

ANESTHESIOLOGY

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

Xiangdong Chen, M.D., Ph.D., Yanhong Liu, M.D., Ph.D., Yahong Gong, M.D., Xiangyang Guo, M.D., Ph.D., Mingzhang Zuo, M.D., Ph.D., Jun Li, M.D., Ph.D., Wenzhu Shi, M.D., Ph.D., Hao Li, M.D., Ph.D., Xiaohan Xu, M.D., Weidong Mi, M.D., Ph.D., Yuguang Huang, M.D., Ph.D., Chinese Society of Anesthesiology, Chinese Association of Anesthesiologists

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The outbreak of Coronavirus disease (COVID-19) that began in December 2019 in Wuhan, China, has attracted great attention from the international community. By February 24, 2020, more than 77,000 cases including 2,595 deaths have been reported in China and in 27 other countries worldwide. Because the outbreak of COVID-19 has required many healthcare workers to provide direct care to infected patients, they are at high risk of infection. Despite great efforts to control the spread of the disease and minimize human-to-human transmission, more than 3,000 healthcare workers have been infected according to reports by the Chinese Center for Disease Control as of February 12, 2020.¹ The risk of getting COVID-19 for healthcare workers is much greater than that of the general population.

Anesthesiologists likely have an even higher risk than healthcare workers of other subspecialties because anesthesiologists manage the airway and ventilation. This requires them to be adjacent to the airway of patients during emergency airway intubation outside the operating room, while taking care of critically ill patients in the intensive care unit (ICU) and while providing perioperative care for patients undergoing urgent and emergency surgeries. Several

ABSTRACT

The outbreak of the new Coronavirus disease, COVID-19, has been involved in 77,262 cases in China as well as in 27 other countries as of February 24, 2020. Because the virus is novel to human beings, and there is no vaccine yet available, every individual is susceptible and can become infected. Healthcare workers are at high risk, and unfortunately, more than 3,000 healthcare workers in China have been infected. Anesthesiologists are among healthcare workers who are at an even higher risk of becoming infected because of their close contact with infected patients and high potential of exposure to respiratory droplets or aerosol from their patients' airways. In order to provide healthcare workers with updated recommendations on the management of patients in the perioperative setting as well as for emergency airway management outside of the operating room, the two largest anesthesia societies, the Chinese Society of Anesthesiology (CSA) and the Chinese Association of Anesthesiologists (CAA) have formed a task force to produce the recommendations. The task force hopes to help healthcare workers, particularly anesthesiologists, optimize the care of their patients and protect patients, healthcare workers, and the public from becoming infected. The recommendations were created mainly based on the practice and experience of anesthesiologists who provide care to patients in China. Therefore, adoption of these recommendations outside of China must be done with caution, and the local environment, culture, uniqueness of the healthcare system, and patients' needs should be considered. The task force will continuously update the recommendations and incorporate new information in future versions.

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anesthesiologists have been infected after providing tracheal intubation for confirmed COVID-19 patients, although the exact number of infected anesthesiologists is yet unknown. Meanwhile, because the operating room is a busy environment, it further increases the risk of nosocomial infections of the perioperative team including anesthesiologists. Therefore, urgent development of safe medical practices and infection prevention protocols for the perioperative management of patients with COVID-19 is needed.

To summarize best practices, the Chinese Society of Anesthesiology (CSA) and the Chinese Association of Anesthesiologists (CAA) jointly formed this task force and drafted these recommendations. This document was created based on World Health Organization² and National Health Commission guidelines for the prevention and treatment of COVID-19,³ clinical experiences from the most frontline care providers,^{4–6} and a comprehensive review of updated literature on the perioperative management of infectious patients.^{7–9} This first edition is not intended to replace any existing guidelines on anesthesia care and infectious disease control. Rather, it is aimed at providing recommendations on how to manage this specific patient population when anesthesiologists provide care either in the perioperative setting or in the management of the airway of patients

outside the operating room. We hope the recommendations from the experts who have managed patients on the frontlines and who have firsthand experience can help our colleagues provide the best care to our patients, including the care of providers themselves, and prevent those who are not infected from becoming infected. We realize that there is a lack of well-designed and executed studies to support these recommendations. However, these recommendations are based on the experience of the frontline healthcare workers who have observed its effectiveness. This task force will be continuously working on and updating the following versions in a timely manner.

COVID-19

Pathogenic Characteristics

The causative agent of COVID-19, also called 2019-nCoV or SARS-CoV-2, belongs to the cluster of Betacoronavirus in the family of Coronaviridae of the order Nidovirales, which includes Bat-SARS-like (SL) -ZC45, Bat-SL ZXC21, SARS-CoV, and MERS-CoV.¹⁰ The diameter of 2019-nCoV varies from about 60 to 140 nm. The virus particles have quite distinctive spikes of 9 to 12 nm in length, which gives the virus the appearance of a solar corona. When isolated and cultured *in vitro*, the virus can be found in human respiratory epithelial cells in about 96 h.¹¹ The 2019-nCoV virus is sensitive to ultraviolet light and heat and can be inactivated at 56°C for 30 min. Ethyl ether, 75% ethanol, chlorine disinfectant, peracetic acid, and chloroform are effective in inactivating the virus. However, chlorhexidine has been found to be ineffective.³

Epidemiologic Characteristics

Currently, individuals infected with 2019-nCoV are the main source of transmission. Even individuals who are infected but asymptomatic can shed the virus and play a critical role in its transmission.³ The vectors of transmission are respiratory droplets or close/direct contact. Aerosol propagation is also possible in the case of prolonged exposure to high concentrations of the aerosols in a relatively closed environment. Individuals of all ages are susceptible to 2019-nCoV. The elderly or those with major medical comorbidities are more vulnerable to become critically ill once becoming infected. By January 31, 2020, more than 20 pediatric cases have been reported in China. Fortunately, children often have mild clinical presentations.^{1,12}

Clinical Manifestations and Treatment

Based on current epidemiologic data, the incubation period of COVID-19 ranges from 1 to 14 days, mostly ranging from 3 to 7 days.^{1,13} The most common manifestations in patients are fever, weakness, and dry cough. However, a small fraction of patients present with nasal congestion, runny nose, sore throat, and diarrhea. Severe cases often develop

dyspnea and/or hypoxemia a week after the onset of the first symptom. In critically ill cases, it progresses rapidly to acute respiratory distress syndrome, septic shock, refractory metabolic acidosis, coagulopathy, and multiorgan failure. The chest x-ray film or computed tomography imaging is characterized, in the early phase, by multiple small band film shadows and interstitial changes (obvious in the extranodal lung), which then develop into multiple ground glass shadows and infiltration in both lung fields. In severe cases, lung parenchymal pathology may occur, but pleural effusion is scarcely observed. Based on the clinical presentations, laboratory tests, and imaging studies, the severity of illness in patients infected with 2019-nCoV can be categorized as mild, moderate, severe, and critical. Currently, there is no effective drug to prevent its transmission or to treat infected patients. Patients in the mild category are managed mainly with rest or antibiotics if a secondary bacterial infection is suspected or evident. Severe and critically ill patients should be admitted to an ICU promptly because patients in this category often require respiratory and/or circulatory support.

Currently, antiviral medications including α -interferon (5 million U or equivalent dose for adults, 2 ml of sterile water for injection, twice a day), lopinavir and ritonavir tablets (200 mg/50 mg, twice a day), ribavirin (500 mg, intravenous injection, twice a day for adults), and chloroquine phosphate (500 mg, twice a day for adults) have been recommended by the Chinese National Health Commission.³ Infusion plasma from patients who have completely recovered from infection with 2019-nCoV and traditional Chinese medications have also been attempted. However, the effectiveness of these therapies for COVID-19 remains to be determined.

Precautions for 2019-nCoV Infection

- (1) 2019-nCoV can cause severe acute respiratory infection, and inhaling droplets generated from the respiratory tract of the individuals infected with the virus has been identified as the primary route of transmission.
- (2) Healthcare workers should receive systemic training on in-hospital infection control, strictly implement standard prevention protocol, and apply correct isolation and protective measures in order to safely provide care to patients. Psychological support may also be needed for healthcare workers providing direct care to infectious patients (fig. 1).
- (3) When a healthcare worker provides care to the patient, he or she should immediately implement and strictly adhere to the standard infection prevention and control measures and assess and triage the patient according to his or her severity.
- (4) Standard prevention measures include (1) universal precaution, (2) handwashing with soap or hand hygiene with 2 to 3% hydrogen peroxide, (3) use of personal



Fig. 1. Psychologic preparation and self-encouragement.

protective equipment (gloves, mask, and goggles), (4) standard handling of medical waste disposal to prevent needle stick or cutting injury, and (5) equipment cleaning and disinfection, as well as environment disinfection (2 to 3% hydrogen peroxide spray disinfection, 2 to 5 g/l chlorine disinfectant, or 75% alcohol wiping of solid surfaces of the equipment and floor).

Precautions in Perioperative Settings When Caring for Patients with Suspected or Confirmed COVID-19

Anesthesia Preoperative Evaluation Clinic

- (1) Recommended personal protective equipment for healthcare workers in the anesthesia preoperative evaluation clinic should include white medical gowns, medical gloves, eye protection shields, disposable surgical caps, and surgical masks or test-fit N95 masks or respirators.
- (2) Patients receiving an anesthesia preoperative evaluation should enter the consulting room one by one to minimize close contact with the clinician and other individuals.
- (3) Patients' body temperatures should be measured (electronic ear thermometer) before entering the consulting room. If the body temperature is higher than 37.3°C, he or she must be escorted to the clinics for fever disorders immediately and should be reported to the infection control officer on duty of the hospital. Patients with normal body temperature can proceed with the evaluation at the anesthesia clinic.
- (4) During the first encounter, the anesthesiologists should take a detailed history and conduct a thorough physical examination, particularly a careful chest examination.
- (5) Hand hygiene must be performed after contact with each patient with 2 to 3% hydrogen peroxide solution or gel, or by washing hands with soap and water.
- (6) Suspected cases of infection with 2019-nCoV even with normal body temperature should be reported to the infection control officer on duty at the hospital immediately.
- (7) At the end of a shift, cleaning and disinfection procedures are applied in the anesthesia clinic appropriate for 2019-nCoV by thoroughly wiping the surfaces of furniture, equipment, and floor with 2 to 3% hydrogen peroxide.

Patient Preparation for Emergency Surgeries

- (1) Patients requiring emergency surgery should complete the primary triage before being admitted to the hospital. A secondary triage before entering the operating room should be performed by anesthesiologists, including reviewing the medical history, a brief physical examination, and reviewing the chest computed tomography and/or chest x-ray. The body temperature should be retaken. Individuals who are ruled out of COVID-19 should undergo the surgical procedure normally if the surgery is urgent or emergent.
- (2) If COVID-19 is suspected or confirmed, non-emergency surgical procedures should be canceled or postponed. In cases of urgent or emergency procedures, patients should be placed in the isolation holding area and transferred to the operating room dedicated to the patients with COVID-19.
- (3) Patients with suspected or confirmed infection with the virus identified in a nondedicated hospital for COVID-19 must be reported to the infection office of the institution and transferred to a designated hospital provided the patient is stable for transfer.

Anesthesia Management in the Dedicated Operating Room

Preoperative Preparation

- (1) The in-room anesthesia care team should communicate with the officer in charge of infectious disease control at the hospital level and inform him or her that the patient with COVID-19 is to be transferred to the dedicated operating room.
- (2) The dedicated operating room and anteroom should be equipped with a negative pressure system, and an appropriate level of negative pressure must be ensured. In a hospital where negative pressure operating rooms are unavailable, the positive pressure system and air conditioning must be turned off.
- (3) A dedicated operating room only for patients with COVID-19 must be labeled "infectious surgery" on the door of the operating room. Only personnel involved in direct care are allowed to enter the dedicated operating room. The functionality of the operating room must be ensured by technical personnel including the appropriate operation of laminar flow and the functional high-efficiency filter.
- (4) An anesthesia machine is dedicated to the dedicated operating room. There is a lack of a consensus for now on how to perform disinfection before it is used for non-infected patients. However, feedback from the practice providers in Wuhan, China, suggests that after disinfection as recommended in this paper (refer to "Anesthesia Equipment Care and Operating Room Disinfection," below), the anesthesia machine can be used in other

non-COVID-19 patients, and no cross-infection has been reported so far.

- (5) Artificial nose (also called breathing circuit filter) must be installed between the proximal end of the endotracheal tube and the distal end of the circuit. The filter can also be placed on each limb of the circuit at the interface of the circuit and the anesthesia machine. Because the specifications of the filter vary from different manufacturers, the anesthesia care team should check with the manufacturer and learn its effectiveness in blocking pathogens. It is recommended to replace the filter after every 3 to 4 h of anesthesia use.
- (6) Personal protective equipment that the in-room anesthesiologist wears must meet the following protective standards: (1) wear hospital scrubs inside and protective coveralls outside; (2) wear a medical protective mask, disposable surgical cap, and goggles/face shield; and (3) wear disposable medical latex gloves and boot covers. The suggested sequence for putting on personal protective equipment is as follows: putting on scrubs and hair cover → performing hand hygiene → putting on the mask → putting on inner gloves → putting on the overall → putting on eye protection (goggles/face shield) → putting on foot protection → putting on the isolation gown → putting on outer gloves → test the fit of the personal protective equipment components → ready to pass through the yellow zone and enter the red zone.

Anesthesia Management

Types of Anesthesia

- (1) General anesthesia is recommended for patients with suspected or confirmed COVID-19 to reduce the risk of patients coughing and bucking, which can generate airborne material and droplets. Other types of anesthesia can be selected dependent on the type of surgery and the individual patient's need. If the patient is not intubated, a surgical mask or N95 mask must be applied to the patient throughout the length of stay in the operating room.
- (2) Spinal anesthesia is still recommended as the primary choice of anesthesia for cesarean delivery in a mother with COVID-19. The infected mother must wear a surgical mask or N95 mask all the times. In case supplementary oxygen is needed, the oxygen mask is applied over the surgical mask or N95 mask. General anesthesia can be used as a backup plan in case spinal anesthesia fails or intraoperative conversion to general anesthesia is indicated.

General Anesthesia Induction

- (1) It is recommended that rapid sequence induction should be used, and appropriate preparation for rapid sequence induction should be similar to that of an

ordinary patient. Induction must be initiated after a complete satisfactory check of personal protective equipment for every person in the operating room. The complete check includes a self-check and, more importantly, a check by another colleague (fig. 2).

- (2) During preoxygenation, it is recommended to cover the patient's nose and mouth with two layers of wet gauze to block some of the patient's secretions and place the anesthesia mask superimposed onto the wet gauze. Caution should be taken to ensure that the wet gauze does not obstruct the patient's airway. Sufficient muscle relaxation should be obtained to prevent coughing during intubation.
- (3) Oral intubation with a video laryngoscope or bronchoscope, if available, is preferred. For physicians who are very familiar with the use of the fiberscope, the fiberscope can also be used for intubation after induction of anesthesia because it may significantly increase the distance between the patient's airway and that of the anesthesiologist who performs the intubation. One disposable fiberscope should be dedicated to a single given patient. If a nondisposable fiberscope is used, cleaning and disinfection should be conducted after completion of each case using ethylene oxide or hydrogen peroxide plasma. When using a direct laryngoscope for intubation, extra attention is needed to reduce patients'

coughing and/or bucking. Transnasal bronchoscopic intubation could be an alternative option when oral intubation is impossible or contraindicated.

- (4) A closed airway suction system, if available, is recommended to reduce viral aerosol production. If it is not available, the team should keep the minimal but necessary number of suctions using a nonclosed suction system.

Recovery from Anesthesia

It is recommended that patients with COVID-19 should be sent to an isolation room in the ICU after surgery, bypassing the postanesthesia care unit. Once the patient meets the criteria for extubation, he or she should be extubated in the operating room. Before extubation, two layers of wet gauze can be used to cover the patient's nose and mouth to minimize exposure to the patient's secretions during extubation.

Patient Transfer

- (1) If a suspected or confirmed COVID-19 patient is stable after surgery and does not meet the criteria for admission to the ICU, he or she should be transferred directly back to the negative-pressure ward or isolation ward after extubation in the operating room.
- (2) During transfer, the circulating nurse and anesthesiologist should wear proper personal protective equipment outside the operating room. The patient should be covered with one disposable operating sheet and then transferred to the negative-pressure or isolation ward through a dedicated lobby and elevator. The patient must wear a surgical mask or N95 mask during transfer. The surfaces of passageways and the elevator should be cleaned and covered.
- (3) If the patient is kept intubated, a single-patient-use Ambu bag must be used during transfer. It is not recommended to use a ventilator during transfer.

Postanesthesia Equipment Care and Medical Waste Disposal

Anesthesia Equipment Care and Operating Room Disinfection

- (1) All of the anesthesia equipment, supplies, and medications must be used for only one patient exclusively. Anesthesia supplies that directly contact the patient's skin or mucosa should be single use, including the video laryngoscope blade, reinforced tubes, anesthesia masks, filters, breathing balloons, suction tubes, and/or catheters, end-expiratory carbon dioxide sampling tubes, water traps, *etc.*
- (2) All anesthesia equipment should be cleaned and disinfected promptly. The carbon dioxide absorber is recommended to be replaced between cases as it provides a large surface area in the anesthesia machine. The respiratory circuit within the anesthesia machine should be disinfected between cases and at the end of the shift. The



Fig. 2. Personal protective equipment self-check and inspection by another colleague.

recommended disinfection procedure of the ventilator on the anesthesia machine consists of either disassembly and sterilization with high temperature, if feasible, or disinfection with 2 to 3% hydrogen peroxide using a disinfection machine. The surface of the anesthesia machine, laryngoscope handles, and other nondisposable equipment should be cleaned and disinfected with 2 to 3% hydrogen peroxide, 2 to 5 g/l chlorine disinfectant wipes, or 75% alcohol wipes after the completion of each case and again at the end of the shift.

- (3) The anesthesia cart and other anesthesia facilities must be cleaned and disinfected following the same process. The infection control team of the operating room keeps a checklist and tracks the cleaning and disinfection of equipment and facilities in a timely manner.
- (4) The operating room used for patients with confirmed or suspected COVID-19 pneumonia should be fully disinfected with 2 to 3% hydrogen peroxide sprays, and then wiped with 2 to 3% hydrogen peroxide, 2 to 5 g/l chlorine disinfectant, or 75% alcohol. The cleaning personnel should complete sufficient training on cleaning, disinfection, and self-protection before work in the dedicated operating room.
- (5) The transfer bed used for patients with COVID-19 should be cleaned and disinfected with 2 to 5 g/l chlorine disinfectant.

Disposal of Medical Waste

- (1) Medical waste should be sorted and disposed of without delay. All the medical waste should be double-bagged and labeled "COVID-19," along with the name of the department, institute, date and time, and the category.
- (2) Before being taken out of the contaminated area, all the packing bags should be sealed and sprayed with chlorinated disinfectant or covered with an additional bag and sealed. Medical waste produced in the clean area can be treated in a routine fashion.
- (3) All healthcare workers participating in the surgery should remove their personal protective equipment and place the personal protective equipment in a designated waste bag in an anteroom. Personal protective equipment should be removed in the following order: shoe covers → gloves → hand hygiene → goggles/face shield → hand hygiene → the gown → hand hygiene → the protective mask → hand hygiene → the head cover → hand hygiene → shower and change into personal clothing. Nondisposable personal protective equipment should be packed into medical waste bags and placed in a designated area.

Considerations for Emergency Tracheal Intubation of Suspected or Confirmed COVID-19 Patients outside the Operating Room

The proportion of patients infected with 2019-nCoV and requiring tracheal intubation outside the operating room

is high. It is estimated that more than 70% of patients with COVID-19 in the ICU in Wuhan, China, are intubated. The risk of exposure to healthcare workers during tracheal intubation outside the operating room appears to be higher than in the operating room, as intubation is frequently emergent and the intubation condition is suboptimal. Therefore, it is critical to apply precautions during airway management outside the operating room.

Indications for Endotracheal Intubation

Our criteria for intubation include acute respiratory distress with a respiratory rate greater than 30 per minute, acute hypoxemic (oxygenation index less than 150 mmHg) or hypercarbic respiratory failure, no improvement after 2 h of high-flow oxygen therapy or alternative methods of noninvasive ventilation, or loss of consciousness and/or inability to protect the airway.

Preintubation Preparation

- (1) Endotracheal intubation is an aerosol-producing high-risk procedure. Therefore, intubating patients warrants specific precautions and should be undertaken in an airborne isolation room. All healthcare workers involved in intubation must use appropriate airborne/droplet personal protective equipment. The personal protective equipment with specifications described above (step 6, "Preoperative Preparation" section under "Anesthesia Management in the Dedicated Operating Room") should be applied properly, including the test-fit N95 mask, protective whole-body garment, two layers of gloves, goggles or face shield, and the waterproof gown.
- (2) When possible, intubation should be performed by an experienced anesthesiologist assisted by another clinician (anesthesiologist or intensive care physician) in order to minimize the number of attempts and production of airborne material/droplets from the patient.
- (3) Equipment preparation for intubation is similar to that of an ordinary case including laryngoscope, endotracheal tube, anesthetics, vasoactive drugs, suction device, ventilators, standard monitoring, and venous access. However, the organization of the equipment drugs must be sufficient as visualization and access to the equipment and drugs are often suboptimal due to restricted space and vapor condensation on the eye shield (fig. 3).
- (4) The team should choose the airway devices that they are most familiar with, including but not limited to: (1) a video laryngoscope with disposable blades; (2) a disposable video-optic stylet or disposable video endotracheal tube; (3) a disposable second-generation intubating laryngeal mask; (4) a kit for emergency cricothyroidotomy; (5) if available, preparation of a disposable flexible video bronchoscope; and (6) if available, preparation of supraglottic and subglottic airway compatible with the insertion of an endotracheal tube. Periodical injection



Fig. 3. Emergency intubation cart.

of 2% lidocaine 2 to 3 ml or 1% lidocaine 4 to 6 ml through the working channel can reduce irritation and minimize the coughing of the patient. For physicians who are very familiar with the use of the video laryngoscope or fiberscope, the video laryngoscope or fiberscope is recommended because it may significantly increase the distance between the patient's airway and that of the anesthesiologist who performs intubation (fig. 4).

- (5) A high efficiency breathing circuit filter should be installed between the mask and the breathing circuit or respiratory bag, and at the proximal end of the breathing circuit as well. However, the efficiency of the filter in blocking the virus is undetermined. Therefore, once the ICU ventilator is used for a patient confirmed with COVID-19, it should be dedicated to patients with COVID-19 only. The disinfection of the ICU ventilator for use on a patient not infected with the virus is the same as described in "Anesthesia Equipment Care and Operating Room Disinfection."

- (6) A closed airway suction system is, if available, recommended to reduce viral aerosol production. If it is not available, the team should keep the minimal but necessary number of suctions using a nonclosed suction system.

Precautions for Intubation

- (1) Intubation should be performed by experienced anesthesiologists, and repeated intubation attempts should be minimized to reduce the risk of exposure.
- (2) Oral intubation with a video laryngoscope or bronchoscope, if available, is preferred. When using a direct laryngoscope for intubation, extra attention is needed to reduce patients' coughing and/or bucking. Transnasal bronchoscopic intubation could be an alternative option when oral intubation is impossible or contraindicated.
- (3) The team should remove the outer gloves immediately after completion of intubation and put on a fresh pair of gloves.
- (4) Be aware that adequate mask seal and minute alveolar ventilation results in adequate preintubation oxygenation. If high flow oxygenation is required, the providers should be cautious as high flow oxygen increases the production of viral droplets and aerosol. The patient's mouth and nose should be covered with two layers of wet gauze, ensuring that it does not obstruct the airway. The preoxygenation mask is superimposed over the gauze. For patients already on noninvasive mechanical ventilation, preoxygenation can be achieved with 100% oxygen for 5 min without alternating the ventilatory settings. The bag-mask ventilation setting can be useful as a backup option.
- (5) For patients with a normal airway, modified rapid sequence induction is recommended. Sufficient muscle paralysis should be achieved after loss of consciousness. However, the team must be aware that the apnea oxygenation time is often extremely short, and great effort is needed to avoid severe hypoxemia. The choice of induction drugs is dictated by hemodynamic considerations. Midazolam 2 to 5 mg with etomidate (10 to 20 mg) or propofol, if the patient's hemodynamics allow, can be used for induction. Fentanyl 100 to 150 μ g or remifentanyl of 50 μ g is recommended to be administered intravenously for an adult patient to suppress laryngeal reflexes and provide optimal conditions for intubation. If no contraindications are present, succinylcholine 1 mg/kg should be administered immediately after loss of consciousness, and intubation can be carried out after muscle fasciculation is completed. If rocuronium 1 mg/kg is used, sugammadex should be immediately available in case "cannot intubate/cannot oxygenate" is encountered. For critically ill patients with COVID-19 pneumonia, patients may develop pulmonary hypertension. The care team must make a great effort to avoid or minimize hypercarbia.



Fig. 4. Intubation with video laryngoscopes and keeping distance from the head of patient. Submitted for publication February 29, 2020. Accepted for publication March 9, 2020. From the Department of Anesthesiology, Union Hospital of Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China (X.C.); the Anesthesia and Operation Center, Chinese People's Liberation Army General Hospital, Beijing, China (Y.L., W.S., H.L., W.M.); the Department of Anesthesiology, Chinese Academy of Medical Sciences and Peking Union Medical College Hospital, Beijing, China (Y.G., X.X., Y.H.); the Department of Anesthesiology, Peking University Third Hospital, Beijing, China (X.G.); the Department of Anesthesiology, Beijing Hospital, National Center of Gerontology, Institute of Geriatric Medicine, Chinese Academy of Medical Sciences, Beijing, China (M.Z.); and the Department of Anesthesiology, Sixth Medical Center of Chinese People's Liberation Army General Hospital, Beijing, China.

- (6) For patients with an anticipated difficult airway and awake intubation is unavoidable, awake oral fiberoptic or video laryngoscopy intubation can be done with sufficient sedation and topicalization with lidocaine or tetracaine through the cricothyroid membrane, pharyngeal cavity, oral cavity, and airway catheter surface.
- (7) Be prepared for an unanticipated difficult airway. This is similar to that for the care of an ordinary patient. However, the preparation should be more robust as help is limited and equipping personal protective equipment is time consuming. In addition, obtaining a clear view of the glottis is extremely challenging due to vapor condensation on the eye shield or goggles.
- (8) Confirm the correct position of the endotracheal tube. In many cases, personal protective equipment and reduced breathing sounds may limit the role of auscultation. Proper positioning of the endotracheal tube can be confirmed by direct visualization of the endotracheal tube passing through the vocal cords, observing bilateral

chest rise and proper capnography waveform, and performing bronchoscopy if necessary. The appropriate depth of the endotracheal tube can be determined by the insertion markers at the upper incisors in adult men (22 to 23 cm) and women (20 to 21 cm), respectively. Chest radiography should be performed at the earliest availability.

Airway Management after Intubation

- (1) Oral or tracheal suction should be performed with a closed suction system after intubation.
- (2) Appropriate cleaning and disinfection of patient-care equipment and environmental surfaces are mandatory to reduce transmission (refer to "Postanesthesia Equipment Care and Medical Waste Disposal").
- (3) Personal protective equipment removal should follow "Personal Protective Equipment Doffing Process for High-risk Level of Exposure." Personal protective

equipment should be removed appropriately under the careful supervision of an infection control officer. Hand hygiene must be performed after removing personal protective equipment. Do not touch the hair or face before proper hand hygiene. A thorough whole-body shower is also highly recommended after removing personal protective equipment, including oral, nasal, and external auditory canal disinfection.

- (4) Personal protective equipment used during intubation must be kept in a contaminated area and must not be taken back to the operating room.

Surveillance of Anesthesia Providers after Caring for Confirmed or Suspected Patients

- (1) If healthcare workers who had direct contact with confirmed or suspected patients develop fever, cough or fatigue, they must inform the occupational health department of the hospital. Complete blood tests including C-reactive protein and chest computed tomography should be performed. If a healthcare worker meets the criteria for medical observation, he or she should be self-isolated at home.
- (2) The criteria of medical observation for COVID-19 are as follows: (1) epidemiologic history: travel within 14 days to the city of Wuhan or contact within 14 days with confirmed or suspected COVID-19 cases; (2) clinical manifestations: fever, radiological characteristics of viral pneumonia, reduced lymphocyte count and normal or reduced leukocyte count in the early phase, and unresponsiveness or even deterioration after a 3-day regular antibiotic treatment.
- (3) All cases under medical observation should be reported to the office of infection control and rounded on by a dedicated team. The level of care must be adjusted promptly based on the assessment.

Research Support

Support was provided solely from institutional and/or departmental sources.

Competing Interests

The authors declare no competing interests.

Correspondence

Address correspondence to Dr. Mi: Anesthesia and Operation Center, Chinese People's Liberation Army General Hospital, Beijing, 100853, China. wvdd1962@aliyun.com. Information on purchasing reprints may be found at www.anesthesiology.org or on the masthead page at the beginning of this issue. ANESTHESIOLOGY's articles are made freely accessible to all readers, for personal use only, 6 months from the cover date of the issue.

References

1. The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team: The epidemiological characteristics of an outbreak of 2019 novel Coronavirus diseases (COVID-19) — China, 2020. *China CDC Wkly* 2020; 2:113–22
2. World Health Organization: Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19). Interim guidance. February 27, 2020. Available at: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/infection-prevention-and-control>. Accessed XXX.
3. National Health Commission and National Administrative Office of Chinese Tradition Medicine: National Recommendations for Diagnosis and Treatment of Pneumonia Caused by 2019-nCoV (6th edition). Available at: <http://www.nhc.gov.cn/yzygj/s7653p/202002/8334a8326dd94d329df351d-7da8aefc2.shtml>. Accessed February 18, 2020. [Chinese only]
4. Jin Y-H, Cai L, Cheng Z-S, Cheng H, Deng T, Fan Y-P, Fang C, Huang D, Huang L-Q, Huang Q, Han Y, Hu B, Hu F, Li B-H, Li Y-R, Liang K, Lin L-K, Luo L-S, Ma J, Ma L-L, Peng Z-Y, Pan Y-B, Pan Z-Y, Ren X-Q, Sun H-M, Wang Y, Wang Y-Y, Weng H, Wei C-J, Wu D-F, Xia J, Xiong Y, Xu H-B, Yao X-M, Yuan Y-F, Ye T-S, Zhang X-C, Zhang Y-W, Zhang Y-G, Zhang H-M, Zhao Y, Zhao M-J, Zi H, Zeng X-T, Wang Y-Y, Wang X-H, Management for the Zhongnan Hospital of Wuhan University Novel Coronavirus Research Team, Evidence-Based Medicine Chapter of China International Exchange, Promotive Association for Medical and Health Care: A rapid advice guideline for the diagnosis and treatment of 2019 novel coronavirus (2019-nCoV) infected pneumonia (standard version). *Mil Med Res* 2020; 7:4. Available at: <https://xs.sci-hub.ltd/https://doi.org/10.1186/s40779-020-0233-6>. Accessed XXX.
5. Chinese Society of Anesthesiology Task Force on Airway Management: Expert recommendations for tracheal intubation in critically ill patients with novel Coronavirus pneumonia (version 1.0). *Chin J Anesthesiol* 2020; 40 [Epub ahead of print, Chinese only]
6. Perioperative Infection Control Society of Chinese Society of Cardiothoracic and Vascular Anesthesia, PLA Society of Anesthesiology and Resuscitation: Guidelines and recommendations for perioperative infection control in patients with 2019 novel coronavirus. *Perioper Saf Qual Assur* 2020;4:63–6 [Chinese only]
7. Wax RS, Christian MD: Practical recommendations for critical care and anesthesiology teams caring for novel Coronavirus (2019-nCoV) patients. *Can J Anesth* 2020:1–9 [Epub ahead of print]

8. Park J, Yoo SY, Ko JH, Lee SM, Chung YJ, Lee JH, Peck KR, Min JJ: Infection prevention measures for surgical procedures during a Middle East Respiratory Syndrome outbreak in a tertiary care hospital in South Korea. *Sci Rep* 2020;10:1–8
9. Missair A, Marino MJ, Vu CN, Gutierrez J, Missair A, Osman B, Gebhard RE: Anesthetic implications of Ebola patient management: A review of the literature and policies. *Anesth Analg* 2015;121:810–21
10. Chen Y, Liu Q, Guo D: Emerging coronaviruses: Genome structure, replication, and pathogenesis. *J Med Virol* 2020; 92:418–23
11. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R, Niu P, Zhan F, Ma X, Wang D, Xu W, Wu G, Gao GF, Tan W; China Novel Coronavirus Investigating and Research Team: A novel Coronavirus from patients with pneumonia in China, 2019. *N Engl J Med* 2020; 382:727–33
12. Chen ZM, Fu JF, Shu Q, Chen YH, Hua CZ, Li FB, Lin R, Tang LF, Wang TL, Wang W, Wang YS, Xu WZ, Yang ZH, Ye S, Yuan TM, Zhang CM, Zhang YY: Diagnosis and treatment recommendations for pediatric respiratory infection caused by the 2019 novel coronavirus. *World J Pediatr* 2020 [Epub ahead of print]
13. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z, Yu T, Xia J, Wei Y, Wu W, Xie X, Yin W, Li H, Liu M, Xiao Y, Gao H, Guo L, Xie J, Wang G, Jiang R, Gao Z, Jin Q, Wang J, Cao B: Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020; 395:497–506

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