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Perioperative Medical and Surgical Coronavirus Disease 2019 Issues: Keeping Surgeons, Operating Room Teams, and Patients Safe

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ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) has infected over 22 million people in the United States (US) and has had a devastating impact on the US economy and healthcare system. In order to help slow the spread of the virus and save hospital resources, nonessential businesses were forced to close and elective surgeries have been postponed.

Methods: As we reach the peak of the pandemic and the COVID-19 vaccine gets distributed, healthcare systems must develop plans to safely resume elective surgeries. This article outlines a single center academic medical center’s perioperative COVID-19 protocol to help keep surgeons, operating room teams, and patients safe.

Results: While testing protocols can help minimize the transmission of the virus, there is still the potential for COVID+ patients to undergo surgery undetected, due to potential false negative tests and the long incubation period before seroconversion and symptom development.

Conclusions: An effective institutional strategy not only includes clear perioperative testing protocols, but also education regarding clinical manifestations and exposure control.

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As of January 10, 2021, there have been over 22 million Coronavirus Disease 2019 (COVID-19) cases and 370,000 deaths in the United States (US) [1]. Although its impact on our patients and their families has been devastating, the pandemic has also had a much broader impact on our healthcare system. California hospitals are operating near capacity and struggling to meet the demands for intensive care unit beds and ventilators [2]. On March 19, 2020, California ordered the first stay-at-home order in the US in an attempt to slow the spread of the virus [3], which was soon followed by 41 other states [4]. Currently, in 2021, there are still regional stay-at-home orders affecting 98% of the population in California [2]. In addition, to help preserve hospital resources, the Centers for Medicare and Medicaid Services [5], the Surgeon General, and the American College of Surgeons [6] recommended against continuing elective surgeries. As a result, 35 states mandated that all elective surgeries be canceled [7]. Although these memorandums may help save hospital beds in the midst of a surge in COVID-19 cases, there are broader implications that must also be considered. With nonessential businesses closed, over 16 million Americans have been forced to file for unemployment [8]. In addition, those healthcare systems relying heavily on elective surgeries for revenue have been forced to furlough employees and withhold surgeon salaries [9,10]. In response, the Coronavirus Aid, Relief, and Economic Security Act was passed by the US Congress to provide $100 billion to hospitals and $350 billion to small businesses including private orthopedic practices [11–13]. Although this has helped to lessen some of the financial burden, hospital systems, like the Mayo Clinic, project up to $900 million in losses [14].

As the COVID-19 vaccine gets distributed and the number of cases begins to decline, healthcare systems must develop plans to safely resume elective surgeries. An effective institutional strategy starts with education about the virus and its clinical manifestations to help develop diagnostics and testing procedures. This article outlines a single center academic medical center’s perioperative COVID-19 protocol to help keep surgeons, operating room teams, and patients safe.

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The Basic Science of COVID-19

COVID-19 refers to the disease that results from the SARS-CoV-2 virus, believed to have originated from a live animal market in Wuhan, China [15]. It belongs to the family of coronaviruses, which contain a single-stranded ribonucleic acid (ssRNA), similar to the viruses that caused the severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome outbreaks [16]. Structurally, the virus consists of an outer lipid membrane that envelopes the inner viral ssRNA. The ssRNA encodes for 5 different proteins, including the spike protein which allows the virus to attach to angiotensin-converting enzyme 2 receptors found on various host cells [17]. Docking then triggers the process of endocytosis, allowing the viral ssRNA to enter the host cell cytoplasm. Once in the cell, the RNA genome is released and used to replicate and produce new viral proteins, which are packaged and released, allowing for infection of other cells.

The SARS-CoV-2 virus triggers an innate and adaptive immune response, involving the production of immunoglobulin (Ig) M or IgG antibodies that bind to viral antigens [18]. The innate immune system primarily consists of cells that respond to the production of inflammatory cytokines, and detection of these cytokines has been correlated with increased viral loads [17]. In contrast, increased IgG/IgM levels have been shown to correlate with decreased viral loads and good clinical outcomes [17].

Various diagnostic tests have been developed to detect if a patient has been infected with the virus. Nucleic acid testing is used to detect viral RNA, and includes real-time (RT) PCR, isothermal amplification, clustered regularly interspaced short palindromic repeats, next-generation sequencing, and micro-nuclear magnetic resonance [17]. Viral antigens and host immunoglobulins can also be detected using serological rapid diagnostic testing, serological enzyme-linked immunosorbent assay, viral antigen tests, microarrays, western blots, or immunofluorescence microscopy. The Food and Drug Administration has currently cleared 261 tests, each with a different assay time, ranging from 15 minutes to over 24 hours [17].

Clinical Manifestations

SARS-CoV-2 spreads through respiratory droplets and can infect a new host via transmission through the mucous membranes of the eyes, nose, or mouth [19]. The incubation period of a virus refers to the time it takes for the viral load to grow large enough to produce clinical symptoms. For COVID-19, studies have suggested that this may range anywhere from 2 to 14 days [17]; however, patients can spread the virus to others prior to the onset of symptoms.

Symptoms typically include a fever (＞100°F), cough, anosmia, shortness of breath, headache, diarrhea, and fatigue [19]. More serious cases may progress to pneumonia, acute respiratory distress syndrome, and death [20]. Higher risk groups include older males and pre-existing cardiopulmonary disease, obesity, diabetes, malignancy, or immunosuppression [17,21].

Exposure Control

Because SARS-CoV-2 is so easily transmissible, efforts should be focused on minimizing exposure to the virus. Social distancing and practicing hand hygiene are simple ways to reduce transmission. Guidelines for personal protective equipment (PPE) are also critical. Our institution recommends that all patients and caregivers wear a procedural mask if over 2 years old. All medical staff should wear a procedural mask and additionally use eye protection when interacting with patients. During aerosol generating procedures, like intubations in the operating room, it is recommended that staff wear an N95 mask plus a face shield. Prompt symptom recognition with clear COVID-19 testing guidelines can also help to minimize the spread of the virus.

Outpatient Testing Protocol

In order to safely resume elective surgeries, preoperative testing protocols must be developed to help determine if a patient can proceed with their scheduled procedures. Proper testing can help identify potential asymptomatic patients who are COVID positive and protect both the hospital staff and other patients from exposure to the virus. At our institution, any patient who has been indicated for a high-risk infectivity surgery, requiring general or monitored anesthesia care, must undergo preoperative COVID testing. Currently, there are 11 acceptable laboratories that have been approved to provide RT-PCR COVID testing, with near 100% sensitivity and specificity [17]. For orthopedic surgeries, not involving instrumentation of the airway, tests must be done as an outpatient within 3 midnight of the scheduled procedure. In rare cases, if patients are unable to obtain an outpatient test, they may undergo rapid COVID-19 testing in the preoperative area. If a patient tests positive, the surgery is canceled, and patients are to follow-up with their primary care doctor for further assessment and management. Patients can then be rescheduled after 20 days and rescheduled for surgery if they have a negative test result. If the preoperative screening test is negative, surgery may proceed as planned. In 2020, since adoption of this perioperative testing protocol, our institution has had a positive testing rate of <1%.

Inpatient Testing Protocol

For patients already admitted to the hospital that are indicated to undergo surgery, similar standardized testing protocols must be developed to minimize transmission of COVID-19. If an admitted patient has had a previous negative COVID test within 3 midnight and does not report any new respiratory symptoms, they may proceed to the operating room as scheduled with routine PPE and precautions. If the patient does not yet have a COVID test and an urgent or emergent surgery is indicated, a rapid COVID-19 test should be ordered, and the patient is allowed to proceed with surgery before the test results. In this case, the patient is treated as a "person under investigation" and full COVID precautions are taken including the use of an N95 mask, face shield, and waiting 20 minutes before entering the room after intubation. For nonurgent surgeries, routine COVID tests are ordered and should be rescheduled prior to proceeding with surgery. If positive, one must consider the risks and benefits of delaying surgery vs potential transmission if deciding to proceed with the procedure in a COVID+ patient.

Medical Provider Testing Protocol

In addition to perioperative patient testing protocols, testing for the medical staff is also of critical importance. Healthcare workers on the frontlines have the highest potential exposure to COVID+ patients. Their health and safety are vital to not only maintaining the capacity to provide care during the current surge in COVID cases, but also for those patients who have other urgent medical problems, not related to COVID. At our institution we define an exposure as a close interaction with a COVID+ patient within 6 feet for over 15 minutes. If asymptomatic, we recommend testing at 2-5 days after the exposure and again at 14 days after the exposure, given the established incubation period of the virus. While waiting for the results, staff are allowed to continue to work with appropriate PPE and social distancing. If symptomatic, staff should undergo the same testing protocol but are not allowed to return to work until after the first negative test result. If a healthcare worker
tests positive and is asymptomatic, they are allowed to return to work in 10 days. If symptomatic with a positive test result, staff must be able to return for 3 consecutive days with improving symptoms before returning to work at a minimum of 10 days after symptom onset. Our institution also recommends testing for asymptomatic individuals who have recently traveled or been in mass gatherings.

Case Review

Although detailed perioperative testing protocols can help minimize the transmission of the virus, there is still the potential for COVID+ patients to undergo surgery undetected, due to potential false negative tests and the long incubation period before seroconversion and symptom development. The following case describes an example of this scenario and highlights potential perioperative factors contributing to COVID transmission.

A 66-year-old male with a past medical history of reactive airway disease underwent an uncomplicated right total knee arthroplasty in July 2020. He had a COVID negative test 2 days prior to his scheduled operation. He was discharged home on postoperative day 2, where he lived with his wife, and had home health nursing and physical therapist visit him 2 times per week. On postoperative day 13, he called our clinical advice service to report difficulty breathing and a productive cough. He was advised to go to the local emergency department where he and his wife were both diagnosed with COVID, requiring admission. He did not require an intensive care unit bed and was discharged home after 6 hospital days without complication on home oxygen. At his 6-week follow-up, his clinical symptoms had improved but he was still using oxygen by nasal cannula on an as-needed basis. At 3 months, he was no longer requiring oxygen but reported feeling tired with dyspnea on exertion.

Despite following our standard preoperative COVID testing protocol and having a negative COVID test 2 days prior to surgery, this patient unfortunately contracted the virus in the perioperative setting. Although it is possible that he had a false negative test, the high sensitivity for the RT-PCR tests that our approved laboratories use, make this less likely. It is also possible that he was exposed to the virus in the community or the preoperative area, after his initial test was obtained. In addition, there is the potential for noncompliance with PPE and social distancing guidelines that may have increased his risk of exposure. Factors pertaining to the inpatient hospital system that may have contributed to exposure include protocols to limit visitors, social distancing, COVID+ patient isolation, cleaning/disinfection, hand hygiene, PPE availability, and potential exposure from the healthcare staff. Outpatient factors include exposure in the community or home environment from his home health visits.

This is a rare case that not only highlights that COVID is a potential cause of readmission after total joint arthroplasty, but it also shows that COVID+ patients exist in the operating room and hospital despite strict perioperative testing protocols. In order to minimize healthcare staff exposure and transmission, it is vital to continue to practice proper use of PPE, social distancing, and minimizing in-person patient interaction.

Conclusion

COVID-19 has had a devastating impact on our patients, the US economy, and the healthcare system. As the current surge in cases begins to decline and the COVID-19 vaccine gets distributed, hospitals must develop plans to safely resume elective surgeries. An effective institutional strategy not only includes clear perioperative testing protocols, but also education regarding clinical manifestations and exposure control to help keep surgeons, operating room teams, and patients safe.

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