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Prevention and control strategies of general surgeons under COVID-19 pandemic



Fenglin Liu^a, Weibin Wang^b, Hong Yu^c, Yong Wang^d, Wenming Wu^b, Xinyu Qin^{a,*}, Yupei Zhao^{b,*}

^a Department of General Surgery, Zhongshan Hospital, Fudan University, Shanghai, China

^b Department of General Surgery, Peiking Union Medical College Hospital, Chinese Academy of Medical Sciences, Beijing, China

^c Department of General Surgery, Sir Run Shao Hospital, School of Medicine, Zhejiang University, Hangzhou, Zhejiang Province, China

^d Department of Bariatric & Metabolic Surgery, Fourth Affiliated Hospital, China Medical University, Shenyang, Liaoning Province, China

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ABSTRACT

The novel coronavirus SARS-CoV-2 and the disease caused by it, COVID-19, have spread to virtually all countries worldwide within just a few months. The economic and sanitary impact has been enormous. In March 2020, the World Health Organization declared COVID-19 a pandemic. How to effectively prevent and control SARS-CoV-2 transmission while providing care to surgical patients during the pandemic is a crucial topic. In order to minimize the risk of cross-infection between patients and physicians, many hospitals have taken measures to limit outpatient services, elective hospitalizations, and the number of operations. Based on the prevention and control measures stipulated by major medical institutions in China, this overview provides recommendations for surgeons from three aspects: outpatient treatment, ward management and perioperative protection. Telemedicine should be encouraged as a means of social distancing. Outpatient examination should be selected. Reasonable spatial arrangement and effective environmental disinfection are important for ward management. Patient selection for surgery and timing of operations should be carefully discussed within multi-disciplinary teams. Appropriate personal protective equipment should be worn adapted to the situational risk.

On December 31, 2019, China reported to the WHO Country Office a pneumonia of unknown cause detected in Wuhan [1,3]. Subsequently, the disease later named COVID-19 affected a substantial proportion of the population in Wuhan and spread to other areas of China. Relying on a nationwide shutdown and mandatory quarantine, China has effectively curtailed the domestic outbreak. However, due to the high transmissibility of SARS-Cov-2 and the mobility of people, COVID-19 spread to the rest of the world. Many hospitals worldwide were faced with confirmed and suspected SARS-Cov-2 infections, putting a huge strain on the safety of patients and employees. Consequently, surgical patients who seek medical care during the COVID-19 pandemic present significant challenges. This paper summarizes medical care and infection prevention and control in general surgery patients during the COVID-19, pandemic in the light of the current situation in China. It provides reference for surgeons and decision makers in health care in other countries suffering from the COVID-19 pandemic.

1. Outpatient treatment

1.1. Advocate telemedicine

Given sufficient availability of internet access, telemedicine (including online consultation, Cloud Computing in Healthcare,) can optimize the prevention and treatment of outpatients during the pandemic. The main benefits of contactless treatment include: (1) guiding patients with surgical diseases from their homes to the nearest appropriate medical facility; (2) reducing unnecessary visits to the hospital for mildly symp-

tomatic patients or asymptomatic follow-up; (3) saving hospital protective materials.

1.2. Improve outpatient medical history collection

According to the epidemiological characteristics of COVID-19, it is important to inquire whether there is a history of travel or residence in an endemic area as well as a history of contact with suspected or confirmed cases within the prior two weeks [2]. In addition, fever, fatigue, dry cough, anosmia and dysgeusia as typical clinical symptoms, should

* Corresponding authors.

E-mail addresses: qin.xinyu@zs-hospital.sh.cn (X. Qin), zhao8028@263.net (Y. Zhao).

Table 1
COVID-19 Related Personal Protection Management [11].

Protection Level	Situation	Protective Equipment	Scope of Application
Level I protection	General outpatient department	<ul style="list-style-type: none"> • Disposable surgical hood • Disposable surgical mask • Work uniform • Disposable latex gloves or/and disposable isolation clothing if necessary 	<ul style="list-style-type: none"> • Pre-examination triage, general outpatient department
Level II protection	Operating with the risk of exposure to the patient's blood, body fluids and excreta	<ul style="list-style-type: none"> • Disposable surgical hood • Medical protective mask (N95) • Work uniform • Disposable medical protective uniform • Disposable latex gloves • Goggles 	<ul style="list-style-type: none"> • Fever outpatient department • Isolation ward area (including isolated intensive ICU) • Non-respiratory specimen examination of suspected/confirmed patients • Imaging examination of suspected/confirmed patients • Cleaning of surgical instruments used with suspected/confirmed patients
Level III protection	Operation of suspected or confirmed patients	<ul style="list-style-type: none"> • Disposable surgical cap • Medical protective mask (N95) • Work uniform • Disposable medical protective uniform • Disposable latex gloves • Full-face respiratory protective device or powered air-purifying respirator 	<ul style="list-style-type: none"> • Staff performing procedures such as tracheal intubation, tracheotomy, bronchoscope, gastroenterological endoscope, etc., during which respiratory secretions or body fluids/blood from suspected/confirmed patients may be sprayed or splashed • When the staff performs surgery and autopsy for confirmed/suspected patients • When the staff carries out nucleic acid tests for COVID-19

be asked for. Abdominal examination should be used to distinguish fever caused by surgical disease. For example, appendicitis, cholecystitis, ileus and other common diseases of general surgery, in addition to fever, are accompanied by abdominal symptoms. Moreover, there is evidence that a small number of COVID-19 positive patients were first treated with non-specific gastrointestinal symptoms such as nausea and diarrhea [4]. For example, the first confirmed case of COVID-19 in the US reported a 2-day history of nausea and vomiting [5]. Therefore, more attention should be paid to screening outpatients with fever and gastrointestinal symptoms for COVID-19.

1.3. Personal protective measures for outpatient departments

Outpatient departments should implement level I protection (listed in Table 1), including disposable surgical hoods, masks and uniforms, disposable latex gloves or/and disposable isolation clothing if necessary. Scientists have isolated SARS-CoV-2 in the stool of patients with abdominal symptoms, which indicates the possibility of fecal transmission of SARS-CoV-2. Therefore, it is recommended to wear double gloves for digital rectal examination, and implement strict hand hygiene after the examination.

1.4. Selection of outpatient examination

The latest version of the Chinese COVID-19 diagnosis and treatment program suggests that a CT scan of the lungs has diagnostic significance for COVID-19 [6]. Thus, it is recommended to perform a combined chest and abdomen CT scan for outpatients planned for general surgery, in order to identify primary disease and screen for COVID-19. More recently, Tan et al. isolated live virus from the stool of COVID-19 patients [7]. Hence, PCR stool testing is recommended for patients with gastrointestinal symptoms combined with fever.

Endoscopy is an important auxiliary diagnosis and treatment technique for surgical diseases. During the examination, contact with respiratory and digestive tract secretions potentially poses a high risk of infection. Thus, it is not recommended to perform without an urgent

indication. Elective endoscopies should be postponed. In our institution, the three most common complaints of patients with pathological findings on esophagogastroduodenoscopy are dysphagia, recurrent melena or moderate/severe occult anemia, and abnormal imaging results. For pathological findings on colonoscopy, typical symptoms are hematochezia, dysentery and abnormal imaging results [8]. Hence, digestive endoscopy can be considered in outpatients with these symptoms. Medical history and physical examination are important for the appropriate selection of patients with an urgent indication for endoscopic procedures.

2. Ward management

2.1. Spatial arrangement

During the outbreak, the ward can be divided into an emergency management area, observation area and safety area [9]. The emergency management area mainly hosts emergency patients who have not yet been screened for COVID-19. The observation area is mainly for the intensive observation of newly admitted patients for two weeks. After the medical observation period, patients in the observation area with negative SARS-CoV-2 test will be assigned to a safe area. It is recommended to implement single rooming or occupy only every second bed for inpatients in the emergency management and observation areas. This spatial partition provides a time and space buffer for further COVID-19 observation and screening, and decreases the risk of hospital infection to some degree.

2.2. Staff management

Each inpatient is allowed to designate only one fixed caregiver at most if there is a strong medical or psychosocial requirement for receiving a visit. Both the patient and the visitor must undergo screening and wear disposable surgical masks. In principle, the patient is not allowed to leave the ward during the hospitalization [10]. Medical staff in the ward should routinely wear a work uniform, disposable hoods and surgical masks. When being at risk of exposure to the patient's blood, body

fluids and excreta, level II protection (listed in Table 1) should be used: disposable latex gloves, goggles, disposable medical protective uniform [10]. In addition, the temperature of medical staff and patients in the ward should be monitored and recorded daily. Once fever or respiratory symptoms appear, medical staff should be arranged to rest and take further screening for COVID-19.

2.3. Environmental disinfection

The ward should be ventilated with an open window at least two times a day, each time for 30–60 min. It is also recommended to disinfect the ward with air sterilizer. The treatment and changing rooms are to be irradiated by ultraviolet light one to two times a day, not less than 30 min each time [6]. The floor, table, door handle and other frequently touched items on the ward should be cleaned with 1000 mg/L chlorine-containing disinfectant. The disinfection time should be no less than 30 min, three times a day. Moreover, the disinfection should be carried out at any time when contaminated. For spills of a small volume (<10 mL) of blood/body fluids from patients with COVID-19, it is advisable to cover the spills with chlorine-containing disinfecting wipes (containing 5000 mg/L effective chlorine). They should be carefully removed, then the surfaces of the object should be wiped twice with chlorine-containing disinfecting wipes (containing 500 mg/L effective chlorine). For spills of a large volume (>10 mL), the spilled fluids should be absorbed for 30 min with a clean towel (containing peroxyacetic acid that can absorb up to 1 L of liquid per towel) and then the contaminated area should be cleaned after removing the pollutants [11].

3. Perioperative measures

3.1. Selection and timing of operation

Elective surgery should be postponed until the ease of the pandemic if no serious influence on the patient's prognosis is expected. For semi-elective surgery, the time of surgery can be postponed under the premise of fully controlling the disease progress and treatment effect. For example, the timing of the operation of patients with early tumors can be adjusted according to expected tumor growth [12,13]. In patients with advanced tumors, if guidelines stipulate neoadjuvant therapy as an equivalent treatment option to upfront surgery, the former can be preferred over surgery if it can be administered in a setting with a low risk of SARS-CoV-2 infection. Yet, the presumed risk of metastasis or the probability of a growth beyond resectability in case of an undue delay of the operation should also be taken into account. Multi-disciplinary team (MDT) discussions are helpful to provide perspectives on which operations could be postponed for how long without jeopardizing short- and long-term outcomes. Of course, patients suffering emergent conditions such as hemorrhage, acute cholecystitis, digestive tract perforation, or intestinal obstruction should be immediately operated on the basis of standard protective measures.

3.2. Pragmatic aspects during perioperative period

- 1) Respiratory care: It is important to focus on the exercise of respiratory function of surgical patients in the perioperative period. This holds especially true for elderly patients, smokers and patients with pulmonary diseases. Specific measures include smoking cessation, active coughing, deep breathing training, sufficient postoperative analgesia, artificial back patting, and the use of expectorants [14].
- 2) Management of pneumoperitoneum during laparoscopy: Since the artificial pneumoperitoneum can lead to decreased lung volume, increased airway pressure, CO₂ retention and decreased lung compliance, the indications for open instead of laparoscopic surgery should be appropriately adapted. In patients undergoing laparoscopy, CO₂ ventilation and pneumoperitoneum pressure should be kept at the lowest possible levels under the premise of ensuring the exposure of

the operative field. Reduction or avoidance of prolonged Trendelenburg position during surgery is beneficial to prevent postoperative pulmonary complications as well.

- 3) Reduction of aerosol production: During the operation, keeping electric knives, ultrasonic knives and other instruments at an appropriately low power, avoiding prolonged cutting and coagulation, and evacuating exhaust fumes in time can reduce aerosol production. Besides, during laparoscopy, the pneumoperitoneum which potentially contains aerosols should be evacuated with a laparoscopic suction device prior to trocar withdrawal at the end of the procedure.
- 4) Fecal disposal: A cohort analysis of 55 COVID-19 patients in Hong Kong indicated that stool was positive for viral RNA in 9 (15.3%) patients. The proportion of patients with detectable viral RNA in stool was higher among those with diarrhea than those without [15]. The high expression of ACE2, which serves as receptor for SARS-CoV-2, in the stratified epithelial cells and absorptive enterocytes of the ileum and colon [16] may explain the fecal nucleic acid test results and gastrointestinal symptoms, indicating a potential risk of fecal-oral transmission. Consequently, an intraoperative exposure to gastrointestinal contents increases the transmission risk during surgery. Therefore, an adequate preoperative bowel preparation (adequate fasting time, enema) and routine intraoperative gastrointestinal decompression (gastric tube insertion) are recommended. Fecal matter and gastrointestinal contents of suspected/confirmed COVID-19 patients shall be collected into special containers and disinfected for 2 h with a 20,000 mg/L chlorine-containing disinfectant at a spill-to-disinfectant ratio of 1:2 during the operation [11].

3.3. Intraoperative protection measure

It is suggested to set up a specific one-way operation channel, and to use chlorine-containing disinfectants to sterilize the passageway and the floor, wall and surfaces of the operating room. The operation should be carried out in a negative pressure operating room as far as possible. One should be alert to the possibility of asymptomatic infection in non-suspected patients, and adopt level II or higher protection in all cases. During the operation of suspected or confirmed patients, the medical personnel should implement level III protection measures (including disposable surgical hood, medical protective mask (N95), work uniform, disposable medical protective gown, disposable latex gloves, full-face respiratory protective devices or powered air-purifying respirator as listed in table 1) [11]. When the anesthesiologist carries out high-risk procedures, such as endotracheal intubation and tracheotomy, all personnel not disposing of level III protection should maintain a safe distance [17].

Currently, the need for COVID-19 prevention and control remains high. In many countries, the number of infected cases has increased or continues to increase exponentially. Some countries are still in the early stages of the pandemic with a passive prevention and control situation. The worldwide spread of COVID-19 is expected to continue for months. Faced with this challenge, countries should strengthen international cooperation and share their experience sharing as well as attach importance to the improvement of their domestic public health systems. For surgeons, the principles of clinical work must be adjusted in order to keep pace with the COVID-19 pandemic. The combination of offering medical care for surgical patients and controlling the COVID-19 pandemic has become a necessary ability of surgeons.

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