REVIEW ARTICLE

Making Intubation and Extubation Safe in the Covid Era

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ABSTRACT

The highly infectious COVID-19 pandemic has in a way or the other affected everyone. Health care workers particularly anaesthesists who deal with airway manipulation are at an increased risk of being infected. Invasive procedures such as intubation and extubation performed mostly by anaesthetists are classified as procedures with high risk of aerosol generating particles where respiratory droplets containing the virus can easily spread to the surroundings. Various methods of preoxygenation, intubation and extubation have been further discussed and improvised with the aim of reducing the spread of aerosolization and making intubation safe. The purpose of this review is to identify the new techniques that are safe and effective in reducing aerosolization of respiratory droplets during the process of intubation and extubation. Anaesthetists are often not familiar with these new techniques and protocols. Thus far, no scientific data has been made available to support the superiority of each technique. Further research is needed to investigate each technique in the future.

Keywords: Intubation, Extubation, COVID-19, Non-invasive Ventilation, Preoxygenation

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INTRODUCTION

COVID-19 is a highly infectious disease caused by a newly discovered coronavirus. This virus primarily spreads through droplets from saliva or from the discharge of the nose. The highly infectious nature of this virus has caused it to be declared a pandemic by the WHO on the 11th of March 2020.

In this COVID era, the role played by health care providers especially the anaesthetists are nevertheless daunting. The workload demand to provide the best for critically ill patients have increased tremendously. Anaesthetists face challenges in many areas while providing critical care to COVID-19 patients. Intubation being performed to support and maintain oxygenation to patients is an uphill challenge because of the highly infectious COVID-19(1). Anaesthetists are being put in a very difficult situation where they need to balance the important task of maintaining safety of themselves, their support team as well as the well-being of their patients. COVID-19 is an infectious disease bearing high consequences thus donning a full personal protective equipment has become a prerequisite before treating these patients. Personal protective equipment (PPE) are clothing or protective gear used to protect the wearer from contact with droplets from the infected patient. A full set of personal protective equipment used while treating COVID-19 patients includes cap, goggles, N-95 masks, face shields, boot coverings, surgical gloves and a special gown for full coverage which is resistant to penetration of droplets (2).

Various methods have also been advocated to make the treatment in COVID-19 patients safe besides the use of personal protective equipment. Preoxygenation, intubation as well as extubation techniques have been improvised to limit the spread of this virus to the surrounding.

PREOXYGENATION

Preoxygenation is a standard of care before intubation to prevent hypoxemia (3-4). The physiological theory behind preoxygenation is to saturate the oxyhaemoglobin with oxygen by creating oxygen reservoir. It increases fractional alveolar oxygen and decreases fractional alveolar nitrogen (5). Many methods can be used to achieve end tidal O2 (Eto2) concentration >90%. Commonly, preoxygenation is done by asking patient to breath normal tidal volume for 3 mins or take 8 deep breaths in 60 second using approximate 100% oxygen with gas flow 10-12L/min. Other techniques of preoxygenation include continuous positive airway pressure (CPAP), bi-level positive airway pressure (BiPAP), head up preoxygenation, transnasal humidified rapid insufflation ventilatory exchange

(THRIVE) and apnoeic diffusion oxygenation method. Bag mask ventilation on the other hand produces dispersion of droplets to the surroundings. A study using human-patient-stimulator showed a good fit mask and continuous oro-tracheal suctioning reduced dispersion distance of droplets in non-intubated patients (6). Although applying the ora-trachea suctioning catheter seem to reduce the dispersion distance of droplets but this technique is not practical during preoxygenation because introducing an ora-trachea suctioning catheter into the patient can induce cough and leakage. Hence in COVID-19 patients, the recommended technique for preoxygenation is to avoid bag mask ventilation and intubate with rapid sequence induction (7). If the patient desaturates during the intubation, two hands vise grip technique with minimal bag mask ventilation can be performed if required. Applying positive pressure during preoxygenation using CPAP or BiPAP is intended to prevent lung atelectasis particularly in morbidly obese thus improving functional residual capacity of the patients. These techniques of preoxygenation is not suitable in COVID-19 patients as applying positive pressure may increase dispersion of droplets if there is a leakage from the mask. As for now, limited data is available on which technique of preoxygenation will cause less dispersion of droplets. Although a few studies show that the usage of high flow nasal therapy did not increase the spreading of infectious droplets (8-10); using high flow nasal canula in preoxygenation in COVID-19 patients remains controversial (11).

INTUBATION

Tracheal intubation is an invasive procedure associated with high risk of aerosol generating particles that increases virus transmission to healthcare providers (12-14). Thus, World Health Organization (WHO) recommends the use of negative pressure room with a minimum of 12 air change per hour or at least 160L/s per patient in a normal room while performing aerosol generating procedure (2). Often, most of the operation theatre is built with positive pressure and negative pressure operation theatre is always not available. Hence, a designated theatre consists of high efficiency particulate air filter with a high frequency of 25 air change per hour which can rapidly reduce viral load can be used (15).

In COVID-19 patients, the recommended technique for tracheal intubation is by performing rapid sequence intubation or modified RSI with videolaryngoscope after adequate preoxygenation (7,16-18). Videolaryngoscope is used to intubate patients with difficult or normal airway. It provides indirect view of epiglottis and increases the success rate of intubation, subsequently reducing the spread of air borne transmission (19-21).

The aim of rapid sequence intubation is to prevent aspiration. This method able to avoid bag mask ventilation by preventing dispersion of droplets to the surroundings. Cricoid pressure manipulation may induce coughing and will increase the spread of droplets if the patient is not adequately sedated. Thus, an anaesthetist not only needs to be skillful to provide safe intubation but also required to administer adequate medication in this case. Furthermore, certain intravenous anaesthetic agents such as fentanyl may induce cough reflex when given. Thus, vigilance is of upmost importance in this situation to ensure patient is deep enough to perform rapid sequence intubation. Pharmacological treatment such as remifentanil, lignocaine and dexmedetomidine are useful to suppress cough reflex during intubation.
Intubation is not always a straightforward situation therefore an anaesthetist should also be well versed on the other methods of securing the airway such as by using the direct laryngoscope, fibreoptic intubation, insertion of supraglottic airway device (SAD) and cricothyroidotomy.

Contrary to videolaryngosope, the use of fibreoptic intubation has an important role particularly in patients with COVID-19 in cases where the videolaryngoscope or direct laryngoscope was deemed not suitable. The study using rapid sequence fibreoptic bronchoscopy tracheal intubation using high flow nasal oxygenation have seen less desaturation and no evidence of virus transmission in critically ill patients with covid-19 pneumonia (22). However, this study is still debatable and inconclusive (23).

On the other hand, a closed technique of supraglottic airway guided flexible bronchoscopic intubation claimed to have the advantage to reduce aerosolization in patient with failed intubation (24). The evidence for the dispersion of droplets by using supraglottic airway device in COVID-19 patients is lacking. Difficult Airway Society (DAS) recommends the usage of second-generation SAD without the need to change the standard airway management protocol but the need to be vigilant regarding the possibility of air leak from the SAD. A new technique has been used in order to minimize the contamination of virus transmission using SAD by preassembling it with high efficiency particulate air filter. SAD preassembled with this high efficiency particulate air filter has been used in out-of-hospital cardiac arrest in COVID-19 patients (25).

Another method of securing the airway is by cricothyroidotomy. The method of securing airway by using scalpel cricothyroidotomy in COVID-19 and nonCOVID-19 patients is similar according to the DAS guideline. However, health care workers will need to don the personal protective equipment when intubating COVID-19 patients. Scalpel cricothyroidotomy is a technique used in a situation where patients are deemed as 'can't intubate and can't ventilate' (CICO).

The proper usage and donning of personal protective

equipment is vital in the treatment of infectious diseases with high consequences such as during the treatment of COVID-19 patients. Without a coverall suit, contamination droplets can be found on uncovered skin, hair, and shoes (26). Even with the use of a personal protective equipment, other barrier methods were used to prevent dispersion of droplets during the intubation. Various barrier enclosures such as aerosol boxes and plastic drapes are used to minimize the dispersion of droplets to the surroundings during intubation. Canelli et al demonstrated the use of aerosol box as an adjunct for intubation. However, there were certain limitations as there was limited space for airway manipulation (27). Asenjo et al demonstrated the use of plunger to cover distal end endotracheal tube to minimise the spread of droplets during intubation (28). Brown et al demonstrated the use of plastic drape as an additional protection to the laryngoscopist; but this was further modified by Yang et al who made two holes on the plastic to facilitate endotracheal intubation (29-30). A large plastic barrier curtain has also been used to facilitate reintubation in case of failed extubation as what was demonstrated by Iwasaki et al (31). Table I shows the advantages and disadvantages of barrier enclosure method between the aerosol box and plastic drape.

Table 1: Advantages and disadvantages of barrier enclosure method between the aerosol box and plastic drape

	Aerosol box	Plastic drape
Advantages	1. cheap 2. can be reused	1. Cheap 2. Easy to store 3. Minimize the dispersion of droplets 4. Can be used in intubation or extubation without causing trauma to patients
Disadvantages	1. Limited space for airway manipulation 2. Need training prior use 3. Bulky 4. Difficult to store 5. May not be suitable for obese patient	1. Need training prior use

Intubating a patient by using the barrier enclosure method seems to reduce the dispersion of air droplets to laryngoscopists but this relatively new method can complicate airway manipulation especially for those who are not familiar with it. Subsequently, more exposure and training of the usage of barrier enclosure methods should be initiated. This will further enhance and optimize a safer mode of airway manipulation in patients with COVID-19 in the future.

EXTUBATION

Technique of performing extubation in COVID-19 patients is equally important as in intubation. To extubate a patient, certain extubation criteria must be fulfilled. This is particularly important when extubating a patient with COVID-19, in order to minimize the dispersion of aerosolization. Patient is usually extubated after the patient is awake. Coughing is a frequent occurrence during the emergence from general anaesthesia (32). Extubation under deep anaesthesia may result in hypoxaemia caused by laryngospasm, airway obstruction, aspiration and poor respiratory effort, risking the chance of reintubation and bag mask ventilation. This indirectly increases air-borne transmission of droplets to the environment. Thus, the recommendation of extubation in COVID-19 patient is to minimize coughing and application of facemask immediately together with oxygen mask or nasal cannula (7,33). Coughing during extubation can be effectively suppressed using lignocaine, dexmedetomidine or opioid (34-36).

Besides using pharmacotherapy, various methods have been improvised in the attempts to reduce the spread of virus droplets during extubation. D'Silva and colleagues described mask over tube extubation technique to reduce the risk of virus transmission in anesthesia providers (37). Subsequently, Ryan and colleagues modified the mask over tube extubation technique using less filter which is capable of end tidal Co2 monitoring after extubation (38). Matava et al demonstrated the usage of 3-drape technique which was found to reduce aerosolization and droplets spray compared to a single plastic drape (39). Kristensen et.al presented a technique of applying a surgical mask with nasal cannula after extubation to minimize droplets aerosolization (40). Negative pressure together with barrier enclosure method have been used to extubate COVID-19 patients in situations where there are no negative pressure rooms available (41-42). Asenjo et al demonstrated another technique of extubation of COVID-19 patients by passing the endotracheal tube through facemask alongside the plastic enclosure method (Figure 1) (28). Masayuki and colleagues showed that there was no cough and straining during extubation in patients with COVID-19 where the endotracheal tube was replaced with a supraglottic airway device (43). Extubation using barrier drape to minimize droplets spread has also been discussed and performed (44).

Extubation is not always a walk in the park especially extubating a patient in the ICU who will need non-invasive ventilation post extubation. Extubating a COVID-19 patient in ICU to bilevel positive airway pressure (BiPAP)/ continuous positive airway pressure (CPAP)/ high flow nasal oxygen (HFNO) may pose a risk of virus transmissions to health care workers. According to WHO clinical guidelines of the management of COVID-19, non-invasive ventilation can be used in COVID-19 with mild acute respiratory distress syndrome but the safety of health care workers should be taken into

Figure 1: Sequence (A-L) of intubation and extubation in COVID-19 patients. (Permission from J.F.Asenjo)

consideration (2). The WHO recommends a designated ward or ICU when extubating COVID-19 patients to non-invasive ventilation with all health care personnel involved in full personal protective equipment. In this case, the setback of donning full personal protective equipment will be the dampening of communication between healthcare workers. To counter effect this setback of communication barrier, proper planning and preparation is vital before extubation of COVID-19 patients is carried out.

The fight of COVID-19 should be an all-round team effort not just for the anaesthetists, but it should be like an orchestra where every individual contributes with their own significance whether big or small. These newfound practices and steps are executed with care and precisely orchestrated to better manage COVID-19 patients without forgoing own safety. If everyone in this orchestra plays a part, the results will be a well-managed pandemic and thus will become a stepping- stone to better manage any occurrence of new pandemics in the future.

CONCLUSION

The battle of COVID-19 is still ongoing, with the hope of cessation of the virus in the coming future, anaesthetists must ensure their own safety and safety of the rest of the team as their upmost priority. The new norm of wearing personal protective equipment is the basic yet important standard of care for safe intubation in COVID-19 patients. Other barrier enclosures can be used as an adjunct but should be abandoned immediately once safety or care of the patient is being compromised. Intubation should optimally be done using RSI method with videolarygoscope while in extubation cough reflex must be minimised in addition to applying a facemask post extubation to minimize aerolization from coughing. Besides donning a full armor of personal protective equipment, intubating by the RSI method with videolaryngoscope and minimizing cough to reduce aerosolization during the extubation process, clear communication between the team members is vital to prevent unnecessary error which could lead to disaster. Proper planning in terms of safety of health care workers and patients during intubation and extubation should always be the main priority. Intubation and extubation in COVID-19 patients should be without doubt handled by experienced anesthetist. Although various methods of intubation and extubation techniques are made but none of it is proven to be better than the other. Further research is needed to compare which method is superior in terms of safety and practicality in handling the highly infectious transmittable virus.

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