes could not be removed or diluted, and remained. Indeed, in a suction tube after disinfection by immersion in sodium hypochlorite solution, a mass of body fluid was discovered (**Fig.3**). On the other hand, all 11 automatic tube cleaners examined were contaminated with < 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). The use of automatic cleaners is a useful disinfection method that has marked disinfection effects without causing side effects due to residual toxicity, as are observed with disinfectants (**8**).

Fig. 3. A mass of body fluid discovered in the suction tube after disinfection with sodium hypochlorite solution.

before disinfection with sodium hypochlorite			before disinfection with hot water			before washing with automatic tube cleaner		
Sample No.	Colony (CFU/tube)	Contaminants	Sample No.	Colony (CFU/tube)	Contaminants	Sample No.	Colony (CFU/tube)	Contaminants
1	2.4×10^{2}	*Escherichia coli*	1	5.5×10^{5}	*Acinetobacter baumannii*	1	3.0×10^{6}	*Acinetobacter baumannii*
2	2.7×10^{7}	*Klebsiella oxytoca*		3.6×10^{4}	*Pseudomonas aeruginosa*	2	3.0×10^{5}	*Stenotrophomonas maltophilia*
	2.2×10^{4}	*Acinetobacter baumannii*	2	3.0×10^{3}	*Stenotrophomonas maltophilia*		4.4×10^{8}	*Pseudomonas aeruginosa*
	2.0×10^{7}	*Stenotrophomonas maltophilia*		4.4×10^{7}	*Pseudomonas aeruginosa*	3	2.6×10^{7}	*Acinetobacter lwoffii*
3	8.0×10^{4}	*Pseudomonas aeruginosa*	3	2.5×10^{6}	*Acinetobacter baumannii*	4	2.0×10^{4}	*Acinetobacter baumannii*
	3.5×10^{6}	*Acinetobacter baumannii*	4	3.4×10^{5}	*Acinetobacter lwoffii*		2.4×10^{6}	*Pseudomonas aeruginosa*
	8.4×10^{5}	*Sphingobacterium multivorum*		3.0×10^{5}	*Chyseobacterium meningosepticum*		5.8×10^{5}	*Sphingobacterium multivorum*
4	2.8×10^{5}	*Acinetobacter baumannii*	5	4.5×10^{6}	*Acinetobacter baumannii*	5	3.0×10^{8}	*Acinetobacter baumannii*
	7.2×10^{5}	*Sphingobacterium multivorum*		5.0×10^{3}	*Pseudomonas aeruginosa*		5.0×10^{3}	*Pseudomonas aeruginosa*
	5.5×10^{6}	*Stenotrophomonas maltophilia*		3.0×10^{5}	*Stenotrophomonas maltophilia*	6	1.0×10^{5}	*Sphingomonas paucimobilis*
5	3.5×10^{6}	*Acinetobacter baumannii*	6	3.0×10^{4}	*Acinetobacter lwoffii*		1.0×10^{7}	*Stenotrophomonas maltophilia*
	1.4×10^{6}	*Sphingobacterium multivorum*		6.0×10^{5}	*Stenotrophomonas maltophilia*	7	4.8×10^{5}	*Pseudomonas aeruginosa*
6	1.3×10^{8}	*Acinetobacter baumannii*	7	4.2×10^{6}	*Pseudomonas aeruginosa*		5.0×10^{4}	*Acinetobacter haemolyticus*
	1.0×10^{7}	*Pseudomonas pertucinogena*		2.7×10^{3}	*Acinetobacter baumannii*		6.0×10^{2}	*Acinetobacter baumannii*
	3.2×10^{6}	*Escherichia coli*	8	7.0×10^{6}	*Pseudomonas aeruginosa*	8	2.3×10^{7}	*Pseudomonas aeruginosa*
7	4.2×10^{2}	*Pseudomonas pertucinogena*		8.0×10^{7}	*Sphingomonas paucimobilis*		8.0×10^{7}	*Sphingomonas paucimobilis*
	1.5×10^{3}	*Acinetobacter baumannii*		3.5×10^{6}	*Acinetobacter lwoffii*	9	5.8×10^{5}	*Stenotrophomonas maltophilia*
	6.0×10^{4}	*Escherichia coli*	9	5.0×10^{4}	*Stenotrophomonas maltophilia*		6.6×10^{6}	*Acinetobacter baumannii*
8	2.3×10^{8}	*Acinetobacter baumannii*	10	2.1×10^{7}	*Chyseobacterium meningosepticum*		7.8×10^{4}	*Pseudomonas aeruginosa*
	1.2×10^{7}	*Pseudomonas pertucinogena*		4.8×10^{6}	*Pseudomonas aeruginosa*	10	2.8×10^{5}	*Stenotrophomonas maltophilia*
9	6.5×10^{8}	*Stenotrophomonas maltophilia*	11	5.3×10^{5}	*Pseudomonas aeruginosa*		3.6×10^{6}	*Acinetobacter lwoffii*
	4.5×10^{7}	*Chryseobacterium meningosepticum*		2.0×10^{7}	*Acinetobacter calcoacceticus*		4.4×10^{7}	*Pseudomonas aeruginosa*
	2.0×10^{5}	*Pseudomonas aeruginosa*				11	6.4×10^{4}	*Stenotrophomonas maltophilia*
10	3.0×10^{6}	*Pseudomonas oryzihabitans*					3.8×10^{6}	*Acinetobacter baumannii*
11	6.4×10^{4}	*Stenotrophomonas maltophilia*						
	2.6×10^{5}	*Chryseobacterium meningosepticum*						

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

after disinfection with sodium hypochlorite			after disinfection with hot water			after washing with automatic tube cleaner		
Sample No.	Colony (CFU/tube)	Contaminants	Sample No.	Colony (CFU/tube)*	Contaminants	Sample No.	Colony (CFU/tube)*	Contaminants
1	4.2×10^5	*Pseudomonas aeruginosa*	1	< 20	—	1	< 20	—
2	2.0×10^4	*Pseudomonas aeruginosa*	2	< 20	—	2	< 20	—
	2.0×10^4	*Acinetobacter baumannii*	3	7.2×10^3	*Acinetobacter baumannii*	3	< 20	—
	7.4×10^5	*Stenotrophomonas maltophilia*	4	< 20	—	4	< 20	—
	1.2×10^6	*Sphingomonas paucimobilis*	5	1.6×10^7	*Pseudomonas aeruginosa*	5	< 20	—
3	1.2×10^4	*Pseudomonas aeruginosa*		4.4×10^6	*Stenotrophomonas maltophilia*	6	< 20	—
	3.6×10^4	*Acinetobacter baumannii*	6	< 20	—	7	< 20	—
	3.4×10^5	*Sphingobacterium multivorum*	7	< 20	—	8	< 20	—
	7.2×10^5	*Sphingomonas paucimobilis*	8	1.0×10^6	*Pseudomonas aeruginosa*	9	< 20	—
4	6.0×10^5	*Acinetobacter baumannii*		3.2×10^5	*Acinetobacter lwoffii*	10	< 20	—
	4.0×10^5	*Pseudomonas aeruginosa*	9	< 20	—	11	< 20	—
	1.1×10^7	*Sphingobacterium multivorum*	10	< 20	—			
5	1.2×10^4	*Acinetobacter baumannii*	11	< 20	—			
	1.6×10^3	*Pseudomonas aeruginosa*						
	6.6×10^4	*Sphingobacterium multivorum*						
6	8.4×10^6	*Pseudomonas aeruginosa*						
	2.8×10^6	*Stenotrophomonas maltophilia*						
7	8.0×10^4	*Pseudomonas aeruginosa*						
	6.4×10^5	*Sphingomonas paucimobilis*						
	4.8×10^5	*Stenotrophomonas maltophilia*						
8	8.0×10^3	*Pseudomonas aeruginosa*						
	1.6×10^4	*Acinetobacter baumannii*						
	1.5×10^5	*Stenotrophomonas maltophilia*						
	5.1×10^5	*Sphingomonas paucimobilis*						
9	3.2×10^6	*Stenotrophomonas maltophilia*						
	6.8×10^6	*Chryseobacterium meningosepticum*						
10	4.0×10^3	*Pseudomonas oryzihabitans*						
	2.0×10^4	*Empedobacter brevis*						
11	4.8×10^6	*Stenotrophomonas maltophilia*						
	4.0×10^6	*Chryseobacterium meningosepticum*						

*Lower detection limit: 20 cfu/tube

Table 2. Microbial contamination inside suction tubes after disinfection with sodium hypochlorite solution, disinfection with hot water, or washing using automatic tube cleaner

The present status survey in the 18 institutions revealed 3 institutions (16%) using disposable tubes and 2 (11%) (including our hospital) where the disinfection of tubes is performed (by immersion in sodium hypochlorite at the ward/outpatient clinic in both institutions). When moist/respiratory tract medical instruments such as suction tube are disinfected at the ward or outpatient clinic, medial workers or sinks are contaminated with water droplets from suction tubes, which may cause occupational infection (**9-11**). On the other hand, washing with automatic tube cleaners is certain decontamination/washing effects than the disinfection method performed at the ward or outpatient clinic, and is also desirable in terms of the prevention of occupational contamination of medical workers performing washing/disinfection (**12-13**). Therefore, it is necessary to recommend the use of disposable suction tubes or washing disinfection using automatic tube cleaners by medical staff members of the central supply room.

6. References

[1] The European society of pneumology task group on BAL. (1990): Eur. Respir. J., 3, 937-974.

[2] Wishart, M.M., Riley, T.V. (1967): Infection with *Pseudomonas maltophilia* hospital outbreak due to contaminated disinfectant. Med. J. Aust., 2, 710—712.

[3] Pokrywka, M., Viazanko, K., Medvick, J. et al. (1993): A *Flavobacterium meningosepticum* outbreak among intensive care paitients. Am. J. Infect. Control., 21, 139—145.

[4] Ferroni, A., Nguyen, L., Pron, B., Quesne, G., Brussent, M.C., Berche, P. (1998): Oubreak of nosocomial urinary tract infection due to *Pseudomonas aeruginosa* in a pediatric sur-gical unit associated with tap-water contamination. J. Hosp. Infect., 39, 301-307.

[5] Widmer, A.F., Wenzel, R.P., Trilla, A., Bale, M.J., Jones, R.N., Doebbeling, B.N. (1993): Outbreaks of *Pseudomonas aeruginosa* infections in a surgical intensive care unit: probable transmission via hands of a health care worker. Clin. Infect. Dis., 16, 372-376.

[6] Miller, D.M., Youkhana, I., Karunaratne, W.U., Pearce, A. (2001): Presence of protein deposits on 'cleaned' re-usable anaesthetic equipment. Anaesthesai., 56, 1069—1072.

[7] Rutala, W.A. (1996): APIC guideline for selection and use of disinfectants. Am. J. Infect. Control, 24, 313—342.

[8] Block, C., Baron, O., Bogokowski, B., et al. (1990): An in-use evaluation of decontamination of polypropylene versus steel bedpans. J. Hosp. Infect., 16, 331-338.

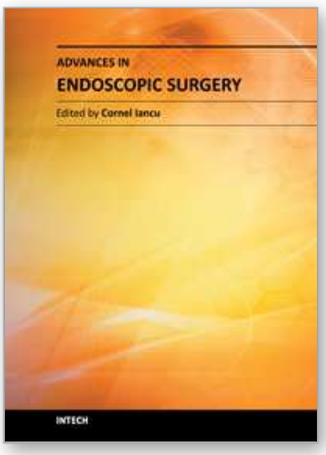
[9] Tordoff, S.G., Scott, S. (2002): Blood contamination of the laryngeal mask airways and laryngoscopes-what do we tell our patients? Anaesthesai., 57, 505—506.

[10] (Coetzee, G.J. (2003): Eliminating protein from reusable laryngeal mask airways. A study comparing routinely cleaned masks with three alternative cleaning methods. Anaesthesai., 58, 346—353.

[11] Bodey, G.P., Bolivar, R., Fainstein, V., Jadeja, L.(1983): Infection caused by *Pseudomonas aeruginosa*. Rev. Infect. Dis., 5, 279—313.

[12] Quinn, J.P. (1998): Clinical problems posed by multiresistant nonfermenting gram – negative pathogens. Clin. Infect. Dis., 27, 117—124.

[13] Bergogne-Berezin, E., Towner, K.J. (1996): *Acinetobacter* spp. as nosocomial pathogens: microbiological, clinical, and epidermiological features.Clin. Microbiol. Rev., 148—165.



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