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Infectious complications in gastrointestinal endoscopy and their prevention

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A B S T R A C T

Gastrointestinal endoscopes are medical devices that have been associated with outbreaks of health care-associated infections. Because of the severity and limited treatment options of infections caused by multidrug-resistant *Enterobacteriaceae* and *Pseudomonas aeruginosa*, considerable attention has been paid to detection and prevention of these post-endoscopic outbreaks. Endoscope reprocessing involves cleaning, high-level disinfection/sterilization followed by rinsing and drying before storage. Failure of the decontamination process implies the risk of settlement of biofilm producing species in endoscope channels. This review covers the infectious complications in gastrointestinal endoscopy and their prevention and highlights the problem of infection risk associated with different steps of endoscope reprocessing.

Endoscopes are medical instruments used for diagnostic and therapeutic purposes. Because the same endoscopes are used to treat different patients, it is important that cleaning, disinfection, and sterilization take place appropriately. Flexible endoscopes are complex instruments with multiple and narrow internal channels which may become heavily contaminated with microorganisms during use [1]. Because of their complex structure endoscopes are difficult to clean and disinfect. The ability of microorganisms to form biofilms inside the endoscope channels can contribute to failure of endoscope

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reprocessing [2]. Failure of the decontamination process can result in microbial transmission from one patient to another and in a possible development of post-endoscopic infectious complications [3].

Endoscope reprocessing is a multistep procedure involving cleaning, followed by disinfection or sterilization with further drying before storage. The main principle is that rigid and flexible endoscopes used in sterile body cavities should always be sterilized, while disinfection is usually enough for endoscopes that come in contact with non-sterile tissues [4]. Heat-resistant, rigid endoscopes are generally sterilized by steam. Due to their material composition, most flexible endoscopes cannot be heat-sterilized without damage [3]. They should receive at least high-level disinfection (HLD) or be decontaminated by another method, for example, by means of ethylene oxide (ETO) sterilization. Preferably, cleaning and disinfection should be performed in automated endoscope reprocessors (AERs).

Infections related to endoscopic procedures are caused by either endogenous flora (the patient's own microorganisms) or exogenous microbes (microorganisms introduced into the patient via the endoscope and/or its accessories) [5]. Endogenous infections in gastrointestinal (GI) endoscopy are commonly caused by *Escherichia coli*, *Klebsiella* spp. or other *Enterobacteriaceae*, and enterococci. The exogenous microorganisms most frequently associated with transmission are *Pseudomonas aeruginosa* and *Salmonella* spp. These microorganisms can be transmitted from previous patients or contaminated reprocessing equipment by contaminated endoscopes or accessories. The most common factors associated with microbial transmission during GI endoscopy involve: inadequate cleaning, disinfection and drying procedures, use of contaminated AERs, and flaws in instrument design or use of damaged endoscopes [3]. Exogenous infections are preventable with strict adherence to accepted reprocessing guidelines.

We review herein the infectious complications in GI endoscopy and their prevention and cover the problem of infection risk associated with different steps of endoscope reprocessing.

Risk of exogenous infection

The true transmission during endoscopy may go underestimated because of low frequency, the absence of clinical symptoms, or inadequate surveillance [2]. Kimmey et al. calculated the risk of endoscopy-related infection following GI endoscopy approximately one in 1.8 million procedures (28 reported cases in 40 million endoscopic procedures) [6]. However, this method of estimating risk was found to be highly prone to reporting bias [7]. An overview of the exogenous endoscopy-related infections and cross-contaminations after GI endoscopy is presented in Tables 1 and 2. The 63 published reports include more than 500 episodes of microbial transmission. The number of the reported cases per 5 years is shown in Fig. 1. The peak in 1991–1995 is probably associated with the introduction and use of contaminated or defective AERs which led to colonization and infections with *P. aeruginosa*. The second peak in 2010–2015 with more than 170 involved patients is particularly related to transmission of multidrug-resistant (MDR) *Enterobacteriaceae* and *P. aeruginosa.*

Transmission of viruses

Transmission of viral pathogens via endoscopic procedures is rare because viruses are obligate intracellular microorganisms and cannot replicate outside viable human cells. Non-enveloped viruses (e.g., enteroviruses, rotaviruses) are more resistant to chemical disinfectants and dry conditions than enveloped viruses (e.g., human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV)). Viruses from the GI tract, such as rota- and enteroviruses can persist on surfaces for approximately 2 months, while blood-borne viruses, such as HBV or HIV, persist for more than one week [8].

Despite the serious concern about the possibility of HIV transmission during endoscopic procedures, no cases have been reported. Three cases of HBV transmission [9–11] and four cases of patient-to-patient HCV transmission [12–15] after GI endoscopic procedures have been related to inadequate cleaning and disinfection of endoscopes and accessories [9–15] and to use of contaminated anesthetic vials or syringes [13,14]. It was concluded that the risk for HBV and HCV transmission by endoscopy is low when adequate endoscope reprocessing is used.