Impact of wearing personal protective equipment on the performance and decision making of surgeons during the COVID-19 pandemic

An observational cross-sectional study

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Abstract

During the coronavirus disease 2019 (COVID-19) pandemic, the mandatory use of personal protective equipment (PPE) has resulted in a significant reduction in the infection rate among health care workers (HCWs). However, there are some ongoing concerns about the negative impact of using PPE for prolonged periods.

This study examined the impact of wearing PPE on surgeons’ performance and decision making during the COVID-19 pandemic. In this cross-sectional study, an anonymous online questionnaire was created and disseminated to surgeons all over the Eastern Province of Saudi Arabia. The questionnaire included the demographic data, the local hospital policies, the non-technical skills (e.g., communication, vision, and comfort) and the technical skills, and the process of decision making.

From June 2020 to August 2020, 162 surgeons participated in this questionnaire. Of them, 80.2% were aged from 26 to 45 years, 70.4% have received a special training for PPE, and 59.3% of participants have operated on COVID-19 confirmed cases. A negative impact of wearing PPE was reported on their overall comfort, vision, and communication skills (92.6%, 95.1%, and 82.8%, respectively). The technical skills and decision making were not significantly affected (60.5% and 72.8%, respectively). More preference for conservative approach, damage control procedures, and/or open approach was reported.

Despite its benefits, PPE is associated with a significant negative impact on the non-technical skills (including vision, communication, and comfort) as well as a non-significant negative impact on technical skills and decision making of surgeons. Extra efforts should be directed to improve PPE, especially during lengthy pandemics.

Abbreviations: COVID-19 = coronavirus disease 2019, HCWs = health care workers, MOH = Ministry of Health, PPE = personal protective equipment, SARS-CoV2 = severe acute respiratory syndrome coronavirus 2.

Keywords: COVID-19, decision making, N95, non-technical skills, performance, personal protective equipment, surgeon, technical skills

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The study was approved by the Institutional Review Board, Imam Abdulrahman Bin Faisal University.

All participant physicians consented and agreed to contribute to this online questionnaire.

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1. Introduction

In March 2020, the World Health Organization declared the coronavirus disease 2019 (COVID-19), which was caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV2), a pandemic.[1] Since then, the Saudi government has implemented many strategies and protocols to increase the readiness of all sectors, especially the healthcare sector. Early March 2020, the Ministry of Health (MOH) has announced the first case of COVID-19 in Saudi Arabia.[2] Initially, the MOH implemented many specific protocols within the healthcare system to ease the predicted stress on the healthcare system and health care workers (HCWs) including, but not limited to postponing all elective surgical procedures in the governmental hospitals, transitioning to virtual online clinics whenever possible, requiring all HCWs to always wear different levels of personal protective equipment (PPE) according to the infection control protocols regardless of dealing with suspected or confirmed cases to protect the HCWs, conducting multiple training workshops for proper donning and doffing of the PPE, increasing the numbers of the screening tests to early detect and isolate any asymptomatic patients, and ensuring sufficient supply of PPE. These protocols were subjected to continuous revision and modification according to the local progression of the pandemic.[3]

The most crucial strategy of the MOH declared protocol was that all HCWs have been mandated to wear different kinds of PPE as a standard practice while dealing with suspected or confirmed cases to protect themselves as a frontline defense. Although elective surgical procedures were canceled or postponed, surgeons continued to perform emergency surgical procedures on patients regardless of their SARS-CoV2 status.

Some studies have started the discussion on the drawbacks of using PPE and its impact on the HCWs, especially with the prolonged use during the COVID-19 pandemic, such as de-novo headache and anxiety.[3–5] However, only few studies have specifically addressed the impact of PPE on surgeons’ performance.[6,7] During surgery, many aspects can be affected including technical skills (e.g., tactile movements and handling of the instruments) and non-technical skills (e.g., vision, visual field, communication, overall comfort, and fatigability). Moreover, the psychological stress (e.g., feeling of insecurity even while wearing the PPE) may alter the process of decision making and the performance while dealing with suspected or confirmed cases.[8,9]

In this paper, we aimed at specifically studying the subjective impact of wearing PPE on the surgeons’ performance and decision making through an anonymous online-based subjective questionnaire. This study can help the healthcare system to deal with this pandemic or any upcoming outbreaks or pandemics.

2. Methods

As a cross-sectional observational study, we created an anonymous online-based subjective questionnaire through Google Forms with a total of 37 questions divided into 5 parts. The first part included the demographic data and the level of surgical experience. The second part included the local hospital policies of routine patients screening, type of PPE while dealing with cases, and the training programs of HCWs for the appropriate use of PPE. The third part included questions about non-technical skills as communication, vision, overall comfort, and fatigability; technical skills as tactile movements and instrumental handling; and the process of decision making.

The fourth part represented the outcome, from the surgeons’ perspective, including patients’ safety and complication rates and self-infection with SARS-CoV2. The questionnaire was then revised and modified by 3 independent professors affiliated with multiple universities to check its integrity, coherence, and relevance.

The sample size consisted of 132 surgeons using a non-probability convenience method. After being approved by the Institutional Review Board of Imam Abdulrahman Bin Faisal University, the questionnaire was distributed as a sharable hyperlink to surgeons with different levels of experience in different hospitals all over the Eastern Province of Saudi Arabia through emails, and different social media platforms such as WhatsApp and Twitter. Inclusion criteria included any surgeon working at any hospital in the Eastern Province of Saudi Arabia where COVID-19 patients are being admitted. Physicians of nonsurgical specialties were excluded from the study.

The analysis of data was performed using Statistical Package for Social Science (IBM SPSS) version 20. The qualitative data collected were presented in the form of numbers and percentages. The quantitative data were presented as mean (±standard deviation) for variables with normal distribution, and median (range) for variables with the non-parametric distribution. Both Chi-Square and Fisher exact tests were used to test the statistical significance of association between categorical variables. The confidence interval was set to 95%, the margin of error accepted was set to 5%, and the P value was considered significant at P < .05.

3. Results

During the period between June 2020 and August 2020, 162 surgeons agreed to participate in this anonymous online survey by accepting the consent at the beginning of the questionnaire. All participants were surgeons of different specialties who worked at hospitals where confirmed cases of COVID-19 were admitted. Approximately, 80.2% of the participants were aged from 26 to 45 years. Surgeons from different levels of experience have participated (junior and senior residents, registrar, and consultants) (Table 1).

Most of the participants reported receiving special training for proper methods of donning and doffing of PPE (70.4%, P < .0001). Most of them encountered confirmed or suspected cases (88.9%, P < .0001), and 59.3% of the participants have operated on confirmed cases. Most surgeons reported routine screening tests for patients before any surgical procedures

| Table 1 | The first part of the questionnaire: demographic data (age and seniority level) of the participants. |
|---------|---------------------------------------------------------------|
| Age     | Number of participants (%)                                   |
| <26     | 4 (2.5)                                                      |
| 26–35   | 106 (65.4)                                                   |
| 36–45   | 24 (14.8)                                                    |
| 46–55   | 16 (9.9)                                                     |
| >56     | 12 (7.4)                                                     |
| Level   |                                                               |
| Junior resident | 64 (39.5)                                               |
| Senior resident | 32 (19.8)                                                  |
| Registrar/senior registrar | 28 (17.3)  |
| Consultant | 38 (23.5)                                                   |
(66.7%, $P = .003$), and no routine screening test before assessing a new patient (61.7%, $P = .035$). In addition, 60.3% of the participants reported performing only emergency surgical procedures ($P < .0001$) (Table 2).

Regarding surgical performance, a significant number of participants reported a negative impact of wearing PPE on their overall comfort (92.6%, $P < .0001$). In terms of their vision, it was affected with either fogging, the affection of the visual field or both (95.1%, $P < .0001$). Moreover, communication with other colleagues or patients was negatively affected (82.8%, $P < .0001$). In contrast, handling of instruments was not significantly affected by wearing the PPE (72.8%, $P < .0001$), and the tactile movements showed no statistically significant difference. Similarly, the decision making process was not significantly affected by wearing the PPE (60.5%, $P < .0001$), and the rate of complications when performing a surgical procedure wearing the PPE (72.8%, $P < .0001$). However, some participants reported more preference of conservative approach rather than surgical approach, damage control procedures rather than definitive procedures, and an open approach rather than minimally invasive approaches and/or postponing all non-emergency procedures. Moreover, 91.4% of the participants reported no changes in the postoperative complications when performing a surgical procedure wearing the PPE (Table 3).

At the end of the questionnaire, an additional comments section was provided for suggestions on how to improve the performance while wearing the PPE. Some participants suggested measures, such as using anti-fog lotion or anti-fog masks, contact lenses instead of glasses, well-fitted, ventilated, and lightweight PPE suits. In addition, they recommended providing a better working environment, such as providing better air conditioning, using electronic devices for communications as headsets, and switching to damage control procedures. Finally, some participants requested more training workshops for the PPE donning and doffing.

### 4. Discussion

During the era of the COVID-19 pandemic, the HCWs were at a clear higher risk of getting infected with the SARS-CoV2, and therefore, their protection was crucial to maintain the healthcare sector and prevent its collapse.[10] The mandatory use of PPE has resulted in a significant reduction in the infection rate among HCWs.[10,11] In the Saudi healthcare system, all HCWs are obliged to always wear different levels of PPE according to the infection control protocols whether dealing with suspected or confirmed cases. The PPE can be classified in different ways and includes at least wearing a pre-fitted appropriate size N95 face

### Table 2

| The second part of the questionnaire: local hospital policies, training programs of the HCWs and load of cases. | Number of participants (%) | P value |
|-------------------------------------------------|-----------------------------|---------|
| Receiving a special training for proper method of donning and doffing PPE | Yes 114 (70.4) | <.0001* |
| | No 48 (29.6) | |
| Average number of on call per week | (Mean±SD) 2.81±2.03 | |
| Did you encounter a positive COVID-19 patient? | Yes 122 (75.3) | <.0001* |
| | Suspected cases only 22 (13.6) | |
| | No 18 (11.1) | |
| Did you operate on a positive COVID-19 patient? | Yes 28 (34.6) | .203 |
| | Suspected cases only 20 (24.7) | |
| | No 33 (40.7) | |
| COVID-19 screening test before assessing a patient | Routine 62 (38.3) | .035* |
| | Not routine 100 (61.7) | |
| COVID-19 screening test before performing a procedure | Routine 108 (66.7) | .003* |
| | Not routine 54 (33.3) | |
| Type of the performed surgical procedure | Emergency 98 (60.5) | <.0001* |
| | Elective 4 (2.5) | |
| | Both elective and emergency 18 (11.1) | |
| | No 42 (25.9) | |

**COVID-19 = coronavirus disease 2019, HCW = health care workers, PPE = personal protective equipment.**

* Statistically significant results at $P < .05$.

### Table 3

| The third part of the questionnaire: the different aspects of surgeons’ performance. | Number of participants (%) | P value |
|----------------------------------------|-----------------------------|---------|
| Comfort | Yes 118 (72.8) | <.0001* |
| | Sometimes 32 (19.8) | |
| | No 12 (7.4) | |
| Vision | Fogging of the googles 74 (45.7) | <.0001* |
| | Affection of the visual field 44 (27.2) | |
| | Affection of the visual field and fogging of the googles 12 (7.4) | |
| Communication | Yes 96 (59.3) | <.0001* |
| | Sometimes 38 (23.5) | |
| | No 28 (17.3) | |
| Handling of instruments | Yes 42 (25.9) | <.0001* |
| | Sometimes 22 (13.8) | |
| | No 98 (60.5) | |
| Tactile movements | Yes 48 (29.6) | .495 |
| | Sometimes 50 (30.9) | |
| | No 64 (39.5) | |
| Decision making | Yes 14 (8.6) | <.0001* |
| | Sometimes 30 (18.5) | |
| | No 118 (72.8) | |
| Rate of complications | Decreased 0 | <.0001* |
| | No change 148 (91.4) | |
| | Increased 14 (8.6) | |

* Statistically significant results at $P < .05$. 

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**5. Conclusion**

The impact of prolonged use of the PPE on the surgeons’ performance is not extensively discussed. In our study, we called attention to the significant negative impact of the prolonged use of PPE on the non-technical skills of surgeons including vision, communication, and overall comfort. Also, the current study highlighted the non-significant negative impact on technical skills, decision making, and patients’ safety. Further studies are recommended to objectively assess these negative impacts. Moreover, extra efforts should be directed to improve the PPE, especially during lengthy pandemics.
Author contributions

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