

## Special Article



# Guidelines for Surgery of Confirmed or Suspected COVID-19 Patients

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### ORCID iDs

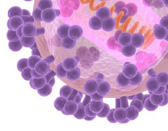
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## ABSTRACT

Coronavirus disease 2019 (COVID-19) has spread widely across the world since January 2020. There are many challenges when caring for patients with COVID-19, one of which is infection prevention and control. In particular, in cases where surgery must absolutely be performed, special infection control may be required in order to perform surgery without spreading infection within the hospital. We aim to present potentially useful recommendations for non-deferrable surgery for COVID-19 patients based on *in vivo* and *in vitro* research and clinical experiences from many countries.

**Keywords:** COVID-19; SARS-CoV-2; Surgery; Guideline

For suspected or confirmed Coronavirus disease 2019 (COVID-19) patients, elective surgery is delayed as far as possible and only emergency surgery is performed [1]. The most important principles to safely perform surgery on COVID-19 patients are to minimize the number of medical personnel in the operating room (OR), wear proper personal protective equipment (PPE), and minimize exposure by reducing patient movement [2]. Given the nature of medical institutions, suspected patients need to be handled in accordance with the physician's judgment to meet the realities of the working environment. For suspected patients, the possibility of delaying surgery should first be investigated and if surgery is unavoidable, confirmatory tests should be performed to verify whether or not the patient is infected. The most important consideration is to protect the medical personnel from infection. It is essential to provide PPE for safe surgery. When moving infected patients for surgery, preemptive measures, planning, preparation, and practical training are needed to minimize the risk of exposure, such as designating restricted areas, using a separate elevator, implementing processes to reduce exposure, medical personnel wearing and removing PPE as necessary, and decontamination of the environment after moving the patient [3].



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## OPERATING ROOM MANAGEMENT

### 1. Operating room management

A negative pressure OR with an anteroom is used, adhering to airborne precautions [4]. If no anteroom is available, the room connecting two OR or the neighboring OR is used as the anteroom. The minimum possible number of staff are allowed to stay in the OR [3]. Laminar airflow is directed from the ceiling to the surgical field, and drawn into air ducts on all four walls, to ensure that air does not rise up from the surgical field [5]. Non-essential objects in the surgical theater should be repositioned or removed as far as possible. Anything that cannot be removed should be covered in vinyl sheets to prevent contamination [2]. If possible, the surgery should be scheduled to be the last surgery of the day.

- 1) A negative pressured OR or an OR with a portable negative pressure machine is established.
- 2) The OR is marked 'Corona-OR', and access by medical personnel is restricted.
- 3) After the patient has entered the room, the automatic doors are set to manual mode and closed.
- 4) If items are required from outside, a request is made to a person waiting outside the OR, and the items are handed over after opening the door from the outside (items are transferred via a pass box or the anteroom) [4].
- 5) The placement, exchange, and extubation of endotracheal tube are dangerous moments that can transmit infection as virus leaks from the patient's lungs into the air. Hence, it is essential that these procedures are performed with the utmost care in places under negative pressure [5, 6].
- 6) Depending on the clinical situation, one may consider performing intubation and extubation in a negative pressure ward or negative pressure intensive care unit (ICU), rather than the OR [5, 6]. However, it is important to be aware of the risk of droplet release into the air when moving an intubated patient to the OR.
- 7) When performing electrocautery, the use of an evacuator is considered [7].
- 8) If possible, it is preferable to avoid performing laparoscopy [7].
- 9) If the negative pressure environment is judged to be insufficient, the use of a portable high efficiency particulate air (HEPA) filter can be considered.

### 2. Personal protective equipment for medical personnel in the operating room

All medical personnel involved in the patient's treatment should be given sufficient time to wear PPE. Putting on PPE can take over 10 minutes.

- 1) PPE is put on in the anteroom.
- 2) PPE and medical personnel requiring PPE [4, 5, 7]
  - Operating surgeon, assistants, OR nurses, anesthetist, nurse anesthetist, circulating nurse
  - Full-body protective suit (including shoe covers) + gloves + powered air-purifying respirator (PAPR) as standard (if unavoidable, a waterproof full-body gown, KF94 or N95 or higher mask, goggles or a face shield, and gloves can be used).
  - Medical personnel in the anesthesiology department and the anesthesia recovery room who are involved in patient intubation or extubation are also included.
  - After disinfection of the surgical site, the gloves and gown are changed before starting surgery.
- 3) Removing personal protective equipment after surgery
  - The surgical gown, gloves, and shoe covers are removed in the OR and placed in

medical waste boxes.

- If necessary, the outer surface of PPE can be wiped with a towel soaked in environmental disinfectant before removing.
- Hands are washed before leaving the OR, disinfected in the anteroom before removing goggles, N95 mask, and hood and then disinfected again before putting on a new mask and hood.

### 3. Taking the patient out of the room after surgery

- 1) Leaving the room: The patient is taken out of the room once they are completely recovered [8] (Depending on circumstances, the patient may be moved directly to an intensive care unit (ICU) negative pressure isolation room while still intubated [5]. If the patient is moved to the ICU in an intubated state, the risk of droplet release into the air while moving the patient should be considered).
- 2) The patient is moved in a manner that minimizes droplet exposure and contact. *e.g.*) using a negative pressure kit.
- 3) If the surgical team will participate in moving the patient after surgery, they should change their PPE before accompanying the patient [7].
- 4) Patient transport protocol is followed.
- 5) After surgery, PPE is removed in the anteroom.

### 4. Management of the surgical suite after surgery

#### 1) Sample management

- ① After collection, samples are packaged in a triple packaging system [4].

#### 2) Waste and laundry management

- ① Medical waste containers are placed in the anteroom of the OR.
- ② The surface of containers is disinfected before collection.
- ③ Regarding the storage place for waste outside the OR, guidelines for the management of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) waste are followed.
- ④ Laundry is handled according to guidelines for the treatment of contaminated laundry.
- ⑤ Care should be taken to prevent exposure of infection and contamination of the surrounding environment in the processes of collection and storage of waste and laundry.

#### 3) Management of operating instruments [5, 8]

- ① Disposable instruments are used as far as possible.
- ② Reusable (non-disposable) instruments are disinfected/sterilized.
- ③ PPE for washing: KF94 or N95 mask, long-sleeved waterproof gown, goggles or face shield, hood, shoe covers or rubber boots, two layers of gloves (rubber gloves for the outer layer)
- ④ Washing
  - a. After use, instruments contaminated with blood, bodily fluids, secretions, or excretions are moved cautiously to the washing location, taking care not to contaminate the surrounding environment.
  - b. Instruments are thoroughly submerged in water in a washing area separated from spaces used by other patients or for clean items, and the instruments are washed carefully to avoid splashing of the washing liquids.
  - c. Instruments are thoroughly scrubbed to ensure that no blood, bodily fluids, secretions, or excretions remain.
  - d. The washing staff wear PPE consisting of a KF94 or N95 mask, long-sleeved waterproof gown, goggles or a face shield, hood, shoe covers or rubber boots, and

two layers of gloves (rubber gloves for the outer layer).

- ⑤ Disinfection and sterilization
  - a. Depending on the risk level of the instrument, no-risk instruments are subjected to low-level disinfection, medium-risk instruments to high-level disinfection or sterilization, and high-risk instruments to sterilization.
  - b. The methods of disinfection and sterilization for each class of instrument are defined in Article 4 of Notification of the Korean Ministry of Health and Welfare No. 2017-101 [9].
  - c. The recommendations of the disinfectant manufacturer must be checked. Disinfectant dilution, treatment time, expiration date, and measurement of the effective dose should adhere strictly to the recommended disinfection process.

#### 4) Environmental management [2, 8]

- ① After the patient and medical personnel have left the room, the room is left empty for 30 mins (based on a ventilation rate of 12 air changes/h) [8].
- ② PPE for cleaning: full-body protective suit or long-sleeved waterproof gown, KF94/N95 or higher mask, goggles or face shield, gloves
  - Environment: bleach 1,000 ppm (4%, 1: 40)

#### 5) Reuse of the surgical suite after surgery

- ① After surgery, the OR is left to ventilate for 30 mins (12 air changes/h), followed by cleaning and management.
- ② The OR may be reused after appropriate disinfection followed by complete ventilation

## INTRAOPERATIVE ANESTHESIA MANAGEMENT [2-4]

### 1. Allocation of anesthesia personnel

- 1) Endotracheal intubation is performed by a highly experienced consultant in anesthesia and pain medicine.
- 2) An assistant with ample anesthesia experience is used. The assistant should be sufficiently capable in techniques such as cricoid pressure during rapid sequence induction (RSI).
- 3) When wearing a level D protective suit it is recommended for the anesthesia team to work in shifts to prevent contamination and minimize fatigue of medical personnel.

### 2. Pre-anesthesia preparation

- 1) Anesthetists participating in endotracheal intubation and extubation must wear appropriate PPE as stated above.
- 2) Awake fiberoptic intubation is not performed unless indicated as essential.
- 3) Spraying local anesthetic should be avoided, since this can cause the release of virus into the air.
- 4) To improve the success rate of intubation, the use of videolaryngoscopy should be actively considered.
- 5) The use of disposable instruments should be actively considered.

### 3. Endotracheal intubation and anesthesia tube management

- 1) Use of high-efficiency hydrophobic filters
  - Between the face mask and the breathing circuit, or between the face mask and the reservoir bag
  - Between the endotracheal tube and the circuit tube
  - The connection between the circuit tube and the ventilator – the inspiratory and expiratory ports
- 2) Preoxygenation is performed for 5 mins using 100% oxygen.
- 3) After performing RSI, during manual ventilation, care is taken to minimize the release of virus from the patient's lungs to the air.
- 4) The method of RSI can be changed to suit the clinical circumstances. When manual ventilation is required, using a small tidal volume or insertion of a supraglottic airway instead of a face mask can be considered.
- 5) Using high-flow oxygen, such as a high-flow nasal cannula, should be avoided, since this can release virus into the air.
- 6) After endotracheal intubation, the door is not opened until at least 99% of the contaminated air has been removed (30 mins, given a ventilation rate of 12 air changes/h).

### 4. Instrument management after intubation

- 1) All types of instruments related to airway management are placed in a sealable plastic bag with a double-zipper, and sealed before disposal or disinfection.
- 2) After intubation, the laryngoscope is immediately sealed in a plastic bag that has been prepared in advance, to prevent further contamination of the environment by a contaminated laryngoscope.
- 3) The end-tidal carbon dioxide sampling line and trap are changed.
- 4) Care is taken to avoid the contamination of stethoscopes and other instruments or tools.

## PROCEDURES FOR COVID-19 PATIENT MANAGEMENT AND TRANSPORT [2, 8]

The patient's movements are planned in advance, accounting for the times when they move through the emergency room and when they are isolated in a negative pressure ward. The patient should not stay in a waiting area.

### 1. Preparing for patient transport

- 1) A patient transport team is formed.
- 2) The patient is moved in a manner that minimizes droplet exposure and contact. e.g.) using a negative pressure stretcher.
- 3) The transport team must perform actual simulation training.
  - ✕ Transport team composition and simulation training.
    - ① Medical personnel responsible for the patient (physician and nurse).
    - ② Infection control team (PAPR, protective suits, disinfection control, transport plan, and training).
    - ③ Facilities/disaster prevention team (negative pressure, elevator operations).
    - ④ Transport agent (practice for wearing and removing PPE).
    - ⑤ OR medical personnel and OR supervisor (surgical suite preparation, contact, disease control, postoperative measures).

**Table 1.** Example of a patient transport plan

Transport from the ward to the OR	① Contact is received from the OR asking to send the patient. ② The patient is handed over at the entrance to the patient waiting room (anteroom).
Transport to the ward after surgery	① The patient is transported to the ward after completely waking in the OR or while still intubated. ② The patient is handed over at the entrance to the patient waiting room (anteroom).
PPE worn by the transport team	Medical personnel: full-body protective suit (including shoe covers) + gloves + KF94 grade respiratory protective equipment + goggles or face shield Patient: surgical mask

OR, operation room; PPE, personal protective equipment.

⊗ Note: Examples of procedures that can cause aerosolization [6, 7]: Intubation/extubation, electrocautery, laparoscopy, tracheostomy, bronchoscopy, upper GI endoscopy, some dental procedures (e.g., high-speed drilling), sputum induction, high flow nasal oxygen.

## 2. Management of patient movement paths

- 1) Staff are placed in the OR, waiting room, elevator, and corridors to secure paths for movement and minimize contact.
- 2) Movement paths are planned to avoid passing through waiting rooms and the anesthesia recovery room.
- 3) Movement after surgery is planned and executed using the same methods.

## 3. Planning movement paths for the patient

- 1) The patient is handed over for movement at the entrance of the patient waiting room (anteroom).
- 2) Staff are positioned to manage corridors.
- 3) An exclusive elevator is used.
- 4) Preparation and contact are made for the patient transport.
- 5) Negative pressure OR transport is performed.

The following example action plan can be considered by referring to the above (Table 1).

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