Review Article

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Anesthesia and COVID-19, Peri-Operative Challenges and Recommendations

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ABSTRACT

The pandemic outbreak of coronavirus disease (COVID-19) has challenged medical professionals and clinicians globally. It is the third infectious disease to happen in the past two decades. With the spread and pandemicity of COVID-19, medical practitioners, hospital administrators, governments, policy makers, researchers have been involved in fighting the disease and saving the lives of people. Despite its contagious features, the very rapid spread of the disease has forced clinicians to manage the disease without evidence-based guidelines. From anesthesia and critical point of view, several consensuses have been generated on the anesthetic management of covid-19 patients based on expert opinions and existing data about the disease. This review tries to focus on the collective overview of the challenges and key recommendations for the anesthesia and critical points which are spread during the perioperative anesthetic management period while caring patients with suspected or confirmed cases of the coronavirus disease made after reviewing literatures available. Several recommendations have been made for the system of isolation and management of patients and it may vary from place to place depending upon the local practices and resource availability. The recommendation has been continually changed and updated as more is still being known about the disease.

Keywords

Covid-19, Contagious disease, WHO, Symptoms.

List of abbreviations

COVID-19: Coronavirus Disease 2019; ETT: Endotracheal Intubation; HEPA HME: High Frequency Particulate Air Heat & Moisture Exchanger: HMEF: Humidity Moisture Exchanger & Filter; ICU: Intensive Care Unit; IV: Intravenous; MERS: Middle East Respiratory Syndrome; PARs: Powered Air Purifying Respirators; PPE: Personal Protective Equipment; RSI: Rapid Sequence Induction; SARS: Severe Acute Respiratory Syndrome; SARS-CoV-2: Severe Acute Respiratory Syndrome-Coronavirus-2; WHO: World Health Organization.

Introduction

Coronavirus disease (COVID -19), a contagious disease caused by the newly identified novel coronavirus (SARS-CoV-2), was initially isolated and identified from Wuhan patients, in China [1-3]. It was then officially named 2019 novel coronavirus disease (2019-nCoV) by the World Health Organization on 11 February 2020 [4]. The outbreak of this still ongoing novel disease was reported in the city of Wuhan in Hubei province, China, in December 2019 [5-7]. It didn't take long for the disease to be labeled as an international public health emergency [8,9] and was declared a pandemic by the WHO on 11 March of 2020 [4]. As of December 01, 2020, a total of 63, 658, 833 laboratory confirmed cases have been reported worldwide, with 1, 475, 636 deaths and 105, 923 (0.6%) cases being in a critical condition [2,10]. Coronavirus disease is the third infectious disease to happen in the two decades following SARS and MERS [11]. The disease occurs in all age groups including children, although more serious clinical symptoms are seen in adults [12-15]. Patients present with varied clinical symptoms in which most of these symptoms are respiratory tract symptoms, including fever, dry cough, and shortness of breath; and multiple mottling and ground-glass opacities on chest CT scans has also been reported [3,5,16-22]. The x-ray findings are consistent with pneumonia [19,20]. The clinical features were initially reported in January 2020 on 41 laboratory-confirmed patients in the city of Wuhan, and it was described that the manifestations in the severe cases were more or less similar to those of severe acute respiratory syndrome [5]. Treatment is largely supportive, and treatment protocols are extremely dynamic and are continuously evolving as the world searches for a way to treat COVID-19 [20].

Patients with severe conditions of the disease develop acute respiratory distress syndrome, septic shock, metabolic acidosis, and coagulopathy, thereby requiring intensive care admission and extensive care. Such care includes oxygen therapy, intubation, sedation, endotracheal intubation, mechanical ventilation, and advanced therapies such as pulmonary vasodilators, prone positioning, cardiovascular support, and even experimental antiviral therapy [7,17,20]. Evidences of human-to-human transmission were found to exist during earlier times [3,8,16,18]. The mechanisms of transmission of the disease has been explained to include droplet contact and the possibility of airborne transmission has also been explained [7,23-27]. Droplets are heavy and usually disperse within a maximum two-meter radius after coughing and sneezing by an infected patient [3]. The people most at risk of acquiring the infection are those who are in close contact with and those who give care to a COVID-19 patient [27].

Infection transmissions among hospital staff were also initially reported and many health workers have been reported to be infected by the virus while caring for infected patients [2,3,8,28,29]. Asymptomatic transmission of the disease has been a significant risk to health care workers [13,14]. A report of asymptomatic case exists in which these cases were with high viral load for 16 days despite being asymptomatic and appearing well [30]. Therefore, such higher risks require to follow appropriate infection control precautions even in the absence of elements of the case definition, especially in areas with high community spread to protect themselves and contaminating the healthcare setting [19,27,31].

Emergency and intensive care departments are needed to prepare themselves with airborne isolated rooms where the suspected cases can be placed in immediate isolation. Patients who are considered as potential cases may present to the emergency department either by themselves from the community or they may be transferred from another site. In such a situation, routine careful questioning about their exposure history and screening is critical to ensure appropriate infection control precautions. Those in the front line should also be given full authority to isolate such suspected cases. Patients need to be immediately isolated in an airborne isolation room if available. The isolation room should be a single room with possible negative air flow and frequent air exchange. In the event in which an airborne isolation room is not available, the patient should be placed in a single room with closed doors [19]. Negative pressure rooms are also prioritized for all high-risk procedures [20].

Personal protection should also be a priority. Enhanced Personnel protection should be available and those who are supposed to have an initial contact with such suspected cases should wear their protective (PPE) wear before they make their initial contact. Precautions to be implemented by the care givers include selecting proper PPE wear and being trained in how to put on, remove, and dispose it. Anterooms with sufficient space to put on and remove the PPE should also be available adjacent to the airborne isolation rooms [7,19,25,27,31,32]. Many countries have been through a crisis and many institutions have been experiencing PPE shortages and many care providers have been forced to work in a resource-constrained environment and frequently reusing equipment. Meanwhile, staff safety should be given the highest priority. Since the outbreak, many manufacturers, donations, and stockpiles have been involved in supplying the PPE. Yet, it has been a challenge especially in poorly supplied places. A lot of health professional has been victims of the disease morbidity and mortality.

It has been reported during the earlier times that nearly 10% health care workers in Italy and 14% in Spain have had a history of morbidity and mortality [20,33]. Inadequate PPE, high burden and extensive exposure to the viral particles with deeper lung penetration are among the bigger challenges to the health care professionals. Considering such inadequacy, it has been recognized to balance the need of PPE use for routine care in asymptomatic patients with future demand for COVID-19 patients [34]. It has been suggested by the WHO and other bodies on the wise use of such protective equipment. PPE should be used based on risk exposure and transmission dynamics of the virus. The need for PPE also should be minimized by limiting the number of professionals to a minimum and the number of cases should be in the fewest possible rooms to conserve the PPE. Those who are not involved in direct care should be restricted from entering the rooms. Monitoring and controlling the distribution of PPE is also important. One of the big challenges in dealing with this pandemic is to set strategies for training the clinicians on how to safely remove the PPE without self-contamination, and setting protocols for cleaning the devices for next use. A proper guideline and PPE coach should be available and the distribution of PPE should be monitored and controlled so that it is not wasted. The protocols for donning and doffing should be reviewed with careful attention to avoid self-contamination [19,27,31,32].

Considering all the potential risks, a global need has surged for guidance of airway management during this pandemic and many consensuses has been made to develop a guideline on airway management during aerosol generating medical procedures in anesthesia. As anesthesia providers always work with patient's airway, the risk is particularly high, thus it is important for the anesthetist to introduce cautious practices including minimizing aerosol generating procedures especially during general anesthesia such as bag mask ventilation, positive pressure ventilation with a mask, open airway suctioning, and endotracheal intubation and management of tracheostomy tubes which are potential causes of the virus [9,35-38]. As the disease continues across the world, many organizations have implemented simulation sessions on the procedure of wearing on and taking off the PPE and airway management. It is important that the simulation to reflect the specific role of the health care team. The anesthetists need to focus on airway management while wearing full appropriate PPE, and minimizing the exposure and spreading of the virus in the perioperative environment [39].

Considering the rapid transmission of the disease, several precautions, guidelines, and recommendations have been drafted and pronounced related to emergency intubation, preoperative evaluation, and infection control in the operating room and prevent nosocomial transmission. The existing recommendation has been spread during the whole perioperative anesthetic practice starting during preoperative assessment of the patients, administrating anxiolytic medications, transporting patients to the operating room, induction of patients, tracheal intubation, use of suction catheters, and transporting patients to post-operative rooms. The Goals to be reached and maintained during care include minimizing aerosolized respiratory secretions, minimizing the number of clinicians in contact with a patient, and recognizing undiagnosed asymptomatic patients who may shed the virus. After reviewing different available literatures, this article tries to present the collective overview of the challenges experienced and the key recommendations made in the management of covid-19 patients from the anesthesia and critical care point of view.

Preoperative period

The anesthetist encounters the patient during the preoperative period while the patient stays in the isolation room and as mentioned earlier, the anesthetist is required to comply with infection control measures and prevent any personal and environmental contamination. Safety precautions and infection control measures have been suggested and those who come in contact with confirmed or suspected cases have been required to comply with these measures [9]. The patient should be kept in limited places to limit contamination to a single location only [9,40].

Generally, the risk of acquiring an infection in the operating room is low, which is associated with meticulous infection control precautions and practice, no matter the amount of time the procedure takes [17]. However, with the rapidly increasing number of covid-19 cases, it is expected that anesthesia practitioners to encounter more of these patients, even those patients who present with other conditions. Moreover, as asymptomatic cases have been reported and as it takes some days to develop the symptoms, it makes it more challenging to identify and isolate those who carry the virus. Therefore, heightened precaution is required during anesthesia practice to reduce exposure and avoid the risk of perioperative viral transmission to health care workers and other patients [9].

Preoperative assessment

The anesthetist who takes care of the covid-19 suspected or confirmed case should be someone who is well experienced in both general and regional anesthesia techniques and the technique selected should be one which is best suited for the patient and the type of surgery with the least risk of viral transmission. The type of operation should also be evaluated [9]. For example, elective surgical procedures have been suspended in many settings. A good airway assessment has a vital importance [7]. Consent taking in many institutions is paper based and this could lead to paper contamination and infection transmission. To avoid this, the reading and writing materials need protection that it was recommended after their printing to be laminated and mounted in care locations [31]. Depending on the availability, it has also been suggested to use digital consent forms like laptop or mobile which can be protected by single use plastic wraps [9]. Premedication may help to reduce the anxiety of patients and to increase their compliance with the preparatory anesthetic procedures. Such pre-medicant may be more beneficial in children as it reduces the risk of vigorous crying of the child and avoids the need of physical restraint on the children. Nasal administration of premedication is undesirable because of the potential for high viral loads and the risk of coughing and sneezing [31].

Patient transport

After the completion of the assessment, patients may need to be transported to the operating theatre for their surgical needs. Different settings use different ways of transporting patients depending upon the infrastructure of the setting and availability of materials required during transport. Generally, transport should be made in a way in which it prevents the cross contamination of the disease. Patients have been made to be transported along a designated route so as the contact with other people is controlled. The transport is made by an infection preventing nurse and a security personnel who is responsible in preventing environmental contamination and ensure compliance with infection control measures [9]. To minimize the risk of transmission, those patients who fall in the need of supplemental oxygen can be given via nasal prolongs under the surgical face mask to reduce dispersion of the virus with the exhaled air [19,41-44]. When the flow rate of the delivered oxygen is increased, it increases the dispersal distance, thus needing to be minimized and controlled [45].

Intraoperative period

Preparation time

It is preferred for the operating room to be a negative pressure for all proven or suspected cases if feasible [46]. The airflow in hospital rooms can dramatically enhance the risk of nosocomial transmission [47]. During the prior SARS outbreak, hospital engineers were able to create negative airflow isolation rooms [48]. It is also important to ensure adequate air exchange and filtration time of the operating rooms before cleaning and preparing for the next case [46]. If negative pressure operating rooms are not available, high-efficiency particulate air (HEPA) filters that sufficiently filter the operating room's square footage were used. Additionally, try to avoid rooms with connected ventilation systems [31]. All equipment and drugs should be prepared and should be readily available before the start of any procedure. Single use equipment should be selected for use to avoid contamination. The number of personnel in the operating room should be kept to a minimum. Clinicians in the room must apply appropriate PPE and careful planning of the intervention is required [9,19,40].

Once the patient is in the operating room, it is important that the contact with the items in the room to be reduced. Adequate preparation ahead of a time reduces the contact and reaching into different parts of the room like shelves, drawer, and bins. Trash cans and waste containers should be readily available nearby and be open to avoid dropping onto the floor. For equipments that require touching, such as a touch screen monitor, a plastic shield should be placed over the screen to minimize contamination. Personal equipment including keys, cell phones should be left outside the operating room and clinicians may use emergency phones for communication purposes [31].

As a recommendation for infection control precautions, the recommended PPE needs to be worn before coming in contact and specially during airway manipulation of confirmed or suspected cases of the virus. The recommended PPE would include a fluid resistant gown, gloves, eye protection, full face shield, and fit-tested N95 respirators, head covers as well as footwear. A double glove technique may also be adopted, in which the other glove will serve to pack the utilized airway device right after the procedure [32]. Depending on availability, the PARS (powered air purifying respirators) may also be worn as they offer superior protection when manipulating the airway. It is believed that PARSs reduce the likelihood of viral transmission and has a higher protective ability as it can be more comfortable to wear for prolonged resuscitations, which eliminate concerns of poor N95 respirator fit as it is less likely to be dislodged when managing an agitate patient [32]. PARS with hoods which cover the entire head and neck, may also provide additional protection [49]. It is preferable for the gloves to be long sleeved and this prevents exposure of the wrist due to glove slippage or the gloves may be striped vertically with the gown as an alternative. The eyes should also be protected by wearing side shields or goggles. Moreover, full face shields would also provide full face protection, protecting the eyes and facial contamination as well. It is preferred to wear a shoe which is impermeable to fluids and which can be decontaminated. Wearing a disposable shoes may expose to self-contamination while removing the clothing [19].

Induction

COVID-19 patients should be sedated with caution as they could also have superimposed respiratory compromise, with close monitoring of oxygenation and ventilation [9]. Inhalational induction, especially in children, may increase exposure to respiratory droplets and aerosols, and it has been suggested that IV induction would be preferred. A child may get anxious, cry and get agitated during the routine pre-induction stage and even during an IV induction, which makes it less desirable as it enhances exposure to respiratory droplets. It is strongly recommended to use rapid sequence induction (RSI) during intubation, although it might be difficult in patients with an already diseased lung and in children [31]. RSI avoids manual ventilation of the lungs and potential aerosolization of the virus from the airway. Meanwhile, RSI may need to be modified depending upon the clinical condition and if manual ventilation is needed, it could be continued by applying small tidal volumes [7,32]. Gentle positive pressure ventilation and giving enough tidal volume to rise the chest while maintaining a tight mask should be followed [31]. Since a bag mask may generate aerosols, the need of a bag mask could also be avoided or minimized through adequate pre-oxygenation before laryngoscopy [19,50]. If anesthesia has to be induced through a mask, clinicians should use the lowest possible flow rate while maintaining a tight mask seal [31]. When a bag mask is used, a filter should be put between the mask and the bag [19,50]. A high frequency particulate air heat and moisture exchanger (HEPA HME), which is a high quality filter, should be attached one between the breathing circuit and the patient's airway and another one at the end of the expiratory limb at the connection point with the anesthesia machine to filter the air. The line for capnography should be attached to this line so that the line may not get contaminated [9,31]. During the outbreak of SARS, oxygen therapy was mentioned to be an independent risk factor for the spreading of the infection [23].

Intubation

Management of patients requires intubation or warrants specific caution and should be undertaken in an airborne isolation room [19]. Airway management should be led and attempted by the most skilled anesthetist to optimize first attempt success [19,32,35,51,52]. The number of personnel should be minimized especially at the time of intubation to decrease the risk of viral transmission. A good preparation of the airway device and detailed intubation plans should be made and the necessary equipment should be prepared ahead of time. If the sedation during induction is inadequate, the patient may get agitated and interfere with the procedure and even dislodge the PPE [19]. Awake fiberoptic intubation, unless indicated specifically, should be avoided. In situations when PPE cannot be applied safely, it is important to consider intubation early to avoid the risk of crush intubation, which would maximize the risk of exposure. Adequate muscle relaxation should be assured before intubation [7,32].

Video laryngoscopy assisted intubation with the video display away from the patient is largely supported as it reduces the close proximity of the intubating personnel to the patient's airway. A transparent plastic barrier could be applied around the patient and anesthetist hands from the elbow may pass through to reach the patient to ventilate and intubate. This barrier may trap the virus reducing exposure and extensive contamination of the operating room [19,31,32,50,53]. Such a procedure is also supported by the WHO as it supports the guideline to use rational use of PPE through the use of physical barriers [27]. A cuffed tracheal tube is an ideal device to secure the airway, especially in children. Depending upon a procedure and patient condition, a supraglotic airway device is also acceptable in some places as it has minimal aerosol dispersion risk [31]. Since open suction is a risk for aerosol creation, an inline closed suction system is preferred [35,51,52]. The barrier or protective equipment may prevent from doing auscultation to confirm correct tube placement, but it can be assessed by checking the end tidal CO_2 [19,50]. Careful observation of bilateral chest rise should also help. A portable radiograph or an ultrasound or a wireless stethoscope may also be used to assist in determining the correct placement of the tube and tube depth [31,50]. Inspired and expired tidal volumes may also be monitored using the ventilator's monitor and this helps to identify leakage from the tubes. If a patient in the ICU needs to go to the operating room for surgery, it is preferred that the patient to get intubated while being in a negative room in the ICU [31]. After securing the airway, the laryngoscope may be re-sheathed immediately and the double glove technique could be helpful for this. All used equipment should be packed in a plastic bag and it must then be removed for decontamination [32]. The anesthetist should consider the benefits and risks of administering additional sedation or neuromuscular blocking agents to prevent coughing, bucking, or any agitated movement of the patient [31]. It is highly recommended that anesthetists to wear the full PPE during the entire operative period as there could be risks of accidental disconnection or extubation or risk of aerosolization from the procedure such as airway, laparoscopic and endoscopic procedures. It has been suggested to use transparent barriers over the airway device and the patient's head to trap the aerosolized virus and some have used wet towels or gauze for similar purposes [54].

Extubation & Emergence

During extubation and emergence, the anesthetist should use closed in-line suction and this minimizes aerosolization during suction procedure. The suction device should be placed under the protective barrier to create a negative pressure microenvironment which could scavenge the droplets and aerosolized materials [31]. Deep extubation should be considered to minimize coughing and bucking during emergence [55]. Although deep extubation can be done, patients may still cough during the subsequent emergence and recovery from anesthesia, thus protective measures should be continued in all stages of care [27].

Regional anesthesia advantages

Regional anesthesia avoids aerosolization and the risk of viral transmission is very much reduced, thus should be considered whenever surgery is planned to such kind for patients [9]. Although regional anesthesia procedure is not an aerosol-generating procedure, it requires for the anesthetist to wear at a minimum a PPE, goggles and surgical face mask. The protective wears may reduce vision, and impede the performance of the anesthesia provider and the time to perform the block may be prolonged. The anesthesia provider may also not be able to hear adequately to the team members and movement is restricted, and the heat and stress created being in that wear may affect the concentration and performance of the anesthesia provider. The number of health personnel in the room should be limited and those who are available should wear contact and droplet precautions. The patient should also wear a surgical mask at all times to limit droplet spread [9,56-59].

In obstetric anesthesia, labor under neuraxial analgesia remains the mainstay of obstetric care with concurrent COVID-19 infection. Placing an epidural line is considered as desirable as it is helpful to avoid exacerbation of respiratory symptoms with labor pain. It also reduces the likelihood of undergoing general anesthesia and airway manipulation. The possibility of thrombocytopenia to be associated with COVID-19 infection has been discussed, thus it is important for a COVID-19 parturient patient to have a checkup prior to the placement of neuraxial analgesia. A platelet count on admission is suggested, without the need to check serial counts prior to needle placement unless there is a major change in clinical symptoms. Generally, it is safe to consider a neuraxial procedure at a platelet count of $70{,}000*10^6$/L and above. However, the risk of spinal or epidural hematoma is rare while the risk of respiratory compromises with general anesthesia is much higher. Thus, neuraxial procedures should also be considered even at lower platelet counts [59]. It is important to do ongoing follow-up and assessment of both maternal and fetal status to avoid the risk of prolonged labor and caesarian delivery. It also helps to plan ahead of time and prepare ultimately incase the mother requires cesarean delivery. In conditions during mechanical ventilation, a multidisciplinary approach should be considered to determine the fetal monitoring and to make a delivery plan. Routine monitoring of vital signs with additional continuous pulse oximetry and strict input and output measures is suggested. The goal of pulse oximetry is oxygen saturation of 95% and above. The practice of high flow oxygen for fetal distress does not improve fetal outcomes and should be suspended due to the risk of aerosolization. When urgent caesarian delivery is required for a patient with unknown status, it is recommended for all providers in the operating room to wear airborne protection (N95 respirator mask). Generally, neuraxial labor analgesia is strongly recommended to minimize exposure and spinal anesthesia may then be given if needed. Moreover, if it is necessary to initiate general anesthesia, the general recommendations should be followed [59].

Regarding peripheral blocks, the ultrasound machine used for nerve block has numerous surfaces that could be harbored by droplets and could serve as a reservoir for the virus. As it is not easy to reach all the surfaces of the machine for decontamination, the machine has been made to be covered by single use plastic covers. The probe that comes in contact with the patient is also covered its entire length with a single use plastic covers to avoid probe contamination. After the producer, the plastic covers should be removed and discarded in a clearly labeled biohazard bin and the machine should be wiped with appropriate disinfectant. It has also been made to be left in the operating room for more sterilization through ultraviolet radiation before it is used in another patient. When assessing the effect of the regional anesthesia, if a reusable equipment is used it should be placed in disposable plastic bags or single use equipment may be used instead and discarded after single use [9,60].

Postoperative period

After the surgical procedure is finished, the patient should be made to stay in the operating room for recovery so the other areas will not get contaminated [9]. Patients may get transferred directly to the inpatient ward bypassing the post-anesthesia care unit if possible, so that the space in which the coronavirus patient would be available is limited and exposure is minimized [31,32]. Patients with the need of mechanical ventilation during their transportation should be transported with a ventilator having a viral filter attached on the patients side of the Y-piece as well as the expiratory limb of the breathing circuit [61]. If a transport ventilator is not available, the viral filter could be attached to the tracheal tube during transport. This may increase the dead space which could be significant especially in small children, but it is still a choice. A high quality HMEF (Heat and Moisture Exchanger Filter) is recommended, which is believed to remove up to 99.9% of airborne particles should be placed between the ETT and the reservoir bag during transfer so that contaminating the environment is avoided. If the patient has come from the ICU, extubation may be done on the ICU and the anesthetist may be called for extubation of the patient. After removing the protective equipment, it is important to remember not to touch the hair or face before a proper hand hygiene is performed [31,32].

Conclusion

This review has been made by reviewing several online available articles. However, since the pandemic still hangs around and information is still evolving, not all the exiting information is included here and more updated information may be added as more is learnt about the virus. It is important that each hospital needs to adapt a guideline based on local conditions, availability of equipment, and prevalence of the disease. These guidelines are made to help clinicians to deliver the best possible and most importantly safer care to their patients. It is hoped that this review would be useful in providing information regarding the challenges and recommendations made to deal with such challenges regarding anesthesia care of suspected or confirmed cases of coronavirus disease.

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