

# The Effect of the COVID-19 Pandemic on the Surgery Process

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## ABSTRACT

With this review, it was aimed to discuss the effect of the COVID-19 pandemic on the process before, during and after surgery. Studies that were accessed using the keywords "COVID-19", "perioperative" and "surgery" in Pubmed and Science Direct and Turkish databases were discussed. The measures taken with the declaration of the pandemic also affected surgical practices, and postponing elective cases other than emergency and cancer surgery was one of the common measures implemented in many countries. In addition to all these measures and recommendations, the fact that the operating room environment has some unique risk factors draws attention to the process before, during and after the surgery. Guidelines for the measures to be taken in the national and international arena are published in order to plan the workforce of health professionals and to use limited health care resources effectively, as well as to prevent the spread of COVID-19. These measures and recommendations are shaped according to the statistical fluctuation in the number of infected cases and health care resources in countries, and policies and procedures regarding the preoperative, intraoperative and postoperative period are updated. It is extremely important to follow the current literature in order to protect both patients and healthcare professionals involved in the surgical process and to prevent cross-contamination against the COVID-19 virus.

**Keywords:** COVID-19, Pandemic, Surgery Process, Perioperative

## 1. INTRODUCTION

With the first case seen at the end of 2019, the COVID-19 virus (SARS-CoV-2) spread rapidly all over the world and was declared a pandemic by the World Health Organization on March 11, 2020 (1). The COVID-19 virus has turned into a global public health problem that increases morbidity and mortality by affecting infected individuals in different ways, from symptoms such as cough, fever, fatigue, loss of smell and taste, to pneumonia, acute respiratory distress syndrome and multi-organ failure (2).

The transmission of the COVID-19 virus through droplets and contact brought practices such as hand hygiene, masks, social distance and social isolation (3). In addition, after the declaration of COVID-19 as a pandemic, various measures were taken in many countries in order to effectively plan healthcare resources and the workforce of healthcare professionals and to meet the increasing demand. These measures also affected surgical practices and included the postponement of elective cases other than emergency and cancer surgery (4).

In addition to all these precautions and recommendations, the operating room environment has some unique risk factors, which also draws attention to the operation process. Aerosol formation increases as a result of conditions such as gases used during intubation, extubation, laparoscopic procedures in surgical procedures, contact with body fluids in open surgery, or increased surgical smoke in the use of electrocautery (5,6). Aerosol formation also increases the risk of being infected with COVID-19 for surgical team members and patients (7). Another risk factor that increases the risk of transmission of COVID-19 is the possibility of air and surface contamination. Studies have reported that the half-life of the COVID-19 virus in ambient air is between 1.1-1.2 hours and it can remain contagious for up to 3 hours. In addition, it is stated that the virus remains alive on tools made of steel for about 48 hours. Accordingly, the use of steel in many instruments in the operating room may increase the risk factors for being infected with COVID-19 (8).

In accordance with the dynamic nature of the COVID-19 Pandemic, the measures taken during the process have also changed. Many national and international guidelines for returning to elective surgery have been published. According to these guidelines, the decrease in the incidence of COVID-19 and the incidence of new cases in the last 14 days at the provincial level should be taken into account. In order for elective surgery to start again, a committee consisting of administrative and health managers should be formed and plans should be made by this committee. The workforce of surgical team members should be planned against the risk of a new COVID-19 wave. Adequacy of resources such as intensive care unit and service bed capacity, personal protective equipment adequacy, and the number of ventilators should be evaluated (9,10).

These measures and recommendations are shaped according to the statistical fluctuation in the number of infected cases and health care resources in countries, and policies and procedures related to the pre, during and post-operative period are updated (9,10).

### **1.1. Aim of the Review**

In this review, it was aimed to discuss the effect of the COVID-19 pandemic on the process before, during and after the surgery.

## **2. PERIOD BEFORE THE SURGERY**

### **2.1. Preoperative Patient Evaluation**

Health professionals who take part in the preparation of the patient before the operation should use personal protective equipment, attention to hand hygiene and social distance rules (11). Before the pre-operative evaluation of the patient, nurses and doctors should collect their hair, wear a hospital gown, and tuck the trouser legs of the clothing into boots that fully cover the ankles, without holes and, if possible, sterilizable. Then, a bonnet, gloves, apron, FFP2(N95) mask, goggles or face-protecting transparent visor and a second layer of outer gloves that completely cover the hair are put on (12). All patients undergoing surgery should be evaluated in three groups based on the likelihood of having COVID-19 infection (ie, uninfected, asymptomatic, and symptomatic people). Before the operation, the general condition of the patient, the presence of active or recent respiratory or gastrointestinal symptoms, symptoms such as anosmia, fever, and a history of recent travel to an endemic country in the last 14 days or contact with a person at risk of contracting COVID-19 infection should be questioned. In cases requiring emergency surgery where the nasopharyngeal PCR test result cannot be expected, patients should be assumed to be infected with COVID-19 and should be approached similarly to infected patients (13,14). Thoracic computed tomography (CT) can be considered as an alternative to waiting for the PCR test result to determine the characteristic appearance

of the lung, especially for patients with COVID-19 symptoms in emergency surgery (14). In these patients, all pre-, intra-, and post-operative precautions should be considered until the diagnosis is confirmed or the patient is discharged (13). Patients diagnosed with or suspected of COVID-19 should be taken to a separate area from patients who have proven to be negative for COVID-19, different predetermined routes should be used during in-hospital transfers, and if possible, they should be admitted to a single room to prevent cross-infection (11,13,15). It is recommended to clarify the patient's status of being infected with COVID-19 by obtaining a nasopharyngeal PCR sample 48-72 hours before surgeries other than emergency surgeries in a previously designated isolated area of the hospital (10,14,16).

The use of telemedicine methods in the pre-operative evaluation of patients will become widespread, allowing patients to spend less time in the hospital and determining the surgical priority (11,17). In addition, in order to protect both the patient and the healthcare professionals, the patient and, if any, the patient's relatives, from the moment they arrive at the healthcare institution, use personal protective equipment, primarily a mask (14). Many institutions have restricted visitors due to the pandemic. When a companion is required, the patient's relatives should be questioned in terms of COVID-19 findings and education should be given on ways to prevent them (10).

Patients who are scheduled for surgery should be questioned if they have three doses of COVID-19 vaccine before surgery, with the last dose at least 2 weeks before the surgery. Completion of vaccine doses as soon as possible should be encouraged during the confirmation of vaccination status and decision-making for surgery. Considering the high level of transmission of the Omicron variant despite vaccination, it is recommended to continue with the existing measures to reduce the risk of patients becoming infected with COVID-19 before, during and after the surgery (11).

While making the decision for surgery of patients diagnosed with COVID-19, surgical indications should be comprehensively evaluated with multidisciplinary cooperation before surgery. It is known in studies that the rate of pulmonary complications and mortality increases in COVID-19 positive individuals. Each patient should be evaluated individually according to the profit-loss balance, and the option of postponing the surgery for at least 7 weeks should be considered (18). This assessment should include the risk of mortality and complications, if possible with a validated risk scoring system, such as the patient's age, comorbid diseases, time of infection with COVID-19 and ongoing COVID-19 symptoms, surgical risk factors, and risk of progression of the condition requiring surgical indication. In addition, patients should be evaluated in terms of modifiable risk factors such as nutrition, exercise and smoking cessation before surgery. These patients should be evaluated in terms of regional or local anesthesia rather than general anesthesia (11).

## 2.2. Arrangement of the Operating Room

For cases diagnosed or suspected of COVID-19, the operating room should be selected in an area with separate access to the operating room and relatively isolated from other operating rooms. During the pandemic, it should be planned to use the same operating room and anesthesia device for COVID-19 patients (19). Signs should be placed on the door of the operating room in a clearly visible way against entering without a COVID-19 warning and personal protective equipment (15). Operating room equipment such as anesthesia monitors, computers, electrosurgical instruments, and ultrasonography device surfaces should be wrapped in plastic sheathing to reduce the risk of contamination and facilitate cleaning (14,20,21).

## 2.3. Preparation of the Surgical Team

Health workers; In addition to patients, their families and other hospital personnel, they are also in contact with day surgery of elective patients, so they are more likely to cause cross-infection. Therefore, daily assessment of health status of health professionals and recording of body temperature should be put into practice (22). Any healthcare professional should be questioned in terms of a history of increased body temperature, cough, cold, body aches, diarrhea, fatigue, contact with a COVID-19 patient without the use of Personal Protective Equipment (PPE), and isolated and investigated for the possibility of contracting the disease (10,22). N95/FFP2 or N99/FFP3 mask with high protection to the surgical team, safety glasses, clear face visor, durable liquid-proof gown, double-layer gloves (first should be washed with a layer of alcohol or virucidal agent), training should be given on the wearing and removal of personal protective equipment such as non-perforated shoes that cover the whole foot, or sterile rubber boots (15). Moreover, surgical team members should protect devices such as cell phones or pagers in a plastic sheath (14). In addition, health professionals who have just joined the surgical team should receive training (10). Two different areas should be designated close to the operating room for them to put on and take off the equipment. Informative articles such as posters explaining the correct wearing and removal procedures of personal protective equipment should be posted in these areas (22). Meeting of the surgical team before the operation seems to be effective in evaluating the current situation and ensuring effective cooperation during the operation process (23).

## 2.4. Patient Transfer to the Operating Room

The patient diagnosed with COVID-19 or suspected of being infected is transferred directly to the operating room after the surgical team is notified, as the surgical team and the necessary materials in the operating room are ready (24). Every non-intubated patient should wear a surgical mask, gloves, disposable cap and shoe cover during transfer. If possible, hand hygiene should be provided before transfer (15). The transfer of the patient to the operating room is

provided by the shortest route, away from common areas and with the least human traffic, taking into account the physical conditions of the hospital (19). Transfer personnel should receive training on the use of personal protective equipment. The patient should come from the clinic to the operating room with nurses and transfer personnel wearing personal protective equipment, and a minimum number of personnel changes should be made in this process. The patient should enter and exit the operating room as quickly as possible. If inter-hospital patient transfer or transfer from other buildings within the hospital is required, a special vehicle should be used. It is important that the driver and the patient are in different parts of the vehicle and that they use personal protective equipment. The elevators used in the transfer of the patient should be cleaned and disinfected at regular intervals and in case of any unexpected contamination during the transfer (15). Items related to COVID-19 should be added to the Safe Surgery Checklist, or A surgical checklist specific to COVID-19 should also be established (25).

## 3. SURGERY PERIOD

### 3.1. Admission of the Patient to the Operating Room

The patient is taken to the operating table after being greeted by the anesthesiologist and circulating nurse in the operating room. The stretcher on which the patient comes to the operating room is disinfected. If the planned surgical procedure does not require general anesthesia and the clinical situation permits, patients should continue to wear protective masks throughout the procedure (15). Keeping the patient's documents and records outside the operating room may reduce the possibility of contamination (6,20,26).

### 3.2. Arrangement of the Operating Room

If a patient has been diagnosed with COVID-19 or is highly suspected of being infected with COVID-19, surgery should be performed in a negative pressure operating room (27). Providing at least 25 air changes per hour is considered sufficient to effectively reduce the viral load in the operating room. Doors should be kept closed during surgery (6,20). Before the operation, only the necessary materials and equipment should be brought to the operating room. Once surgery has begun, every effort should be made to use the materials available in the room to minimize the risk of infection and to minimize personnel entering and leaving the operating room (15). Caution should be exercised in aerosol-generating applications, it is recommended to operate devices such as electrocautery at the lowest power and to use surgical smoke evacuation devices (13,26). Alcohol-containing solutions should always be available for hand hygiene (15).

### 3.3. Surgical Team and Anesthesia

After the surgical team member enters the operating room, they should not leave the operating room until the surgery is

completed and should not re-enter, if possible, after leaving the operating room (15). A heat and moisture exchange filter should be installed at the expiration outlet of the anesthesia device in the breathing circuit, and soda-lime and this filter should be replaced after each operation (6,19,28). The anesthesiologist should place all necessary medications and equipment on a tray prior to surgery. The anesthesia medicine cart should be located in the corridor in front of the operating room. In case of need for additional medication, hand hygiene should be provided and gloves should be changed before contacting the anesthetic medicine car. A staff waiting in the operating room or a second circulating nurse may be assigned to provide supplies. The healthcare professional assigned for the supply of materials should wear personal protective equipment when entering the corridor where the operating room is located (19). When communicating with these personnel, it is recommended to use a pager or telephone to avoid cross-contamination (24). During the anesthesia induction and intubation procedure, no one from the surgical team other than the anesthesia team should be present in the operating room. An experienced member of the anesthesia team should perform the intubation procedure (26). During anesthesia induction and patient awakening, surgical team members within 2 meters of the patient should use personal protective equipment and, if possible, a Powered Air Purifying Respirator (PAPR). All procedures, from the induction of anesthesia to the patient's awakening and transfer to the ward or intensive care unit, should be performed in a single operating room, if possible (19). Just like the surgical team, the anesthesia team should wear double gloves and the outer gloves should be removed after intubation (21). After the anesthesia application, the surgical team should come to the operating room to position the patient, wearing non-sterile personal protective equipment. Then, removing the non-sterile gown and gloves in the operating room, and putting on the personal protective equipment such as surgical hand washing, sterile gloves, sterile surgical gown and second layer of sterile surgical gloves, the operating room should be re-entered (15,29). In these cases, it is recommended to form a separate team with more experience (30).

#### 4. PERIOD AFTER THE SURGERY

If a patient diagnosed with COVID-19 is to be transferred directly to the intensive care unit, a dedicated transport ventilator should be used. To reduce aerosol risks, gas flow should be turned off and the endotracheal tube should be clamped with forceps when switching from an operating room ventilator to a portable device (15). Intensive care personnel should use personal protective equipment and, if possible, PAPR during transport (19). The route used should be disinfected while transferring from the operating room to the intensive care unit or surgical service after the surgery (15). Samples taken from a patient diagnosed with COVID-19 during surgery should be placed in double bags and labeled as 2019 nCoV and handled as infectious samples in the

pathology laboratory (13,22,31). During the transfer of the patient from the operating room, the responsible healthcare professional should wear personal protective equipment different from those worn in the operating room (15).

Surgical team members should remove the upper glove, durable waterproof apron and shoe cover and throw them in the biological waste bin to provide hand hygiene. Then, the face visor and gloves should be removed and hand hygiene should be ensured, and the N95 mask should be removed last. Surgical team members should take a shower after each operation (20).

A minimum of one hour is scheduled between surgery of elective patients to allow operating room personnel to provide patient transfer, to operate through decontamination of all surfaces in the operating room, screens, cables, monitors, and anesthesia equipment (19). After the patient leaves the operating room, all disposable materials should be thrown into biological waste bags, even if they are not used. Disposable materials must be closed and sealed in the operating room before being transported to the waste management predetermined waste collection area. When waste bins are damaged, they must be replaced immediately. Personnel involved in closing and transporting waste bins should wear personal protective equipment and should be removed immediately afterwards. Likewise, textile products such as sheets and pillows should be chosen for single use if possible. Non-disposable laundry (pillow, pillowcases, crossbars, etc.) should be thrown directly into special collection boxes and the boxes should be closed and sealed before being sent for sterilization (15). Decontamination, disinfection and sterilization processes should begin for reusable instruments. Instruments that are visibly contaminated with blood and body fluids should be cleaned in a designated area before disinfection (28). Surgical instruments should be labeled as COVID-19 and delivered to the sterilization unit in double-layer medical waste bags and closed boxes. In addition, the sterilization unit should be informed (32,33). It is recommended that all surfaces in the operating room be sprayed with a quaternary ammonium chloride compound and wiped with a dry cloth after 1-3 minutes (34).

Surface disinfection of floors, walls and medical devices in the operating room where COVID-19 cases are accepted should take at least 30 minutes and a disinfectant containing 1000mg/L chlorine should be used. This process should be applied 3 times a day and should be repeated in case of contamination. Surface cleaning should be done from the clean area to the dirty area, and the cloth used for cleaning different areas should be renewed. Reusable surgical instruments exposed to patient body fluids; If there is no visible contamination in the disinfectant containing 1000mg/L chlorine; If there is visible contamination, it should be kept in disinfectant containing 5000mg/L chlorine for at least 30 minutes, after drying, the devices should be completely closed, packaged and sent to the sterilization center (35). After cases of COVID-19, hydrogen peroxide vapor or ultraviolet-C rays should be used for cleaning the operating room (19,34,35).

A record should be kept of the surgical team involved in procedures involving potentially infected patients (15).

## 5. POSTOPERATIVE PATIENT CARE

To minimize the risk of post-operative contamination and limit it to a single operating room, patients with a diagnosis of COVID-19 should not be brought to the Post-Anesthesia Care Unit (PACU) (20,34). While the patients diagnosed with COVID-19 are transferred to the previously determined COVID-19 services in line with the physical facilities of the hospital after the surgery; negative patients can be transferred to the standard surgical service (24). Negative patients also require daily assessment of body temperature and respiratory symptoms. Any patient with a new-onset fever or cough should be isolated and thoroughly investigated to rule out COVID-19 infection. Patients with a suspected or confirmed diagnosis of COVID-19 should be isolated in a negative pressure single room. Personal protective equipment should be used in all interventions such as postoperative patient care, medications, and wound treatment (13,22,31). In addition, the post-operative administration of COVID-19 treatment to infected patients is controversial, but multidisciplinary follow-up by anesthesiologists and pulmonologists is required due to the prevalence of postoperative pulmonary complications in these patients (12). Moreover, it is thought that the positive results of ERAS protocols, such as less postoperative complications, shorter hospital stay and lower cost, will have positive effects for patients undergoing surgery in the COVID-19 Pandemic (15,36).

## 6. CONCLUSION

In this review, national and international publications regarding the pre, during and post-operative period with the declaration of the COVID-19 pandemic were reviewed. The surgical process, by its nature, consists of a complex chain of events that are stressful and require attention. By adding the risk of an infectious disease to this chain; A multidisciplinary cooperation is required from the pre-operative preparation of the patient to the discharge. These measures and recommendations are shaped according to the statistical fluctuation in the number of infected cases and health care resources in countries, and policies and procedures regarding the preoperative, intraoperative and postoperative period are updated. It is extremely important to follow the current literature in order to protect both patients and healthcare professionals involved in the surgical process and to prevent cross-contamination against the COVID-19 virus.

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