

Experience for use of modified full-face snorkel mask as personal protective equipment during endoscopic procedures in the era of coronavirus disease pandemic

The rapid spread of coronavirus disease 2019 (COVID-19) has led to a personal protective equipment (PPE) shortage worldwide.^{1,2} Recently, the adaptation of commercially available modified full-faced snorkel masks (mFFSMs) has been proposed as an alternative in times of PPE shortage. The mFFSMs were adapted and used by health care workers during the COVID-19 crisis.³ An mFFSM is composed of an off-the-shelf snorkel mask, a custom adapter (three-dimensional-printed with a custom print file that sourced attributes from the designs found at Pneumask and OceanReef), and a filter cartridge (Fig. 1a).

Nine endoscopists performed endoscopic procedures using general facial protection (N95 mask, goggle, and face shield) (Fig. 1b) and mFFSM (Fig. 1c). The vital signs of the endoscopists were assessed before they wore the PPE and were re-assessed after 30 min. All vital signs pre- and post-endoscopic procedures are shown in Table 1. With a mFFSM, the respiratory rate increased significantly post-endoscopy ($P = 0.034$).

This is the first report of experience with using a mFFSM during endoscopic procedure. We estimated that the benefits of a snorkel mask are that it provided an integrated full-face shield instead of masks, goggles, and shields and allowed a clear view; thus, this mask is an off-label application. We can consider the use of mFFSM, when no alternative PPE is available.



Figure 1 (a) Modified full-face snorkel mask: snorkel mask (Easy-breath Surface Snorkeling Mask; Decathlon) (black arrow), a custom adapter (red arrow), and a filter cartridge (HME Twin Star[®] MPO 1805; Dräger, Lübeck, Germany) (blue arrow). (b) Personal protective equipment with general facial protection. (c) Personal protective equipment with a modified full-face snorkel mask.

The fit-test of the mFFSM has been reported.^{4,5} The quantitative fit-test measures the leaks at the wearer's face, leaks concerning the connection after the filter, and leaks related to the exhaust valve. However, it was suggested that the rise in carbon dioxide (CO₂) intake triggered an increase in minute ventilation and the respiratory rate, thereby maintaining the level of end-tidal CO₂ within the normal range.⁴ The mFFSM has the potential for use during endoscopic procedures when PPE is insufficient, it is necessary to consider the characteristics of mFFSMs concerning the possibility of CO₂ accumulation.

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CONFLICTS OF INTEREST

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Table 1 Comparison of the vital signs of the endoscopists using general facial protection vs. the modified full-face snorkel mask

	General facial protection		P-value	Modified-FFSM		P-value
	Pre-endoscopy	Post-endoscopy		Pre-endoscopy	Post-endoscopy	
Blood pressure						
Systolic (mmHg)	117.4 ± 18.2	115.2 ± 15.5	0.889	118.1 ± 16.7	122.2 ± 12.9	0.313
Diastolic (mmHg)	78.5 ± 14.1	77.8 ± 12.1	0.721	79.3 ± 13.1	82.1 ± 9.8	0.313
Pulse rate (/min)	72.2 ± 11.6	76.7 ± 15.2	0.108	74.7 ± 13.0	78.7 ± 16.1	0.291
Oxygen saturation (%)	98.5 ± 1.0	97.6 ± 0.8	0.056	98.4 ± 1.0	97.6 ± 1.0	0.106
Respiratory rate (/min)	15.5 ± 1.8	15.6 ± 2.6	0.798	16.0 ± 3.5	17.5 ± 3.2	0.034

(Mean ± SD)

Categorical valuables were analyzed via the Wilcoxon signed-rank test. Statistical significance was considered as $P < 0.05$. All analyses were conducted using R language and environment for statistical computing (version 3.5.2, R Core Team, 2018, R Foundation for Statistical Computing, Vienna, Austria).