

Microbial Contamination of In-use Lubricants for Non-touch Urethral Catheters in Intermittent Self-catheterization

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There are no reports on microbial contamination of repeatedly used lubricant (84–87% glycerin containing 0.02% benzalkonium chloride) for non-touch urethral catheters in intermittent self-catheterization. In this work, we evaluated microbial contamination of in-use lubricant and its prevention. Between September and December, 1996, microbial contamination and water activity of in-use lubricants in sheathed and lubricated non-touch catheters connected to a tube used by 46 outpatients at our hospital was examined. Microbial contamination was detected at 5 to 2.6×10^8 colony-forming units (CFU)/ml in 14 (30.4%) of 46 samples. With higher water activity of the lubricant (a higher dilution rate of the lubricant with water), a higher concentration of microbial contamination was observed. In 3 (21.4%) of the 14 patients using contaminated lubricant, urine samples showed the same microbial species as those detected in the lubricant. To prevent microbial contamination of the lubricant, dilution of the lubricant with water, as a result of repeated use, should be avoided.

Key words glycerin; benzalkonium chloride; microbial contamination; intermittent self-catheterization; lubricant; water activity

In long-term intermittent self-catheterization in patients with a neurogenic bladder, a sheathed and lubricated non-touch catheter connected to a tube (Fig. 1) is widely used. A non-touch urethral catheter is placed in a tube filled with a lubricant containing disinfectant (84–87% glycerin containing 0.02% benzalkonium chloride), and the catheter is removed from the tube at the time of use. After use, the catheter is washed with tap water and placed back in this tube. This method can be readily performed, is economical, and is very useful.^{1–3)} However, there have been no studies on microbial contamination of lubricant that is repeatedly used by this method. If the lubricant is contaminated with microorganisms, it could be a source of infection, therefore, we evaluated microbial contamination of the widely used in-use lubricant for the non-touch urethral catheter.

MATERIALS AND METHODS

Between September and December, 1996, we evaluated water activity (A_w) and microbial contamination in in-use lubricants in sheathed and lubricated non-touch catheters connected to a tube used by 46 outpatients at the Department of Urology of our hospital. On the day of consultation, each patient brought a sample of the lubricant in the tube. The lubricant (84–87% glycerin containing 0.02% benzalkonium chloride, a sterile preparation in a 100 ml container) had been repeatedly used. Data for urine cultures were obtained from our Clinical Laboratory. Urine cultures were considered to be positive when 10^4 colony-forming units (CFU)/ml or more microorganisms were detected.

Microbial Contamination of the Lubricant Forty-six in-use samples were examined. Each sample was diluted 10^1 , 10^2 , 10^3 , 10^4 , 10^5 and 10^6 -fold in nutrient broth containing 0.5% Tween 80, 0.5% Lubrol W, and 0.25% soya lecithin as inactivator⁴⁾; 0.2 ml of undiluted sample and of each dilution was placed onto trypticase soy agar or Sabouraud's dextrose agar, both containing the above inactivators, and spread with a glass "hockey stick." Plates were incubated at 30 °C for 24–72 h (trypticase soy agar) or 25 °C for 2 to 7 d (Sabouraud's dextrose agar).

The resultant colonies were counted and the organisms identified by Gram-staining, morphology, OF test, cytochrome oxidase test, and the "API" system.

Measurement of Water Activity Water activity (A_w) was measured using a water activity measurement system WA-40 (Gunze Inc., Tokyo) for the 46 in-use lubricant samples and for mixtures of 84–87% glycerin containing 0.02% benzalkonium chloride and tap water at various ratios.

The concept of A_w has been developed to quantify the proportion of unbound water available to equilibrate with any contaminants and for growth and metabolism. It may be estimated from: $A_w = \text{vapour pressure of solution} \div \text{vapour pressure of water at same temperature}$.^{5,6)}

Data Analysis Data were analyzed by the Kruskal-Wallis test.

RESULTS

Of 46 in-use lubricant samples, 14 (30.4%) were contaminated with 5– 2.6×10^8 CFU/ml (the minimum level of detection was 5 CFU/ml) (Fig. 2). Of 6 samples with $A_w \geq 0.8$, 5 (83.3%) were contaminated with 1.3×10^4 – 2.6×10^8 CFU/ml. Of 16 samples with A_w from 0.6–<0.8, 5 (31.2%) showed 5–510 CFU/ml. Of 24 samples with A_w from 0.47–

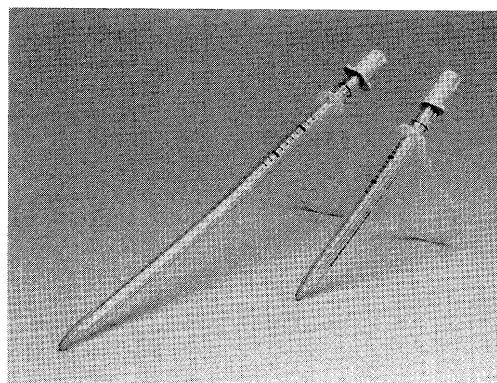


Fig. 1. A Sheathed and Lubricated Non-touch Catheter Connected to a Tube for Intermittent Self-catheterization in A Neurogenic Bladder
Left, for males; right, for females.

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<0.6, 4 (16.6%) showed 15–115 CFU/ml. Microbial contamination was significantly higher in the samples with $A_w \geq 0.8$ than in those with A_w from 0.6–<0.8 or 0.47–<0.6 ($p < 0.01$). Table 1 shows A_w values with various water dilutions of lubricant (84–87% glycerin containing 0.02% benzalkonium chloride). The A_w of lubricant alone was 0.42, and was 0.6 at a lubricant : water ratio of 1 : 0.1 and 0.79 at a ratio of 1 : 0.6.

Table 2 shows microbial counts, contaminants, and results of urine culture for patients using contaminated lubricant. The microbial species detected in the contaminated lubricant were the same as those in urine samples in 3 (21.4%) of the 14 patients. The microbial species were glucose nonfermentative gram-negative bacilli such as *Pseudomonas aeruginosa* and *Alcaligenes xylosoxidans*.

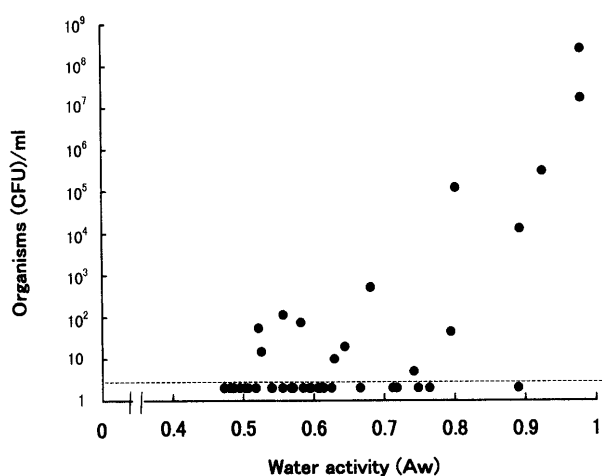


Fig. 2. Water Activity (A_w) and Microbial Counts of In-use Lubricant (Glycerin Containing Benzalkonium Chloride)

DISCUSSION

Our results indicated that bacterial contamination at a high concentration tends to occur when the lubricant in a sheathed and lubricated non-touch catheter connected to a tube used in long-term intermittent self-catheterization is diluted with water, due to repeated use. Although no genetic evaluation was performed, the microbial species detected in the lubricant were the same as those detected in urine samples in some patients. This suggests that contaminants in the lubricant may be the infection source.

Questioning of the 46 outpatients employed in this study showed that the lubricant in the tube had been replaced by fresh material at intervals of 1 d–1 month. Each patient had always washed the non-touch catheter with water after use and placed it back in the tube. Dilution of the lubricant with water may also have resulted in the case of patients who did not replace the lubricant for a long period or did not adequately drain the non-touch catheter after washing. With a

Table 1. Water Activity at Various Ratios of 84–87% Glycerin Containing 0.02% Benzalkonium Chloride and Water

84–87% Glycerin containing 0.02% benzalkonium chloride	Water	Water activity (A_w)
1 : 0		0.42
1 : 0.1		0.60
1 : 0.2		0.63
1 : 0.4		0.73
1 : 0.6		0.79
1 : 0.8		0.83
1 : 1		0.86
1 : 2		0.92
1 : 4		0.95
1 : 10		0.96

Table 2. Culture Results from Lubricant (Glycerin Containing Benzalkonium Chloride) and Urine in Patients Using Contaminated Lubricant in Intermittent Self-catheterization

Patient no.	Lubricant		Urine	
	Colony count (CFU/ml)	Contaminants	Result	Contaminants
1	2.6×10^8	<i>Alcaligenes xylosoxidans</i> ^{a)} <i>Trichosporon cutaneum</i> <i>Candida guilliermondii</i>	+ ^{c)}	<i>Alcaligenes xylosoxidans</i> <i>Serratia marcescens</i>
2	1.7×10^7	<i>Pseudomonas aeruginosa</i> <i>Alcaligenes xylosoxidans</i> <i>Candida guilliermondii</i>	+	<i>Pseudomonas aeruginosa</i> <i>Citrobacter freundii</i> <i>Enterococcus faecalis</i>
3	3.0×10^5	GNGB ^{b)}	— ^{d)}	
4	1.2×10^5	<i>Pseudomonas aeruginosa</i> <i>Flavobacterium</i> sp. <i>Candida parapsilosis</i>	+	<i>Pseudomonas aeruginosa</i> <i>Flavobacterium</i> sp. <i>Enterobacter cloacae</i>
5	1.3×10^4	CDC gr.IV C-2	—	
6	510	<i>Pseudomonas mesophilica</i>	+	<i>Escherichia coli</i>
7	115	<i>Bacillus</i> sp.	+	<i>Klebsiella pneumoniae</i>
8	75	<i>Sphingomonas paucimobilis</i>	+	<i>Enterobacter cloacae</i>
9	55	<i>Bacillus</i> sp.	—	
10	45	<i>Bacillus</i> sp.	+	<i>Serratia marcescens</i> <i>Streptococcus agalactiae</i>
11	20	<i>Bacillus</i> sp.	—	
12	15	<i>Rhodotorula rubra</i>	+	<i>Escherichia coli</i>
13	10	<i>Comamonas acidovorans</i>	+	<i>Citrobacter freundii</i>
14	5	<i>Bacillus</i> sp.	—	

a) The contaminants detected in both the lubricant and urine are in bold-face. b) GNGB: Glucose nonfermentative gram-negative bacilli. c) +: positive culture (organisms in concentrations of $\geq 10^4$ CFU/ml). d) —: negative culture (organisms in concentrations of $< 10^4$ CFU/ml).

higher dilution of the lubricant in water (a higher A_w), a higher concentration of microbial contamination occurred. Lubricant samples with $A_w < 0.8$ showed no or negligible microbial contamination. As shown in Table 1, when water increased above a lubricant:water ratio of 1:0.6, the A_w increased above 0.8. Therefore, it is important not to increase water dilution of the lubricant above this level. In our hospital, patients are instructed to replace the lubricant in the tube every day. Investigations performed after issuance of this instruction revealed no microbial contamination for the patients who had followed this instruction.

In Asia, 84–87% glycerin containing 0.02% benzalkonium chloride is widely used as a lubricant for non-touch urethral catheters. Lubricants with this composition are expected to have not only lubrication effects but also disinfection effects. However, due to the addition of a disinfectant, no measures to prevent microbial contamination, such as instructions on replacement frequency of the lubricant, have been given. This may have caused microbial contamination at high concentration. Recognition of possible microbial contamination of disinfectants such as benzalkonium chloride and chlorhexidine gluconate is necessary.^{7–11)}

To prevent microbial contamination of in-use lubricant (84–87% glycerin containing 0.02% benzalkonium chloride) for non-touch urethral catheters, dilution of the lubri-

cant with water should be avoided. The lubricant in the tube connected to sheathed and lubricated non-touch catheters should be repeatedly (for example, at 24-h intervals) substituted by fresh samples.

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