Use of sterile compared with tap water in gastrointestinal endoscopic procedures

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Background: Because of the concern for infection risk, use of sterile water has been recommended in the water bottle for endoscopic equipment, although studies evaluating prevalence of contamination of the water bottle with clinical outcomes have not been performed.
Methods: Over a 12-week period in three endoscopy rooms at a university teaching hospital, the water bottles were filled on a weekly schedule with either sterile (one room) or tap water. The water bottles were sterilized on a weekly basis with an automated endoscope washer. At the end of each week, an aliquot of the remaining water was transferred to a sterile container, and quantitative cultures for aerobic and facultative anaerobic bacteria were performed by use of a 0.01 ml calibrated loop according to standard protocols. Cultures were performed in a blinded fashion without knowledge of the water source. Follow-up was performed on all patients within 2 weeks of the procedure to determine any potential infectious complications.
Results: During the study period, 437 procedures were performed (203 endoscopy, 68 colonoscopy, 38 sigmoidoscopy, 128 endoscopic retrograde cholangiopancreatography). Of a total of 36 cultures (12 sterile), the results of nine (25%) were positive, including three bottles where sterile water was used. Bacterial isolates included five *Flavobacterium* sp., four *Acinetobacter* sp., two *Pseudomonas* sp., and one *Stenotrophomonas maltophilia*. Colony counts ranged from 900 to more than 10,000 per ml. On follow-up no patient had development of a clinical infection from any of these organisms.
Conclusions: Bacterial growth in the water bottle was infrequent, consisted predominantly of nonpathogenic organisms, and was not associated with clinical complications. Our pilot study suggests that the use of tap water as compared with sterile water may be practical, as well as provide cost savings. (AJIC Am J Infect Control 1996;24:407-10)

Endoscopic procedures are commonly performed for the diagnosis and therapy of gastrointestinal disorders. Because these procedures are invasive, there has always been concern over infection risk. A number of case reports have documented infectious complications after endoscopic procedures.[1-10] In almost all of these cases, infection was linked to improper cleaning of the endoscope. In some reports, however, *Pseudomonas* sp. were identified in the endoscope channels, water bottle, and bile, suggesting contamination from the equipment.[8-10] Given these reports, sterile water has been recommended for the water bottle by the manufacturer and infection control committees of many institutions.

To address the need for sterile water in the water bottle, we studied the use of tap water and sterile

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water, evaluating the prevalence of contamination, as well as the development of any infectious complications.

MATERIAL AND METHODS

Patients population. The study was conducted from July 31, 1995, through October 16, 1995, at the University Hospital of the University of Alabama at Birmingham, a 750-bed tertiary care referral center serving a large portion of the southeastern United States. The endoscopy unit serves mostly inpatients and is composed of three rooms, one of which is used primarily for the performance of endoscopic retrograde cholangiopancreatography (ERCP).

Endoscopic techniques. During the study period the water bottle for each endoscopic unit was filled on a weekly basis by the principal investigator (C.M.W.) with approximately 30 ml of either sterile water or tap water. The water bottle is a sealed plastic container with a tube that connects to the umbilicus of the endoscope. When the water button on the endoscope is pushed, a small quantity of water (< 0.5 ml) from the bottle travels through a channel in the endoscope across the lens for cleaning. The room for sterile water was rotated on a weekly basis such that two of the three rooms in use had tap water. Neither the endoscopy nurses nor physicians were aware of the type of water used. The tap water was obtained from the procedure room; a new bottle of sterile water was used weekly (Abbott Laboratories, North Chicago, Ill.). The water bottle was filled to the appropriate level as suggested by the manufacturer (Olympus Corporation, Lake Success, New York, N.Y.), and the water bottle was changed at the same time each week. The water level was routinely checked during the week and, if insufficient, the same type of water placed in the container that week was added. The endoscopes and water bottles were sterilized weekly with an automated endoscope washer (Steris; Steris Corp., Mentor, Ohio). Briefly, this device sterilizes the endoscope by soaking and forcing a disinfectant (35% peracetic acid) through all channels of the endoscope as it is bathed in this closed system. The wash cycle is 30 minutes, and endoscopic accessories such as the water bottle can also be placed in the machine for sterilization. After sterilization, the water bottles were stored with the top of the bottle off in a nonsterile plastic container. After all procedures, the endoscopes were cleaned manually with soap and water to remove any debris, blood, or secretions, the channels were brushed, and the endoscope was sterilized and then hung in a cabinet in the procedure room. The endoscope channels were blown dry with compressed gas if they were not used for the remainder of the day.

Microbiologic techniques. At the end of each week, an aliquot from the water bottle (at least 10 ml) was placed in a sterile container and transported immediately to the microbiology laboratory. Quantitative cultures for aerobic and facultative anaerobic bacteria were performed without knowledge of the use of either sterile or tap water. Trypticase soy agar plates supplemented with 5% sheep blood (BBL, Cockeysville, Md.), MacConkey agar (BBL) and trypticase soy agar (BBL) were inoculated with 0.01 ml water by use of a calibrated loop. Plates were incubated at 35° C under atmospheric conditions for up to 72 hours before being designated negative. Organisms were enumerated and then identified by standard biochemical procedures. Cultures were similarly performed of tap water on 3 consecutive days for each room and from three randomly selected bottles of sterile water. Cultures for mycobacteria and fungi were not performed on any samples.

Follow-up. After the procedure, clinical follow-up was obtained in all patients within 2 to 4 weeks of the procedure either in clinic or by phone by a nurse coordinator to document any potential infectious complications. Follow-up was performed in a blinded fashion for the type of water used. Patients contacted by phone were specifically questioned regarding the presence of fever or other signs/symptoms of infection, as well as hospitalization after hospital discharge. An infectious complication was defined as the development of systemic symptoms or signs of infection that developed within 2 weeks of the procedure associated with documented isolation from the blood stream of the same organism as found in the water bottle used for that patient.

RESULTS

Over the 12-week study period, 437 procedures were performed, including 203 upper endoscopy, 68 colonoscopy, 38 sigmoidoscopy, and 128 ERCPs. Tissue biopsy was performed in more than 50% of procedures, with more than 70% of ERCPs being therapeutic (sphincterotomy, stent placement).

Of the 36 cultures performed, the results of nine (25%; 95% confidence interval 11% to 39%) were

positive. Of the 24 cultures performed of the tap water, the results of six (25%) were positive. Of the 12 sterile water cultures performed, the results of three (25%) were positive. There was no significant difference between the prevalence of culture positivity of the two types of water (chi square; $p = 0.3$). The water source and identified bacterial isolates are listed in Table 1. As illustrated, most of the bacteria were considered water commensals, except for *Acinetobacter baumannii*. All cultures of tap water, as well as newly opened bottles of sterile water were sterile.

Clinical follow-up was available in all patients; 85% by phone and 15% by either hospital or clinic visit. No patient had development of an infectious complication after the procedure related to any of these isolates. No patient undergoing ERCP had development of cholangitis or had an obstructed bile duct at the completion of the procedure. In addition, no patient had development of an infection with fungi or mycobacteria as a result of the procedure.

Table 1. Bacterial isolates, colony count per ml, and water source

	Isolates	Colony count	Water source
1.	*Pseudomonas fluorescens* *A. baumannii*	>10,000	Sterile
2.	*Flavobacterium* sp.	>10,000	Tap
3.	*A. baumannii*	>10,000	Tap
4.	*Flavobacterium* sp.	900	Tap
5.	*A. baumannii* *Stenotrophomonas maltophilia*	5,000	Sterile
6.	*Flavobacterium* sp.	>10,000	Tap
7.	*Flavobacterium* sp.	>10,000	Sterile
8.	*Flavobacterium* sp.	>10,000	Tap
9.	*A. baumannii* *Pseudomonas* sp.	1,100	Tap

DISCUSSION

To address the importance of using sterile water as compared with tap water in water bottles for endoscopic procedures, we evaluated the use of both sterile and tap water in a large cohort of patients undergoing a variety of diagnostic and therapeutic endoscopic gastrointestinal procedures. To further characterize the importance of finding a bacterial isolate, clinical follow-up was obtained in all patients to identify any potential infectious complications. We found that contamination of the water bottle was uncommon, occurring in only 25%. In addition, contamination of the sterile water was almost as frequent as when tap water is used. Importantly, in spite of the contamination, no patient had development of an infection with any of these isolates.

A number of prior case reports have documented infections after endoscopic procedures.[1] Most of these reports were published early in the use of endoscopic equipment when the disinfection methods were much inferior to currently used techniques. Thus, in most of these cases, the infection could be linked to improper cleaning of the endoscopic equipment. Cholangitis resulting from *Pseudomonas aeruginosa* after ERCP has been documented to be related to contaminated endoscopes[8,9]; in these studies the water bottle was also culture positive for *Pseudomonas* sp. It is unclear, however, whether this infectious complication was related to the contaminated water bottle or the endoscope channel. In addition, the methods and frequency of cleaning the endoscope and water bottle, as well as type of water used in the water bottle were not described. In some cases of post-ERCP infections,[4-6] contrast was injected into an obstructed biliary system or common bile duct stones were present, and ductal drainage was not performed at the completion of the procedure; this did not occur in our patients because biliary drainage was established in each patient. Common bile duct stones and biliary strictures may cause secondary bacterial contamination of the biliary system and thus likely contributed to this complication.[5]

Although we identified bacterial isolates in both sterile and tap water in similar concentrations usually exceeding 10,000 colonies, no measurable effect on clinical outcome was found. It is likely that if bacteria enter the gastrointestinal tract from the contaminated water bottle source during the procedure, clinical infection does not occur, given that these procedures are performed uniformly in a nonsterile environment This would be most true for colonoscopy. Contamination of the water bottle also appeared to have no effect on any infectious complications of ERCP, whether the procedure was diagnostic or therapeutic. The exact mechanism by which contamination occurs is unknown. Given the type of isolates found, it is possible that small volumes of water may remain in the water bottle prior to its use. It is unlikely that contamination results from "retrograde" infections from contamination of the endoscope.

In spite of the lack of any identifiable differences in culture positivity between the two groups, our results must be interpreted cautiously given the

small number of cultures performed. Because no prospective studies have been performed to provide reliable estimates of culture positivity, assuming culture positivity of 20% to 25% for sterile water, our sample size would only have been able to detect differences in culture positivity of 40% to 45%. Nevertheless, the large number of patients undergoing endoscopic procedures should have been adequate to detect clinically significant differences in the development of infectious complications.

Our findings have clinical relevance. At most centers, including our own, cost control is an increasingly important issue. Although the cost of sterile water is variable ($1.00/L at our institution), it is reported to be more than $40 at other centers.[11] With the large number of procedures that are performed nationwide, recommendations regarding the use of tap water may be cost-saving, regardless of the cost of the water. In addition, the use of tap water is quite practical.

Given our findings, we believe that tap water can probably be safely used in the water bottle for endoscopic procedures. The water bottle should be routinely sterilized before use and changed at least once weekly. Changing the tap water and bottle more frequently could further decrease the contamination of the bottle, although it may not affect patient outcomes. Future studies may be required to confirm our results before these findings can be universally applied.

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