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A Protocol for Performing Reconstructive Microsurgery on Patients With COVID-19

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On March 11, 2020, the World Health Organization declared COVID-19 to be a pandemic, challenging health care systems all over the world. National health care systems have reorganized to cope with the disease. Surgical services departments around the world have been affected and elective surgical procedures have been postponed to conserve medical resources. When a patient with COVID-19 requires an urgent microsurgical free flap due to trauma or a tumor, personnel from the health care facility must have a protocol in place to follow for the patient's care and follow-up. In this article, we present our protocol for patients with COVID-19 requiring reconstructive microsurgery.

In December 2019, a pneumonia of unknown viral origin was discovered in Wuhan, the capital of Hubei Province, China. On January 30, 2020, the World Health Organization (WHO) declared the subsequent coronavirus outbreak to be a Public Health Emergency of International Concern (Pan American Health Organization, 2020). The virus spread rapidly in numerous countries and on March 11, 2020, the WHO declared the virus outbreak to be a pandemic (Braswell & Joseph, 2020). The WHO named the virus that caused the pneumonia SARS-Cov-2 and called the illness caused by the virus COVID-19 (Rabi, Al Zoubi, Kasasbeh, Salameh, & Al-Nasser, 2020). To date, there have been more than 1 million confirmed cases all around the world, and more than 60,000 deaths. By the time this article is published, these numbers are bound to have increased significantly (Grech, 2020).

This viral infection poses a health challenge for most health care systems. To help prevent the virus from spreading, exceptional measures have been implemented. These measures have included wearing masks, social distancing, home confinement, reducing collective gatherings, closing restaurants and meeting spots, and, at its most severe form, mandatory quarantine (Lai, Yeung, & Celi, 2020; Wang et al., 2020).

A rapid and urgent reorganization of health care systems has also been carried out, and recommendations for preventing viral transmission and treating COVID-19 have emerged for the medical and surgical fields (Besnier, Tuech, & Schwarz, 2020; Burki, 2020; Forrester, Nassar, Maggio, & Hawn, 2020). In many health care institutions, surgical procedures have been restricted to emergency cases, such as trauma, infections, and malignancies, with elective surgical procedures and nonurgent surgical consults postponed.

During a pandemic, performing plastic and reconstructive surgical procedures as well as other surgical specialties may be limited. However, there are cases where reconstructive microsurgical procedures and other emergent surgical procedures must be performed as quickly and safely as possible. Although there are recommendations for health care personnel to follow for preventing the transmission of infection (e.g., performing hand

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hygiene, wearing personal protective equipment [PPE], identifying patients at risk), each health care specialty (e.g., anesthesia) has had to develop specific protocols for caring for patients with COVID-19 (Wax & Christian, 2020). There are no established clinical guidelines for performing reconstructive microsurgery on patients with COVID-19. This article outlines the protocol we developed at a university hospital in Valencia, Spain.

PROTOCOL

We divided the protocol into logistical and preoperative, intraoperative, and postoperative and follow-up recommendations.

Logistical and Preoperative Recommendations

Because of reduced numbers of personnel and decreased amounts of PPE and other surgical supplies, the number of surgical cases approved to be performed may be lowered. The need to perform urgent procedures requiring microscopic reconstruction should be reviewed by a clinical advisory committee.

All patients should be evaluated for SARS-CoV-2 infection using polymerase chain reaction testing. If this testing is positive, the protocol described later should be activated. It may also be necessary to implement protocol precautions for patients whose COVID-19 status is unknown but who have a history of possible exposure to or contact with individuals who have or are at high risk for COVID-19. Precautions may also be considered for patients undergoing high-risk procedures (e.g., where the oropharyngeal mucosa is breached) even when the patient has no risk factors for the disease. The amount of hospital personnel contact with the patient should be reduced as much as possible during the admission process.

To reduce the risk of contamination to patients and staff working in operating rooms, two of the operating rooms available in our institution were specifically dedicated for performing surgical interventions on patients with COVID-19. Specific anesthesia and nursing personnel were dedicated to working in these rooms for the duration of the pandemic. These dedicated operating rooms were clearly marked and personnel who were not members of the dedicated staff were prohibited from entering them. Access to these rooms was also forbidden when they were not being used. We draped the operating microscope with its manufacturer-recommended sterile cover before the patient was brought to the room.

Another measure we introduced to reduce the risk of viral particle spread was changing the positive pressure system of the dedicated operating rooms to either neutral pressure or negative pressure. In facilities where this is not possible, using portable high-efficiency particulate air (HEPA) filters may help reduce the number of viral particles in the air during surgical procedures on patients with COVID-19 (Ti, Ang, Foong, & Ng, 2020).

A circuit of four consecutive rooms was designed (Figure 1) to facilitate a one-way input–output system. The first room, known as the anteroom, was used for hand hygiene and donning surgical attire and PPE. In this area, personnel participating in the surgical procedure don their surgical caps, waterproof shoe covers, and perform hand hygiene. Then, as recommended by the Centers for Disease Control and Prevention (CDC), personnel don either a filtering facepiece (FFP) 2 that removes 94% of airborne particles 0.3 µm or greater or an N95 respirator that removes 95% of airborne particles 0.3 µm or greater. Personnel may also choose to don a second surgical mask (i.e., an FFP1 that removes 80% of airborne particles ≥0.3 µm) over the FFP2 or N95 respirator.

After donning surgical respirators, personnel don their microsurgery glasses. To avoid using a microscope, surgical team members wear loupes with 5.5 or 6.4 magnification. Surgical team members then don a surgical helmet. Wearing a surgical helmet without an FFP2 or N95 respirator is not recommended because helmets are not designed to filter submicrometer-sized particles (Rengasamy & Eimer, 2012). Thus, it is important for personnel to check their respirator fit before donning microsurgery glasses and surgical helmets. Visibility through microsurgery glasses and a surgical helmet is clear if the microsurgery glasses lens is adjusted close to—but not in contact with—the protective helmet shield.

Personnel perform a surgical hand scrub using water and chlorhexidine gluconate scrub or an alcohol-based surgical hand rub using an aqueous alcohol solution. A disposable surgical gown is donned, followed by a first and second pair of surgical gloves. Figure 2 shows a surgical team member wearing the appropriate PPE.

Surgical team members enter the adjacent operating room after the anesthesia professional administers the anesthetic. The risk for direct contact with the patient's respiratory secretions is increased during the intubation process (Altiparmak, Korkmaz Toker, Uysal, & Gümüş Demi Rbi Lek, 2020). To avoid contact with the patient's respiratory secretions, whenever possible, the anesthesia professional uses neuraxial anesthesia, peripheral nerve blocks, and/or interfascial plane blocks. However, some patients require endotracheal intubation. For example,

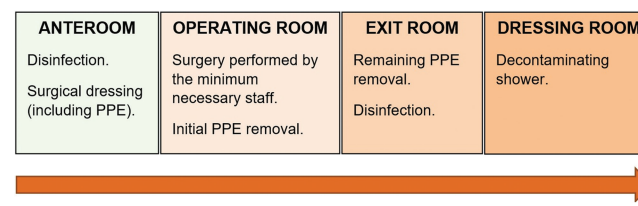

FIGURE 1. A circuit of four consecutive rooms was designed to facilitate a one-way input–output system. PPE = personal protective equipment. This figure is available in color online (www.psnjournalonline.com).

FIGURE 2. (A) A surgical team member wearing full complement of personal protective equipment. (B) Close-up of a surgical team member wearing microsurgery glasses, respirator, surgical mask, and surgical helmet. This figure is available in color online (www.psnjournalonline.com).

there may be an association between thrombocytopenia and COVID-19 infection (Lippi, Plebani, & Henry, 2020). Therefore, a diagnosis of thrombocytopenia may preclude the use of spinal anesthesia. In this situation, the anesthesia professional uses a rapid induction technique to help prevent patient coughing (Wen & Li, 2020).

The number of personnel present in the operating room is kept to a minimum. The initial surgical team should remain in the operating room throughout the procedure. Using a two-team approach may be considered to decrease the surgical team's operative time. Personnel who leave the operating room and wish to return must complete the exit process, which includes removing their surgical gown, gloves, and cap in the operating room and then departing through the exit room and returning through the anteroom to complete their surgical hand scrub and don fresh PPE and sterile attire.

At the end of the operation, while still in the operating room, scrubbed personnel remove their surgical gown and second pair of gloves. They apply an aqueous alcohol solution to the remaining first pair of gloves. The scrubbed personnel then remove their surgical mask, cap, and the first pair of gloves. After removing the gloves, personnel perform hand hygiene using an aqueous alcohol solution. The surgical team member then removes any remaining PPE and performs hand hygiene after each piece is discarded. Personnel leave the operating room through a corridor that connects the operating room with a dressing room. After entering the dressing room, each team member takes a shower.

Intraoperative Recommendations

When patients with COVID-19 must undergo reconstructive microsurgery, surgeons should use only flaps and other reconstructive techniques with which they are fully familiar. When performing microsurgery, the surgeon selects the most reliable recipient vessels. Adhering to these recommendations provides the highest level of safety and the lowest probability of complications.

To avoid using a microscope, surgical team members wear loupes with 5.5 or 6.4 magnification. The surgeons determine the pedicle flaps and recipient vessels to enable a comfortable and precise anastomosis using only loupe magnification. In addition, they spare the thoracic region as a donor area as much as possible. Creating a surgical wound in this area may lead to problems with the patient's superficial breathing or positioning for pain relief. This could be detrimental in patients with compromised ventilation due to a respiratory tract infection. In addition, raising the lower-limb flap allows for pain control using locoregional techniques in lower-limb reconstruction.

It has been reported that the using electrosurgery, bone saws, and drills releases aerosols (Yeh et al., 1995) with the potential to spread the virus. Therefore, surgeons minimize the use of these technologies and when they must be used, the power settings are set as low as possible. Suction devices are also used to remove smoke and aerosols during surgical procedures (Rodrigues-Pinto, Sousa, & Oliveira, 2020; Zheng, Boni, & Fingerhut, 2020).

When evaluating patients with skin defects susceptible to grafting, surgeons individualize the indication for surgery. Admitting patients to the hospital, especially patients who may require immobilization until the first dressing change, may consume already scarce resources. Therefore, only those patients whose procedures cannot be deferred should undergo surgery. Surgeons make efforts to achieve direct closure of donor areas and prioritize the use of fasciocutaneous flaps rather than muscle flaps with overlying skin grafts.

In all surgical interventions, surgeons take rigorous efforts to reduce the potential for hematoma formation and decrease the likelihood of complications requiring reoperating. Compression bandages are used for graft and flap donor areas.

Postoperative and Follow-Up Recommendations

After the surgical procedure is completed, the patient may be transferred directly to the post-anesthesia care unit (PACU). It may not be possible to admit a patient with COVID-19 to the PACU, but at a minimum, efforts are made to minimize the length of the patient's stay in the PACU as much as possible.

Although we normally recommend assessing reconstructed flaps every hour (Chen et al., 2007), for patients with COVID-19, we accept assessments every 2–3 hr. Each patient has a dedicated Doppler probe for detecting blood flow to the reconstructed flap. To minimize the number of room entries, flap assessments are coordinated with other clinical observations. The presence of patient visitors is strictly prohibited. After the patient is discharged, the Doppler probe is decontaminated by washing with an appropriate disinfectant.

FINAL CONSIDERATIONS AND CONCLUSIONS

During a pandemic, our duty as plastic surgeons and plastic surgical nurses is to understand the threat we are facing and to act appropriately. We must understand that our surgical activity may be diminished by the exceptional circumstances in which we are living. This may be due, in part, to the elective or nonurgent nature of our specialty. To carry out nondeferrable surgical procedures in the safest way possible, it is mandatory for the surgical team to develop and apply specific protocols for each pandemic.

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