Surgical mask designed for endoscopic procedures to prevent the diffusion of droplets

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To the editor,

Coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has become a global pandemic. The human-to-human transmission of SARS-CoV-2 occurs primarily through droplets, aerosols, and direct contact. Endoscopy is performed at a short physical distance between an endoscopist and patient, which increases the risk of SARS-CoV-2 transmission to the endoscopist through contact with body fluids and exposure to droplets due to vomiting, retching, and coughing during endoscopic procedures (1). Gastrointestinal endoscopic procedures generate aerosols, which mandates the use of appropriate personal protective equipment (PPE) (1,2). To further reduce the risk of viral infection during endoscopy, additional infection protection is needed to assist PPE from not only the side of endoscopists but also the side of patients (3).

Various infection prevention devices, such as a reusable plastic cube barrier, have been reported (3); however, we focused on a surgical mask as a simple and inexpensive method (4). Previous studies proposed modified surgical masks with an endoscopic insertion port, which were handmade with an incision for endoscope insertion into commercially available surgical masks (2,4). Although these "handmade" masks may be easily modified, their preparation is burdensome and not sterile. We developed a novel disposal surgical mask with a mask manufacturer that is specifically designed as a droplet prevention device for endoscopic procedures that may be mass-produced with uniform quality and easily introduced into endoscopy units. This novel surgical mask has a 10-mm slit in the center for the insertion of an endoscope and two small 6-mm slits for suction on the left and right. The width of the pleats in the center have been widened to easily cut the slits, which allows for cost-effective mass production. Despite its close fit, the narrow slit allows for the easy passage of an endoscope and smooth endoscopic manipulation. Furthermore, the leakage of droplets and aerosols through the slit in the surgical mask is minimized (Fig. 1A-D).

We evaluated the efficacy of this surgical mask to prevent droplets using a high-speed camera (ViEST, Shin Nippon Air Technologies, Tokyo, Japan) which can visualize particles of 80 nm or more. The diffusion of droplets was photographed when a subject coughed without the surgical mask and again with the mask under endoscope insertion through the slit. Without the mask, numerous droplets scattered more than 50 cm and spread beyond the shooting range. On the other hand, no droplets were observed with the surgical mask under endoscope insertion (Fig. 2). These results suggest that this mask will effectively prevent the diffusion of droplets during endoscopic procedures.

In conclusion, this novel surgical mask, which is specifically designed for endoscopic procedures, effectively prevents the diffusion of droplets during endoscopic procedures and, thus, reduces the risk of SARS-CoV-2 transmission to endoscopists as an ancillary infection prevention for PPE. This prevention method is simple and cost-effective and may be applied to any upper endoscopic procedure.

Contributors

Kazuhiro Furukawa, Kazuhide Sato, and Shotaro Okachi contributed equally to this work.

Conflicts of interest

The authors declare no conflicts of interest associated with this manuscript.

Key words: COVID-19, endoscopy, infection prevention, personal protective equipment, SARS-CoV-2, surgical mask.

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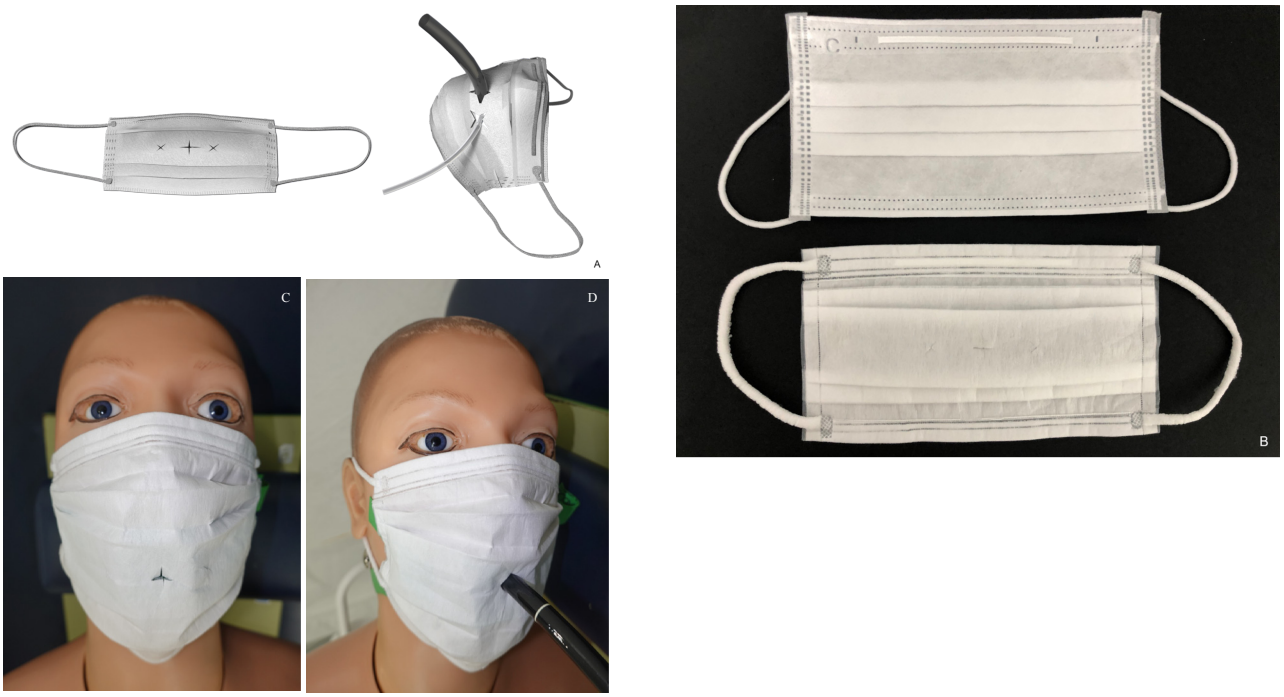

Fig. 1. — A novel surgical mask specifically designed for endoscopic procedures. A) Schema of the novel surgical mask. This surgical mask has a 10-mm slit for the insertion of an endoscope in the center, and two small slits for suction on the left and right. B) Comparison of a commercially available surgical mask and the novel surgical mask. The top is the commercially available mask, and the bottom is the novel mask. The width of the pleats in the center is widened to cut slits easily; therefore, the mask may be mass-produced at a low cost. C) Phantom with a surgical mask. The surgical mask covers the phantom's face tightly. D) Phantom with an endoscope (GIF-H290Z, Olympus, Tokyo, Japan) inserted through the slit in the surgical mask. The endoscope may be easily inserted through the slit, and the operability of the endoscope is smooth.

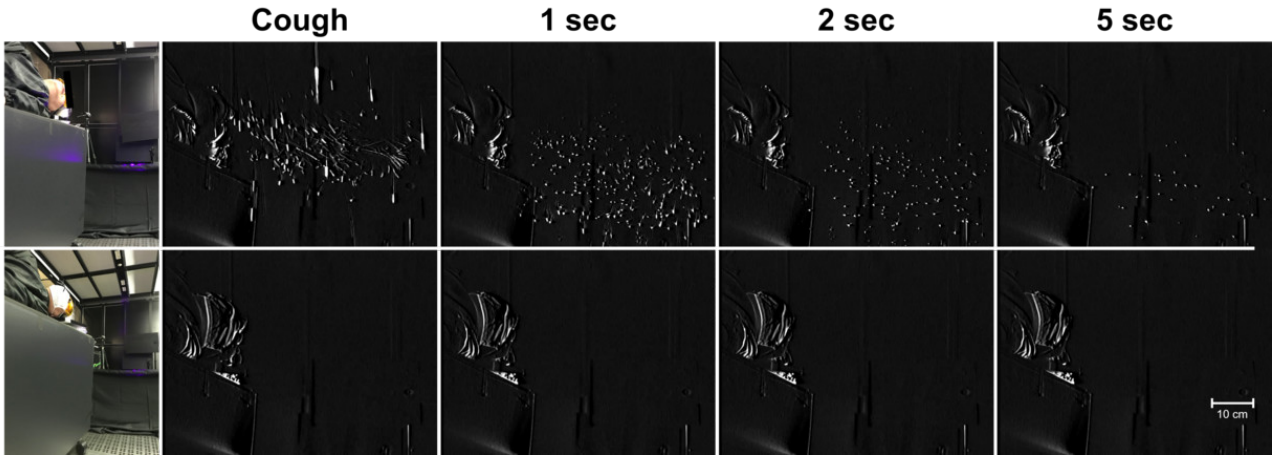

Fig. 2. — Visualization of the diffusion of droplets using a high-speed camera without and with the mask under endoscope insertion. The top is a series of photos without the surgical mask, and the bottom is a series of photos with the surgical mask under endoscope insertion. To shoot small transparent droplets, a high-speed camera was used with a black background and high-intensity lighting. The resulting footage was analyzed with dedicated image processing software. A flexible, thin endoscope with a 5-mm caliber was inserted and did not interfere with the shooting of the high-speed camera. Although many droplets diffused without the mask, none were observed with the surgical mask under endoscope insertion. This result indicates that the mask effectively prevents the diffusion of droplets not only in peroral endoscopy, but also in nasal endoscopy or ultrathin endoscopy with a small caliber.

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