Carol Rees Parrish, M.S., R.D., Series Editor

Sterile Water and Enteral Feeding: Fear Over Logic

Todd W. Rice

Many practitioners believe they must utilize sterile water for administration into enteral feeding tubes, due to a fear of exposing the patient to potentially pathogenic infectious organisms, especially in critically ill patients, immunocompromised patients, or those with post-pyloric feeding tubes. However, the data supporting this practice are very limited. Enteral feeding tubes are not sterile devices; they are not placed or maintained under sterile conditions. Furthermore, the gastrointestinal tract is designed to handle foreign material and infectious organisms. This does not change in patients receiving enteral feedings. The recommendation to utilize sterile water for administration into enteral feeding tubes is both unjustifiable and costly. This manuscript will expose the flaws in the rationale behind the practice and outline why other forms of potable water are not only acceptable, but preferred as the type of water to administer to patients with enteral feeding tubes.

INTRODUCTION

A number of practitioners and healthcare systems have insisted on the use of sterile water in enteral feeding tubes. This use of sterile water is sometimes limited to administration of free water, and other times also includes any mixing of powder formula or medications. Many reserve this practice for enterally fed critically ill patients, immunocompromised patients, or those receiving post-pyloric enteral feedings that bypass the stomach. This is an interesting practice pattern, which has its origins in a few anecdotal reports of infections from contaminated water in patients who happen to be receiving enteral feeding. In fact, the last American Society of Parenteral and Enteral Nutrition (ASPEN) Safe Practices for Enteral Nutrition Therapy guidelines published in 2009 recommend the use of sterile water in certain populations of patients receiving enteral feeding.[1] However, the use of sterile water in these situations is neither logical nor practical, but instead based on an irrational fear of harming patients.

Todd W. Rice, MD, MSc, Associate Professor of Medicine Division of Allergy, Pulmonary and Critical Care Medicine Vanderbilt University School of Medicine, Nashville, TN

Enteral Feeding

First, let's examine the universal use of sterile water in enteral feeding tubes. The gastrointestinal system is not a sterile environment. From the oropharynx through the rectum, and every location in between, is saturated with commensal bacteria forming the normal flora and individual microbiome of each patient.[2] When these bacteria are decreased, opportunistic organisms, such as *Clostridium difficile* are more easily able to multiply and cause infections. In addition, placement of enteral feeding tubes is not a sterile procedure – while gloves are donned for the placement, the gloves are not sterile

(continued on page 36)

(continued from page 34)

and are intended to minimize soiling of the person placing the tube over preventing contamination of the tube. The patient is not taken to an operating room, the nares (or oropharynx) are not sterilized prior to placement, and a whole sterile field is not used during the placement procedure. Instead, these tubes are often placed at the bedside under non-sterile conditions by the bedside nurse. Furthermore, once placed, the enteral feeding tube is not maintained with sterility. It is not covered with a sterile dressing, nor is the hub sterilized with chlorhexidine or alcohol prior to access.

Medication Administration

Furthermore, the enteral feeding tube is often used for medication administration – medications which are delivered from the pharmacy (or kept in a medication dispensing unit on the floor), are not sterile. They are touched by numerous human hands, often without gloves, prior to administration to the patient. In fact, in order to be administered through an enteric feeding tube, medication in pill form often has to be crushed – which occurs using a non-sterile pestle and mortar or pill crusher kept on each floor or unit. The mortar and pestle, or pill crusher, are washed after each use, but not sterilized. Liquid medications are often dispensed in smaller quantity aliquots from large quantity storage containers in a non-sterile fashion. While the bottles used to dispense the liquid medications are clean, they are not handled under strictly sterile conditions. While this delineation of all of the non-sterile interactions with the enteral feeding tube may startle some practitioners, it should not cause concern. The gastrointestinal tract is meant to handle non-sterile conditions.

In addition to the huge number of bacteria present as its normal flora, the GI tract is also designed to handle exposure to extraneous organisms. The GI tract secretes a number of molecules, which help to protect against infectious insults as part of its normal function. Digestive enzymes may help kill some bacteria, bile salts may bind some bacteria, and IgA antibodies provide a level of immunity against bacteria that are not part of the normal flora.[3] This allows us to eat without having to sterilize our food. While we often wash fruits, vegetables and other non-packaged food products, we do not wash them with sterile water, nor worry that they must be sterile prior to consumption. Similarly, we do not limit our consumption of water to only sterile water. Imagine having to find (or carry with you) sterile water for every time that you wanted or needed a drink of water.

Critical Illness

Yes, but that is in normal, non-sick humans. Is the critically ill patient different? Of course, the critically ill patient is different than a healthy individual. Many critically ill patients are not eating on their own and are dependent on enteral feedings. Therefore, they are not ingesting fruits or vegetables or non-packaged products. While this is true, many of the same facts above are also true. Medications administered to critically ill patients through enteral feeding tubes are not sterile – they are not handled with sterility in the pharmacy or ICU, they are not crushed under sterile conditions, and they are not administered using sterile technique. As soon as the enteral feeding tube is removed from its package, it loses any sterility that it had. It is placed through the nose or oropharynx, which have their own microbiome and are not sterile. The placement is done with non-sterile gloves, without chlorhexidine or povidone-iodine prep. Also every time the enteral feeding tube is accessed, it is not done under sterile conditions. The feeding tubes are not thoroughly washed with chlorhexidine or alcohol prior to touching them, administrations are not done using sterile gloves, the connectors or insertion end of the feeding tube is not sterilized with chlorhexidine or alcohol wipes prior to administration of anything through the tube, and the feeding tube is not maintained in a sterile sleeve or dressing (like the sterile protective sleeve that covers pulmonary artery catheters or dressing covering intravenous catheters to maintain their sterility). Some practitioners administer probiotics through the enteral feeding tube[4] in certain critically ill patient populations, purposefully introducing bacteria into the enteral tube in an effort to replenish normal flora in the gastrointestinal tract, in order to prevent the overgrowth of pathogenic bacteria such as *Clostridium difficile*.

Immunocompromised Patients

What about immunocompromised patients receiving enteral feedings? They are a bit more complicated as they, by definition, do not have normal immune function. The use of probiotics in immunocompromised patients is currently discouraged as there are reports of bacteremia from the specific bacteria in the probiotic.[4] However, like all patients, these patients do not have

(continued on page 38)

(continued from page 36)

a sterile gastrointestinal tract. When they eat, they do not eat sterile food – despite a lack of evidence to support the practice, their diets may be modified to avoid fresh fruits or vegetables. However, their diet is not limited to sterile food. Their enteral feeding tubes are not placed, nor maintained, in a sterile fashion. In addition, the medications that they receive are also not sterile. While caution should be taken to not introduce known contaminated materials, including contaminated water, into their enteral system, their gastrointestinal tract still has adequate defense mechanisms to handle bacteria.

Post-pyloric Feeding

Lastly, some have advocated for the use of sterile water for post-pyloric tubes, or when the distal end of the enteral feeding tube terminates somewhere beyond the stomach. While the acid from the stomach represents one of the first lines of defense against bacteria, it is not the only line of defense, and the bile salts and IgA protective mechanisms of the gut are present in the small intestine and not the stomach. In fact, these are more effective at countering potential infectious organisms than the acid of the stomach.[5] Furthermore, most patients receiving enteral feedings are also receiving some sort of acid suppression (i.e. histamine blocker, proton pump inhibitor, etc), so even patients who have gastric tubes likely lack much of the natural protection afforded by the acidity of the stomach. If there is concern that post-pyloric feeding bypasses this protective mechanism, there should be equal concern for our gastrically fed patients receiving histamine receptor blockade or proton pump inhibitors.

The caution about using non-sterile water, and recommendation for sterile water use, appears to come from two misunderstandings. First, there is an irrational fear of harming the patient by either introducing an infection with contaminated water or precipitating bowel necrosis. However, infections documented from contaminated water are not from enteral administration. The vast majority are pulmonary infections such as legionella, pseudomonas, or mycobacteria[6-10] and according to Smith et al.., these respiratory infections almost assuredly were obtained by inhalation of contaminated droplets from the air and not from hematogenous spread from an initial GI source. Washing hands (with subsequent aerosolization of the water source) is more likely the culprit than enteral administration of the water, where the gastrointestinal tract has numerous defense mechanisms in place to prevent contraction of infectious organisms. Secondly,

Table 1. Types of Water[13,14]

Type	Description	Impurities	Potable (Yes or No)	Cost
Tap Water	Water which comes straight from the tap or spigot	Probably numerous	Depends on Tap	Free
Bottled Water	Water sealed in containers without added ingredients; sold in stores – usually for drinking	Regulated by FDA; Treated to move organisms, metals and other impurities	Yes	$
Filtered Water	Filtered through physical, chemical, or biological process	Most impurities removed	Yes	$
Purified Water	Processed to purify off most impurities	Most impurities removed	Yes	$$
Distilled Water	Boiled into steam which is collected and allowed to condense in separate container	Possible low level bacteria, solid contaminants	Yes	$$
Disinfected Water	Processed with disinfectant, usually fluorine, chlorine, iodine, or UV light	Diminished number of alive organisms, but still potential low level	Yes	$$
Sterile Water	Verified free of all infectious organisms; must meet USP regulations	None	Yes	$$$

Legend: Potable is defined as drinkable[13] $ = $0.10-$1.00/Liter; $$ = $1.01 – $2.00/Liter; $$$ = $2.01–$4.00/Liter bowel necrosis is a rare event in patients receiving enteral feedings. One case report associates distilled water administration into the jejunum with bowel necrosis and perforation in a burn injury patient.[11] Due to hypernatremia, the patient was receiving 400 mL of distilled water flushes every 2 hours. Data from a study in one rat suggest that electrolyte-free water may permit digestion of the bowel wall and predispose to perforation, compared to infusion of salt water.[11,12] Even if these limited data are true, administration of sterile water does not ameliorate this risk. Sterile water is still electrolyte-free, and in fact, is likely more electrolyte free due to its sterile processing than other forms of drinkable water. Furthermore, although distilled water was utilized in the case report, there is no evidence that the use of sterile water in that patient would have prevented the necrosis. The two are as likely unrelated as they are coincidentally related. In addition, this case report does not provide evidence that tap water flushes into the jejunum in reasonable volumes pose any danger to humans.

In addition, there is a misunderstanding of different types of water (Table 1). There are not merely two options, sterile vs. contaminated. These represent two ends of the spectrum, with numerous options in between. Sterile water is verified to be free of all infectious organisms, is produced for use in sterile medical procedures, and must meet USP regulations.[13] Due to this, it carries a higher cost compared to other forms of water. Potable (drinking) water is not sterile. It can come from many sources, including tap water, spring water, and filtered water.[13] Bottled water, which is defined as water sealed in containers without added ingredients, is regulated by the Food and Drug Administration and is also not sterile. It often comes from springs and is treated to remove most of the infectious organisms and heavy metals and other impurities, but it is not sterile. Other types of water in the spectrum between sterile and contaminated include filtered, purified, distilled, disinfected, and tap water. These water types are also not sterile and should not be used in place of sterile water in medical situations where sterility is needed, like an operating room or lavaging a sterile body cavity (like the abdomen, thorax, urinary bladder, etc). Filtered water has been filtered through a physical, chemical, or biological process to remove many of the impurities[14] and is an acceptable grade for drinking. Purified water is similar to filtered. It has been processed to remove impurities and is also acceptable for drinking.[14] Distilled water is the steam from boiled water, which is allowed to condense in a separate container, leaving many of the solid contaminants behind. However, it is not sterile; it can still have some low level of bacteria present. Distilled water is also potable, meaning it is an acceptable grade for drinking. Disinfected water has been processed with a disinfectant, often chlorine, fluorine, iodine, or ultraviolet light to kill bacteria. While this process greatly diminishes the number of live infectious organisms in the water, it does not ensure sterility. Tap water simply describes water that is obtained from the tap, or spigot. The quality of tap water varies greatly, depending on the source of the water and any processing that occurs prior to delivery at the tap. Potable water should be used for administration into enteral feeding tubes. Often, tap water is potable and can be used. Most tap water in the United States is acceptable for drinking, but contaminated taps do exist. If there is any concern, tap water should not be used for drinking, even by healthy people. Caution should be taken to avoid using known contaminated tap water or water that personnel on the unit would not feel comfortable drinking. In these situations, tap water should also not be used for enteral feeding tube administration, regardless of whether or not the patient is critically ill, immunocompromised or has a feeding tube whose distal end terminates in the small bowel.

Table 2: Before Adopting Sterile Water for Enteral Feeding

- Check to see if your hospital has a high nosocomial infection rate—if so, which ones?
- Find out how the tap water is treated to prevent nosocomial infections?
    - Hospital epidemiologist (academic centers)
    - Clinical engineering
- Examine and optimize your staff's track record with hand washing.
- Optimize mouth care
- Use clean technique when preparing to hang enteral feedings.
- Do not dilute enteral feedings or add anything to the bag if an open system is used.

However, even these situations do not require the use of sterile water. Other forms of potable water, namely filtered, purified, distilled, or even bottled water bought at the store can be used instead, and often at considerably less cost. Any water that healthcare personnel or other people drink (filtered, purified) is more than adequate for administration through enteral feeding tubes.

Despite this, one may ask, even if the risk of non-sterile water is very low, why not be safe and use sterile water for the highest risk patients receiving enteral feeds? Sterile water is not without downside. It is expensive, often costing up to $4 per liter (not to mention personnel to deliver to unit, storage space required on the unit, as well as nursing time spent retrieving, etc.). While this may sound like a minor expense, in patients receiving one to two liters of free water via feeding tubes each day (not an uncommon amount for a patient to be receiving), this would amount to $4-8 or more per day, or almost $1500-$3000 per year per patient. An added healthcare cost without benefit that will have to come out of someone's budget – either the hospital's or the patient's. Many patients receive more than two liters of water each day, especially with medication administration, formula reconstitution, and feeding tube flushes. In addition, the use of sterile water is not maintaining sterility of the feeding tube – other things administered via the feeding tube, including medications, supplemental protein, and unclogging agents, are not sterile.[15] Furthermore, obtaining sterile water is more difficult than other forms of potable water. Given its medical grade, and requirement for meeting USP standards, it is only available from places that sell medical goods or medications. It is not routinely available at the grocery, nutrition, or convenience store. This inconvenience may be onerous for the patient or caretaker, and many times, the patient (or caretaker) simply stops using sterile water, despite the guilt, which may occur. Furthermore, the use of sterile water in this fashion also creates environmental concerns as unneeded trash from empty containers (i.e. plastic bottles) must be disposed of someplace and is likely to end up in our landfills.

CONCLUSION

Given the soaring health care costs in this country, clinicians should always weigh the cost against demonstrated benefits of practices prior to implementation. The routine use of sterile water in enteral feeding tubes increases cost, is more labor intensive and is harmful to the environment, without any added benefit to our patients. Regardless of the condition of the patient or location of the distal ports of the feeding tube, the mandated use of sterile water is illogical, unfounded, and expensive. Instead, we should recommend against using known contaminated water (including contaminated tap water) or water which is known or thought to be non-potable. Any water administered into an enteral feeding tube should be potable, just like any water drunk by patients able to ingest on their own. When safe potable tap water is not available, numerous cheaper, more practical, and more easily accessible forms of potable drinking water exist than medical grade sterile water. Therefore, we should stop recommending the use of sterile water in our patients with enteral feeding tubes. Finally, see Table 2 for practical interventions before considering a switch to bottled water for enterally fed patients. ■

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