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Review

How to Face with Minimally Invasive Abdominal Surgery During Covid-19 Outbreak? Surgical and Anesthesiological Concerns

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Abstract

The COVID-19 outbreak has profoundly changed both the management and scheduling of surgical patients, necessitating a reduction in the number of elective cases and reserving priority for high-risk classes, such as oncological and emergency surgery. Notwithstanding the introduction of new protocols, much about the disease still remains unknown and surgical approaches, including minimally invasive surgery, are being examined for potential biohazard risks. The purpose of this article is to provide some clarification and to offer some recommendations to minimize the risk of diffusion of the virus during abdominal surgery.

Keywords: Airway management, COVID-19, laparoscopy, minimally invasive surgery

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The COVID-19 pandemic forced a re-examination of surgical care for patients, resulting in the rescheduling of non-urgent and non-cancerous cases with a subsequent revaluation. Among elective surgery procedures, cancer patients remain a priority and are subjected to rigorous clinical, laboratory, and history assessments (individual exposure evaluation, microbiological swabs, chest X-ray/computed tomography). The outbreak led to delays in the recruitment and redistribution of consultants and specialists for dedicated departments as well as a substantial decrease in the availability of non-COVID-19 intensive care beds due to the extraordinary adjustments to cope with the emergency. In response, centers dedicated to pandemic patients were created, and intraregional and national networks were developed to define elective structures to manage nosocomial transmission, albeit with differences between countries dictated by pre-existing health networks and local support services.

Notwithstanding these changes and the reduction in dedicated staff, in general, hospital access to surgery has not been substantially altered, regardless of the patient's COVID-19 status, thus guaranteeing priority as needed. However, concerns about both direct and indirect exposure remain central for both healthcare professionals and patients due to the theoretical risk of fueling the onset of nosocomial infectious clusters, especially in cases of asymptomaticity or paucisymptomaticity. This is largely preventable with the routine use of personal protection equipment (PPE),

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the identification of isolated biohazard operative pathways, the adoption of structural restraints, and dedicated services.

Debate continues about the possibility of indirect surgical exposure (airborne transmission), which could theoretically dictate both anesthesiological and surgical procedures (orotracheal intubation, traditional vs minimally invasive approach, the use of energy devices vs monopolar and bipolar electric generators). In fact, even if COVID-19 aerogenic transmission is recognized, little is known about its presence and its relative virulence index when delivered by means other than droplets (blood, gastrointestinal liquid, cavity secretions, saliva).[1] Although molecular assays have detected viral RNA in several biological specimens from COVID-19 patients, the irregular incidence means that the potential for viremic progression remains unclear.

Wang et al.,[2] reporting on 1070 reverse transcription polymerase chain reaction 1ab COVID-19 gene specimens collected from 205 patients, found positivity in 29% of feces and 1% of blood samples, while there were no copies in urinary collections. However, hematogenous detection seems to be inconstant, with a prevalence ranging up to 10.5%.

Speculatively, it could then be argued that COVID-19 syndrome, manifesting as a multiorgan viremia (coexistence of gastrointestinal, vascular, respiratory, cardiac, and neurological symptoms),[4] potentially puts each anesthesiological and surgical procedure at risk. The approach would be that any tissue should be considered infectious and recommendations urge consideration of factors such as virus microbiology, virionic penetrability index, replicability, and host tissue interactions. Clinical practice, therefore, would be faced with accommodating the preference for such strategies as well as with the remodulation of merely technical elements.

Van Doremalen et al.[5] reported that COVID-19 remains stable on stainless steel with virus availability of up to 72 hours after application and demonstrated stability kinetics for 2 days, similar to the severe acute respiratory syndrome (SARS) coronavirus.[6] Thus, any operation should be assumed to be contaminated and an effective source for virus spread. In these circumstances, a negative pressure environment (NPE) and continuous sanitation are recommended.[7] An NPE could prevent environmental suspension of an aerosolized bloodborne virus from energy device application or dissection maneuvers. Although current data do not provide conclusive evidence about COVID-19, previous experience with other viruses (hepatitis B hepadnavirus, HIV retrovirus) has clearly demonstrated that aerosolization can be a biohazard for operating personnel. Baggish et al.[8] reported HIV proviral DNA in cell vaporization, and Kwak et al.[9] found sequences of hepatitis B virus DNA in surgical smoke collections from patients undergoing minimally invasive abdominal surgery. To ensure safety in the struggle to address current conditions, similar concerns may be warranted.

Functional airborne isolation cannot be maintained during patient airway management when both anesthesiological induction and ventilation are crucial. Recently, the Italian Society of Anesthesia, Analgesia, Resuscitation and Intensive Care (SIAARTI)[10] released a statement that stressed the priority role of integrated and systematic multidisciplinary management, focusing on the importance of a trained team (including simulations), the availability of a suitable environment, the adoption and rational use of second and third level PPE, and checking clinical lists. To satisfy these objectives, airway management should include the availability of closed section systems and airway protection barriers, and awake intubation and unnecessary disconnections and clamping should be avoided as much as possible. Similarly, the Anesthesia Patient Safety Foundation (APSF)[11] has suggested avoiding awake fiberoptic intubation, adopting rapid sequence induction protocols in order to reduce manual lung ventilation and potential aerosolization, and ensuring the placement of high-quality heat and moisture exchange filters. There are conflicting data regarding nasogastric tube placement and its role as an aerosol-generating procedure, although the specific circumstances, such as in the case of abdominal surgery, could provide some resolution. Under ideal conditions, the use of gastric detension devices during general anesthesia is regarded as non-aerosol-generating, as there is no induced sneezing or coughing. In these circumstances, nasogastric tube placement would be risky only with conscious patients, but as yet we have no evidence regarding COVID-19 transmission of this type. Referring to previous experiences during a SARS outbreak, Tran et el.,[12] reported that insertion of a nasogastric tube in an operative setting was not associated with an increased risk of virus transmission (pooled odds ratio: 1.2, 95% confidence interval: 0.4-4.00).

The surgical approach may also raise concerns, especially in the current era of a progressive transition to minimally invasive strategies in both elective and emergency surgery. Despite some issues about laparoscopic surgery during a coronavirus outbreak, since it is still an aerosol-generating procedure, it is not clear if aerosolized carbon dioxide solutions could convey virions during pneumoperitoneum. Li et al.,[13] in a cohort study comparing the effects of laparoscopic and open abdominal surgery on the intraoperative concentration of microparticulate (PPM3-PPM5), reported a higher cumulative dose in cases with a minimally invasive approach, perhaps due to an accumulation effect with

a concentrated release of particles suspended in the air. However, aside from any theoretical speculation, minimally invasive abdominal surgery includes 2 vulnerable aspects: tissue dissection with energy devices (favoring moment) and pneumoperitoneum resolution (dispersion). On the other hand, laparoscopy could reduce direct continuous exposure to smoke compared with an open approach in a closed system, but in daily clinical practice, air leakage around trocars during induction of anesthesia and airway maintenance are common. Risk management for the resolution of pneumoperitoneum, however, could be solved by using closed circuit filters or water valves with protection systems.[14]

Due to the availability of only limited experience, rather than monocentric or national data, dissonant and fragmented indications have emerged supported by very little evidence. The unproven risks of COVID-19 viral transmission must, however, be weighed against the well-known benefits in terms of morbidity and mortality, reduced hospital stay, and early return to daily activities.[15]

The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) and the European Association of Endoscopic Surgery (EAES),[16] have noted that continued monitoring and data gathering may lead to revisions of their current recommendations, yet recognize the critical role of measures such as the use of PPE, the establishment of dedicated environments, and minimizing human resources as much as possible. The microbiological gray zone as well as incoming new evidence has led to the adoption of preventive technical strategies derived from experience with other viral infections, such as the minimization of electrosurgical dissectors and pneumoperitoneum pressure. Thus far, the result is a statement with current yet inconclusive recommendations for the adoption of minimally invasive techniques in abdominal surgery, which is consistent with the Association of Italian Hospital Surgeons (ACOI) – Italian Society of Surgery (SIC) position.[17]

Similar recommendations, given the lack of strong evidence, have also been provided by the European Society of Gyneacological Endoscopy (ESGE),[18] albeit in a non-exhaustive form and suggesting a relative contraindication to laparoscopy of *"there would be a risk to staff, increased beyond that for an open operation."* In contrast, the British Society for Gynaecological Endoscopists (BSGE) has supported the feasibility of laparoscopy.[19]

The indications for minimally invasive abdominal surgery appear to be influenced by and subject to the current pandemic, both in procedural terms and in material resources. The need for a required environmental capacity as well as recommended instruments or devices could significantly interfere with the adoption of laparoscopic options instead of traditional open surgery, especially in communities where the availability of resources is limited. The management of COVID-19 patients requires an intensive/subintensive multidisciplinary approach with specific resources usually present only in tertiary hospitals, which may translate into a sort of forced coexistence of the need for optimal management of the epidemic outbreak and the need to safely perform minimally invasive surgery. This would appear to be a limitation of the current hub-spoke models and suggest that proposals for dedicated in-hospital isolation strategies may not be practical.

The currently available evidence need not discourage the practice of minimally invasive surgery. Nonetheless, a laparoscopic approach cannot disregard 3 important overarching aspects (Fig. 1): environmental safety (health workers and physical structures), dedicated anesthesiological procedures, and surgical technical precautions.

Priority should be given to checking an operating field with closed systems, including ensuring the tightness of the ports, and avoiding high positive intraperitoneal pressure. In a continuous filtering setting, the handling of viscera would appear to be safe, avoiding the aerosolization of organic combustion products as well as exposure to theoretical direct vehicles of disease, such as blood or enteric material. Therefore, intracorporeal rather than extracorporeal visceral resections and anastomoses would be recommended.

Abdominal drainage should be discouraged whenever possible, as it could include 2 important risks, 1 immediately (residual gaseous blow-out), and 1 remotely (contact with intra-cavitary biological materials). Finally, meticulous attention should be paid to the reduction of pneumoperitoneum at the end of the procedure or during inadvertite

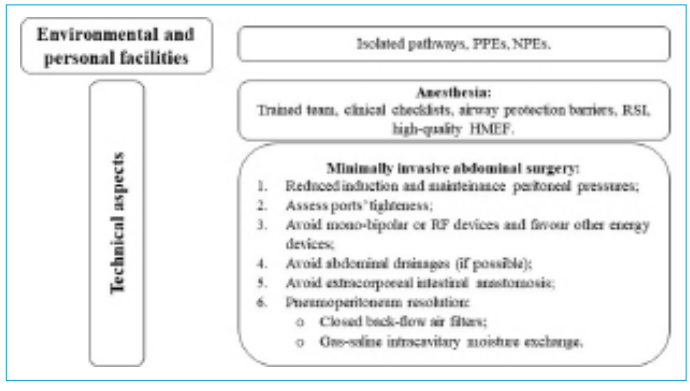

Figure 1. A pragmatic approach to minimally invasive abdominal surgery.
PPE: Personal Protective Equipement; NPE: Negative Pressure Environment; RSI: Rapid Sequence Intubation; HMEF: Heat and Moisture Exchanging Filters; RF: Radiofrequency.

conversion to an open approach. In particular, desufflation should take place using closed gas filtering systems, the use of air-liquid barrier systems (translating the experience of some postoperative collection systems for thoracic surgery), or through methods of mixed gas-saline resolution into special hermetic suction devices (as occurs during intracavitary chemohyperthermia).

In conclusion, minimally invasive surgery, in the absence of further evidence, should not be opposed, but rather revised in its technical specifications at the cost of a prolonged operating time, which will lead to a not-negligible reduction in per day occupation rates.

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