

Review Article

Impact of the Coronavirus (Covid-19) Pandemic on Surgical Practice: A Literature Review

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Abstract: The World Health Organization (WHO) has subsequently designated this ongoing disease as Coronavirus Disease 2019 (COVID-19). One month later, the COVID-19 outbreak was declared a pandemic. The rapid global spread of viral infections and diseases led to the introduction of broad containment and reduction strategies in affected countries worldwide. Since the early phase of the pandemic, operating rooms have been converted into additional ICUs to support critically ill patients, and non-urgent and non-cancerous surgical procedures have been cancelled or postponed to a later date. The impact of COVID-19 on surgical practice is widespread, ranging from labor and staff issues, procedure priorities, the risk of intraoperative virus transmission and the impact on surgical education. The impact on surgical practice includes the use of surgical facilities, redeploying staff, staff preparation, national referral procedure and preoperative phase. The impact of COVID-19 on surgeons' daily practice and surgeon education is enormous. The cancellation of elective and non-urgent surgeries has allowed surgeons to become an important staff resource for the health system to deal with the COVID-19 pandemic. Surgeons are considering safe, non-surgical alternative options for treating their patients during COVID-19.

Keywords: COVID-19, Surgery, Policy, Impact, Emergency surgery.

Introduction

The World Health Organization (WHO) has subsequently designated this ongoing disease as Coronavirus Disease 2019 (COVID-19).^{1,2,3} One month later, the COVID-19 outbreak was declared a pandemic. The rapid global spread of viral infections and diseases led to the introduction of broad containment and reduction strategies in affected countries worldwide. In order to provide hospital capacity, protective equipment and ventilators for the expected increase in the number of COVID-19 patients, the surgical discipline in Germany was ordered to suspend all elective surgeries and reallocate staff to intensive care units and COVID-19 wards as needed.¹ Recommendations from the public, both the political and the medical community, aim to delay elective therapy, particularly elective surgery aimed primarily at restraining beds, intensive care and operating room capacity available during the pandemic. The second goal is to protect patients from nosocomial COVID-19 infection.¹ Balancing the need for SARS-CoV-2 measures on the one hand and emergency surgical care of patients on the other hand makes the SARS-CoV-2 pandemic a daily challenge for emergency operations around the world. Since the rapid spread of SARS-CoV-2 worldwide in late 2019, a great deal of research has been published on the pandemic and disease characteristics of

COVID-19, but little is known about the impact of the pandemic. Several structural changes were established in hospitals around the world to address the (potentially) high number of seriously ill and critically ill patients infected with COVID-19.¹

Since the early phase of the pandemic, operating rooms have been converted into additional ICUs to support critically ill patients, and non-urgent and non-cancerous surgical procedures have been canceled or postponed to a later date; All nurses and medical personnel, including residents, were reallocated to the COVID unit. In this pandemic scenario, emergency surgeons accept their critical role in managing infected and uninfected patients and the need to work safely to limit the spread of the virus in healthcare facilities and reduce the morbidity and mortality rates, which may result from delayed diagnosis and treatment of surgical patients. The World Society of Emergency Surgery education (WSES) compiled this position paper to provide recommendations for the management of surgical patients in emergency settings under the COVID-19 pandemic for the safety of patients and healthcare workers based on available evidence and experienced surgeon opinion.²

This review and other similar studies prompted the cancellation of millions of surgical procedures worldwide. The COVIDSurg Collaboration estimates that more than 28 million surgical procedures in 190 countries will be canceled in an estimated 12-week 'pandemic peak' for each country. The cancer surgery cancellation rate is estimated at 37.6%. For benign surgery, the cancellation rate is estimated to be much higher at 81.6%, comprising 90.2% of all cancellations.³ While regulatory bodies such as colleges and academies of surgery have made recommendations to change the delivery of surgical services in response to COVID-19, they do not always provide explicit instructions on how the program should operationalize the recommendations. Thus, the surgical triage and service delivery approach remains unclear: who has done what, where, and why.⁴ Finally, once COVID-19 begins to loosen its grip on the world and post-pandemic recovery begins, programs will be tasked with rebuilding the surgical capacity needed to reschedule and address the backlog of pending procedures. Evidence filtered from the experiences of others in the context of COVID-19 and other public health emergencies (i.e., H1N1, Ebola, and SARS) is needed to guide approaches to surgical service delivery.⁴

The impact of COVID-19 on surgical practice is widespread, ranging from labor and staff issues, procedure priorities, the risk of intraoperative virus transmission, and the impact on surgical education. While there is a growing literature base describing the early clinical course of COVID-19 and the critical care aspects associated with the care of these patients, there is a dearth of evidence on how this pandemic will affect surgical practice.⁵ While several clinical commentaries and management indications have been published by research groups working in severely affected areas, there is a paucity of evidence-based literature providing clinical and organizational guidelines for managing general surgery departments during the COVID-19 epidemic.⁶ The aim of our study was to collect and review the available guidelines and recommendations published by the Society of General Surgery and Healthcare Institutions and evaluate the underlying literature.

Method

A literature review was carried out with following keywords and/or medical subject titles were used: "COVID-19" or "pandemic" or "pneumonia" or "2019-nCoV" and "surgery" or "stomach pain", "laparoscopy", "emergency", "stomach open", "results", "SARS-CoV-2" and "postoperative care" or "contamination" or "spread." All available articles (reviews, editorials, epidemiological studies, case series, and research letters) about COVID- 19 and surgery in the last five years.

Results

1. Changes in the surgical system

1.1. Use of surgical facilities

Critical care bed capacity in the United Kingdom (UK) compared to other countries in Europe. For example, a comparison between the UK and Germany shows a difference in the number of intensive

care unit (ICU) beds of 7.5 versus 31.8 per 100,000 population, respectively. Additionally, predictions made by Imperial College's COVID-19 Response Team show that demand for critical care beds is more than 30 times the UK's capacity. As a result, UK National Health Service (NHS) hospitals have been reconfigured to provide more room for critically ill patients, anticipating a larger spike in COVID-19 cases. To date, 33,000 hospital beds have been released, and 1,200 ventilators have been provided by the private sector. Other elective and routine surgeries have been canceled or postponed, allowing access to the operating room (OR) and recovery room for use as a critical care unit.⁶

1.2. Redeploying staff (Redeploying)

Emphasis has also been placed on increasing the number of medical staff trained to treat these patients, considering a large number of critically ill patients. The NHS has published guidelines with recommendations on staff frameworks for critical care patients and deployment of medical staff to meet surges in a critical care capacity. The cancellation of elective and non-urgent surgery means surgeons can play a key role and contribute to the critical care of these patients. In particular, the surgeon can perform line insertion and patient proning while ensuring airway safety and infusion and line management. Other healthcare staff with experience in OR such as nurses and related health workers can provide critical-care care. The Royal College of Surgeons of England (RCS) has set several priorities for adapting the surgical workforce. It is critical to maintain other non-COVID emergency surgery lines with competent surgical staff and virtual teleconferencing from specialists to generic surgeons and virtual outpatient clinics to minimize exposure.

The second priority is to protect and preserve the surgical workforce with proper use of PPE, in addition to adequate rest and psychological support if needed. Lower importance has been established to fulfill alternative surgical and non-surgical roles. The adaptive role of the individual surgeon can be divided into current practice, "on the edge" practice, and "beyond the edge" practice. For surgical staff who need to work beyond their competence, the RCS has recommended that their expanded scope of practice depend on the specific local needs identified. The recommendations emphasize the need for appropriate training, support, and collaboration with appropriately trained colleagues to enable the best possible patient care.

The same recommendations apply to retired surgeons and trainees temporarily returning to practice. A strategy to minimize the risk of contracting COVID-19 infection while managing critical care patients is to rearrange the surgical team into two groups. One active within the hospital, and one working remotely in isolation, the two groups were taking turns with each other at 2-week intervals. Hopefully, this will ensure that any symptoms are identified within the COVID-19 incubation period. An alternative strategy is to consolidate the surgical team on a daily basis into two teams working long (e.g., 12 hours) shifts using each available operating room in turn (rather than completing lists throughout the day in one OR) to provide maximum time for deep cleaning each OR and minimize the number of staff in potentially exposed departments.⁶

Before elective surgery, it is necessary to consider whether or not it is necessary to perform elective surgery, thereby further helping us make surgery safer during the pandemic and enabling a more focused use of safety precautions. Risk Factors for Perioperative SARS CoV-2 Infection Studies have shown that Emergency surgery is associated with a higher risk of perioperative SARS-CoV-2 infection and is also associated with higher morbidity and mortality.⁴

The study describes that 30-day mortality from perioperative SARS-CoV-2 infection is higher with emergency surgery, cancer surgery, previous transplantation, immunosuppression, presentation within the first week after surgery, those >75 years, and ASA > 2.¹ Such risk factor analysis for the serious morbidity or mortality associated with perioperative SARS-CoV-2 infection will further help us make surgery safer during the pandemic and allow for more focused use of safety precautions. In terms of the infection itself, emergency surgery was associated with a greater risk of perioperative

SARS-CoV-2 infection ($p \leq 0.001$), and this was supported in the colorectal ($p = 0.001$) subgroup analysis and upper gastrointestinal/hepato-pancreato-biliary surgery ($p = 0.008$).

Laparoscopic surgery appears to be associated with a reduced risk of COVID-19 infection compared with open surgery for complex major and major surgeries ($p = 0.040$).⁷ There is further evidence that the smoke composition at laparoscopy and laparotomy is similar, but laparoscopy allows more controlled release. All of these factors seem to suggest that laparoscopic surgery is safe during the pandemic.⁴

Other Security Measures

Among other suggestions that can help reduce perioperative SARS-CoV-2 infection are reducing time spent by patients in health care settings. Where possible virtual manner of preoperative consultation, assessment, postoperative consultation, and use of appropriate personal protective equipment by staff is recommended. There is currently little evidence that this will reduce perioperative SARS-CoV-2 infection or mortality, but it seems plausible and may have other benefits.⁴

1.3 Staff preparation

During the early weeks of the pandemic, the hospital's Human Resources Department issued health performance evaluations to all department heads. The instructions are to classify which staff members cannot perform direct care for patients with suspected or confirmed COVID-19. According to the Indonesian Ministry of Health protocol, the exclusion criteria included staff aged over 60 years, pregnant, immunocompromised, severe obesity, and other criteria. Those who meet the exclusion criteria are directed to get support in routine health services.^{4,5} The hospital infection prevention and control committee (PPI) or the hospital infection prevention and control team provides comprehensive information about the use of PPE in each unit, the flow of patients with suspected or confirmed COVID-19, as well as strategies for preparing facilities and infrastructure in the event of a spike in cases through training posters, mobile examinations, and demonstration videos.¹

The PPE for the COVID-19 Operating Room staff is fitted with N-95 masks, goggles, face shields, hats, gowns, shoe covers, boots, boot covers, and hazmat suits. In a hospital that does not provide powered air-purifying respirators (PAPR), the appropriate N95 mask size needed to be tested using a "fit test" conducted by the hospital's infection prevention and control team. The anesthesia and intensive care department has three additional work areas to cover: COVID-OR, COVID-19 high care/intensive care, and COVID-19 emergency room units.

During this period, anesthesiologists played an important role in managing COVID-19 in hospitals, and policies adapted from WHO or Indonesian Ministry of Health guidelines were established to safeguard the general well-being of the staff.⁹ First, the general policy was to cease all scientific teaching and examination administration in hospitals, where a group of people will gather and then move to an online platform. Then, all residents and consultants are given a day off following COVID-19 treatment.⁶ Third, a "bubble" system is created where one team has no limited contact with other staff outside their bubble group. Fourth, an internal surveillance team is formed to monitor the health of the staff daily and immediately locate and track if a possible infection occurs. Finally, all staff are barred from work if they have a fever or have an influenza-like syndrome, or are generally unwell.^{4,5,6}

1.4. National referral procedure

The operating room receives locally sourced and referred emergency surgical cases with suspected or confirmed COVID-19 from the emergency department. Referral cases are referred to the hospital through the national referral system of the Ministry of Health of the Republic of Indonesia known as the integrated referral information system (SISRUTE) or the 'Integrated System', containing

information on basic demographics, symptoms, laboratory, and patient imaging results, which will then be evaluated from remotely by the emerging and reemerging team.⁸ The infection team will approve or reject the consultation based on postoperative bed availability and requirements. Among the team's board of consultants, designated surgeons, anesthesiologists, and obstetricians are involved in serving the needs of the surgical case. Surgical patients from the emergency department are consulted into the operating room via the hospital information system after the infection team evaluates them.¹⁰ Once approved, district hospitals transport their patients according to national standard patient transport guidelines to the referred hospital. Then, the isolation emergency unit accepts suspected and confirmed cases in a separate wing/section of the regular emergency room complex.¹¹

1.5 Preoperative phase

General screening for COVID-19 was performed in emergency triage during the preoperative period using a standardized questionnaire. Patients who meet the criteria for suspected COVID-19 or confirmed cases with positive PCR results are isolated in a special isolation ward of the emergency department.^{3,5} Regarding surgery, two possible scenarios arise: either the patient is a surgical patient who requires COVID-19 screening for surgery, or the patient is a medical case with a suspected/confirmed case of COVID-19, which then requires surgery. Screening procedures have not changed during the pandemic, but diagnostic options are evolving rapidly in late 2020. As anesthesia and surgery involve high-risk aerosol procedures and social distancing principles, the use of surgical masks and ventilation is challenging to maintain in the surgery room.⁸ In addition to the standard questionnaire, a series of blood tests, chest X-ray, antibody and/or rapid antigen test, PCR test, and chest scan are required. Laboratory and radiological examinations to determine a patient's COVID-19 status are evolving due to innovations developed during the pandemic and available new technologies. As no on-site testing is available during the initial months, screening for COVID-19 relies heavily on findings through history taking, contact tracing, physical examination, blood tests such as leukocyte, total lymphocyte, and neutrophil-lymphocyte ratio, chest radiographic images of bronchopneumonia, and. The findings mentioned rapid antibody tests have only 40-60% sensitivity or specificity for diagnosing COVID-19 compared with PCR. A significant proportion of COVID-19 patients are asymptomatic during admission, and a false-negative finding in patients' preoperative and preoperative COVID-19 examination is possible.¹⁰⁻¹² Limitations of laboratory hours and time to results also impact surgical treatment. As a result, hospitals are facing increased surgical demand for PPE, increased use of negative pressure operating theaters, and requirements for postoperative isolation wards, resulting in inefficiencies in both resources and general costs. According to the hospital's policy, only two surgical cases did not require preoperative COVID-19 screening, namely life-threatening bleeding and fetal distress in which surgery would be continued using the required level 3 personal protective equipment (PPE). Anesthesia visits are made via video call for history taking to minimize exposure and limit the use of PPE, while laboratory and radiological examinations are available online at the hospital information system (HIS).¹¹

Discussion

Studies stated that many other centers around the world have had to take a multidisciplinary approach and change their operation workflows to meet specific needs during this pandemic time. As Italy became the epicenter of the initial outbreak in Europe, an Italian hospital reported a massive reorganization effort for emergency operations such as triage infection in emergencies, designating COVID-19 specific negative pressure operating theaters, and complete PPE for surgery.¹ Another report from a Singapore hospital reported the same stringent preparation for COVID-19 surgery with a few differences, such as utilizing PAPR, avoiding staff cross-contamination by dedicating personnel only to COVID-19 surgery, and the ability to pre-simulate with all the staff. These measures, in theory, conform to some guidelines but are not applicable in every hospital due to budgetary and human resource constraints.¹⁵ A critical issue for surgery on COVID-19 patients is the additional waiting time required for patients to get the surgery with significant delays are caused by screening and diagnostic procedures for COVID-19.¹² Availability and timing for antigen test results

are important in the diagnosis of COVID-19. As a more advanced technology-based assay is needed, like PCR, delays are unavoidable in developing countries where this technology may not be readily available.¹¹

In the early weeks of the pandemic, surgical decisions were so late due to screening protocols that can cause patients to die before undergoing surgery. CT scanning is the recommended tool for rapid diagnosis of SARS-CoV-2 because meta-analyses concluded that CT chest imaging detection of COVID-19 is very high among symptomatic individuals at high risk with a sensitivity of up to 80% in asymptomatic patients for diagnosing COVID-19. However, CT scan was not available in all hospitals in early 2020.¹³ False-negative results on CT-scans are also problematic as the report from the Italian hospital who was requiring screening of preoperative chest CT scans instead of routine chest X-rays for surgery shows three percent of patients with non-respiratory symptoms had negative chest CT scans and ended up having positive nasopharyngeal swabs. The same problem in COVID-19 diagnosis compared to operating time was also reported from zero in Wuhan.⁷ Level 3 protection and negative pressure operating theaters are used regularly, and while considered safe, these precautions may not be the most efficient approach. The effects of level 3 PPE for emergency surgery have an unavoidable impact on the surgeon's general health and clinical ability to perform even simple and routine procedures. Because surgery is a meticulous process and its duration is often longer than the standard 3-4 hour PPE time limit, staff report dizziness, heat stress, and reduced concentration during surgery.¹⁴ Studies have shown that after wearing PPE, considerable thermal stress ultimately affects human performance and increases physical stress resulting in decreased concentration.⁶ Innovations for lighter, cooler, separate oxygen supply, and affordable clothing are urgently needed as the pandemic continues to be a problem in the near future.

A study reported that their hospital used the readily available GeneXpert MTB/RIF molecular platform (Xpert; Cepheid, Sunnyvale, CA, USA) to detect COVID-19 within 45 minutes. Optimization of existing technologies, such as the GeneXpert MTB/RIF platform, requires a minimum number of trained staff and less infrastructure and equipment when compared to classic real-time PCR. Reports from studies suggest that optimizing the GeneXpert MTB/RIF platform for SARS-CoV-2 surveillance in low-and middle-income countries is relevant and achievable and should be considered in settings with difficult access to laboratories.^{2,3} Another delay is the Availability of postoperative rooms because the hospital also treats COVID-19 non-surgically. At the highest peak of COVID-19 in Bandung, Indonesia, room availability was extremely scarce even when room capabilities were fully maximized. This issue becomes complicated when COVID-19 surgical patients require high care or postoperative intensive care as the room availability is even lower.¹¹

Delays are also unavoidable as preparation for surgery for COVID-19 is complex. It is imperative that during this pandemic, operating theaters develop checklists, conduct simulations, carry out evaluations and adjustments regularly. The use of checklists and workflows can increase the capacity to deal with these delays and able to shorten the preparation time to 40 minutes. At the peak of the COVID-19 infection rate, a second COVID-19 patient operation is being planned while the first one is being carried out or cleaning procedures have not been completed can be carried out. Studies show that healthcare workers are 23 times more at risk of catching COVID-19, which is the basis of rational fear among healthcare workers. As a mitigation measure, postoperative evaluations in an online setting on a case-by-case basis enable team members to communicate their fears and input to the system. Ensuring PPE availability, supporting routine tracing, and providing swabs for staff also must be taken as safety measures. The hospital must also provide treatment for staff who contracted COVID-19 and guaranteed income for staff who were on sick leave due to COVID-19.¹¹

Conclusion

The impact of COVID-19 on surgeons' daily practice and surgeon education is enormous. The cancellation of elective and non-urgent surgeries has allowed surgeons to become an important staff

resource for the health system to deal with the COVID-19 pandemic. During an epidemic or pandemic, carrying out operations requires different levels of protocol, applying known guidelines to local capacities and needs. The operating room must be prepared to modify structures, workflows, processes, and evaluations to safely manage infected patients. This approach requires a multidisciplinary approach such as anesthesiologists, surgeons, nurses, Infectious disease specialists, infection prevention teams, pharmacists, and non-medical staff to develop careful but effective surgical care.

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