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BRIEF ARTICLE

Swab culture monitoring of automated endoscope reprocessors after high-level disinfection

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Abstract

AIM: To conduct a bacterial culture study for monitoring decontamination of automated endoscope reprocessors (AERs) after high-level disinfection (HLD).

METHODS: From February 2006 to January 2011, authors conducted randomized consecutive sampling each month for 7 AERs. Authors collected a total of 420 swab cultures, including 300 cultures from 5 gastroscope AERs, and 120 cultures from 2 colonoscope AERs. Swab cultures were obtained from the residual water from the AERs after a full reprocessing cycle. Samples were cultured to test for aerobic bacteria, anaerobic bacteria, and mycobacterium tuberculosis.

RESULTS: The positive culture rate of the AERs was 2.0% (6/300) for gastroscope AERs and 0.8% (1/120) for colonoscope AERs. All the positive cultures, including 6 from gastroscope and 1 from colonoscope AERs, showed monofloral colonization. Of the gastroscope AER samples, 50% (3/6) were colonized by aerobic bacterial and 50% (3/6) by fungal contaminations.

CONCLUSION: A full reprocessing cycle of an AER with HLD is adequate for disinfection of the machine. Swab culture is a useful method for monitoring AER decontamination after each reprocessing cycle. Fungal contamination of AERs after reprocessing should also be kept in mind.

Key words: Automated endoscope reprocessor; Gastrointestinal scope; High-level disinfection; Swab culture; Monitoring; Decontamination

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INTRODUCTION

Gastrointestinal (GI) scopes are complex reusable instruments that require unique consideration with respect to decontamination. Most of the guidelines with updated guidance emphasize decontamination of these scopes[1-3]. While decontamination has been reviewed by several working groups in Britain, problems related to preventing contamination of rinse water, and procedures to monitor contamination have not been addressed thus far. In a recent study, we reported that GI scope contamination might be the result of a contaminated automated

endoscope reprocessor (AER)[4]. There is currently no literature on the quality of disinfection of AERs after reprocessing with high-level disinfection (HLD). Therefore, we conducted this bacterial culture study on AERs after HLD in order to monitor the quality of disinfection.

MATERIALS AND METHODS

From February 2006 to January 2011, a 5-year prospective bacterial study was conducted with randomized consecutive sampling every month in GI scope unit, Chang Gung Memorial Hospital, Kaohsiung Medical Center. We took a total of 420 swab cultures, including 300 cultures from gastroscope AERs and 120 cultures from a colonoscope AER. The swab cultures were obtained from the dependent part of the inner surface of the AER after a full reprocessing cycle. Collected samples were cultured to test for aerobic and anaerobic bacteria and mycobacterium tuberculosis. The samples were incubated at 37 ℃ and examined for bacterial growth at 24 h and 48 h and for mycobacterium growth at 6 wk, and then the results were analyzed.

Culture results were reported as positive or negative. If a culture was positive, the specific AER was reprocessed and could only be used again for clinical use after repeated cultures were found negative according to our previous method[2]. GI scope decontamination was performed in accordance with the guidelines of the European Society of GI Endoscopy (ESGE)[3]. Manual cleaning was performed by trained GI nurses, with tap water, enzymatic soap, brushing, and irrigation, followed by AER, performed by a trained health technician. The liquid disinfectant used was 2.4% alkaline glutaraldehyde, and disinfectant-soaking duration was 20 min. If the cultures were positive, the soaking duration was prolonged to 25 min. The disinfectant was forced into the working channels and the GI scope was completely submerged. Then, the GI scopes were flushed with sterile filtered water prior to forced air-drying. The disinfectant solution, 2.4% alkaline glutaraldehyde, was stored at a temperature of 15 ℃-30 ℃ and changed every 2 wk despite overstorage[4].

Reprocessing cycle of AER

After each scope procedure, thorough manual cleaning with Endozime Premium (Ruthof Corporation, NY, United States), including brushing and flushing of all accessible endoscope channels, was performed before automatic endoscope disinfection. We used the EW-30 AER (Aizu Olympus Co., Ltd, Tokyo, Japan) for reprocessing. Manual cleaning and reprocessing was performed by a fully trained scope nurse using accredited standards of practice as defined by the Digestive Endoscopy Society of Taiwan. HLD involved total immersion of the scope in 2.4% alkaline glutaraldehyde solution (Cidex 14, Ethicon, Inc., NJ, United States) for 20 min at a preset temperature of 25 ℃ and an additional washing cycle of 30 min in each reprocessing. The disinfectant was forced into the suction channels and the scope was completely submerged. The normal relief valve pressure of the AER was 1.85 ± 0.05 kgf/cm^2, and the water supply requirements were 17 L/min. Subsequent flushing with 200 cc of 90% alcohol for 10 min, rinsing, and drying were essential steps to remove the chemical solution and prevent bacterial colonization during storage. The rinse cycle used reverse osmosis-treated water for decontamination.

Table 1 Rate of positive swab culture from the automated endoscope reprocessor after gastroscope and colonoscope reprocessing *n* (%)

Category	AER	*P* value
Gastroscope (*n* = 300)	6 (2.0)	NS
Colonoscope (*n* = 120)	1 (0.8)	NS
Total (*n* = 420)	7 (1.7)	NS

AER: Automated endoscope reprocessor; NS: Not significant.

Table 2 Organisms from swab culture of automated endoscope reprocessor after a full cycle of reprocessing with high-level disinfection

Category	Gastroscope	Colonoscope	Total
GNGN Bacteria[1]	2	1	3
Moraxella osloensis	1	-	1
Yeast-like organisms	2	-	2
Candida glabrata	1	-	1
Total positive culture	6	1	7

[1]All of the positive cultures had aerobic bacteria and mono-floral colonization. GNGN: Glucose-nonfermenting gram-negative bacteria.

Statistical analysis

The χ^2 test was used to analyze independent and paired samples. Statistical analyses were performed using the SPSS statistical software for Windows, version 19.0 (Chicago, IL, United States). *P* values less than 0.05 were considered statistically significant.

RESULTS

The overall positive culture rate was 1.7% (7/420) in swab cultures from AERs after a full reprocessing cycle with HLD. For gastroscope and colonoscope AERs, the positive swab culture rates were 2.0% (6/300) and 0.8% (1/120) respectively, without a statistically significant difference in the culture rate between the upper and lower GI scope AERs (Table 1). All 7 positive swab cultures, including 6 gastroscope reprocessing culture and 1 colonoscope reprocessing culture, showed monofloral colonization. None of the cultures was positive for mycobacterium tuberculosis, and no anaerobic bacteria were found in any swab cultures. Among the cultures from gastroscope reprocessing, 50% (3/6) were positive for aerobic bacteria, while the remaining 50% (3/6) showed fungal contamination (Table 2).

DISCUSSION

The British Society of Gastroenterology Endoscopy Committee first published recommendations on endoscope decontamination practices in 1988, and recommendations from the fourth working group were published in the journal Gut in 1998[1]. Some of these decontamination recommendations are based on microbiological studies[5-8]. Most of the decontaminating guidelines are directed towards GI scopes and associated devices, but no literature is available on AER decontamination. According to our previous report, leakage of the inflow water valve of an AER could be one of the reasons for failure of decontamination of GI scopes and associated devices, even after subjecting them to a full reprocessing cycle[4]. Therefore, in this study, we aimed to monitor proper disinfection of AERs after HLD; to the best of our knowledge, this is the first study to do so. The overall positive culture rate of swab cultures from AERs after a full reprocessing cycle with a HLD process was 1.7% (7/420). Surprisingly, the rate was lower than the previously reported 18.4%-24% contamination rate for GI scope culture[5-8]. This suggests the contamination of GI scopes is not fully caused by AER contamination. We would like to clarify that since drying has been shown to be an important component of GI scope decontamination, the same is true of AERs as well?

The importance of drying in decontamination to make this point clearer is performing in our ongoing study. On the other hand, controlled trials in the field of GI scope decontamination are lacking because of a reluctance to expose "placebo control" patients to the risk of an infection. A controlled study to clarify the relationship between AER and GI scope contamination is necessary and is ongoing in our lab. An AER should be used for all GI scope decontamination following manual cleaning. Effective disinfection is difficult to achieve due to the complex nature of the internal structures of these long and narrow diagnostic instruments[4,9,10]. Manual disinfection is unacceptable. Inflow water used in an AER should be free of particulate contamination and microorganisms. This can be achieved either by using bacteria-retaining filters or by reverse osmosis. In our GI scope units, we used water treated by reverse osmosis in AER reprocessing[10]. The final rinse water should be sampled from the AER and regularly tested for microbiological quality in accordance with the current Health Technical Memorandum (HTM)[11]. A glutaraldehyde-based disinfectant (Cidex®) that was widely used in the past has been withdrawn from the United Kingdom market by its manufacturer. This is not only because there have been advances in the development of disinfectants with superior bactericidal activity but also because glutaraldehyde is chemically related to formaldehyde and has similar toxic effects on the skin and mucous membranes as formaldehyde does. The resulting adverse effects include severe dermatitis, conjunctivitis, sinusitis, asthma, and even chemical colitis. A further problem with glutaraldehyde-based disinfectants is their potential to cross-link residual protein material. The resulting amalgam is very difficult to remove from the working channels of endoscopes that have been repeatedly flushed with aldehydes[3]. This again underscores the importance of manual pre-cleaning and brushing of all accessible internal channels and valve chambers before disinfection. Glutaraldehyde and its derivatives kill most bacteria and viruses (including human immunodeficiency virus and hepatitis B) in less than 5 min. Mycobacteria are more resistant to 2% glutaraldehyde, and earlier guidelines recommended that endoscopes be immersed in 2% glutaraldehyde for 20 min at room temperature[1]. Although we did not detect mycobacterial contamination in our study, we found that of the 1.7% positive cultures from AERs, 50% (3/6) were positive for fungal contamination. The high rate of fungal contamination is most likely due to failure to properly dry the AER after completion of reprocessing. Other than manual pre-cleaning and reprocessing disinfection, the last of the major processes of decontamination of a scope is drying before storage[3]. This step can prevent contamination by fungus or bacterial colonization on the surface of the GI scope after disinfection. It has been recommended that, before the start of each list, each scope to be used should undergo a full reprocessing cycle unless last used and decontaminated within the preceding 3 h. Many GI units are now using drying and storage chambers built purposefully for these scopes, some of which have been shown to prevent colonization of endoscope channels for up to 72 h. Therefore, all AERs should be validated and tested in accordance with guidance provided in the DoH Estates and Facilities HTM publications and relevant standards[12]. AERs should also include flow monitoring for each individual channel to detect blockages.

Furthermore, variant Creutzfeldt-Jacob disease (vCJD) is a rare and fatal condition cause by the consumption of beef contaminated by the bovine spongiform encephalopathy agent[13]. In contrast to the traditional forms of CJD, vCJD contaminated in GI tract, conventional HLD with AER was reported hard to full decontamination. ESGE guideline suggested that endoscope study is not recommended in possible patients[14]. Fortunately, there is no patient with suspicion of vCJD infection before endoscope examination, and there was no positive culture for vCJD in our seriers. The further study is necessary.

In conclusion, a full reprocessing cycle of an AER with HLD is adequate for disinfection of the machine. Swab culture is a useful method for monitoring AER decontamination after each reprocessing cycle. Fungal contamination of AER after reprocessing should be considered.

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COMMENTS

Background

Swab culture is a sample method for the detection of bacterial contamination. In the real world, it is always used to monitoring of the clearing effectiveness such

as the button of the elevator. But up to now, there are still now ideal methods to monitor the decontaminated effect of automated endoscopy reprocessor itself in clinical practices.

Research frontiers

Automated endoscopy reprocessor is a very important washing machine for the endoscopy decontamination in daily clinical practice. Authors apply the swab culture method to monitor the examinated endoscopy, which is the source of the reprocessor contamination.

Innovations and breakthroughs

In fact, decontamination of the automated endoscopy reprocessor is limited description before. Swab culture is a common method for the identification of the pathological organisms from the wound infection. For the quality of the infection control and the hospital identification with high standard monitoring, the results of the swab culture from the automated endoscopy reprocessor should be a standard score of a hospital identification and guideline in the clinical practice in the future.

Applications

The study results suggest that the method of swab culture from the inner surface of automated endoscopy reprocessor is a useful method that could be used in monitoring decontamination after a complete endoscopy reprocessing cycle.

Terminology

Automated endoscopy reprocessor: Automated endoscopy reprocessor is a automatic washing machine for the decontamination of the practically used endoscopy. Accompanist with high-level disinfection, it is effective prevention the hospital acquired microbiological infection.

Peer review

This is an interesting prospective study. Which has dealth with an important topic not properly coverly before. The authors analyze the monitoring effect of swab culture from the inner surface of automated endoscopy reprocessor after the end of daily decontamination. The results are interesting and suggest that swab culture is a potential monitoring method that could be used in preventing not complete disinfection or contamination induced by hospital acquired infectious outbreak.

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