EDITORIAL

Behind the mask: physiologic effects of facial personal protective equipment during endoscopy

In December 2019, a cluster of severe pneumonia cases of unknown causes was identified in Wuhan, Hubei, China. In January 2020, a novel coronavirus, SARS-CoV-2, was identified as the causative virus of COVID-19. This highly contagious virus rapidly spread and was declared a global pandemic on March 11, 2020.[1,2] Respiratory droplets and aerosols were found to be the primary method of transmission of this potentially lethal virus. A major challenge in controlling the propagation of COVID-19 is its ability to spread from presymptomatic and asymptomatic individuals.[3] In response, global communities have implemented unprecedented recommendations for protecting populations through the use of hand hygiene, wearing masks, and the use personal protective equipment (PPE) during medical care. In the United States, these recommendations are provided by the Centers for Disease Control and Prevention.[4] Given the degree of infectivity, the mode of transmission, and the aerosolizing nature of endoscopic procedures, the American Society for Gastrointestinal Endoscopy and other gastroenterologic societies were prompt in issuing guidance for PPE use during the COVID-19 pandemic.[5]

Although the routine use of surgical masks with face shields in addition to gowns and gloves during GI endoscopy may appear self evident, given the previously published society guidelines[6] and studies characterizing the increased risk of bacterial exposure to an endoscopist's face during endoscopy,[7] significant variability in PPE usage practices existed before the COVID-19 pandemic. In fact, a survey of gastroenterologists from 3 academic centers, published before the pandemic, found the use of any facial protection to be only 41.7% and 27.8% among trainees and attendings, respectively.[7] This suggests that the transition toward full-barrier PPE at the start of and during the current pandemic represented a significant change in typical practice patterns.[8,9]

Aside from the regular use of face shields, one of the most dramatic shifts in our practice during the pandemic has been the routine use of N95 filtering facepiece respirators (FFRs) and powered air purifying respirators (PAPRs) as a means for reducing intraprocedural transmission of aerosolized pathogens. Well-designed studies in the COVID-19 era have shown that multiple factors including patient safety concerns, changes in medical center resource utilization, and PPE supply shortages have affected clinical volume.[8] In contrast, studies on the effect of PPE on the health of the workforce have been largely neglected.

In the current issue of *Gastrointestinal Endoscopy*, Khalid et al[10] present their work evaluating the physiologic effects of using a surgical mask, an N95 FFR under a surgical mask, and a PAPR during simulated colonoscopy.[10] Eighteen volunteer gastroenterologists participated, and the study was completed in 2 phases. In phase 1, participants were observed during 3 sequential and randomly ordered 60-minute sessions of simulated endoscopy while wearing a surgical mask, N95 FFR, under a surgical mask, or a PAPR. In phase 1, measurements familiar to most gastroenterologists were obtained, including heart rate, blood pressure, respiratory rate, and peripheral pulse oximetry (SpO_2). A survey was completed after each portion of phase 1 to assess the participant's subjective experience and symptoms related to PPE during the simulation. In phase 2, participants performed simulated colonoscopies while using a surgical mask alone (15 minutes), followed by an N95 FFR (60 minutes), followed by surgical mask alone (15 minutes). In contrast to phase 1, the participants were monitored by continuous electrocardiogram and with a BIOPAC respiratory belt (BIOPAC Systems, Inc, Goleta, Calif, USA) for strain-gauge respiratory measurements.

When the survey results from the N95 FFR users were evaluated, familiar criticisms, emerged including

> As we emerge from the depths of the pandemic to a point at which precautions such as social distancing and maximum PPE use can be lessened, it remains to be seen what life in the endoscopy unit will look like. Likely, we will never return to the time when nearly half of practicing GI endoscopists refrained from wearing facial PPE.

0016-5107/$36.00
https://doi.org/10.1016/j.gie.2021.03.007

respiratory complaints (75%), frustration (50%), fatigue (50%), claustrophobia (50%), palpitations or dizziness (42%), headache (33%), and nose/jaw pain (25%). Importantly, all gastroenterologists thought that performing typical pre-COVID procedural volume would not be possible in the long term while using an N95 FFR. These subjective complaints largely correlated with physiologic changes, with 75% of participants experiencing rises in heart rate when comparing N95 FFR with surgical mask or PAPR use, but there were no observed changes in respiratory rate, diastolic blood pressure, or SpO_2 (Table 2 of Khalid et al[10]). In the PAPR versus surgical mask comparison, significant findings included decreased heart rate in 6 participants and an increased heart rate in 4, all of whom reported symptoms of headache (Table 2). Phase 2 physiologic data collected were analyzed to assess respiratory effort and to estimate changes in sympathetic and parasympathetic nervous system activity by measurements and equipment likely unfamiliar to many gastroenterologists. Statistically significant changes were not found; however, the authors report similar trends among all participants, including an immediate increase in depth of breathing when switching from a surgical mask to an N95 FFR. They also observed a pattern of decreased sympathetic to vagal tone ratio when the participants switched from a surgical mask to an N95 FFR, and an increase when switching back from an N95 FFR to a surgical mask. Although an in-depth discussion of the significance of these findings is beyond the scope of this commentary, it is reasonable to postulate that changes in sympathetic and vagal tone may have a tangible impact on both subjective symptoms, such as frustration and fatigue, and objective changes in vital signs.

The investigators of this study have accepted the great challenge of understanding how our subjective experience wearing obtrusive, unfamiliar, and uncomfortable PPE can translate into an objective change in our physiology. Their expertise and innovation in using novel techniques and tools to approach this problem is commendable. Also deserving of admiration are the 18 volunteers who dedicated a substantial amount of time to participate in this study.

There are several limitations to this study, many of which are adequately addressed by the authors. One limiting factor was that the simulated endoscopy examinations were not standardized among participants, raising the question whether some results might be explained by simulations that were more physically or mentally taxing than others. Also, this study was performed at a single center with a relatively small number of participants. In addition to the statistical consequences of the small dataset, health privacy concerns must be and were appropriately considered; however, this limitation restricts our understanding of the effects that age, medical comorbidities, medications (for example, antihypertensives or β-blockers), and other demographic factors might have on the results. A larger multicenter study might produce important information about which endoscopists might incur the greatest physiologic effect using one form of PPE versus another, specifically because a small subset of the volunteers did not have significant measurable effects from wearing the N95 FFR.

As we emerge from the depths of the pandemic to a point at which precautions such as social distancing and maximum PPE use can be lessened, it remains to be seen what life in the endoscopy unit will look like. Likely, we will never return to the time when nearly half of practicing GI endoscopists refrained from wearing facial PPE. In addition to a heightened awareness of individual risk, there will almost certainly be more stringent regulations of PPE use at the institutional and federal (ie, Joint Commission) levels. What these regulations will be, exactly, remains to be seen. Will N95 FFR use continue to be recommended for all aerosol-generating procedures, or only in areas where there is a high community prevalence, or with a patient known to be infected with SARS-CoV-2? Regardless, endoscopists need to become familiar and comfortable with the routine mandated use of facial PPE because it will be part of our lives for the long haul. Intuitively, ongoing use of N95 FFRs will result in better tolerability and comfort over time, and further studies examining the adaptability of endoscopists as it relates to subjective and objective outcomes will better elucidate this acclimatization. Moreover, studies evaluating other physical conditioning exercises and their associations with the tolerability of long-term N95 mask use may be worthwhile. Until then, we must remain diligent, strictly adhering to local and federal PPE guidelines, ensuring we do our part to mitigate risk to ourselves, our patients, and our loved ones.

DISCLOSURE

Both authors disclosed no financial relationships.

Phillip R. Chisholm, MD
Zachary L. Smith, DO
Division of Gastroenterology and Hepatology
Medical College of Wisconsin
Milwaukee, Wisconsin, USA

Abbreviations: FFR, filtering facepiece respirator; PAPR, powered air purifying respirator; PPE, personal protective equipment; SpO_2, peripheral pulse oximetry.

REFERENCES

1. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. JAMA 2020;323:1239-42.
2. Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020;382:727-33.
3. Arons MM, Hatfield KM, Reddy SC, et al. Presymptomatic SARS-CoV-2 infections and transmission in a skilled nursing facility. N Engl J Med 2020;382:2081-90.

4. Centers for Disease Control and Prevention. Healthcare Workers. Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations.html. Accessed February 8, 2021.
5. Soetikno R, Teoh AYB, Kaltenbach T, et al. Considerations in performing endoscopy during the COVID-19 pandemic. Gastrointest Endosc 2020;92:176-83.
6. Banerjee S, Shen B, Nelson DB, et al. Infection control during GI endoscopy. Gastrointest Endosc 2008;67:781-90.
7. Johnston ER, Habib-Bein N, Dueker JM, et al. Risk of bacterial exposure to the endoscopist's face during endoscopy. Gastrointest Endosc 2019;89:818-24.
8. Kushnir VM, Berzin TM, Elmunzer JB, et al. Plans to reactivate gastroenterology practices following the COVID-19 pandemic: a survey of North American centers. Clin Gastroenterol Hepatol 2020;18:2287-94.e1.
9. Forbes N, Smith ZL, Spitzer RL, et al. Changes in gastroenterology and endoscopy practices in response to the coronavirus disease 2019 pandemic: results from a North American survey. Gastroenterology 2020;159:772-4.e13.
10. Khalid A, Romutis S, Ibinson J, et al. Acute physiologic effects of N95 respirator use on gastroenterologists performing simulated colonoscopy. Gastrointest Endosc 2021;94:160-8.