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RESEARCH ARTICLE

POTENTIAL TRANSMISSION OF PATHOGENIC MICROORGANISMS ASSOCIATED TO GASTROSCOPES IN COSTA RICA

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ABSTRACT

Background: Flexible gastrointestinal endoscopes (gastrosopes) have been associated with patient infections and outbreaks, especially because of the high contamination they suffer during procedures. The aim of this investigation was to evaluate the presence of diverse bacteria, including pathogens on the surface of endoscopes before their use on patients having an *Esophagogastrroduodenos* copy (EGD). **Methods:** 68 different gastro scopes used at a type A hospital in San José, Costa Rica, were analyzed in order to determine the presence of different bacteria that might potentially infect patients. The external surface of the insertion tube was analyzed before its introduction into the patient. Also, the disinfecting agent used was microbiologically tested. **Results:** The results obtained showed an important contamination of the gastro scopes with potentially infectious agents. The disinfectant solution, after 30 days of use also showed microbiological contamination. **Conclusions:** an important rate of contamination of gastro scopes with different bacteria, including potential pathogens was found. Additional efforts must be done to assure proper procedures for the cleaning and disinfection of this equipment in order to offer patient safety and diminish potential infections.

INTRODUCTION

Flexible gastrointestinal endoscopes have been associated with patient infections and outbreaks, especially because of the high contamination they suffer during procedures (Ofstead *et al.*, 2015; Ofstead *et al.*, 2016, Virsroda *et al.*, 2014). The World Gastroenterology Organization has established that all patients shall be considered as a potential source of infections, and for this reason all endoscopes and accessory devices must be decontaminated rigorously after each endoscopic procedure (World Gastroenterology Organization, 2011). There are few prospective studies referring to the incidence in the transmission of pathogens during esophagogastrroduodenoscopy (EGD). Also, there is a limited estimation of the transmission of infections. However, some studies have demonstrated that disinfecting techniques are not well followed, especially by developing countries (World Gastroenterology Organization, 2011). Most of the guidelines for the reprocessing of endoscopes indicate at least three basic steps between each patient, including cleaning, rinsing and disinfecting. Cleaning includes the use of some detergent in order to eliminate blood, mucous or any other organic remains. Low foam detergents are recommended so that the visual field is not compromised. Also, foam may block adequate contact between the liquid, and the device's surfaces.

After an extensive rinse, endoscopes have to be immersed in a high level disinfecting, or sterilizing solution. The ideal disinfecting agent must be effective against a broad range of microorganisms, including blood transmission viruses, and prion proteins. Also, they must be compatible with endoscopes and accessories. They must be innocuous and non-irritant for patient. These disinfecting agents must be tested regularly in order to ensure optimal activity. The most commonly used disinfecting agents include glutaraldehyde, orto ftal aldehyde, and peracetic acid. The endoscope has to be completely immersed in any of these for at least for 20 minutes (Panget *et al.*, 2002, Santos *et al.*, 2004). An adequate disinfection depends on several factors, including: previous hygiene, presence of organic material, level, and kind of microbial contamination, microbial agent concentration, exposure time, presence of biofilms, temperature, and pH used for disinfection (Santos *et al.*, 2004). The social security health system in Costa Rica provides a broad coverage, and procedures including the use of flexible endoscopes are done almost daily. There is no information about the potential transmission of pathogens between patients associated with these devices. The aim of this study was to evaluate the presence of diverse bacteria, including pathogens on the surface of endoscopes before their use on patients having an EGD.

MATERIALS AND METHODS

During the second semester of 2018, 68 different gastroscopes used at a type A hospital in San José, Costa Rica, were analyzed in order to determine the presence of different bacteria that might potentially infect patients. The external surface of the insertion tube was analyzed before its introduction into the patient. A sterile swab was moistened with sterile saline solution 0,85% and rolled over the external surface of the gastroscope. The swab tip was then cut off into a sterile tube containing 1 mL of sterile saline solution and immediately transported to the Food and Water Microbiology Laboratory at the University of Costa Rica (Universidad de Costa Rica, UCR). Additionally, a sample of new disinfectant, and a sample from the disinfectant where the gastroscopes were submerged for over 30 days was taken to the lab to be microbiologically analyzed. After arrival to the lab, each sample was vortexed for 25 seconds. 100 uL of each sample was cultured in blood agar plates, incubated for 48 h at 35°C. At the end of the incubation, each relevant colony was identified using the Biomerieux Vitek 2 system. At priori, a clinically relevant level of contaminations was defined as >100 CFU/mL.

RESULTS

In the gastroscopy service evaluated in this study, the gastroscopes are reused daily after being sanitized and submerged in a disinfecting solution for 10-20 min. From the 68 gastroscopes analyzed, 20 resulted positive for a relevant level contamination (29,4%). From these, 28 different bacteriological isolates were obtained. The identification of these isolates is detailed on Table 1.

Table 1. Identification of the isolates obtained from gastroscopes analyzed during the second semester of 2018 from a class A hospital in San José, Costa Rica

Microorganism	Frequency (%)
<i>Stenotrophomonas maltophilia</i>	5 (17,8)
<i>Bacillus sp</i>	4 (14,2)
<i>Kocuria varians</i>	3 (10,7)
<i>Staphylococcus capitis</i>	2 (7,1)
<i>Micrococcus luteus</i>	2 (7,1)
<i>Pseudomonas fluorescens</i>	2 (7,1)
<i>Pseudomonas putida</i>	2 (7,1)
<i>Sphingomonas paucimobilis</i>	2 (7,1)
<i>Pseudomonas aeruginosa</i>	2 (7,1)
<i>Pseudomonas luteola</i>	1 (3,6)
<i>Escherichia coli</i>	1 (3,6)
<i>Rhizobium radiobacter</i>	1 (3,6)
<i>Methylbacterium</i>	1 (3,6)

The disinfecting solution used for submerging the gastroscopes was also cultured on the day it was first used (day 0), and on day 30 (day in which it would be changed according to hospital protocol). On day 0, the disinfectant solution showed no growth. Nevertheless, on day 30 there were four different relevant bacteria isolated, including *Kocuria varians*, *Staphylococcus capitis*, *Micrococcus luteus*, and *Stenotrophomonas malophilia*. All of these bacteria match with those isolated from the gastroscope surfaces.

DISCUSSION

Flexible endoscopes are difficult to clean and disinfect, and easy to damage because of their design and delicate materials (Gillespie et al., 2008; Martiny et al., 2004 and Rutala and

Weber, 2004) Also, they are considered semi-critical items, since they come into contact with the patient's mucosa, but do not penetrate it (Leung, 2000). Because of this, the incidence of infections associated to this procedure is low. In spite of this, it's the medical device that is most linked to healthcare associated outbreaks (Moses and Lee, 20034 de microbiological) mainly caused by bacteria (Cowen, 2001). Pathogen transmission through this equipment has been described, and is especially associated to failure in its cleaning, and disinfection (Gillespie et al., 2008). Literature describes infections associated to gastroscopes due to *Pseudomonas*, *Escherichia coli*, *Klebsiella*, *serratia* and even *Helicobacter pylori* (Santos et al., 2004). Results obtained show an important contamination of the routinely used gastroscopes (29,4%). Similar results have been reported in literature (Ofstead et al., 2015; Ofstead et al., 2016, Virsroda et al., 2014) where even a 50% of patient ready gastroscopes harbor nonpathogenic bacteria (Ofstead et al., 2016). As in other studies, most of the isolates identified are considered nonpathogenic commensals of either the skin, or upper respiratory tract. Nevertheless, the presence of potentially pathogenic groups represents a risk for patients, especially if they have any kind of immunodeficiency. *Stenotrophomonas maltophilia* was isolated from 5 different gastroscopes. It's considered an opportunistic human pathogen associated to blood stream infections, and even pneumonia. This bacterium has the ability to colonize the surfaces of medical devices, and presents a high level of intrinsic resistance to many antibiotic classes (Looney et al., 2009). *Kocuria varians* was isolated from 10,7% of the gastroscopes analyzed. This Gram positive coccus can be isolated from skin, and oropharynx microbiota. Nevertheless, it has been associated to bacteremia, sepsis associated to catheters, endocarditis, cholecystitis, peritonitis, and even abscess in immunocompromised patients (Savini et al., 2010). *Pseudomonas* spp is a genus associated to infections, especially in patients with compromised host defense mechanisms. Also, it's the most common pathogen associated to nosocomial infections. It exhibits innate resistance to common use antibiotics (Fazelli et al., 2012), and can even be a life threatening agent. (pseudo) In this study, almost 18% of the isolates were from the Pseudomonaceae family, representing an important risk for patients.

Coagulase negative staphylococci, including *Staphylococcus capitis*, and *Micrococcus luteus* were also isolated from the gastroscopes analyzed. These microorganisms have emerged as responsible agents for a large number of infections. They have been reported as etiological agents of catheter associated infections, valve infections, superficial abscesses, and even skin, and urinary tract infections. (Fariña et al., 2013). The presence of microorganisms on ready to use gastroscopes demonstrates that either the hygienic practices, or the disinfectant are not achieving their goal. Mechanical cleaning of gastroscopes can eliminate 99% of microorganisms (Scanlon et al., 2016). Efficacy of this step is personal-dependent, and contact time is critical for an effective disinfection. Completely clean gastroscopes will not be obtained if they are submerged for less than 20 min. These disinfecting agents have to be periodically changed, and tested for efficacy. The cause of contaminated disinfectants includes the use of contaminated stock disinfectants, not changing the disinfectant after a prolonged use, or the use of contaminated containers. When the disinfecting solution was analyzed, four different bacterial genus were isolated. All of them were also isolated from the gastroscopes throughout the study. Since the

analysis of the disinfecting agent at day 0 was negative for bacterial growth, it can be concluded that the contamination of this solution is due either to mishandling, or not changing the solution after a prolonged period of time. In conclusion, we found an important rate of contamination of gastroscopes with different bacteria, including potential pathogens. Also, we found that disinfecting solutions may be contaminated depending of the period of time they are used. These data suggest that additional efforts must be done to assure proper procedures for the cleaning and disinfection of this equipment. Also, solutions of disinfectants in use should be tested, and changed regularly in order to offer patient safety and diminish potential infections.

Conflicts of interest: The authors declare that there is no conflict of interest.

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