COVID-19 and gastrointestinal endoscopy: Importance of reducing SARS-CoV-2 infection risks of medical workers and preserving personal protective equipment resources

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In December 2019, the World Health Organization (WHO) was informed of cases of pneumonia of unknown etiology detected in Wuhan, China. Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), a novel coronavirus, was identified, and SARS-CoV-2-related disease, called coronavirus disease 2019 (COVID-19), has spread worldwide. The WHO has declared COVID-19 to be a pandemic on March 11, 2020. Clinical symptoms of the COVID-19 include cough (67.8%), fever (43.8%), fatigue (38.1%), production of sputum (33.7%), and shortness of breath (18.7%). Gastrointestinal symptoms of COVID-19 include nausea or vomiting (5.0%), as well as diarrhea (3.8%).

It is estimated that 1.2% of infected subjects are asymptomatic, but the rate of severe disease is 13.9% with an overall mortality rate of 2.3%.

COVID-19 is mainly transmitted through aerosols or by direct contact. Upper endoscopic procedures, including esophagogastroduodenoscopy (EGD), endoscopic ultrasonography (EUS), and endoscopic retrograde cholangiopancreatography (ERCP), could increase the risk of SARS-CoV-2 transmission to endoscopists and assistants because coughing and retching can occur during upper endoscopy, and could generate aerosols. Moreover, SARS-CoV-2 has been detected in the fecal samples of infected subjects, so the possibility of fecal–oral transmission may pose a risk for SARS-CoV-2 transmission.

During the current COVID-19 outbreak, gastrointestinal endoscopists should know how to prevent further transmission of SARS-CoV-2 during per-endoscopic procedure. Some international organizations, such as the European Society of Gastrointestinal Endoscopy, the British Society of Gastroenterology, the United States Joint GI Society, and the Asian Pacific Society for Digestive Endoscopy, have already produced guidance and/or the statements on gastrointestinal endoscopy during the COVID-19 pandemic. There are several essential points detailed in those statements, such as the risk stratification of patients with suspected COVID-19, classification of endoscopic procedures by urgency, and the availability and use of personal protective equipment (PPE), which must be addressed to prevent further dissemination of COVID-19.

First, risk stratification of patients with potential SARS-CoV-2 infection is needed. Patients undergo prescreening for: (i) symptoms including fever or more than 37.5°C, cough, shortness of breath, diarrhea, dysgeusia, and dysosmia with no other etiology; (ii) travel or residence in countries with a high incidence of COVID-19 within the past 14 days; (iii) occupational exposure including health care worker or laboratory staff handling specimens of COVID-19; and (iv) contact with subjects having an established diagnosis of COVID-19 or those highly suspected of the infection, such as a traveler to high-risk countries, during the 14 days before the endoscopic procedure. Subjects positive for any one of the above items should be regarded as suspected cases. If an endoscopic procedure is considered for a suspected case, it is desirable to implement PCR or the antibody testing for SARS-CoV-2 whenever possible. If any of the tests are positive, the endoscopic procedure should be postponed except for urgent endoscopies.

Next, endoscopic procedures should be classified according to urgency, as urgent, semi-urgent, and elective endoscopy should be considered (Table 1). Urgent endoscopies, such as acute gastrointestinal bleeding with hemodynamic instability, acute ascending cholangitis, foreign body in the esophagus, or gastrointestinal obstruction requiring stenting, should be performed promptly.

All elective endoscopic procedures should be postponed until the pandemic is over. Routine diagnostic, surveillance and follow-up endoscopy, therapeutic endoscopy for non-cancer diseases (e.g. esophageal low-grade dysplasia, gastric or colonic adenoma, polyps, achalasia, and varices with low risk of bleeding) are considered to be elective endoscopic procedures. ERCP procedures for asymptomatic biliary stones, chronic pancreatitis, pancreaticobiliary stricture/neoplasm without malignant condition, and papillectomy...
for ampullary adenoma are also elective. In EUS, the diagnosis of a benign condition, follow-up for pancreatic cyst, and tissue sampling for subepithelial lesions are considered to be elective.

Semi-urgent endoscopic procedure includes diagnosis and/or treatment for malignancies or lesions strongly suspected to be malignant. Such cases include endoscopic submucosal dissection for gastrointestinal cancer, EUS, and ERCP for hepatobiliary or pancreatic cancers. Endoscopic procedures for symptomatic cases are also considered as semi-urgent. EGD for dysphagia, dyspepsia, and anemia, colonoscopy for inflammatory bowel disease, gastrointestinal access for feeding (e.g. percutaneous endoscopic gastrostomy), as well as ERCP for gallstone-related pancreatitis, and necrosectomy are also included. A case-by-case evaluation based on medical necessity is needed to determine whether a semi-urgent endoscopic procedure is performed or postponed. Semi-urgent endoscopic procedures for confirmed or suspected COVID-19 cases should be postponed as much as possible. Appropriate reductions in the number of endoscopic procedures could help both to minimize the exposure to SARS-CoV-2 and to reduce the

| Table 1 | Classification of endoscopic procedure according to urgency |
|----------|----------------------------------------------------------|
| **Urgent** | **Semi-urgent** | **Elective** |
| Acute GI bleeding | ESD/EMR for gastrointestinal cancer | Routine diagnostic endoscopy |
| Acute cholangitis | EGD and CS for highly suspicious case of cancer | Surveillance and follow-up endoscopy |
| Foreign body in the esophagus | EUS and ERCP for hepatobiliary/pancreas cancer | Therapeutic endoscopy for non-cancer diseases |
| High-risk foreign body in the stomach | ERCP for gallstone-related pancreatitis | ERCP for asymptomatic case without malignant condition |
| Stenting for GI obstruction | Small bowel enteroscopy for occult GI bleeding | EUS for diagnosis of benign condition |
| Volvulus | EGD and CS for symptomatic case | Papillectomy for ampullary adenoma |
| | GI access for feeding | Per-oral endoscopic myotomy |
| | Endoscopic necrosectomy | |

CS, colonoscopy; EGD, esophagogastroduodenoscopy; EMR, endoscopic mucosal resection; ERCP, endoscopic retrograde cholangiopancreatography; ESD, endoscopic submucosal dissection; EUS, endoscopic ultrasonography; GI, gastrointestinal.

Figure 1 Standard personal protective equipment (PPE) and enhanced PPE. Standard PPE includes goggles, a surgical mask, gloves, and an isolation gown. Enhanced PPE includes a hairnet, goggles, an N-95 mask, two pairs of gloves, and an isolation gown. Inner gloves extend inside of the wrist of the isolation gown, and the outer gloves extend to cover the wrist of the isolation gown. The surgical mask covers the N-95 mask to prevent contaminating.

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use of medical supplies, many of which are limited during the COVID-19 pandemic.

All health care staff working at an endoscopy unit should receive education and training on infection control for SARS-CoV-2, including the appropriate use of PPE during an endoscopic procedure. Medical supplies, including PPE, will be limited during the pandemic, so the use of PPE should be optimized according to a patient’s risk for SARS-CoV-2 infection (optimized PPE). Standard PPE, including a surgical mask, gloves, isolation gown with water resistance, and protective eyewear (goggles or face shield), should be used for low-risk cases during endoscopy. For confirmed, suspected or unknown cases of COVID-19, enhanced PPE, including N-95 or FFP-2/3 high-filter respiratory masks, two pairs of gloves, isolation gown with water resistance, hairnets or headcovers, and protective eyewear (goggles or face shield), should be used during endoscopy (Fig. 1). Procedures for confirmed or suspected cases should be performed in a negative-pressure room.

1. Remove the outer gloves

2. Remove the isolation gown

3. Remove the hairnet, the inner gloves, the goggle, and the surgical mask over the N-95 mask

4. Remove the N-95 mask outside of the room

Figure 2 How to remove personal protective equipment. 1. Outer gloves. Only outer gloves should be removed. First, perform hand hygiene. Grasp a gloved hand and peel off the outer glove. Slide the fingers under the other outer glove at the wrist and peel it off without touching the outside of the glove. Discard the outer gloves in a waste container and perform hand hygiene. 2. Isolation gowns. Unfasten the gown ties while ensuring the hands do not contact the front of the gown, and the sleeves do not contact your body. Slide the fingers under a sleeve and pull out the sleeve. Next, pull out the other sleeve, touching only the inside of the gown. Pull the gown away from the waist without touching the front of the gown. Turn the gown inside out, roll it into a bundle and discard it into a waste container. Perform hand hygiene. 3. Hairnet, inner gloves, goggles, and surgical mask over the N-95 mask. First, remove the hairnet from the back and perform hand hygiene. Next, remove the inner gloves like the outer gloves and perform hand hygiene. Third, remove the goggles from the back by lifting the earpieces. Finally, remove the surgical mask over the N-95 mask without touching its front, and perform hand hygiene. 4. N-95 mask. First, leave the negative-pressure room, close the door, and perform hand hygiene. Grasp the elastics of the N-95 mask, and remove it without touching its front. If there is no visible contamination or damage to the N-95 mask, it can be reused by the same medical staff on the same day.
Protocols for putting on and removing PPE are essential. The US Centers for Disease Control and Prevention have provided guidelines about how to put on and remove PPE. Pieter et al.9 also detailed the procedures involved in dressing and undressing with PPE. There are a variety of ways to put on and remove PPE. To remove PPE safely after an endoscopic procedure, it is essential to know which parts of the PPE are contaminated by SARS-CoV-2. The outsides of gloves, googles or face shields, hairnets, gown fronts and sleeves, and the front of a mask or respirator can be considered to be contaminated, so healthcare staff should not touch them during removal, and must perform hand hygiene between undressing steps (Fig. 2).

Unfortunately, adherence to the guidance with respect to gastrointestinal endoscopy during the COVID-19 pandemic cannot completely prevent SARS-CoV-2 infection in endoscopy units.10 When endoscopic procedures are necessary for confirmed or suspected COVID-19 patients, the number of staff should be minimized, with one experienced endoscopist, to minimize exposure and the consumption of PPE. The buddy system, a two-person system involving a team including one experienced medical doctor and one assistant (the buddy) together in a negative-pressure room with the COVID-19 patient, may be useful to maximize the smoothness of the procedure and reduce the procedural and exposure times.9 A fixed expert endoscopy team for COVID-19 patients might help to prevent the inappropriate use and removal of PPE.

When elective endoscopies are resumed, the number of COVID-19 patients and the availability of medical supplies should be considered. The downturn in the new cases of COVID-19 and the suboptimal medical supplies reserve, which may be between 4 and 8 weeks, mean that we should consider resuming elective endoscopies gradually. Elective endoscopies can be fully resumed when no new patients of COVID-19 have presented for at least 2 weeks, and the normal amount of medical supplies is available.

In conclusion, gastrointestinal endoscopists are at high risk for infection by SARS-CoV-2 during the COVID-19 pandemic. Considering the patient’s risk of COVID-19 and the urgency of the endoscopic procedure, endoscopy units can manage the number of endoscopic procedures to minimize the risk of SARS-CoV-2 infection and to reduce the use of medical supplies. When the endoscopists have to perform an endoscopic procedure for a confirmed or suspected COVID-19 patient, appropriately optimized PPE, and the use of a fixed expert endoscopy team may help to minimize the risk of SARS-CoV-2 infection.

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CONFLICT OF INTERESTS

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