



Review Article

## Minimal access surgery during COVID-19 wave – Review of literature

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Received : 08 May 2022

Accepted : 18 June 2022

Published : 14 July 2022

DOI

10.25259/GJMPBU\_19\_2022

Quick Response Code:



### ABSTRACT

COVID-19 has now become an endemic disease and a definitive set of protocols should be applied worldwide for safe clinical and surgical practice. Minimal access surgery is becoming more popular and standard of care for many routine surgeries. However, during COVID-19, a lot of dilemmas were there about whether to perform minimal access surgery or not. As of now, most of the guidelines are established on the opinions of expert committees and the level of evidence is not much high. Minimal invasive approaches are still a safe approach during the COVID-19 pandemic with proper case selection and with additional safety precautions. Hence, we have reviewed the literature for the safe practice of minimal access surgery during COVID-19.

**Keywords:** Minimal access surgery, COVID-19, Guidelines, Evidence

### BACKGROUND

COVID-19 pandemic has generated significant consequences on the healthcare delivery system, especially surgery. Outpatient activity has been decreased and telemedicine has been used to provide consultations. Routine referrals had been postponed. Elective surgeries and daycare surgeries had been postponed to decrease the risk of infection to patients and direct hospital resources for the management of patients with COVID-19 disease. Various studies conducted on COVID-19 patients suggest post-operative increase in morbidity and mortality. A similar study by Hölscher concluded that the post-operative mortality of the COVID-19-positive group was higher than in the controls, that is, around 16%.<sup>[1]</sup> Patients are triaged based on clinical need, availability of hospital resources, and weighing the benefit of treatment against the risks of infection. Emergency surgery for cancer cannot be delayed. Patients whose surgery is postponed tend to present with advanced forms of disease and complications, thereby putting more stress on healthcare facilities.

Respiratory droplets mainly transmit COVID-19. Airborne transmission of the virus is possible by aerosol-generating methods such as intubation, laryngoscopy, bronchoscopy, tracheostomy, and cardiopulmonary transmission.<sup>[2]</sup> Endoscopy was considered a high-risk procedure as the SARS-CoV-2 virus had been found in fecal samples of patients with COVID-19 disease.<sup>[3,4]</sup>

There have been concerns regarding the spread of COVID-19 through aerosols formed by leaked CO<sub>2</sub> and surgical smoke in laparoscopic surgery. These theoretical risks stemmed from

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previous evidence of transmission of hepatitis B virus and HIV, in surgical gas.<sup>[5-7]</sup> However, abdominal fluid samples tested from patients with severe COVID-19 disease showed no evidence of SARS-CoV-2 virus through polymerase chain reaction (PCR) testing in one recent report. This indicates that the likelihood of transmission through open and laparoscopic surgery might not be high as initially expected.<sup>[8]</sup>

Given the benefits of minimal access to surgery and after giving due attention to the possibility of transmission of the virus, scientific organizations such as society of American gastrointestinal and endoscopic surgeons (SAGES) and European association of gastroenterology and endoscopic surgery (EAGES) have given guidelines for minimally invasive surgery during the pandemic. As of now, most of the guidelines are established on the opinions of professional committees and the level of evidence is low (below Level 5). Guidelines will continue to get revised as a higher level of evidence develops.

## CONCERNS ABOUT STARTING ELECTIVE SURGERY

With the acknowledgment of the universal prevalence of COVID-19, surgical governing bodies have decided to postpone elective surgeries and reallocate hospital resources to handle an increasing number of COVID-19 patients. Only emergent and semi-urgent surgeries are being carried out. The use of personal protective equipment (PPE) has made it feasible to perform emergent and semi-urgent surgeries. However, surgeons recognized various limitations such as visibility and communication, and other non-technical skills while using PPE in COVID-19 patients.<sup>[9]</sup> This strategy has been utilized to decrease the nosocomial spread of COVID-19 to patients, but this also resulted in patients presenting with advanced stage of disease and with complications, thereby again burdening the health-care facilities. Although surgery postponement is required, it cannot be indefinitely done because it leads to a further progression of the disease. Surgical guidelines and strategies are continuously evolving with the evolution of pandemics. The current recommendations are Level 5 evidence and further evidence needs to be generated to formulate evidence-based guidelines for surgery during the pandemic.

## GUIDELINES FOR MINIMAL ACCESS SURGERY

### General recommendations

1. All patients should undergo SARS-CoV-2 PCR testing 24 h prior to surgery. Patients who are SARS-CoV-2 PCR negative but positive for antibody do not require any further testing during the hospital stay days and patients who are PCR negative and antibody-negative for SARS-CoV-2 require testing to be done once a

week during their hospital stay. Patients who are SARS-CoV-2 positive should be treated according to national guidelines and surgery should be postponed if possible until recovery and viral shedding stop<sup>[10]</sup>

2. Limiting health-care personnel and traffic in the OR room to reduce the amount of exposure and number of staff exposed
3. Dedicated OT and operating team for COVID-19-positive patients if feasible
4. The OR should be equipped with high-efficiency particulate air (HEPA) filter with ideally >25 air exchanges in the theatre
5. Positive pressure (laminar flow and air conditioners) to be switched off before intubation and extubation
6. Entry of surgeons and nurses into the operating room 20 min after intubation and leaving OT during extubation to keep exposure to a minimum
7. Regional anesthesia is favored over general anesthesia with endotracheal intubation since the latter is a high aerosol-producing procedure
8. Vaccination status of the patient should be kept in mind during the pre-operative period. If the patient is not vaccinated, consider the patient for vaccination unless the procedure is an emergency
9. All vaccines are now already proven to be practical, secure, and efficacious tools to prevent severe COVID-19, days of hospital stay, and death, but the quality of evidence greatly differs depending on the type, dose, and duration of vaccines considered.

### Procedure-related considerations

1. There is very low authentication regarding the relative risk of transmission of SARS-CoV-2 of open, laparoscopic, or robotic surgery. Emerging evidence will determine the safest approach to surgery. Precautionary measures are to be strictly implemented for operation theater personals to reduce the chance of contamination, transmission, and to maintain the workforce. Strict use of PPE which includes N95 masks and face shields should be used by all OR staff regardless of known or suspected COVID-19 status<sup>[11,12]</sup>
2. Although currently, there is very less evidence to indicate that laparoscopy leads to the dispersal of the virus as aerosol, devices to filter released CO<sub>2</sub> are strongly recommended. Minimal access surgery has proven benefits of decreased length of stay and complications and potential for filtration of aerosolized particles whereas it is difficult to filter aerosolized particles in open surgery.

### Feasible measures for surgery

1. Patient's consent for surgery should cover the possibility of COVID-19 exposure and possible consequences

2. If helpful surgical patients should be preoperatively tested for COVID-19 so that protective measures can be enacted as required. Personnel in the OT should Don adequate PPE according to PPE guidelines
3. Negative pressure room is to be used for procedures on the airway such as intubation and extubation. Operating theaters for COVID-19 suspected and confirmed patients should be different from others with adequate filtration and ventilation<sup>[13,14]</sup>
4. Only the crucial staff should be participating in the surgery with the minimal exchange of room staff unless there is an emergency.<sup>[15]</sup> Minimum 1 h interval/time gap should be maintained in between consecutive surgeries. Disinfection of OT tables and trolleys using 1% sodium hypochlorite
5. Minimizing duration of surgeries by avoiding multiple and complex procedures, surgical, and nursing training
6. The lowest possible settings should be used in electrosurgical units. The use of monopolar cautery devices, advanced bipolar devices, and ultrasonic dissectors which generate aerosols should be kept down or used with smoke evacuators. Surgical instruments used for COVID-19 patients should be cleaned separately. Bipolar is preferred over monopolar energy and pulses are kept short on tissue area<sup>[16]</sup>
7. Minimal use and short burst usage are advised. Cold hemostasis is the choice method
8. Incisions for ports should be just adequate for passage of trocar to prevent leaks around the ports. Minimum number of incisions and minimum size for port sites. Avoidance of hand-assisted surgery
9. Minimizing the degree of Trendelenburg incision
10. Carbon dioxide insufflation should be done at the lowest possible flow rate. Pneumoperitoneum should be created with a closed technique and maintained at 10–12 mmHg and a smoke deportation system should be used. Pneumoperitoneum should be cleared through the system of filtration<sup>[17,18]</sup>
11. Measures such as avoiding opening of trocar stopcocks, connection of trocars to filter for evacuation of smoke, minimal torque at trocar sites, airtightness around trocars, and port site closure after complete desufflation of pneumoperitoneum help to decrease the spread of aerosols<sup>[16]</sup>
12. Insufflator port site should be closed before while removing tubing from the port site or switching off the insufflator
13. Specimens retrieval and fascia closure need to be done once all gas and smoke are evacuated.

### Concerns in minimally invasive surgery

Aerosolization of a virus, leak from port sites, and chances of COVID-19 infection to operating time are the topmost concerns during every COVID-19 pandemic. There is no actual data on COVID-19 risk during conventional laparoscopy and robotic surgery.<sup>[19]</sup>

The release of pneumoperitoneum is giving rise to most of the aerosol in the operation theater. SAGES and royal college of surgeons of England (RCS) have advised caution regarding minimally invasive surgery that minimally invasive surgery has a potential risk of transmission of infection although there is no evidence for the same.

The release of CO<sub>2</sub> cannot be eliminated as closed ports with valves leak when instruments are inserted. The CO<sub>2</sub> and plume need to be filtered to reduce the release of untreated aerosols in the air. Although there was no evidence that CO<sub>2</sub> and plumes have COVID-19 virus, previous studies have shown that hepatitis B viral RNA has been detected in surgical smoke. There are case reports on exposed surgeons getting infected with HPV after performing laser ablation on HPV-positive tumors.<sup>[6,20]</sup>

The size of the COVID-19 virus is between 60 and 140 nm.<sup>[21]</sup> Smoke evacuation and filtration systems such as AirSeal (0.01 micron size filter), SurgiQuest, and PneumoClear (0.08 micron size filter) removes CO<sub>2</sub> and pass them through ultra-low particulate air (ULPA) filter. Use of these systems further decreases the spread of the virus. Another concern is the suction devices that remove a considerable amount of CO<sub>2</sub> are also to be filtered by connecting to filtration systems like Neptune waste evacuation systems

Applying standard methods of filtration for smoke clearance during minimally invasive surgery, although escalate the cost, are mandatory for the safety of both patient and healthcare professionals. Thus, it will probably remain a normal practice in the future.<sup>[22]</sup> The most recommended filters are HEPA filters, with a capability of almost 100% in filtering particles >0.03 μm diameter or ULPA filters, which can evacuate particles >0.05 μm in size. Various cost-effective filtration systems were developed, both having as the central piece a heat and moisture exchangers (HME) filter, with connection to a trocar which allows safe desufflation of carbon dioxide and other surgical gas. Because of having high resistance to flow along with bacterial and viral filtration efficiency of ≥99.999%, HME filters have come to light.<sup>[22]</sup> Use of the different kinds of filters made its high cost.

This apprehension led to recommending the restrictions regarding minimally invasive surgery. However, the benefits of minimally invasive surgery on patient recovery cannot be left unaccounted.

### ROBOTIC-ASSISTED VERSUS LAPAROSCOPIC VERSUS OPEN SURGERY IN COVID-19 PANDEMIC

Aerosol generation in robot-assisted and laparoscopic surgeries is more than open surgery but can be limited by filters and locks. Open surgery although has less aerosol formation cannot be filtered and has unconfined dispersion

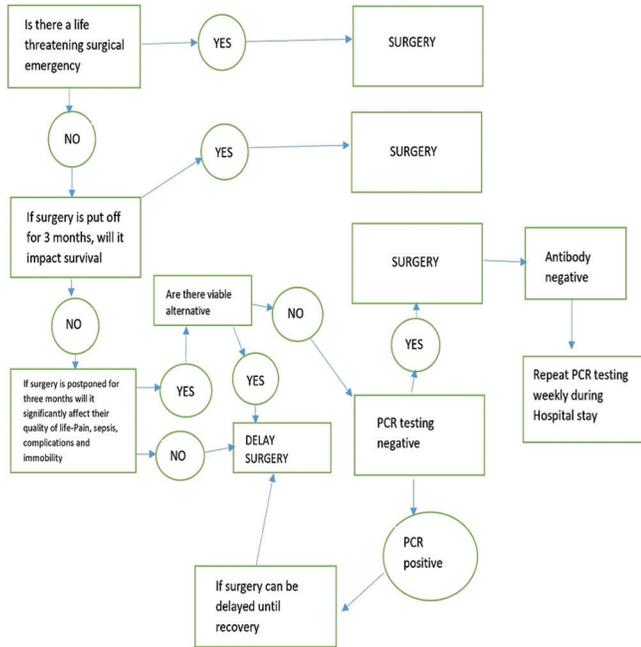


Figure 1: Algorithm for MIS during COVID pandemic.

and chances of maximum exposure. Healthcare staff at the bedside is limited in robot assisted surgery when compared to laparoscopic and open surgery. This reduces the chances of infection among health care workers. Hospital stay is reduced with minimally invasive surgery and thereby the chances of nosocomial infection are less when the patient is treated with minimal access surgery. Experience regarding minimal invasive urological surgery in patients who are nasopharyngeal swab negative at two-volume centers in Italy showed that staff and patients did not develop an infection during the 15-day follow-up period after surgery.<sup>[23]</sup>

## CONCLUSION

With proper patient selection and additional precautions, minimal access approaches are still safe during the COVID-19 pandemic. Minimally invasive surgery, by reducing hospital stay, needs to be considered as a means of decreasing the transmission of the SARS-CoV-2 virus. At present, there are studies comparing open and minimally invasive approaches for COVID-19 infection risk to surgical teams. However, the development and implementation of proper guidelines has undeniably minimized the incidence of COVID-19 infection.

## TAKE-HOME MESSAGE

The coronavirus pandemic has caused devastation over the past 2 years. It has not only caused considerable loss of human life but also hindered in patient management and

surgical training. The pandemic has crossed its acute phase and is now into endemicity. The WHO and several nations have achieved desired vaccination rates and health education about the disease. However, still, there are possibilities of further coronavirus infections due to the indolent nature of the virus to achieve mutation into different strains. Hence, preparedness is a must and for minimal access surgeries, set, defined protocols have to be defined.

1. Mandatory vaccination along with SARS-CoV-2 PCR testing for all undergoing minimally invasive surgeries. Patients should be questioned about their past COVID-19 infections, vaccination status, and any ongoing infections at home
2. Educating the hospital staff especially the surgical OT team about PPE, and proper precautions while operating on a patient affected with COVID-19.
3. Modification of OR keeping in mind for COVID-19 patients like separate cabins along with backup for post-operative cabins
4. The use of smoke evacuators with filters has to be made mandatory
5. Special cabins in the OR for health care workers in case of any cross infections
6. Proper sterilization of instruments used for COVID-19 patients along with disinfection of the high touch surfaces in OT
7. Training young surgeons about the precautions of operating during a pandemic and motivating them to perform better toward preparedness for further coronavirus pandemics in the future.

## Declaration of patient consent

Patient's consent not required as there are no patients in this study.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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**How to cite this article:** Sandhu H, Dhivakar S, Acharya P. Minimal access surgery during COVID-19 wave – Review of literature. *Glob J Med Pharm Biomed Update* 2022;17:8.