Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Purpose: The purpose of this study was to evaluate the knowledge of operating room nurses (ORNs) of preventive practices in terms of protection against coronavirus disease 2019 (COVID-19).

Methods: About 279 ORNs from 17 provinces of Turkey were included. Data were collected online using Google Form. ORNs were communicated via WhatsApp or other social media platforms and were asked to answer the questionnaire. In the questionnaire, there were 12 questions on descriptive characteristics and 20 statements regarding the knowledge of ORNs on preventive practices for protection against COVID-19.

Findings: The rate of yes responses provided by ORNs to statements on preventive practices for protection against COVID-19 was found to be between 10% and 98.6%, whereas the rate of no responses was found to be between 0% and 25.8%. The rate of those stating that they did not have an opinion on statements was found to be between 1.8% and 48.4%.

Conclusions: The level of knowledge of ORNs on protective measures against COVID-19 was quite high. However, there are important issues to consider such as the fact that most ORs do not use an algorithm or guideline for protective practices and that almost half of ORNs had not received training on protection against COVID-19.

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surgery and type of anesthetics, and management of intraoperative gases.4,9,10,11 No studies have been found evaluating the knowledge of ORNs of protection against COVID-19. It is necessary to identify the knowledge of ORNs on protective measures recommended on a global scale. Identifying this knowledge will enable people to understand how ORNs protect themselves. It would also be beneficial in terms of introducing practices that can reduce the risk of COVID-19 transmission in ORs. The aim of this study was to evaluate the knowledge of ORNs of preventive practices for protection against COVID-19.

Materials and Methods
Study Design and Participants

This descriptive study was conducted between July 3, 2020 and July 8, 2020 with 279 ORNs. The data were obtained from ORNs working in hospitals in 17 provinces in Turkey. Four of these provinces are located in the Eastern Anatolia Region, four in the Southeastern Anatolia Region, four in the Central Anatolia Region, two in the Aegean Region, two in the Marmara Region, and one in the Mediterranean Region. Because data collected from Black Sea, Aegean, Marmara, and Mediterranean Regions were very small in size, these regions were combined under the category of other. The identified hospitals were selected based on accessibility (communication, cooperation, and interest). Data were publicly available, and the hospitals had multiple specialties and actively running ORs. In this study, answers to the following question was sought:

1. What is the level of knowledge of ORNs about preventive practices for protection against COVID-19?

Data Collection Tools and Intervention

The data were collected using a data collection form created by the researcher after a literature review.1,7,10,12 The study was prepared based on universal recommendations in the literature. There was not a reliable and valid scale evaluating the level of knowledge about preventive practices regarding protection against COVID-19. A preapplication was made with 10 nurses to determine the comprehensibility of the form. Results of the preapplication were excluded from final data analysis. The data collection form was created electronically using Google Form. The form was then administered to ORNs recruited online using communication networks (WhatsApp, social media, etc). Those who volunteered were invited to participate in the study.

The data collection form had three sections. The first section included the purpose of the study, noting that it was a voluntary study and an informed consent form indicating that the answers would be confidential. Those who approved the first section were able to move onto the second section. The second section contained 12 questions about demographic information and the working situation of the participants in the OR. Information gathered included age, gender, marital status, residential province, level of education, experience in OR and overall experience, daily working hours, type of hospital they were working in, whether they attended the surgery of a COVID-19 patient, whether they received training on how to protect themselves from COVID-19 in the OR, whether they were concerned about contracting COVID-19, as well as whether there was an algorithm or guideline on protection against COVID-19 in the OR (see Table 2). The third section contained 20 statements about protective practices in the OR against COVID-19 (see Table 3). The participants had three options to respond to a statement: yes, no, and do not know. To make sure that the questionnaire answers were not biased, statement numbers 7, 9, 10, 13, and 19 were reversed using negative particles. Participants were informed that clicking the send button after responding to all statements would submit the responses to the researchers.

Ethics

This study was conducted based on the principles of the Declaration of Helsinki. Permission from the Scientific Research Platform of the Ministry of Health (2020-06-02T12_19_15) and ethical approval was obtained from the Clinical Studies Ethics Committee of Amasya University (02/07/2020-E.13068). Participants joined the study by clicking on the box that read I will fully agree to participate in this study after reading the informed voluntary consent form.

Data Analysis

SPSS 20 package program (IBM Corporation, Armonk, NY) was used to analyze the data. Sociodemographic details and responses to statements on preventive measures against COVID-19 of participants were indicated by figures and percentages.

Results

Distribution of ORNs by their descriptive characteristics is presented in Table 1. About 57.7% of the participants were females, 38.4% were aged between 27 and 35, 73.8% were married, and 64.5% had an undergraduate level of education. About 31.2% had OR experience for 5 years or less. Most ORNs who participated in the study were from the Central Anatolia Region (55.2%) and were working at a research and training hospital (78.5%). About 88.5% of the participants worked for 8 hours or more per day.

Table 1: Distribution of ORNs According to Their Descriptive Characteristics

| Descriptive Characteristics | Category | n (%) |
|-----------------------------|----------|-------|
| Gender                      | Female   | 161 (57.7) |
|                             | Male     | 118 (42.3) |
| Age (y)                     | 18-26    | 33 (11.8) |
|                             | 27-35    | 107 (38.4) |
|                             | 36-44    | 94 (33.7) |
|                             | 45-53    | 45 (16.1) |
| Marital status              | Married  | 206 (73.8) |
|                             | Single   | 73 (26.2) |
| Educational level           | High school | 20 (7.2) |
|                             | Associate | 44 (15.8) |
|                             | Education | 180 (64.5) |
|                             | Master's degree | 35 (12.5) |
|                             | and above |         |
| Years of experience in      | Less than 8 h | 32 (11.5) |
| operating theater (y)       | 8-10     | 46 (16.5) |
|                             | 11-15    | 71 (25.4) |
|                             | 16 y and older | 75 (26.9) |
| Working regions             | Central Anatolia | 149 (53.4) |
|                             | Eastern Anatolia | 33 (11.8) |
|                             | Southeastern Anatolia | 68 (24.4) |
|                             | Other (Black Sea, Aegean, Marmara, Mediterranean) | 29 (10.4) |
| Type of hospital            | University hospital | 33 (11.8) |
|                             | Research and training hospital | 219 (78.5) |
|                             | State hospital | 27 (9.7) |
| Daily working time          | Less than 8 h | 32 (11.5) |
|                             | 8 h or more | 247 (88.5) |
| Total                       |          | 279 (100) |

ORNs, operating room nurses.
Distribution of ORNs’ answers regarding the working situation in COVID-19 is presented in Table 2. In total, 88.9% of the participants were concerned about contracting COVID-19 while working in the OR. In addition, 80.6% of the participants working in ORs were not equipped with any algorithm or guideline of preventive practices for protection against COVID-19.

| Working Situation in COVID-19 | Category | n (%) |
|------------------------------|----------|-------|
| Are you concerned about contracting COVID-19 in the OR? | Yes | 248 (88.9) |
| | No | 31 (11.1) |
| Have you ever attended the surgery of a COVID-19 patient? | Yes | 110 (39.4) |
| | No | 169 (60.6) |
| Have you received a training on how to protect yourself from COVID-19 in the OR? | Yes | 147 (52.7) |
| | No | 132 (47.3) |
| Is there an algorithm or a guideline in place for preventive measures against COVID-19 in the OR? | Yes | 54 (19.4) |
| | No | 225 (80.6) |
| Total | | 279 (100) |

Distribution of the responses of ORNs on protection against COVID-19 is presented in Table 3. The rate of yes responses of participants to 20 statements about protection against COVID-19 ranges between 10% and 98.6%, whereas the rate of no responses ranges between 0% and 25.8%. The rate of those stating that they did not have an opinion on a statement ranges between 1.8% and 48.4%. The highest rate of yes answers (98.2%) was given to the fourth statement. The highest rate of no answers (25.8%) was given to the 13th statement. The highest rate of do not know answers (48.4%) was given to the 16th statement (Table 3).

Discussion

COVID-19 can transmit from human to human and can cause hospital-acquired infections, severely threatening ORNs. The aim of this study was to evaluate the level of knowledge of ORNs on protective measures against COVID-19 in the light of the literature. Kah Ti et al. suggested that using algorithms and protocols on how to approach COVID-19 patients in the OR can reduce the risk of transmission of COVID-19. About 86% of the ORNs in that study stated that it is necessary to use a written algorithm or guideline about preventive measures against COVID-19 in an OR. However, it was found that only 19.4% of ORNs were working in hospitals where algorithms or guidelines were used. This shows that accurate
information is not being translated into practice. These protocols include many topics such as the proper use of PPE and ventilation of the OR.

Nearly all participants (97.1%) thought that it was necessary to implement additional isolation measures in addition to existing protection methods when a confirmed or suspected COVID-19 patient is undergoing surgery. Under normal conditions, surgical teams are expected to implement tier 1 protection measures (single-use cap, single-use surgical gown, medical mask, and gloves). However, surgical interventions are high-risk practices where there is possible contact with a patient's respiratory secretions, blood, or bodily fluids.1,2 Thus, it has been reported that those who attend surgical interventions must take tier 3 protection measures.3,4 Such measures include the use of PPEs. In addition to tier 1 measures, these measures include the use of protective medical mask (N95), single-use liquid-proof gown, protective glasses, equipment to protect the face, the respiratory system, and feet, and the use of motor air filters.5 The literature supports that it is necessary to wear liquid-proof clothes and boots covering the feet underneath sterile gowns during a confirmed or suspected COVID-19 surgery. The purpose is to prevent contamination with the patients' bodily fluids.6,7,10 In this study, the participants considered that protective overalls (53.8%) and rubber boots (81.7%) should be worn, which is in line with the literature recommendations. However, another study conducted in Turkey revealed that rubber boots were the least-worn PPE in ORs.11 Moreover, in addition, surgical personnel are recommended not to grow their hair or beard long so that hair and beard can fit in the cap and mask properly.5,10 Most ORNs in this study (70.6%) state that long hair and beard can increase the risk of viral contamination. It has been reported that all OR personnel should be trained on how to wear and remove PPE.11 The fact that nearly all participants (98.2%) think that training must be delivered on PPE use is in line with the literature. However, the fact that only 52.7% of the participants received training on how to protect from COVID-19 in the OR shows that this is not the case in terms of the approach of the participants and the real situation in ORs. Another study revealed that only 55.4% of the OR personnel received training on COVID-19.12 ORNs have a unique experience and skills on respiratory and airway management. However, they may not have the same experience and skills in how to approach infectious diseases.13 This clearly shows the necessity to attach more importance to COVID-19 training and increase the number of trained personnel in ORs.

About 69.9% of ORNs have stated that surgical masks are not enough during surgery on a confirmed or suspected COVID-19 patient, and N95 masks or filtering face piece (FFP) masks should be used. On the other hand, ORNs (30.1%) not having this opinion are at risk for transmission because of the surgical procedures. The main transmission route of COVID-19 is through the spread of large respiratory droplets carrying viral particles formed during coughing, sneezing, and speaking. These droplets stay in the air for a few seconds and cover only a short distance before landing on the surfaces because of their weight. However, virus-bearing droplets occurring during certain procedures, such as mask ventilation, intubation, tracheostomy, tracheal aspiration, electrical devices, surgical gases, and endoscopic examination, may lose their amount of fluid and form aerosols, mixing with the air. These aerosols can stay in the air for up to 3 hours and stay on surfaces even longer because of their lightness. Viral droplets stay in the air for a few seconds and cover only a short distance before landing on the surfaces because of their weight. Infection can also occur after inhalation of these aerosols or contacting the mouth, nose, or eyes with contaminated hands.14 N95 masks or FFP masks should be used because a traditional surgical mask will not protect against aerosols.4,5 Only N95 or FFP masks protect against aerosols.6 There are no studies reporting that COVID-19 is transmitted via aerosols. However, Yu et al15 reported that transmission of COVID-19 via aerosols could not be ignored. The fact that 66.7% of ORNs in this study think that the gases used in surgeries can lead to COVID-19 contamination shows that they believe transmission is possible. However, the fact that 33.3% of the ORN did not respond to this question appropriately revealed a significant lack of knowledge. The management of surgical gases to prevent the transmission of COVID-19 in the OR is recommended.16 In addition, this factor should be addressed during in-service training and in circular communication. The use of carbon dioxide filters is recommended to prevent gases used in laparoscopic procedures from generating aerosols.12 Nevertheless, the use of portable air purifiers with high-efficiency particulate air filters has been discussed as an adjunctive means for decontamination of COVID-19 aerosols in health care settings. Portable air purifiers with high-efficiency particulate air filters should be considered during the COVID-19 pandemic.16 In addition, in cases where aerosols are generated in a surgical procedure, glasses or face shields should also be used.7 In this study, nearly all participants (95%) stated that protective glasses or face shields must be used in surgeries in addition to standard measures. About 90.7% of ORNs noted that only urgent surgeries should be performed during the pandemic. It is recommended to postpone elective operations and perform only those that are vital, urgent, or needed to address rapidly progressing malignancies.10,13 However, the definition of a nonurgent surgery is questionable. The American College of Surgeons published a triage framework. Accordingly, the Elective Surgery Acuity Scale was recommended to be applied for each case. It has been reported that using this scale would be helpful in terms of deciding the urgency of a surgery.14 It is also recommended to perform COVID-19 tests in urgent surgical operations,15 assume a suspected case to be a confirmed case, and perform a thorax computed tomography.16 It is estimated that COVID-19 will continue for months. ORNs may be required to join the routine surgeries of COVID-19 patients. For this reason, the protective measures should be the standard practice to protect providers from COVID-19. Çolakoğlu et al17 have identified that 34.2% of the personnel address all surgical cases as positive, 31.2% evaluate cases based on symptoms, 20.5% perform a thorax computed tomography, and 7.3% perform a COVID-19 test. About 98.6% of ORNs in the study thought that suspected COVID-19 cases should be considered as positive cases, which is in line with the literature and may improve the perception of protection. Another study reported that administering two doses of nasal povidone-iodine within an hour after incision could achieve patient decolonization.18 Chen et al19 have noted that surgical operations should be at a minimum level to prevent crossinfection during this period. It is possible to reduce crossinfection and protect other patients and surgical staff by using isolated and negative-pressure ORs. ORs reserved for COVID-19 patients should be located in an isolated and a remote section of the hospital. There should also be a negative-pressure hall with a separate access.20 This hall should be reserved for suspected and confirmed COVID-19 cases. ORNs participating in this study think that ORs for COVID-19 cases should be isolated (95.7%) and have negative pressure (75.6%). This is also in compliance with the relevant literature.

About 44.1% of ORNs noted that general anesthesia should not be preferred in operations, whereas 55.9% of ORNs did not have the same attitude. Literature has highlighted that local anesthesia should be the preferred anesthesia method in COVID patients when possible. If general anesthesia is necessary, all personnel within 2 m of the patient should use motor air filters during anesthesia.21 For operative airway procedures such as tracheostomy, all personnel should keep their motor air filters on throughout the procedure.6 However, 48.4% of ORNs in this study did not identify
that everyone in the immediate vicinity of the patient should use motor air filters during anesthesia. It is well established that the rate of general anesthesia application is high in surgical interventions. It is believed that this lack of knowledge may increase the transmission risk of COVID-19. This point should be addressed during training for ORNs.

From the conventional point of view, when an equipment or a medication is required or a tissue sample is to be referred to the laboratory during a surgery, a circulating nurse not wearing PPE is the personnel bringing in the equipment during the operation of a surgery. This situation increases the risk of transmission of COVID-19. This point should be addressed during training for ORNs. A circulating nurse not using PPE is the personnel providing the required supplies (medication, equipment, etc) during a surgery. However, it has been reported that tier 2 protection measures (single-use liquid-proof overall, protective glasses, and face shield in addition to standard measures) would also be sufficient. The same approach should also be adopted when blood and tissue samples are being taken from the OR. ORNs participating in this study think that personnel providing the required supplies (medication, equipment, etc) during a surgery should deliver these supplies at the entrance without going into the OR is in line with the literature.

About 67% of the participants thought that leaving at least an hour between cases is enough for the decontamination of all surfaces. Study results supported the suggestion that at least an hour should be left between cases to decontaminate all surfaces after a surgery, including screens, keyboards, cables, monitors, and the anesthesia machine. In addition, all unused materials on the medicine tray and the airway cart should be considered contaminated. Similarly, more than half of ORNs think that even if not used, and/or did not have any contact with the patient, sterile supplies in the OR should be treated as contaminated after a surgery. However, 46.6% of ORNs lacked knowledge about accepting the unused sterile materials in the OR as contaminated at the end of the surgery. This situation increases the risk of transmission of COVID-19 for ORNs and may also cause the development of cross-infection between cases.

Study Limitations

This study has some limitations. The scale used for data collection did not have established validity and reliability, which is a significant limitation of the study. The fact that participants could not contact the researcher in case of a problem during online data collection and that some nurses do not use social media may have limited the sample size. In addition, because the questionnaire was administered online, all responses were considered honest. Another limitation of this study is that it is not known in which hospitals the guideline and algorithms are used. Additionally, ORNs working under difficult circumstances during the pandemic may not have participated in the study.

Conclusions and Recommendations

This study shows that ORNs have a high level of knowledge on most COVID-19 preventive measures. Although it is encouraging to know that the staff has a sufficient level of knowledge about the pandemic, it is more important to turn this knowledge into practice. In addition, the lack of an algorithm or guideline on preventive measures in most ORs, and the fact that only half of the staff received training on protection can be a threat to the health of ORNs. There is no doubt that this situation has an adverse effect on OR services. These results support that practices for protection against COVID-19 should be put into a written form such as an algorithm or a guideline, and measures taken to assure that ORNs apply them. There is still a lot more to be understood about COVID-19. ORNs should be trained through seminars, online training, and other methods for new situations. Thus, ORNs can have a standardized level of knowledge regarding protection.

References

1. Kah Ti L, Ang LS, Foong TW, Su Wei MB. What we do when a COVID-19 patient needs an operation: operating room preparation and guidance. J Can Anesth. 2020;67:756–758.
2. Yu GY, Lou Z, Zhang W. Several suggestion of operation for colorectal cancer under the outbreak of corona virus disease 19 in China. Zhonghua Wei Chang Wai Ke Za Zhi. 2020;23:9–11.
3. Tran K, Cimon K, Severn M, Pessoa-Silva CL, Conly J. Aerosol generating procedures and risk of transmission of acute respiratory infections to healthcare workers: a systematic review. PLoS One. 2012;7:e35797.
4. Hussen ZB, Shoman H, Yau PWP, et al. Protecting healthcare workers from COVID-19: learning from variation in practice and policy identified through a global cross-sectional survey. Bone Joint Open. 2020;1:144–151.
5. Kamer E, Colak T. What to do when a patient infected with covid-19 needs an operation: a pre-surgery, peri-surgery and post-surgery guide. Turk J Colorectal Dis. 2020;30:1–8.
6. Wax RS, Christian MD. Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-ncov) patients. Can J Anesth. 2020;67:568–576.
7. Celik B, Yasak K, Turhan Damar H, Cakir Umar D, Ogec F. Operating room and case management during Covid-19 outbreak. Anatolian J Nurs Health Sci. 2020;23:331–342.
8. Hong C, Yu C, Zuo Bing C, et al., eds. Handbook of COVID-19 Prevention and Treatment. The First Affiliated Hospital, Zhejiang University School of Medicine. 2020. Available at: https://esge.org/documents/Handbook_of_COVID_19_Prevention_and_Treatment.pdf.
9. Stannard D. COVID-19: impact on perianesthesia nursing areas. J PeriAnesthesia Nurs. 2020;35:237–238.
10. Karaca AS, Ozmen MM, Ucar AD, Yasti AC, Demirer S. General surgery operating room applications in patients with COVID-19. Turk J Surg. 2020;36:1–V.
11. Vilaaz A, Unlusoy Dincer N, Erek Kazan E. COVID-19 pandemic and isolation precautions for health workers. Turkije Kliniker J Health Sci. 2020;5(2):384–393.
12. Stucky CH, De Jong MJ, Low LF, Mathews B. COVID-19: initial perioperative and peri-anesthesia nursing response in a Military Medical Center, J PeriAnesthesia Nurs. 2020;35:353–356.
13. Ferioli M, Cistermino C, Leo V, Pisani L, Palange P, Nava S. Protecting healthcare workers from SARS-CoV-2 infection: practical indications. Eur Respir Rev. 2020;29:200068.
14. Coaklegu MK, Ozgun YM, Piskin E, Bostanci EB, Ozmen MM. The attitude of Turkish general surgeons during the COVID-19 pandemic: results of “general surgery COVID-19 pandemic attitude survey. Turk J Surg. 2020;36:137–146.
15. Koekal E, Dost B, Terzi O, Ustun YB, Oztin S, Bilgin S. Evaluation of depression and anxiety levels and related factors among operating theatre workers during the novel Coronavirus (COVID-19) pandemic. J PeriAnesthesia Nurs. 2020;35:472–477.
16. Chen Q, Lan X, Zhao Z, et al. Role of anesthesia nurses in the treatment and management of patients with COVID-19. J PeriAnesthesia Nurs. 2020;35:453–456.
17. Örhan KS, Şen C, Aydemir L, Çelik M, Keleş Türel MN. ENT surgery during COVID-19 pandemic: tips for safe surgery and how to prioritize them. Tr-ENT. 2020;30:41–51.
18. Christopherson D, Yao WC, Lu M, Vijayakumar R, Sedaghat AR. High-efficiency particulate air (HEPA) filters in the era of COVID-19: function 2 and efficacy. Otolaryngology–Head Neck Surg. 2020. Available at: https://www.entnet.org/sites/default/files/uploads/sedaghat3HepaFilters_in_era_of_covid-19.pdf.
19. Ahmed N, Shakoor M, Vohra F, Abduljabbar T, Marjam Q, Rehman MA. Knowledge, awareness and practice of health care professionals amid SARS-CoV-2, corona virus disease outbreak. Pak J Med Sci. 2020;36:549–556.
20. Aco S. COVID-19: Guidance for Triage of Non-Emergent Surgical Procedures. 2020. Available at: https://www.facs.org/covid-19/clinical-guidance/triage.
21. Doster F, Loftus RW. Perioperative COVID-19 defense: an evidence-based approach for optimization of infection control and operating room management. Anesth Analg. 2020;131:37–42.
22. Chen N, Zhou M, Dong X, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel corona virus pneumonia in Wuhan, China: a descriptive study. Lancet. 2020;395:507–513.
23. Peng PW, Ho PL, Hota SS. Outbreak of a new coronavirus: what anesthetists should know. Br J Anesth. 2020;124:497–501.