Research

Safety and Comfort of Wearing Medical Masks in Adult Surgical Patients After General Anesthesia During the COVID-19 Epidemic: A Retrospective, Observational Cohort Study

Feng Lv, MD, Qiuju Xiong, MD, Su Min, MD*, Jing Chen, MD, Li Ren, MD, Zunyan Zhu, MD, Yiwei Shen, MD, Fusen Huang, MD, Jun Hu, BSN, Jing Li, BSN

Department of Anaesthesiology, The First Affiliated Hospital of Chongqing Medical University, Chongqing, China

Keywords:
COVID-19
medical masks
general anesthesia
patient comfort
PACU

ABSTRACT

Objective: This study assessed oxygen saturation variation and comfort in adult surgical patients wearing masks in PACU during the COVID-19 epidemic.

Design: Retrospective observation was applied in this study.

Methods: One hundred thirty-seven patients wearing no medical masks (Group A, aged from 20 to 87) and 136 patients wearing medical masks (Group B, aged from 18 to 91) were selected in this retrospective study after extubation in PACU. After extubation their pulse oxygen saturation, noninvasive mean blood pressure and heart rate were recorded at two different time points (treated with 40% O_2 oxygen therapy for 10 minutes and breathing room air for 10 minutes). The comfort, arterial blood gas data, complications and duration of patients were also reviewed in PACU.

Findings: There were no significant differences in the pulse oxygen saturation between the two groups after inhaling 40% O_2 or air. Compared with Group A, patients in Group B have lower comfort (6 [4-7] vs 7 [6-8]; P < .001), with shortened duration after extubation in PACU (50 [45-55] vs 56 [48-60]; P < .001). No significant differences were found in heart rate, noninvasive mean blood pressure, arterial blood gas data and complications. And no hypoxemia and respiratory adverse events happened in two groups.

Conclusions: Wearing medical masks does not reduce oxygen saturation in adult surgical patients during recovery from general anesthesia. The discomfort caused by masks is the concern in PACU.

© 2022 Published by Elsevier Inc. on behalf of American Society of PeriAnesthesia Nurses. All rights reserved.

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) virus, is the causative agent of a potentially fatal disease, with great global public health concern.[1-3] The World Health Organization has assessed that COVID-19 can be characterized as a pandemic by March 11, 2020. As of December 29, 2020, more than 79.2 million cases and more than 1.7 million deaths have been documented globally.[4]

The main means of person-to-person transmission are droplets spread through coughing or sneezing, and direct contact with an infected person infected with SARS-CoV-2.[5,6] Facial masks (medical masks, surgical masks and N95 respirators in Figure 1) can effectively reduce person-to-person infection through droplet transmission.[7,8] For health care workers and the general public, self-isolation with masks is recommended during the COVID-19 epidemic.[9,10] Compared with N95 masks and surgical masks, the effectiveness of medical masks in preventing viral respiratory infections is not inferior to that of surgical masks.[8,11] So medical masks can be used effectively, especially when there is a shortage of N95 masks and surgical masks.

With the use of masks, people are interested in its safety. Many researchers have reported that health care providers wearing a mask may experience headaches and nasal pressure,[12,13] and N95 respirators can reduce PaO_2 in patients with end-stage renal disease.[14] In healthy subjects, wearing masks during short-term moderate-intensity aerobic exercise is associated with an increase in end-tidal carbon dioxide ($EtCO_2$).[15]

The perianesthesia nursing areas have been impacted by COVID-19.[16] A high risk of potential infection from exposure to respiratory droplets or aerosols during airway management by anesthesia providers and nurses occurs.[17] Coughing and bucking are common and
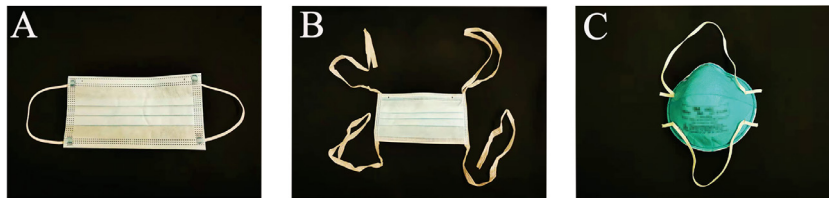
Figure 1. Three types of masks. (A) Medical mask; (B) surgical mask; (C) N95 respirator. Medical and surgical masks are designed to protect wearers from microorganism transmission and fit loosely to users' face. N95 respirators are designed to prevent users from inhaling small airborne particles and must be attached to the wearer's face. The straps for an N95 respirator, or a surgical mask, should be placed on the crown of the head (top tie) and base of the neck (bottom tie); for a medical masks, the loops should be hooked appropriately behind the ears. This figure is available in color online at www.jopan.org.

unpredictable events during extubation. Therefore, during the COVID-19 epidemic, postanesthesia care units (PACU) recommended that patients undergoing general anesthesia should wear masks after extubation.[18] As respiratory adverse events such as hypoxemia are important and common postoperative complications after extubation,[19] PACU nurses should detect and care for patients when they are at greatest risk of developing respiratory complications.[20] Unfortunately, there is little information about the impact of wearing medical masks on patients in PACU.

In this report, we aim to share our experience by reporting the perioperative characteristics and impact on oxygen saturation of medical masks worn by adult surgical patients following general anesthesia in PACU during the COVID-19 epidemic.

Methods

Research Design

We conducted a retrospective database review at the First Affiliated Hospital of Chongqing Medical University from January 1 to January 27, 2020 (patients wearing no medical masks after extubation, group A) and from March 1 to March 18, 2020 (patients wearing medical masks after extubation, group B) in PACU. This study was approved by the Institutional Ethics Committee of our hospital on April 15, 2020 (approval number: 20201601). And the study was registered prior to patient enrolment at http://www.chictr.org.cn (registration number: ChiCTR2000032213). Informed consents have been obtained from all participants.

Inclusion Criteria

Patients aged over 18 undergoing elective non-cardiac surgery in general anesthesia within 3 hours, who were enrolled after extubation in PACU.

Exclusion Criteria

Patients in thoracic surgery with emergency anesthesia, operation time over 3 hours, and direct intubation to intensive care unit (ICU) after anesthesia in our hospital were excluded, with preoperative hypoxemia as acute respiratory pathology, and patients who had no complete arterial blood gas data in PACU were also excluded from the study.

Data Collection

The following pre-existing conditions already existed in the database: (1) age, (2) sex, (3) body mass index (BMI), (4) smoking status, (5) difficult airway history, (6) comorbidities, (7) American Society of Anesthesiology (ASA) classification, (8) chest CT scans, (9) throat swab testing for COVID-19, (10) type of surgery, (11) laparoscopic surgery. After extubation, pulse oxygen saturation, heart rate (HR), noninvasive mean blood pressure (MBP) were compared for all patients at two different time points (treated with 40% O_2 oxygen therapy for 10 minutes and breathing room air for 10 minutes), duration and complication in PACU, and arterial blood gas (ABGs) data before leaving PACU.

Treatment in PACU

The patients in Group A receiving general anesthesia were transferred from operating room (OR) to PACU with supplemental oxygen. Then, we treated by the general principles of guidelines for the management of tracheal extubation.[21] After arrival in PACU, airway patency, vital signs, oxygenation, and level of consciousness were assessed immediately and recorded every 5 minutes. After extubation, the patients were allowed to inhale 40% O_2 at 10 L min^{-1} by anesthetic facial masks,[22] and then inhaled in the room air until peripheral capillary hemoglobin oxygen saturation (SpO_2) remained stable. When SpO_2 was less than 94%, 40% O_2 was given again. If the patient had a radial artery cannulation during surgery, ABGs was routinely checked before leaving PACU. As an assessment tool, PACU nurse can determine a patient's acid-base status and initiate prompt and appropriate nursing intervention and medical consultation through ABGs.[23]

During the COVID-19 epidemic, the patients in Group B received general anesthesia after elective noncardiac surgery, with negative reverse transcription-polymerase chain reaction (RT-PCR) and chest CT scans for COVID-19 before surgery arrived the PACU in our hospital at a distance of at least 2 m (6 ft) between the two of them.[24] The anesthesiologists and nurses wore personal protective equipment (PPE) with medical gowns, medical gloves, eye protection shields, disposable surgical caps, and surgical masks in PACU, complied with infection control measures, with alcohol-based cleaners installed at the bedside. One nurse only took care of one patient at the same time and changed medical gloves before contacting another patient. The appointment of a nurse in charge was to ensure that optimal staffing can be provided at all times, including an appropriate response to emergencies.

We have tried to avoid extubation during mild anesthesia. To minimize coughing during extubation, patients received dexmedetomidine ($1 \mu g$ kg^{-1} i.v.) for over 10 minutes.[25] The patient's tracheal intubation and pharynx were both thoroughly aspirated before extubation. And after extubation, we placed a medical mask over the patient's nose and mouth immediately to ensure that there was no gap between the facial mask and face, keeping a tight seal,[26] then anesthetic face-mask was put above the medical mask to take in 40% O_2 at 10 L min^{-1}. We were much more careful in monitoring and oxygen therapy as wearing medical masks in PACU during the COVID-19 epidemic. After meeting all PACU discharge criteria, the patients with medical masks were transferred from PACU to their ward by nurses with a portable monitor. Other treatments accorded to patients in Group A.
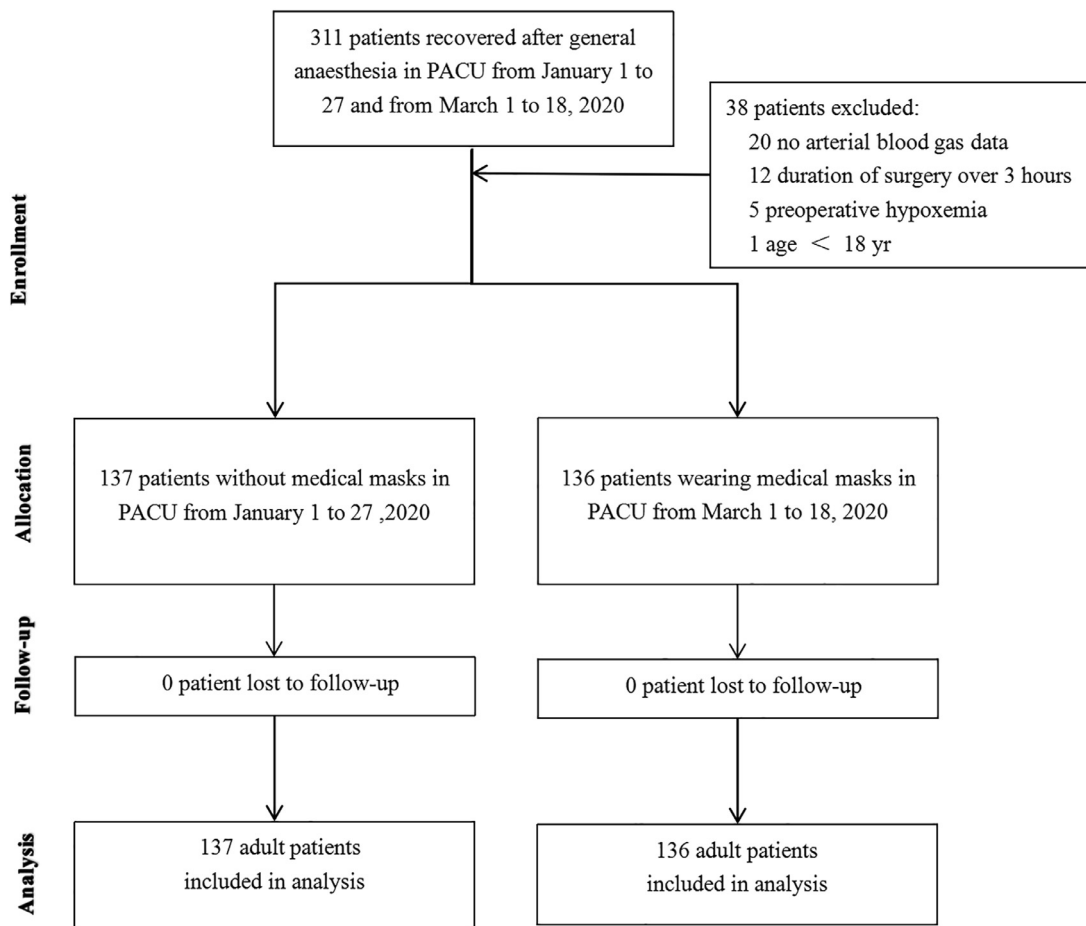
Figure 2. Flow diagram of patients included in the analysis in postanesthesia care unit (PACU).

Primary Outcome

The primary outcome of the study was the oxygen saturation of patients at two different time points (treated with 40% O_2 oxygen therapy for 10 minutes and breathing room air for 10 minutes) in PACU.

Secondary Outcome

The secondary outcomes we assessed were:

1 Arterial blood gas data and patient comfort before leaving PACU.
2 HR and MBP variation after 10 minutes at two different time points.
3 Duration and complications after extubation in PACU.

Patient comfort was evaluated by a verbal numeric rating scale (VNRS). All patients were asked to rate comfort on a 0- to 10-point VNRS, where "0" was "no comfort" and "10" was "the most comfortable" before leaving PACU.[27]

Statistical Analysis

Continuous variables were expressed as mean (standard deviation or interquartile range) for normally distributed data and median (interquartile range) for non-normal distributions. Categorical variables were reported as the number and percentage. χ^2 or Fisher's exact test were used for categorical data, and patients' *t*-test and

Mann-Whitney *U*-test were used for continuous data in compared subjects. All statistical analyses were conducted in SPSS 21.0 statistical (SPSS, Inc. Chicago, IL, USA). *P* < .05 was considered statistically significant.

Results

Patients' Characteristics

In this study, 151 patients who were extubated in PACU between March 1 and March 18 in 2020 were identified, of which, 9 were excluded for lacking arterial blood gas data for the study period, 5 for the duration of surgery over 3 hours, and 1 for hypoxemia before surgery. The rest (n = 136 patients) were assigned to Group B. In addition, 160 patients who were extubated in PACU between January 1 and January 27 in 2020 were also identified, of which, 11 patients were excluded for lacking arterial blood gas data, 7 for the duration of surgery over 3 hours, 4 for preoperative hypoxemia, and 1 for aging 17. The rest (n = 137 patients) were assigned to Group A (Figure 2).

In total, 273 patients were selected in this study, including 137 patients (aged from 20 to 87) without masks (Group A) and 136 patients (aged from 18 to 91) with masks (Group B). No patients were confirmed with COVID-19 by RT-PCR and chest CT scans before surgery, with no statistically significant in age, BMI, smoking status, history of chronic obstructive pulmonary disease (COPD), ASA classification, type of surgery, which might be the

Table 1
Clinical Characteristics of Patients Wearing Medical Mask or Not in PACU (N = 273)

Patients Characteristics	Group A (n = 137)	Group B (n = 136)	P Value
Age, mean (IQR), y	55.20 (46-67)	55.10 (45-65.75)	.655
Age ≥65, y	42 (30.7%)	40 (29.4%)	.895
	n (%)	n (%)	
Sex			
Male	58 (42.3%)	61 (44.9%)	.715
Female	79 (57.7%)	75 (55.1%)	
BMI, mean (SD), kg/m²	23.59 (3.28)	23.19 (3.06)	.345
BMI > 35 kg/m²	0 (0%)	0 (0%)	-
Smoking status	29 (21.2%)	33 (24.3%)	.665
Difficult airway history	0 (0%)	0 (0%)	-
Comorbidities			
Hypertension	28 (20.4%)	28 (20.5%)	.975
COPD	13 (9.5%)	12 (8.8%)	.849
Diabetes	8 (5.8%)	5 (3.7%)	.401
Coronary heart disease	6 (4.4%)	3 (2.2%)	.315
Stroke history	2 (1.5%)	2 (1.5%)	.994
Other	6 (4.4%)	10 (7.3%)	.296
Positive RT-PCR for COVID-19	-	0 (0%)	-
Positive chest CT for COVID-19	-	0 (0%)	-
ASA classification			
I	28 (20.4%)	37 (27.2%)	.130
II	89 (65.0%)	72 (52.9%)	
III	20 (14.6%)	27 (19.9%)	
Type of surgery			
Head and neck surgery	23 (16.8%)	16 (11.8%)	.224
Chest surgery	7 (5.1%)	15 (11.0%)	
Abdominal surgery	83 (60.6%)	84 (61.8%)	
Limbs and spine surgery	24 (17.5%)	21 (15.4%)	
Laparoscopic surgery	58 (42.3%)	47 (34.6%)	.214

IQR, interquartile range; PACU, postanesthesia care unit; RT-PCR, reverse transcription-polymerase chain reaction; SD, standard deviation.
Data are presented as mean (SD or IQR) or n (%). Group A, patient wearing no medical mask; Group B, patient wearing medical mask.

risks of postoperative hypoxemia in PACU between the two groups[19,28,29] (Table 1).

Primary Outcome

There was no significant difference in SpO_2 between two groups, (100 [99-100] and 99 [98-100], inhaling 40% O_2 in 10 L min^{-1}) (P = .213) and (98[97-99] and 98[97-99], taking in the air) (P = .923), respectively (Table 2). No patient had hypoxemia (SpO_2 < 90%) in two groups. And there were 13 (9.5%) in Group A and 14 (10.3%) in Group B with SpO_2 < 95% (P = .824) after taking in the air.

Secondary Outcomes

There was no patient with PaO_2/FiO_2 < 150 mm Hg in two groups. Patients with PaO_2/FiO_2 < 300 mm Hg in two groups were 10 (7.3%) and 11 (8.1%) (P = .807), respectively. $PaCO_2$ > 45 mm Hg were 29 (21.2%) in Group A and 31 (22.8%) in Group B (P = .746; Table 3).

No significant differences were found in heart rate, noninvasive mean blood pressure between oxygen group and nonoxygen group (P > .05; Table 2). The median duration after extubation in PACU was shorter (50 [45-55]) in Group B than (54 [48-60]) Group A (P < .001). There was no significant difference in postoperative complications between the two groups (Table 3).

Patient comfort is depicted in Table 3. Compared with Group A, wearing masks was associated with a lower comfort (6 [4-7] vs 7 [6-8]; P < .001). All patients, anesthesiologists and nurses in this study had no cough, sore throat, myalgia, shortness of breath, and gastrointestinal reaction in the hospital.

Discussion

This is the first retrospective report to explore the impact of wearing medical masks on oxygen saturation in adult surgical patients undergoing general anesthesia during the COVID-19 epidemic. Compared with patients wearing medical masks or not in PACU after extubation, we did not find a reduction in oxygen saturation in adult patients with or without medical masks after extubation. Nevertheless, wearing medical masks may reduce the patient's comfort in PACU. Arterial blood gas data including PaO_2, PaO_2/FiO_2, and $PaCO_2$ were not affected by wearing medical masks or not, with no adverse effects in hemodynamics and complication after extubation.

It is recommended that patients with COVID-19 should be sent to an isolation room in the ICU after surgery or be extubated in the operating room, bypassing the PACU.[17] With the control of COVID-19, an increasing number of surgical patients with a negative history of epidemiology, RT-PCR, and chest CT scan will

Table 3
Arterial Blood Gas Data, Duration After Extubation, and Complication in Patients Wearing Medical Mask or Not in PACU

Variable	Group A (n = 137)	Group B (n = 136)	P Value
PaO_2/FiO_2 median (IQR), mm Hg	405 (358.33-480)	416 (345-494.58)	.675
PaO_2/FiO_2 < 300 mm Hg	10 (7.3%)	11 (8.1)	.807
PaO_2/FiO_2 < 150 mm Hg	0 (0%)	0 (0%)	-
$PaCO_2$ median (IQR), mm Hg	42 (37.50-45)	42 (38-45)	.308
$PaCO_2$ > 45 mm Hg	29 (21.2%)	31 (22.8%)	.746
Duration after extubation in PACU, median (IQR), min	54 (48-60)	50 (45-55)	<.001
Complication			
Hypertension	5 (3.6%)	4 (2.9%)	.749
VAS > 3	4 (2.9%)	3 (2.2%)	.722
Arrhythmia	1 (0.7%)	0 (0%)	1.000
Nausea	1 (0.7%)	0 (0%)	1.000
Patient comfort	6 (4-7)	7[6-8]	<.001

IQR, interquartile range; PACU, postanesthesia care unit; SD, standard deviation; VAS, visual analogue scale.
Data are presented as median (IQR) or n (%). Group A, patient without wearing medical mask; Group B, patient wearing medical mask.

Table 2
Oxygen Saturation, Heart Rate (HR), and Noninvasive Mean Blood Pressure (MBP) in Patients Wearing Medical Mask or Not in PACU

Variable	Inhaling 40% O_2 in 10 L min^{-1}			Taking in the Air		
	Group A (n = 137)	Group B (n = 136)	P Value	Group A (n = 137)	Group B (n = 136)	P Value
SpO_2 median (IQR), %	100 (99-100)	99 (98-100)	0.213	98 (97-99)	98 (97-99)	.923
SpO_2 < 95%	0 (0%)	0 (0%)	-	13 (9.5%)	14 (10.3%)	.824
SpO_2 < 90%	0 (0%)	0 (0%)	-	0 (0%)	0 (0%)	-
HR, median (IQR), beats/min	77 (67.50-82)	72 (67-79)	0.109	75 (67.5-82)	71 (66-79)	.050
MBP, median (IQR), mm Hg	92 (85-101)	88 (82-99.75)	0.115	92 (84.50-101)	90 (81-98)	.063

IQR, interquartile range; PACU, postanesthesia care unit; SD, standard deviation.
Data are presented as median (IQR) or n (%). Group A, patient wearing no medical mask; Group B, patient wearing medical mask

either be in low-risk infected areas or undergo surgery and recover in PACU.[30] However, to avoid nosocomial transmission of the virus, the medical and nursing staff should always use PPE, and the patients should wear masks during the entire stay. In spite of this, all the PACU staff have to comply with infection control measures, including hand cleansing and changing gloves in time. To shorten the length of stay in PACU during the COVID-19 epidemic, we transferred the patients to ward when they met the standards for leaving PACU.

During the COVID-19 pandemic, health care workers and the general public are recommended for self-isolation with wearing masks,[9,10,31] which can be also used in patients after extubation to reduce the risk of contamination in PACU, as a risk of affecting the respiratory system as well. Hypoxemia is one of the most adverse respiratory events in PACU,[32] which could increase 1-year postoperative mortality.[33] In our study, we did not found that wearing medical masks could reduce oxygen saturation after extubation. No more hypoxemia and $SpO_2 < 95\%$ happened in these patients. According to Fikenzer, ventilation could be reduced by wearing surgical masks during exercise in healthy individuals.[34] Furthermore, wearing masks at rest or brisk walking is safe for cardiopulmonary capacity in children.[35] Intensifying monitoring and nursing is also essential to prevent hypoxemia in PACU, especially when patients were wearing masks.

Generally, wearing masks dose increase the resistance to breathing, resulting an increase in CO_2 in the mask's dead zone. Although recent research have demonstrated that short-term moderate-strenuous aerobic physical activity with masks is associated with an increase in $EtCO_2$,[15] variation of $PaCO_2$ has not found in our study. It was useful to reduce dead space by making sure no gaps between the medical mask and face.

In the present study, wearing medical masks reduced patient comfort. Clinical study has suggested a consistent and significant increase in negative ratings for all items of discomfort (humidity, heat, breathing resistance, itchiness, tightness, saltiness, feeling unfit, odor, fatigue, and overall discomfort) from surgical masks to FFP2/N95 masks.[34] Despite discomfort, compliance can still be achieved by understanding the benefits and need, which can be further reduced by effective communication with patients who will have a positive attitude toward personal protection.

There are clearly multiple limitations in this study. First, we just compared the data in adult patients, and did not include other patients at high risks (preoperative acute respiratory pathology, BMI > 35 kg m^{-2}, duration of surgery over 3 hours) of postoperative hypoxemia; therefore, we cannot address whether hypoxemia increase in these patients or not. Second, headaches, dyspnea, pressure on nose, and rash on face variations were not recorded, as these symptoms often occur with wearing masks. Additionally, studies on the prolonged use of surgical masks after general anesthesia and qualitative studies to assess the impact of mask use in children and the aged will have to be undertaken.

Conclusions

In summary, the median SpO_2 we reported in adult surgical patients with medical masks after general anesthesia did not reduce. Wearing medical masks may be safe without more hypoxemia and adverse respiratory events in PACU during the COVID-19 epidemic. Our report can contribute valuable data to the rational use of masks in perioperative COVID-19 defense.

References

1. Cossarizza A, De Biasi S, Guaraldi G, Girardis M, Mussini C, Modena COVID-19 Working Group (MoCo19)#. SARS-CoV-2, the virus that causes COVID-19: cytometry and the new challenge for global health. *Cytometry A*. 2020;97(4):340–343.
2. Deng CX. The global battle against SARS-CoV-2 and COVID-19. *Int J Biol Sci*. 2020;16 (10):1676–1677.
3. Wu Y, Ho W, Huang Y, et al. SARS-CoV-2 is an appropriate name for the new coronavirus. *Lancet*. 2020;395(10228):949–950.
4. Organization WH. Weekly epidemiological update - 29 December 2020. Available at: https://www.who.int/publications/m/item/weekly-epidemiological-update−29-december-2020.
5. Rothan HA, Byrareddy SN. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *J Autoimmun*. 2020;109: 102433.
6. Adhikari SP, Meng S, Wu YJ, et al. Epidemiology, causes, clinical manifestation and diagnosis, prevention and control of coronavirus disease (COVID-19) during the early outbreak period: a scoping review. *Infect Dis Poverty*. 2020;9:29.
7. Bartoszko JJ, Farooqi M, Alhazzani W, Loeb M. Medical masks vs N95 respirators for preventing COVID-19 in health care workers a systematic review and meta-analysis of randomized trials. *Influenza Other Respir Viruses*. 2020;14(4):365–373.
8. Radonovich Jr LJ, Simberkoff MS, Bessesen MT, et al. N95 respirators vs medical masks for preventing influenza among health care personnel: a randomized clinical trial. *JAMA*. 2019;322:824–833.
9. Wang Q, Yu C. The role of masks and respirator protection against SARS-CoV-2. *Infect Control Hosp Epidemiol*. 2020;41:746–747.
10. Ling L, Wong WT, Wan W, Choi G, Joynt GM. Infection control in non-clinical areas during COVID-19 pandemic. *Anaesthesia*. 2020;75(7):962–963.
11. MacIntyre CR, Wang Q, Seale H, et al. A randomized clinical trial of three options for N95 respirators and medical masks in health workers. *Am J Respir Crit Care Med*. 2013;187:960–966.
12. Person E, Lemercier C, Royer A, Reychler G. Effect of a surgical mask on six minute walking distance. *Rev Mal Respir*. 2018;35:264–268.
13. Lim EC, Seet RC, Lee KH, Wilder-Smith EP, Chuah BY, Ong BK. Headaches and the N95 face-mask amongst healthcare providers. *Acta Neurol Scand*. 2006;113:199–202.
14. Kao TW, Huang KC, Huang YL, Tsai TJ, Hsieh BS, Wu MS. The physiological impact of wearing an N95 mask during hemodialysis as a precaution against SARS in patients with end-stage renal disease. *J Formos Med Assoc*. 2004;103:624–628.
15. Epstein D, Korytny A, Isenberg Y, et al. Return to training in the COVID-19 era: the physiological effects of face masks during exercise. *Scand J Med Sci Sports*. 2021;31:70–75.
16. Stannard D. COVID-19: impact on perianesthesia nursing areas. *J Perianesth Nurs*. 2020;35:237–238.
17. Chen X, Liu Y, Gong Y, et al. Perioperative management of patients infected with the novel coronavirus: recommendation from the joint task force of the Chinese Society of Anesthesiology and the Chinese Association of Anesthesiologists. *Anesthesiology*. 2020;132(6):1307–1316.
18. D'Silva DF, McCulloch TJ, Lim JS, Smith SS, Carayannis D. Extubation of patients with COVID-19. *Br J Anaesth*. 2020;125(1):e192–e195.
19. Kaushal A, Goyal P, Dhiraaj S, Agarwal A, Singh PK. Identification of various perioperative risk factors responsible for development of postoperative hypoxaemia. *Turk J Anaesthesiol Reanim*. 2018;46:416–423.
20. Luckowski A. Safety priorities in the PACU. *Nursing*. 2019;49:62–65.
21. Difficult Airway Society Extubation Guidelines GroupPopat M, Mitchell V, et al. Difficult Airway Society guidelines for the management of tracheal extubation. *Anaesthesia*. 2012;67:318–340.
22. Marley RA. Postoperative oxygen therapy. *J Perianesth Nurs*. 1998;13:394–410. quiz 410-2.
23. Taylor L, Stephens D. Arterial blood gases: clinical application. *J Post Anesth Nurs*. 1990;5:264–272.
24. Bahl P, Doolan C, de Silva C, Chughtai AA, Bourouiba L, MacIntyre CR. Airborne or droplet precautions for health workers treating COVID-19. *J Infect Dis*. 2020. Online ahead of print.
25. Tung A, Fergusson NA, Ng N, Hu V, Dormuth C, Griesdale D. Medications to reduce emergence coughing after general anaesthesia with tracheal intubation: a systematic review and network meta-analysis. *Br J Anaesth*. 2020;22. S0007-0912(20)30012-X.
26. Desai AN, Mehrotra P. Medical masks. *JAMA*. 2020;323(15):1517–1518.
27. Chooi CS, White AM, Tan SG, Dowling K, Cyna AM. Pain vs comfort scores after Caesarean section: a randomized trial. *Br J Anaesth*. 2013;110:780–787.
28. Liu SS, Chisholm MF, John RS, Ngeow J, Ma Y, Memtsoudis SG. Risk of postoperative hypoxemia in ambulatory orthopedic surgery patients with diagnosis of obstructive sleep apnea: a retrospective observational study. *Patient Saf Surg*. 2010;4:9.

29. Walker M, Farmer RG, Schelew B. Risk factors for oxygen desaturation on arrival in the postanesthesia care unit. *Can J Anaesth*. 2015;62:1019–1020.
30. Guerci C, Maffioli A, Bondurri AA, Ferrario L, Lazzarin F, Danelli P. COVID-19: How can a department of general surgery survive in a pandemic. *Surgery*. 2020;167 (6):909–911.
31. Zhou ZG, Yue DS, Mu CL, Zhang L. Mask is the possible key for self-isolation in COVID-19 pandemic. *J Med Virol*. 2020;92(10):1745–1746.
32. Xará D, Santos A, Abelha F. Adverse respiratory events in a post-anesthesia care unit. *Arch Bronconeumol*. 2015;51:69–75.
33. Bartels K, Kaizer A, Jameson L, Bullard K, Dingmann C, Fernandez-Bustamante A. Hypoxemia within the first 3 postoperative days is associated with increased 1-year postoperative mortality after adjusting for perioperative opioids and other confounders. *Anesth Analg*. 2019;131(2):555–563.
34. Fikenzer S, Uhe T, Lavall D, et al. Effects of surgical and FFP2/N95 face masks on cardiopulmonary exercise capacity. *Clin Res Cardiol*. 2020;109:1522–1530.
35. Maggiore SM, Idone FA, Vaschetto R, et al. Nasal high-flow versus Venturi mask oxygen therapy after extubation. Effects on oxygenation, comfort, and clinical outcome. *Am J Respir Crit Care Med*. 2014;190:282–288.