Effect of enhanced personal protective equipment on colonoscopy performance and pain linked to procedure during the COVID-19 pandemic

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Abstract

Background and study aim: **During the COVID-19 pandemic, the use of standard personal protective equipment (SPPE) reduces transmission risks during endoscopic procedures. Our aim was to assess the effect of enhanced personal protective equipment (EPPE) on colonoscopy performance and pain linked to the procedure compared with SPPE.**

Patients and methods: **During two similar periods with three-month duration (in 2019 and in 2020 during the COVID-19 pandemic), electronic medical records and colonoscopy reports were investigated for sequential patients undergoing colonoscopy. SPPE was used in 2019 and EPPE in 2020. The patients' clinical data and information related to the procedure were collected and analyzed. Primary outcomes were the duration to intubate the cecum, total procedure duration and patient pain score at the end of the procedure. Secondary outcomes were adenoma detection rate (ADR), polyp detection rate (PDR) and cecal intubation rate (CIR).**

Results: **A total of 426 patients with colonoscopy performed were analyzed. The demographic features and indications for colonoscopy were similar for patients in both groups. The EPPE group had higher values for the parameters assessed as primary endpoints of cecal intubation time, withdrawal time, total procedure time and pain at the end of the procedure compared to the SPPE group and the differences were statistically significant.**

Conclusion: **Our findings show that though the use of EPPE negatively affected colonoscopy performance and patient pain at the end of the procedure, it had no effect on the colonoscopy quality indices such as ADR, PDR and CIR.** (Acta gastroenterol. belg., **2022,** 85, **269-275**).

Keywords: Enhanced personal protective equipment, colonoscopy, cecal intubation time, adenoma detection rate, polyp detection rate.

Introduction

At the start of the COVID-19 pandemic, affecting the whole world, it was believed that it could be transmitted through the respiratory tract (1). Like most respiratory pathogens, SARS-CoV infection occurs through direct contact or air droplets. People closer than 1 meter from the infected person have highest risk of infection (2).

During endoscopic procedures, the physical distance between the patient and endoscopist is less than 1 meter. We know that during endoscopy, the endoscopist's face is exposed to potentially infectious biological samples undetected (3). For this reason, endoscopy personnel are at risk of SARS-CoV infection during endoscopic procedures (4). Additionally, there was more recognition of different transmission routes apart from the respiratory tract like fecal-oral with increasing experience during the pandemic (5). Considering the recent identification of SARS-CoV in biopsy samples and feces, the exposure risk of endoscopy personnel was shown not just to be limited to upper endoscopy procedures; this situation leads to possible fecal-oral transmission (6). Colonoscopy is an endoscopic procedure requiring close and direct contact with patients and it is thought there is high SARS-CoV infection risk due to droplets in air and possible fecal-oral transmission in colonoscopy procedures during the pandemic (7-9).

Many recommendations were made to minimize the infection risk of endoscopic procedures during the pandemic. Testing asymptomatic patients for infection before elective endoscopic procedures was found to be cost-effective and testing for COVID-19 is recommended before all elective endoscopic procedures during the pandemic (10). Another precaution recommended by a variety of professional health organizations is the use of enhanced personal protective equipment (EPPE) during endoscopic procedures (11-13,17). For endoscopic procedures, in addition to standard personal protective equipment (SPPE) of waterproof gloves and apron, enhanced personal protective equipment for endoscopic procedures is defined as face guard, hair net and face masks with filters (N95, FFP2 or FFP3). The use of EPPE during endoscopic procedures reduces the possible infection transmission risk, while the long-duration use of filtered face masks especially and face guards may create difficulties in terms of respiration, thermal balance, vision and communication with surroundings for the endoscopist (14).

Considering the COVID-19 pandemic may continue for a longer period, the use of EPPE may be required for longer durations. The aim of this study was to assess the effect of EPPE use on colonoscopy performance, outcomes and patient pain after the procedure.

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Materials and methods

Study Design

This study is a retrospective observational study completed in a tertiary referral center in Turkey. The study was permitted with local ethics committee decision number 2021/149. The study duration assessed two similar periods: a) 1 June 2019-1 September 2019 before the pandemic and b) 1 June 2020-1 September 2020 during the pandemic. Elective colonoscopy procedures performed between these dates were assessed and compared. Procedures during the first time period were performed using SPPE, while procedures during the second time period were performed using EPPE.

Patient Selection

Colonoscopy reports from sequential patients with colonoscopy performed in our endoscopy unit were obtained from the computer database. Databases of patient demographic data affecting colonoscopy performance including body mass index (BMI), medical history, colonoscopy indications and previous abdominal surgery recorded prospectively were examined retrospectively. All colonoscopy procedures were performed by an endoscopist with experience performing more than 2000 endoscopies. All diagnostic colonoscopies were included in the study, while colonoscopy procedures with treatment purposes like colonic stenting were not included in the study (Figure 1). After all patients received the same dose of sedo-analgesia (initially midazolam 2.5 mg (iv) + pethidine hydrochloride 25 mg (iv), then a dose repeated every 5 minutes linked to the extension of the procedure time), they were taken for the colonoscopy procedure. Later all patients were placed in left lateral decubitus position and the colonoscopy procedure began. There was no anesthesiologist included in the study. Observation of the appendix orifice and ileocecal valve was defined as an indicator that cecal intubation was successful. For all patients, the priority target was to reach the cecum, if any lesions (polyp, cancer, etc.) were observed in an intestinal segment, procedures were performed during withdrawal after the cecum was reached (polypectomy, biopsy, etc.). Since there is no CO2 insufflation in our endoscopy unit, all procedures were completed with air insufflation. Adult colonoscopy tools and similar video endoscopy systems were used. At the end of the procedure, slow infusion over two minutes with 0.2 mg flumazenil (IV) was administered with repeated doses of 0.2 mg up to maximum 1 mg dose until the desired effect was obtained after patients were taken to the recovery room. Twenty minutes after patients fully emerged from the effect of sedation, they were requested to rate the degree of pain felt after the procedure by evaluating with a visual analog scale (VAS) and the responses were recorded. Data related to colonoscopy indications, endoscopic findings for cecum intubation time (CIT), withdrawal time (WT), total procedure time (TPT), cecal intubation rate (CIR), polyp detection rate (PDR), and adenoma detection rate (ADR) and patient pain scores after the procedure were compared.

COVID-19 Precautions

The EPPE group included a total of 218 patients, and all were tested for COVID-19. Thirteen patients with high risk in terms of COVID-19 and with positive COVID-19 PCR results had the procedure postponed. These patients were referred for COVID-19 monitoring and treatment. All patients had the procedures completed with EPPE of face guards, hair nets and N95 filter face masks in addition to SPPE (water-resistant gloves and apron) (Figure 2).

Outcomes

The primary endpoints were determined to be CIT, WT, TPT and pain score after the procedure (scored using VAS) as they best represent colonoscopy performance. Secondary endpoints were PDR, ADR and CIR.

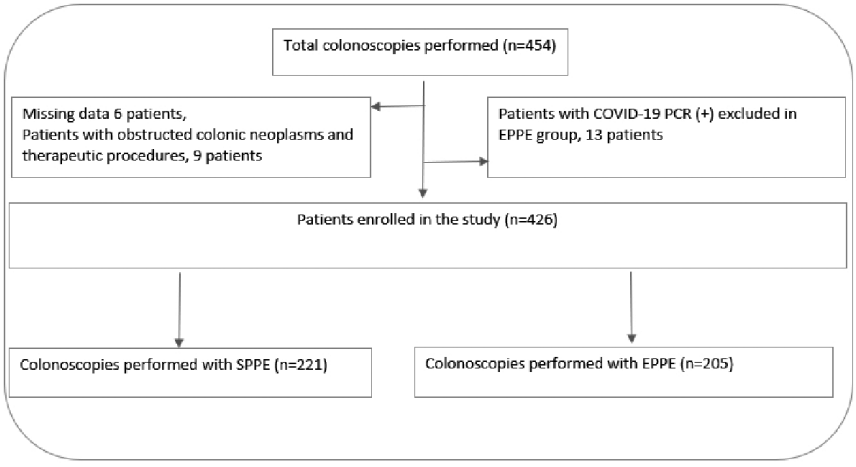

Figure 1. — Flowchart of the study.

Figure 2. — Enhanced personal protective equipment consisted of face guards, hairnets, and N95 filtering facepiece respirators, in addition to the standard personal protective equipment of water-resistant gloves and gown.

Statistical analysis

Statistical analyses were performed with SPSS software (Statistical Package for the Social Sciences, version 20.0, SPSS Inc., Chicago, USA). Descriptive statistics for all variables calculated frequency and percentage. Continuous variables with normal distribution are presented as mean ± standard deviation (SD). Comparison between groups of parameters with normal distribution were analyzed with the Student's-*t* independent test. Categoric data were analyzed using the chi-square or Fisher's exact test. Significance level was determined as $p<0.05$.

Results

During the study period, a total of 454 patients had colonoscopy performed. A total of 28 patients were excluded from the study, including 6 patients with missing data, 9 patients with obstructing colon tumor and colonoscopy with therapeutic purposes, and 13 patients in the EPPE group with COVID-19 PCR positivity before the procedure. Of the remaining 426 cases, 221 were completed using SPPE and 205 were completed using EPPE (Figure 1). Mean patient age was 51.6 ± 13.7 years (min 19-max 84). Mean BMI was 28.6 ± 5.9. The most common colonoscopy indications were changes in intestinal habits in the SPPE group (20.4%) and abdominal pain in the EPPE group (23.4%). There were no significant differences between patient demographic parameters and comorbidities in both patient groups (Table 1). Adequate bowel preparation was present in 93.7% of the patients in the SPPE group and 88.8% of the patients in the EPPE group, there was no statistically significant difference between the 2 groups (p=0.077).

Among parameters assessed as primary endpoints, compared to the SPPE group there were significantly higher values in the EPPE group for CIT (4.27 ± 1.94 min vs. 4.88 ± 2.44 min, p=0.019), WT (5.15 ± 1.06 min vs. 6.27 ± 1.26 min, p<0.001), TPT (9.08 ± 2.21 min vs. 11 ± 2.92 min, p<0.001), and VAS score after the procedure (2.52 ± 2.02 points vs. 4.29 ± 3.68 points, p<0.001) (Table 2). For the secondary outcomes, there were no statistically significant differences between the SPPE and EPPE groups for ADR (16.3% vs. 21%, p=0.216), PDR (25.8% vs. 29.8%, p=0.363) and CIR (98.6% vs. 98%, p=0.633) (Table 3).

Discussion

In the early days of the pandemic, we decided to postpone elective endoscopic procedures, as in most endoscopy centers, in order to reduce the risk of infection transmission and to protect the health of endoscopy personnel until the COVID-19 pandemic is resolved (15-17). In June-September 2020 when the effect of the COVID-19 pandemic reduced, selected elective and semi-urgent procedures could be performed. In spite of testing asymptomatic cases for COVID-19 before the procedure, due to the high false-negative results from virologic tests and high asymptomatic patient number with possible infectious transmission, we accepted all patients as potential COVID-19 patients independent of their risk status for COVID-19. Therefore, all endoscopic procedures were performed using EPPE. For this reason, we took the opportunity to assess the effect of the use of EPPE on endoscopic procedures. To ensure quality outcomes, we focused on colonoscopy instead of other endoscopic procedures due to the presence of objective markers, collected available data, and inclusion of well-structured indexes for analysis.

The use of EPPE during endoscopic procedures involves some righteous anxiety due to clear physical discomfort and breakdowns in communication with personnel assisting the endoscopy and patients. The disadvantages of the use of EPPE during endoscopic

Table 1. — **Demographics variables, chronic diseases and colonoscopy indications of patients**

		Times							
		SPPE (2019)				EPPE (2020)			
		Count	%	Mean	Standard Deviation	Count	%	Mean	Standard Deviation
Number of patients		221	51.9%			205	48.1%		
Age (years)				51.7	12.8			51.8	14.7
Gender	Male	87	39.4%			88	42.9%		
	Female	134	60.6%			117	57.1%		
BMI (kg/m²)				29.7	6.6			27.6	5.0
Diseases	No chronic disease	121	54.8%			116	56.6%		
	Diabetes mellitus	29	13.1%			21	10.2%		
	Arterial hypertension	35	15.8%			29	14.1%		
	Cardiac disease	7	3.2%			8	3.9%		
	Cerebrovascular disease	7	3.2%			8	3.9%		
	Chronic Kidney disease	9	4.1%			10	4.9%		
	Liver cirrhosis	6	2.7%			6	2.9%		
	Inflammatory bowel disease	6	2.7%			3	1.5%		
	Abdominal surgery	1	0.5%			4	2.0%		
Indications	Change in bowel habit	45	20.4%			35	17.1%		
	Rectal bleeding	32	14.5%			37	18.0%		
	Positive fecal occult blood	56	25.3%			35	17.1%		
	Anemia	31	14.0%			35	17.1%		
	Pain	40	18.1%			48	23.4%		
	Polyp surveillance	10	4.5%			10	4.9%		
	Others	7	3.2%			5	2.4%		

procedures in the COVID-19 pandemic were assessed in a limited number of studies (18,19,24).

In our study, objective outcome criteria like CIT, TPT, WT and VAS were higher in the EPPE group compared to the SPPE group and the differences were statistically significant. In this situation, we can say that the use of EPPE adversely affects the WT, CIT, TPT and VAS scores, unlike the studies in the literature (16,18,19). In subgroup analyses, the use of EPPE did not have a significant effect on polyp detection rate, adenoma detection rate and cecum intubation rate compared to the SPPE group. The results from the subgroup analyses are consistent with the literature (18,19). In a study including fewer patients (247) assessing the effect of EPPE use on colonoscopy performance by Teh et al., they compared CIT, TPT, WT, PDR and ADR values between 2 groups. In this study, the degree of pain linked to the procedures was not assessed with VAS score and they stated the other parameters were not significantly different between the 2 groups (18). Additionally, Düzenli et al. evaluated the effects of EPPE use on ERCP performance for 221 patients in a similar study and reported there was no significant difference in terms of ERCP performance in the SPPE and EPPE groups (19). Apart from the higher patient number in our study compared to similar studies in the literature, another different situation is the assessment of patient pain after the procedure. Levels of pain felt linked to the procedure were assessed with VAS score after the procedure and the EPPE group had higher VAS score compared to the SPPE group and this was statistically significant. The CIT, WT and TPT during colonoscopy were longer in the EPPE group causing more exposure to air during the procedure for patients. Patients with more exposure to air during the procedure in the EPPE group had more abdominal pain complaints compared to the SPPE group, as expected, and this situation was recorded using the VAS score. The higher VAS scores in the EPPE group compared to the SPPE group may be explained in this way.

Table 2. — **Primary outcomes of SPPE and EPPE groups**

	Times						*p*
	SPPE (2019)			EPPE (2020)			
	Mean ± SD	n	%	Mean ± SD	n	%	
Number of patients		221	51.90%		205	48.10%	
Withdrawal time (min)	5.15 ± 1.06			6.27 ± 1.26			<0.001*
Cecal intubation time (min)	4.27 ± 1.94			4.88 ± 2.44			0.019*
Total procedure time (min)	9.08 ± 2.21			11 ± 2.92			<0.001*
VAS score	2.52 ± 2.02			4.29 ± 3.68			<0.001*

*p< 0.05 is accepted as statistical significance level. Student's-t independent test was used.

Table 3. — **Secondary outcomes of SPPE and EPPE groups**

	Times				*p*
	SPPE (2019)		EPPE (2020)		
	n	%	n	%	
Number of patients	221	51.90%	205	48.10%	
Adenoma detection rate	36	16.30%	43	21.00%	0.216
Overall polyp detection rate	57	25.80%	61	29.80%	0.363
Cecal intubation rate	218	98.60%	201	98.00%	0.633

*p< 0.05 is accepted as statistical significance level. Student's-t independent test was used

The longer CIT, WT and TPT in the EPPE group compared with the SPPE group may be explained in several ways. The use of EPPE in endoscopic procedures may cause discomfort for the endoscopist due to movement restrictions, difficulty communicating, weight and increased temperature and thus affect performance. A variety of studies evaluated the effect of the use of EPPE on respiration, vision, hearing and physical movement. Respiration work increases due to negative pressure caused by lower pressure within filter face masks (FFM) compared to the environmental pressure. Humidity due to exhaled air increases respiration work by accumulating in the N95 mask over time. Increasing resistance to breathing is a physiological stress factor and may cause shortness of breath, fatigue of respiratory muscles and changes to pulmonary volumes and ventilation (23). Additionally, there are negative effects of FFM on speaking. FFM suppresses speech and may make communication difficult or even impossible with long duration of use and may disrupt communication between the endoscopist with personnel assisting the endoscopy and patients (14). Additionally, FFM may disrupt performance of cognitive tasks. Mental fatigue becomes more severe when personal protective equipment is used and there is the possibility that the total effects of stress may worsen cognitive disorder. This mental fatigue may emerge as anxiety disrupting operational memory as a result of processing foreign information (20). The use of FFM has negative effects on thermal balance. An N95 mask may cause increases in facial and skin temperature linked to exercise. This situation may negatively affect the performance of endoscopists especially during lengthened procedures (21). One of the EPPE components of face guards may become foggy during use and are easily scratched during cleaning after each procedure which may disrupt the endoscopist's vision and reduce visual acuity during the procedure and make procedures more difficult (22). For all these reasons, the CIT, WT and TPT in the EPPE group were longer than in the SPPE group due to discomfort of the endoscopist linked to movement limitation, difficulty communicating, weight and temperature increases and effect on performance. The lengthened procedure time linked to the effect on performance led to patients in the EPPE group being exposed to air for longer durations compared to patients in the SPPE group and may have caused more pain complaints linked to the procedure among patients in the EPPE group.

The main advantage of our study is that it is the first study in the literature assessing the effects of the use of EPPE on colonoscopy performance and post-procedure patient pain, to the best of our knowledge, and it has a larger sample size compared to similar studies. Limitations of our study include being a single-center and retrospective study.

In conclusion, the use of EPPE caused negative effects on colonoscopy performance due to restrictions of respiration, vision, hearing and physical movement, and

hence negatively affected pain linked to the procedure. In spite of the negative effect of the use of EPPE on colonoscopy performance and pain felt by the patient after the procedure, we can say it had no negative effect on the colonoscopy quality indexes of ADR, PDR and CIR.

Conclusion

Use of EPPE during the pandemic may negatively affect colonoscopy performance and pain linked to the procedure. However, despite this, colonoscopy can continue to be performed safely and effectively using EPPE, on condition of abiding by the guidelines proposed by a variety of health organizations to protect endoscopists from infection.

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Conflict of interest

Mevlut Kiyak and Beslen Goksoy declare that there is no conflict of interest. The authors declared that this study has received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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