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ASEPTIC ENDOSCOPY: APPLICATION OF NEWLY DEVELOPED ENDOSCOPE WASHER SYSTEM

(immersion disinfection/ waterproof endoscope)

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The effect of disinfection on a flexible fiberoptic endoscope with 2% glutaraldehyde solution was compared with disinfection by watery wash alone. The number of bacteria in the biopsy channel decreased from 10^4-10^5 to 10^2-10^3 CFU/ml immediately after watery wash alone. The number, however, increased to 10^5-10^6 CFU/ml after storage in the endoscope cabinet for 3-4 days. The increase in the number of bacteria was caused by proliferation of bacteria such as *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Proteus mirabilis*. The use of these contaminated endoscopes for patients with leukemia or for long term administration of corticosteroid hormone or anticancerous agents was, therefore, concluded to be unsuitable. On the other hand, disinfection with 2% glutaraldehyde solution kept the number of bacteria zero even after storage in the endoscope cabinet for 3-4 days.

Endoscope models with perfect waterproof (OLYMPUS OES series) and total immersion endoscope washer have been developed, and total immersion disinfection has made possible. This method of disinfection was easier to operate and more effective than that of conventional disinfection methods, because immersion of the whole endoscope including the operating part became possible.

Although pseudomonas septicemia (1), salmonellosis (2,3) and Hepatitis B viral transmission (4) are infrequently reported after upper gastrointestinal endoscopy, such severe infections sometimes induce a critical condition. Disinfection of the endoscope is therefore thought to be necessary and a new disinfection method with glutaraldehyde solution was evaluated and compared with a watery cleaning method in this study, because waterproof endoscopes (OLYMPUS OES series) have been recently developed and total immersion disinfection has become possible (Fig.1).

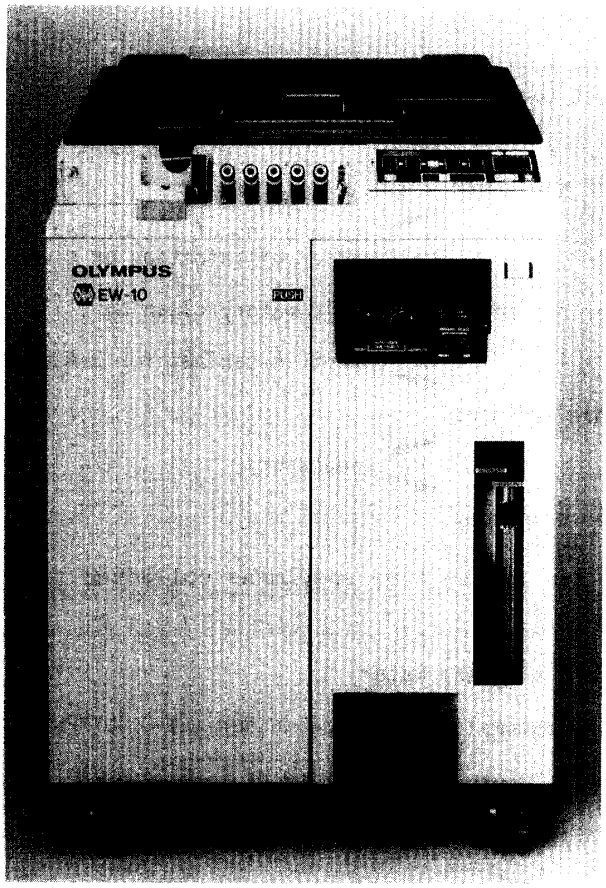

Fig.1 Newly developed total immersion endoscope washer (EW-10, OLYMPUS)

MATERIALS AND METHODS

Bacteria adhering to the biopsy channel were collected in the following way; 5 ml of sterile distilled water was injected

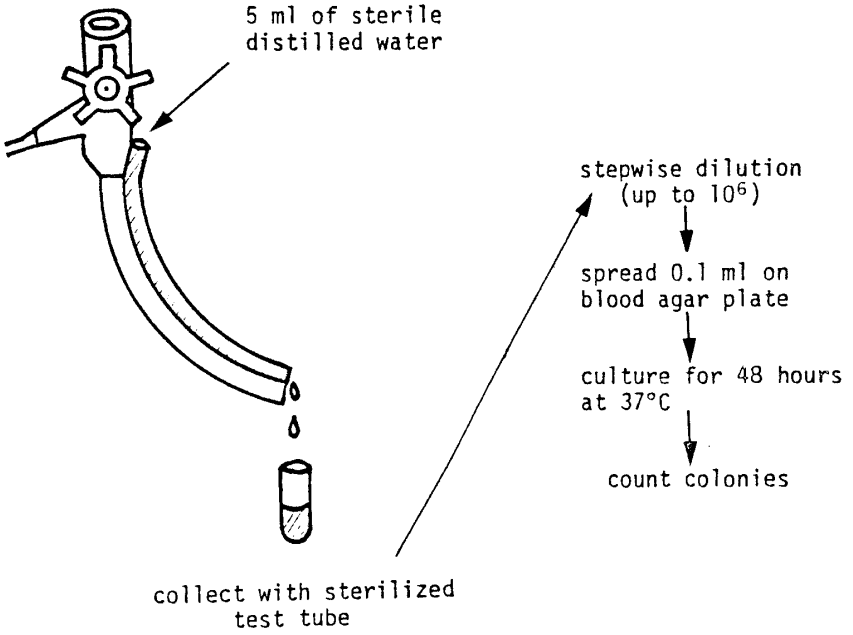

Fig.2
Collecting method
of specimens

1) after endoscopy

suctioning of 1 L of tap water
after disinfection or cleaning

2) after disinfection or only watery cleaning

kept in cabinet for 3-4 days

3) before endoscopy

endoscopy

1) after endoscopy

Fig.3 The time specimens collected

A) Suctioning of 1 L of tap water

B) Watery wash by automatic endoscope washer (EW-D,OLYMPUS)

watery wash → suctioning of 1 L of tap water

30 min.

B) Disinfection by EW-D

watery wash → chemical wash → watery wash → suctioning of 1 L of tap water

4 min. 20 min. 2 min.

C) Immersion disinfection by automatic total immersion endoscope washer (EW-10, OLYMPUS)

watery wash → immersion → watery wash → suctioning of 1 L of tap water

4 min. 20 min. 4 min.

Fig.4 Method for cleaning and disinfection

into the biopsy channel, flushed and collected into a sterilized test tube at the distal tip. One tenth ml of each collected specimen diluted 10-fold up to 10^6 was spread on a blood agar plate. The number of colonies was counted after 48 hours culture at 37°C and expressed as CFU/ml (Fig. 2).

Specimens were collected at three points; after endoscopy, immediately after watery washing or disinfection and before the next use after storage for 3-4 days (Fig. 3).

Disinfection and cleaning methods are shown in Fig. 4; A) watery wash alone, B) watery wash by automatic endoscope washer (EW-D, OLYMPUS), C) disinfection with 2% glutaraldehyde solution by EW-D and D) immersion disinfection with 2% glutaraldehyde solution by automatic total immersion endoscope washer (EW-10, OLYMPUS).

RESULTS

The effect of cleaning without any chemical materials is shown in Table I-A and -B. There was no difference in bacterial count between 1 ℓ tap water suctioning method and watery washing by EW-D. In each specimen, the number of bacteria decreased from a post-endoscopy level of 10^4-10^5 to 10^2-10^3 CFU/ml, although increased to 10^4-10^5 CFU/ml after keeping the endoscope in the cabinet for 3-4 days; this being suggested the possibility of heavy contamination.

Table 1 Number of colonies in 48 hours' culture

A) Suctioning of 1ℓ of tap water

after endoscopy	after suctioning	before endoscopy
5.3×10^4	5.0×10^2	6.7×10^5
4.6×10^4	9.0×10^3	1.8×10^5
4.0×10^4	3.0×10^2	1.0×10^6
6.0×10^5	1.2×10^3	1.1×10^5

B) Watery wash by EW-D

after endoscopy	after cleaning	before endoscopy
4.6×10^5	5.0×10^2	1.1×10^6
1.6×10^4	1.9×10^2	1.0×10^5
1.0×10^5	6.0×10^2	4.0×10^5
2.5×10^4	1.0×10^3	6.0×10^5

C) Disinfection with glutaraldehyde by EW-D

after endoscopy	after disinfection	before endoscopy
1.6×10^4	0	0
8.0×10^3	0	0
1.4×10^4	0	0
2.0×10^5	3	1.2×10

D) Immersion disinfection with glutaraldehyde by EW-10

after endoscopy	after immersion	before endoscopy
2.8×10^2	0	0
3.0×10^3	0	0
5.0×10^2	*0	*0
1.4×10^4	**0	**0

* : 10 minutes' immersion
** : 5 minutes' immersion

(CFU/ml)

Table 2 IDENTIFICATION OF ISOLATES

after endoscopy	before next endoscopy
α-*Streptococcus**	*Pseudomonas aeruginosa**
γ-*Streptococcus**	*Klebsiella pneumoniae**
*Staphylococcus epidermidis**	*Proteus mirabilis**
*Flavobacterium**	*Flavobacterium**
Candida albicans	*Candida albicans*
Neisseria	*Pseudomonas maltophilia*
	Pseudomonas pancimobilis
	Pseudomonas cepacia
	Acinetobacter

* : detected more than three times

Identified bacterial strains in these specimens are presented in Table II. Although pharyngeal indigenous bacteria including α,γ-*Streptococcus* and *Staphylococcus epidermidis* were frequently detected just after endoscopy, bacteria such as *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Proteus mirabilis* which might cause opportunistic infection increased in number after storage in the cabinet for 3-4 days.

Results of disinfection with 2% glutaraldehyde solution are shown in Table I-C and -D. The number of bacteria was kept zero even before the next endoscopy in both methods, this being suggestive of efficient disinfection. In immersion disinfection, the relationship between immersion time and effect of disinfection was also evaluated. Even 5 minutes' immersion was effective for bacterial disinfection.

DISCUSSION

Disinfection is thought to be necessary for an endoscope before every use on account of the possibility of infection (1-7). Similar care should be paid for disinfection of biopsy forceps, because bacterial transmission is reported more frequently in biopsied cases than non-biopsied cases(2,3).

Glutaraldehyde solution is commonly used for the endoscope disinfection and shows an excellent effect of disinfection. This solution, however, has cutaneous and mucosal irritation. In fact, three cases of pharyngeal ulcer were experienced in our hospital. It was thought that accidents to pharyngeal mucosa were caused by the direct action of the concentrated glutaraldehyde solution used during the storage period. Such accidents have never been encountered since rinsing with 1 ℓ of tap water was adopted. It appears that the rinsing with water is indispensable because glutaraldehyde solution is reported to cause cutaneous and mucosal injury even at a concentration of 2% (8).

Newly developed flexible endoscopes (OLYMPUS OES series) can be immersed entirely including the operating part, for disinfection. A newly developed apparatus for endoscope disinfection (total immersion endoscope washer, EW-10, OLYMPUS) was examined for its effectiveness and a sufficient effect for the endoscope disinfection was obtained, which was similar to that obtained by using a conventional automatic washer (EW-D) or other endoscope disinfection system (9-13). There are some advantages in the new disinfection system; the operating part can be disinfected at one time. Additionally, neither degradation of image quality nor trouble in operation was evidenced even after immersion for 100 hours. The durability of the endoscope is, however, unknown and must be examined for a longer period against various chemical solutions.

The time established in the present study for immersion disinfection in 2% glutaraldehyde solution proved to be sufficient for the inhibition of bacterial proliferation (14), but immersion for 10-20 minutes seemed to be necessary from the viewpoint of viral infection (15,16).

There are two points where improvement is needed in this newly developed total immersion endoscope washer, EW-10. One is that this system requires a large quantity (15 ℓ) of 2%

glutaraldehyde solution for immersion and about 5 ℓ are consumed in every use. Immersion space of the endoscope should be made smaller. Another is that tap water flow of 17 ℓ/min is necessary for the operation of this apparatus. Some device which compresses the tap water pressure is required to attach to this washer system, because the flow level needed in this washer system is difficult to obtain from the cock of the ordinary tap water.

It is concluded that 1) total immersion endoscope washer was easy to operate, because immersion of the whole endoscope including the operating part was made possible, 2) where this system was use, the effectiveness of disinfection was excellent and in no way inferior to that of conventional disinfection systems.

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