

Suggestions on surgical treatment during coronavirus disease 2019 (COVID-19) pandemic

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SUMMARY Coronavirus disease 2019 (COVID-19), caused by SARS-CoV-2 virus, is now generating a global epidemic, leading to a severe public health emergency. Until April 12, 2020 around 1,700,954 confirmed cases and 105,633 deaths have been reported all over the world. The World Health Organization (WHO) has declared COVID-19 as a Public Health Emergency of International Concern. Under this circumstance, surgical activities should be carefully evaluated to avoid excessive occupation of limited medical resources, and to reduce the possibility of hospital infection. China has achieved an inspiring achievement on epidemic control. Here, we reviewed available studies on surgical activities during the outbreak, in combination with our current experience, with the aim of providing feasible suggestions on surgical issues during the COVID-19 pandemic.

Keywords COVID-19, surgery, public emergency

1. Introduction

With the pandemic of coronavirus disease 2019 (COVID-19), most medical resources have been allocated to its treatment. Diagnosis and treatment of other diseases have been seriously restricted. As far as surgical activities, it is suggested that except for the dedicated COVID-19 center, other hospitals should only provide urgent or time-sensitive elective surgical services after deliberated evaluation (1). The exhaustion of medical resources and the risk of infection during operations should be a concern. COVID-19 spreads mainly through respiratory droplets produced by infected patients. Operations, including endoscopy, laparoscopy, intubation and extubation, tend to transmit droplets and aerosols. Surgeons, anesthetists and operating nurses within the operating room are at high risk of exposure and infection. Personal protective equipment (PPE), including N95 mask, disposable medical protective clothing, surgical cap, sterile gloves, goggles and face shield, should be provided to all staff if surgery is recommended (1).

2. Emergency surgery

Screening of symptoms and exposure risk should be performed for all patients at time of their arrival. If

patient's vital signs are unstable, emergency surgery should be performed, with the highest level of protection measures conducted. If the patient's vital signs are stable, suspected patients should be streamed into dedicated fever clinic, with all non-urgent surgery postponed. For the non-suspected, if operation is needed, further nasopharyngeal swab (NPS) or chest CT still should be examined. After all screening is finished and patients triaged, requested surgical activity is subsequently triggered (2).

For suspected or infected patients, a separate path for transport should be pre-designed. A dedicated negative-pressure operating room should be prepared. Experienced surgeons outside the learning curve and standardized surgical procedures are recommended to decrease the operation time, in order to minimize the possibility of infection. Well-trained operating room nurses and anesthesia should be in position for pre-operative preparation. Personal protection equipment is recommended for all participating medical staff (3).

Special attention should be paid to pregnant women whose general condition is proved to be worse than others (4). Thus, caesarean section for infected or suspected pregnant women is the most challenging emergency surgery. Compared with vaginal delivery, caesarean has the advantage of minimized in-patient stay and reduced physical exertion. Evaluation of

maternal disease condition, fetal intrauterine status and gestational age determines the timing of caesarean (5).

Application of laparoscopic technique and energy devices for bleeding control should be carefully evaluated. Zheng *et al.* reported that aerosolization of blood through energy devices has a risk of spreading virus (6). This leads to concern about the safety of urgent minimal-invasive surgery, such as appendectomy and cholecystectomy. Thus, prevention of aerosol dispersal, lowering pneumoperitoneum pressure, lowering electrocautery power setting and using bipolar cautery should be implemented in laparoscopic surgery (6).

In addition, some traditional urgent surgeries can be replaced by alternative treatment. Patients with uncomplicated appendicitis can receive interval appendectomy after nonoperative management, which has proved to have a similar outcome compared with upfront appendectomy (7). Likewise, percutaneous transhepatic-gallbladder drainage can be performed in acute cholecystitis followed by cholecystectomy in 3 months (8). These strategies enable surgery teams to be effectively allocated to other urgent surgeries, and can reduce the utilization frequency of operating rooms.

3. Elective surgery

Comprehensive consideration of limited medical resources and severity of the epidemic are needed to assess the benefit of elective surgery. England's NHS hospitals have suspended non-urgent elective surgery at least 3 months to reserve resources in the face of the COVID-19 outbreak (9). A recent study suggested that the median safe postponement period is 3 weeks (10).

For benign diseases, we suggest that follow-up and assessment should be performed through telephone or on-line inquiry, and surgery should be postponed until the end of outbreak.

For oncological diseases, Liang *et al.* reported that cancer patients are more susceptible to coronavirus infection, probably due to compromised immune system and effects of chemotherapy (11). The Society of Surgical Oncology (SSO) provided recommendations for the management of different cancers during the COVID-19 outbreak, including breast cancer, colorectal cancer, endocrine tumor, gastric and esophageal cancer, hepato-pancreato-biliary cancer, melanoma, peritoneal surface malignancy and sarcoma (12). All these recommendations are based on evidence and reported experiences. However, treatment decisions for each individual patient should be made on a case-by case discussion, considering the cancer biology, alternative strategy, COVID-19 epidemic situation and time schedule of surgery team. We suggest that decisions should be made based on triage. In general, patients can be divided into three categories: *i*). Surgical procedures

should be performed without delay; *ii*). Surgery can be postponed without severe impact on prognosis; *iii*). Surgery can be replaced by other treatment (13).

The first category refers to patients with severe complications during tumor progression. For example, obstruction or perforation as a complication of colorectal cancer is recommended to receive surgical treatment (12).

For the second category, postponed surgery may reduce the possibility of infection with no significant impact on prognosis (14). A recent study from *Annals of Surgery* proved that surgery can be postponed for at least 4 weeks in 48% of cancer types. For patients receiving neoadjuvant chemotherapy, the median safe postponement period is 8 weeks (10).

For those surgeries that can be replaced by other treatment, we should note that chemotherapy is reported to raise susceptibility to COVID-19 (11). In addition, checkpoint inhibitors, which can induce hyperinflammation, may raise a cytokine storm and interstitial mononuclear inflammatory infiltration in a pneumonia condition theoretically. Lung immune-related adverse events caused by immune-check point inhibitors can overlap with COVID-19 related pneumonia (15). Thus, decisions should be made deliberately based on evidence and MDT discussion. Accordingly, intensive personal protection should be provided to these patients to decrease the risk of infection.

Robot assisted surgery has the advantage of reducing hospital stay and minimizing the number of directly exposed medical staff. Additionally, with support of robotic arms, pneumoperitoneum pressure can be reduced to 8 mmHg. It can decrease the infection risk for both patients and surgeons. Thus, it is suggested to be implemented for undelayed complex oncological surgery (16).

4. Anesthesia

Because of the transmission pathway through respiratory droplets, anesthesia, involving intubation and extubation, is at an extremely high risk. Awakened intubation should be prohibited. During the intubation and extubation operation, non-essential staff should leave the operating room. All items should obey the "Only-In" principle. The anesthetist and other remaining staff should wear FFP3 filter and personal protective equipment properly, and a negative pressure operating room is necessary (3). In the pandemic area, anesthesiologists and ventilators limit general anesthesia. Even for urgent surgery, epidural anesthesia and local anesthesia should be considered under some circumstances (17).

5. Patient transport

Transport of diagnosed or suspected infected patients

Table 1. Key points of suggestions*Emergency surgery*

- 1). Screening of symptoms and exposure risk should be performed followed by NPS.
- 2). For infected or suspected patients, highest level of PPE should be implemented.
- 3). Separate path should be pre-designed.
- 4). Dedicated negative-pressure operating room and experienced surgeon are recommended.
- 5). Application of laparoscopy and energy devices should be carefully evaluated.
- 6). For infected pregnant women, caesarean is recommended compared with vaginal delivery.
- 7). Traditional emergency surgery can be replaced by alternative treatment.

Elective surgery

- 1). For infected patients, elective surgery should be postponed
- 2). For uninfected patients, non-time-sensitive elective surgery should be postponed
- 3). For benign disease, telemedicine is suggested for follow-up and assessment
- 4). For malignancies, surgery can be performed when a severe complication occurs. Otherwise, median safe postponement period is 3 weeks.
- 5). Robot assisted surgery has advantage of minimizing the number of exposed surgeons in complex oncological surgery

Anesthesia

- 1). Non-essential staff should not enter the operating room during Intubation and extubation.
- 2). Epidural anesthesia and local anesthesia is suggested under some circumstances.

Patient transport

- 1). For non-intubated patient with no oxygen requirement, surgical mask is suggested.
- 2). For non-intubated patient with oxygen requirement, face mask over surgical mask is recommended.
- 3). For intubated patient, dedicated ventilator rather than bag-valve mask is suggested.
- 4). Disinfection measures must be taken immediately if contamination occurs during transport.

before or after surgery needs proper protection measures. A non-intubated patient is recommended to wear a surgical mask. Oxygen can be delivered through face mask over surgical mask. Intubated patient should be transported with ventilator rather than bag-valve mask. Staff participating in transport should wear proper personal protection equipment (18). A separate path must be pre-designed to segregate these patients from the non-infected. Make sure that there is no extra stay in anesthetic bay and recovery room before arriving at the dedicated COVID-19 ward (3). If contamination occurs in transport, disinfection measures must be taken by dedicated cleaning team.

6. Blood supply

The sudden outbreak of COVID-19 has seriously influenced blood supply. Decreased donation limits the reservation of blood derivatives, which in turn, restricts surgical activity. In addition, blood safety also raises attention. Although SARS-CoV-2 virus mainly affects respiratory tract, viral RNA also can be detected in plasma and serum, resulting in the theoretical possibility of transmission through blood products. It has been reported that Wuhan Blood Center has already started to test for SARS-CoV-2 RNA from blood donations since February 10. Meanwhile, appropriate measures are taken to exclude suspected infected donors, including: *i*). Taking body temperature before donation; *ii*). Detailed inquiry for related symptoms, and travel history to epidemic areas within 28 days of donors and relatives; *iii*). Telephone follow-up to all blood donors for subsequent physical condition after donation; *iv*). Callback blood products from infected donors (19).

7. Conclusion

Except for all the recommendation above (Table1), we suggest that surgical schedule should be made based on careful consideration of the availability of dedicated operating room, the exhaustion of PPE, the demand for ICU beds, the need for blood supply, etc. Standardized treatment procedures for diagnosed or suspected COVID-19 patients must be provided to all relative staff. Don and doff of PPE must be strictly trained for all medical staff. Face-to-face interaction is recommended only in emergencies. Telemedicine should be considered whenever possible to reduce the risk of exposure. We should note that present control interventions are based on symptoms. Primary screening is performed for patients with relative symptoms, such as fever and cough. Asymptomatic carriers, may be a blind spot of COVID-19 screening, leading to an unanticipated resurgence (20). Exposure risk evaluation and contact history inquiry can help to identify some asymptomatic patients, but the rest may be a threat to medical security. Although most of the asymptomatic patients are in the incubation period, and will develop relative symptoms later, we are still concerned about the presence of chronic asymptomatic carriers, just like Typhoid Mary.

Abating spread has not been observed all over the world, and limitations of medical resources may not be improved in a short time period. We still need a long time to overcome this difficulty. The present suggestions are based on published studies and our experience in clinical practice during the COVID-19 outbreak in China. We wish that these recommendations are useful in the battle against COVID-19 infection around the world.

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