CHAPTER 8

THE POINTS TO BE CONSIDERED IN AIRWAY MANAGEMENT IN ANESTHESIA APPLICATIONS OF PATIENTS WITH COVID-19

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INTRODUCTION

Coronavirus disease 2019 (COVID-19) is a contagious disease that started in Wuhan in late December 2019 and spread all over the world, and resulting in a pandemic being declared by the World Health Organization. COVID-19 also named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), can materialize with symptoms as mild as the common cold or as severe as causing acute respiratory distress syndrome.

Although some information regarding COVID-19 is still unclear, what is certain is that the virus spreads very quickly among individuals. Its transmission occurs by respiratory droplets and contact routes. When a patient who has COVID-19 coughs, sneezes, or talks, the virus is passed on to healthy people via respiratory droplets. Similarly, COVID-19 can also occur when a person touches their eyes, nose, or mouth after touching an infected surface. Therefore, healthcare workers are at great risk against a virus that can spread
so quickly and easily, and those dealing with aerosol-generating procedures should be more careful in this regard.

Aerosol-generating procedures include airway management (e.g., endotracheal intubation, bronchoscopy, or tracheostomy), cardiopulmonary resuscitation, invasive and noninvasive mechanical ventilation applications, endoscopy, and colonoscopy. It is hypothesized that airway management may be one of the most important issues for both patients and healthcare professionals. As such, in this review, airway management in anesthesia applications of patients with COVID-19 will be discussed.

**PREOPERATIVE ASSESSMENT**

Preoperative assessment, which employs a face-to-face interview to assess a patient’s history, symptoms, and laboratory and radiologic parameters, plays an important role in anesthesia applications. However, these interviews are being re-evaluated by practitioners due to the COVID-19 outbreak, and alternatives have been developed. The common idea from the literature is to consider every patient who arrives at a hospital as potentially infected with COVID-19, and therefore attention should be paid to preventive equipment. Furthermore, preoperative assessment of COVID-19 positive or suspicious patients should be done by primary anesthesiologists and the patients’ cardiac and pulmonary functions should be evaluated as a priority.

The South African Society of Anesthesiologists recommend behaving in accordance with a set of guidelines (e.g., wearing a surgical mask, maintaining a distance of > 1 m, hand hygiene) and utilizing a short checklist during the interview. Chinese anesthesiologists recommend measuring the body temperature of patients before preoperative assessment; patients with higher body temperatures (>37.3 °C) should then be consulted by the relevant clinics. Furthermore, Chinese anesthesiologists emphasized the importance of detailed chest examinations. The Indian Society of Anesthesiologists underlined the importance of taking anamnesis in terms of combating COVID-19. Alternatively, Mihalj et al. highlighted the benefits of telemedicine, a technological approach for preoperative evaluations.

In preoperative assessment, one of the most important examinations an anesthesiologist carries out is an airway evaluation to determine possible difficulties for intubation. However, airway evaluation in patients with suspected or confirmed COVID-19 may be risky for the person who undertakes it. During the interview, if the patient has a difficult intubation history or there
is no obvious feature, an evaluation without removing the patient’s surgical mask will be sufficient. On the contrary, if there is a possibility of difficult intubation, a detailed examination is required and all team members should be informed before the operation, and preparations for difficult intubation should be made in the operating room. On assessment of a patient with a difficult airway, the MACOCHA score is clearly useful as the only validated tool. The MACOCHA score consists of seven items over three categories: factors related to the patient (Mallampati class III or IV, obstructive sleep apnea syndrome, reduced mobility of cervical spine, limited mouth opening <3 cm), factors related to pathology (coma and severe hypoxemia), and factors related to the operator (non-anesthetist). MACOCHA scores range from 0 (easy) to 12 (very difficult), and a MACOCHA score above 3 predicts difficult intubation.

PREOPERATIVE PREPARATION

COVID-19 is a highly contagious disease. Hence, airborne precautions and personal protective equipment (PPE) training are two issues that must be considered before operating on patients with COVID-19.

To prevent the spread of infection, it is recommended that airway management and any subsequent operation or interventions should preferably be applied in negative pressure rooms or positive pressure in operating rooms must be turned off. In addition, the doors of the operation room must remain closed.

Furthermore, the number of personnel in the operating room should be kept to a minimum, and all personnel should be wearing appropriate PPE before the patient arrives. PPE includes fit-tested N95 masks or higher level aspirators, disposable head covers, goggles or face shields, waterproof gowns, two pairs of gloves, and shoe covers. In addition, disposable PPE should be changed for every patient, and reusable PPE should be cleaned after each patient. Donning and doffing PPE should be done according to the rules to avoid accidental self-contamination.

Another consideration in preoperative preparation is the anesthesia machines and the drugs and devices used. To prevent contamination of the operating room atmosphere, heat and moisture exchange (HME) filters can be used. A HME filter can eliminate approximately 99% of airborne particles larger than 0.3 microns. However, care should be taken since the properties of HME filters can vary depending on the manufacturer. HME filters can be
installed between tracheal tubes or face masks and breathing circuits, as well as between expiratory limbs and anesthesia machines.

Only essential devices and medications for anesthesia application should be kept in an operating room to prevent contamination. The emergency tracheal intubation kit includes an oropharyngeal airway, a stylet, a bougie, a tracheal tube with subglottic suction, a second generation supraglottic airway (SAG) device, a yankauer suction, tube fixations, lubrication, a syringe, a mapleson C circuit, a videolaryngoscope, and a tube clamp. In addition, the emergency front-of-neck kit (FONA) should be readily available for use and kept in another room to be used in possibly difficult intubation scenarios; if necessary, it can be delivered to the operating room by the personnel present outside. To reduce medication contamination and wastage, the required medications should be prepared by drawing them into syringes and labeling them, and the vaporizer should be filled with the specific volatile agent. Finally, the anesthesia machine and aspirator should be checked to ensure they are functioning.

**FACEMASK VENTILATION**

The prime purpose of airway management of patients with COVID-19 is to apply aerosol-generating procedures (AGP) safely and without increasing the viral load in the operating room. Facemask ventilation is one of the AGPs; however, in the COVID-19 setting, the application of facemask ventilation may be avoided to decrease the viral load in the environment. If facemask ventilation is applied, the following points should be considered.

During facemask ventilation, aerosol generation is associated with peak airway pressure, duration of facemask ventilation, and removal of the mask from the face during the procedure. Additionally, it is inevitable that there will be leakage with masks that do not fit well on the face during the procedure. If a facemask is to be used, it should be done so with the aim of minimizing the spread of aerosol. Therefore, recommendations are as follows: optimal airway position, airway maneuvers, sufficient anesthesia depth, and early use of an oropharyngeal airway. If there is an air leak despite these recommendations, the following points should be considered: repositioning, two-handed two-person bag-mask technique with the VE hand position, neuromuscular blockers, and the use of a SAG device.
ENDOTRACHEAL INTUBATION

Briefly, principles of COVID-19 airway management are expressed as safe, accurate, and swift. In patients with COVID-19, general anesthesia is suggested to decrease both airborne and droplet transmission. It is known that in terms of practitioners’ exposure, endotracheal intubation is a high-risk procedure that can cause the patients to spray secretions or blood, or produce aerosols. Therefore, this procedure should be managed quickly, accurately, and safely by experienced practitioners.

Patient positioning

In general, the head up (including 45°) or ramped position is recommended for all patients, including COVID-19 patients. This is especially important for high-risk patient groups, such as hypoxemic, obese, and pregnant, since they are prone to rapid and profound desaturation during anesthesia induction. These positions seek improved preoxygenation and ventilation; prolonged safe apnea time; and facilitated face mask ventilation, direct laryngoscopy, and tracheal intubation. Sometimes, these positions may not be practical for those performing intubations, and alternative methods such as using elevation pillows or a footstool to provide the optimal height may be considered.

Preoxygenation

In patients with COVID-19, preoxygenation is a recommended practice whereby 100% oxygen is utilized via a tight-fitting mask for five minutes through a closed circuit (an anesthesia breathing circuit or a Mapleson C). The bag-valve-mask method is not recommended because it expels exhaled breath contaminated with virus. During the procedure, a minimum gas flow (≤ 6 L/minutes) should be used to decrease aerosol contamination.

For preoxygenation, there are no clear recommendations for the use of low-flow nasal oxygen, high-flow nasal oxygen, and non-invasive ventilation modes. However, the general opinion of the authors is to avoid these applications in terms of aerosol dispersion.

The intubation procedure

Rapid sequence induction is recommended for patients with COVID-19. Induction drugs are determined according to the hemodynamic findings of
patients. Ketamine, etomidate, and propofol can be used for induction of anesthesia. For neuromuscular blockage, rocuronium (1.2 mg/kg) is recommended, however succinylcholine (1.5 mg/kg) can also be considered. It is important to note that rocuronium is a long-acting neuromuscular blockage agent relative to succinylcholine, and furthermore it reduces aerosol generation in contrast with the possibility of early cough response with succinylcholine. Neuromuscular blockage can be evaluated via neuromuscular monitoring or by waiting one minute after drug administration. If there is no leakage with a tight-fitting mask, gentle continuous positive airway pressure may be applied after loss of consciousness.

The use of cricoid pressure, which has a place in rapid sequence induction, blocks the esophagus and prevents aspiration of gastric contents. However, its use in patients with COVID-19 is controversial due to the potential for unfavorable effects, such as airway obstruction, impeding SGA insertion, and inferior laryngoscopic views. In such cases, the risks and benefits of applying cricoid pressure should be cautiously evaluated.

For adequate endotracheal intubation, the choice of laryngoscopy is determined by the anesthetist’s experience and training. Videolaryngoscopy or conventional direct laryngoscopy can be used for endotracheal intubation in patients with COVID-19; however, videolaryngoscopes offer a better view than conventional direct laryngoscopes and while also increasing the distance between the airway practitioner and the patient during airway management. Therefore, videolaryngoscopy is recommended as the first preference for the airway practitioner.

In patients with COVID-19, it is recommended that endotracheal intubation is applied at the first attempt by an experienced airway manager to reduce aerosol contamination and protect healthcare workers. Immediately after the endotracheal tube (ETT) is placed in the trachea, its cuff should be inflated with air so that there is no leakage and the cuff pressure should be measured. The patient should not be ventilated before this procedure is performed due to aerosol generation. If a stylet or bougie is used, attention should be paid to their removal and subsequent disposal due to droplet spread. Similarly, the laryngoscope blade should be sheathed immediately after endotracheal intubation. Successful ETT placement is confirmed with end-tidal carbon dioxide. Another option to confirm ETT placement may be auscultation of the chest; however, auscultation is not recommended due to the difficulty in applying pressure in the presence of PPE, and stethoscope and practitioner can become contaminated. To confirm ETT placement, other suggestions are as follows:
observing for bilateral chest wall expansion during ventilation, lung ultrasound, and chest x-ray, if necessary. If ETT suction is required, a closed airway suction system should be applied. If the closed airway suction system is not available, the minimum number of aspirations required are applied using the non-closed suction system by disconnecting the circuit. To prevent aerosol generation during circuit disconnection, the following points must be considered: the adjustable pressure limiting valve should be opened fully, fresh gas flow should be turned-off and positive pressure ventilation should be stopped, and the ventilator bellows should be at end-expiration. Moreover, it should not be forgotten that the ETT is clamped when the circuit is interrupted.

**The use of airway tents, aerosol boxes, or airway shields during the intubation procedure**

Previously, plastic sheets and rigid plastic barriers with arm holes were described in the SARS outbreak. The goal was to decrease droplet and aerosol transmission to healthcare workers during the intubation procedure. However, using barriers during the COVID-19 outbreak is a controversial issue. There are concerns that the complexity of these materials and the risk of contamination during their use may increase. A recent study shows that barriers can increase intubation times and may increase the risk of contamination due to damage to PPE. If a barrier is to be used, it is recommended to choose a simple system that allows good visibility, sufficient seal, free arm movements, and does not cause any contamination.

**THE USE OF SUPRAGLOTTIC DEVICES**

After an unsuccessful primary endotracheal intubation attempt, it is recommended to use a second generation SGA device (e.g., i-gel, LMA® Protector™) since repeated endotracheal intubation attempts may increase aerosol generation. Successful SGA ventilation causes reduced leakage compared to face mask ventilation.

After successful SGA placement and ventilation, four different options subsequently present themselves during airway management. First, airway management may be continued via SGA devices. However, this option is not recommended due to airway leaks and the fact that endotracheal intubation has already failed. Second, SGA devices allow for endotracheal intubation with flexible bronchoscopy and the patient can be intubated. However, it should be...
noted that efforts should be made to not increase contamination while performing these practices. Third, the patient can be woken up. Fourth, FONA can be applied in the presence of SGA devices if there is an indication to do so.

**AWAKE INTUBATION**

Awake intubation should be avoided as it carries a high risk of droplet spread and aerosol generation. There are very limited indications for this procedure (e.g., neck abscess compromising the airway). If there is an indication, the procedure should only be performed by an experienced airway manager. Antisialagogue and sedative agents may be used to reduce droplet spread and the patient’s anxiety. In addition, mucosal atomizers, local anesthetic-impregnated swabs and cotton pledges, and nerve blocks may be used. Provided that decontamination is observed, ultrasound-guided techniques may be helpful for the procedure. The use of single-use flexible bronchoscopy and videolaryngoscopy may be considered. If awake intubation fails, an awake tracheostomy performed under local anesthesia is another option to consider. While performing these procedures, the goal should be to minimize aerosol generation and droplet spread.

**FRONT-OF-NECK ACCESS**

In the event of a “cannot intubate, cannot oxygenate” scenario, the options are as follows: a surgical (scalpel, bougie, and tube) or a cannula cricothyroidotomy. A cricothyroidotomy poses a high risk in terms of aerosol generation. The Difficult Airway Society guidelines recommend administration of supplemental oxygen during FONA. However, as mentioned above, the goal should always be to reduce aerosol generation and droplet spread in the airway management of patients with COVID-19. Aerosol generation may be relatively higher when performing the cannula technique due to aerosolization during oxygen insufflation or jet ventilation. During the procedure, sufficient neuromuscular blockage should be provided. Finally, the use of suctioning should be limited during cricothyroidotomy.
EXTUBATION

When a patient has all criteria for extubation after surgery, he/she should be extubated in the operating room. Otherwise, the patient should be transferred to an intensive care unit as intubated. Extubation is a risky stage of airway management in terms of aerosolization as well as intubation. Furthermore, when patients wake up agitated, the process can get more complicated.

To prevent the spread of patient secretions, two layers of wet gauze should be available. The materials (e.g., suction system, face mask, oxygen mask, and nasal cannula) to be used should be checked. Vomiting can cause droplet spread and should be prevented via antiemetic drugs. There is no clear recommendation about the routine use of drugs such as dexmedetomidine, lidocaine, or opioids, to reduce coughing at emergence.

The patient may be placed in a head-up position. Deep extubation may be considered to reduce the patient's airway response. SGA device exchange is not recommended as a bridge to extubation to minimize coughing. The extubation procedure may be performed under a clear plastic sheet to reduce aerosol generation and droplet spread.

At the end of the extubation process, if the patient has adequate effort capacity, he/she can be transitioned to a standard facemask or nasal cannula for oxygen supplementation. Facemasks with in-built viral filters are ideal for these patients. If there is a surgical mask in the operating room, it can be placed over the supplemental oxygen delivery device contributing to reduced aerosol generation.

CONCLUSION

It is a fact that we will continue to fight the COVID-19 outbreak in the coming years until an effective treatment is found. During this time, protection from the virus is the main goal. Airway management in patients with COVID-19 presents considerable risk in terms of aerosol generation and droplet spread, and practitioners who perform these procedures must first be protected. The second consideration is that these cases should be taken for surgery in appropriate operating rooms (e.g., negative pressure rooms) in the company of healthcare workers wearing appropriate PPE. Third, it is recommended to have only the necessary materials, such as drugs and the emergency tracheal intubation kit, in the operating room to prevent contamination. Fourth, while intubation and extubation procedures are performed by the airway manager,
aerosol generation and droplet spread should be kept to a minimum. As a result, it can be said that the use of any unknown technique or drug can make this process difficult.

REFERENCES


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