

Performing Tracheostomy in Intensive Care Unit- A Challenge during COVID-19 Pandemic

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ABSTRACT

COVID-19 is a rapidly spreading infection caused by novel corona virus. It is a challenging to the medical community in an unprecedented degree. Clinicians and health care workers are at added risk for infection during the procedure performing at the intensive critical care unit (ICU). Tracheostomy is a common surgical procedure performed at ICU for prolonged ventilation of the patient. Performing tracheostomy is currently a challenging for otolaryngologist at the ICU because of high chance of spread of the virus to the surrounding health care workers and also to the other patients. The location for this procedure in ICU should be well ventilated and the pressure in the room must be maintained negative or neutral. The health care personnel particularly Otolaryngologists have a central role for managing this situations where they are assessing the patients, preventing the contamination to other assisting staff and other patients. As there is progressive rise of the COVID-19 patients worldwide, it is surely expected that several patients may need intubation and mechanical ventilation. So, in this condition, patient may require tracheostomy for prolonged ventilation. Because of the very minimum literature available regarding tracheostomy in the COVID-19 pandemic, so this review article will surely increase awareness among health care workers and surgical team for prevention of the transmission of the infection from tracheostomy to medical staffs and other patients.

Keywords: COVID-19 pandemic; tracheostomy; intensive care unit; aerosolization (Siriraj Med J 2020; 72: 436-442)

INTRODUCTION

Currently we are facing a devastating pandemic with a great impact on the whole world because of the rapid spread of a novel corona virus (COVID-19). The medical fraternity is on the process to know the behavior of the virus. This knowledge of the medical community is extremely dynamic as the behavior of this virus is still not established. COVID-19 is a contagious infection of the respiratory tract caused by a novel virus called acute respiratory syndrome corona virus 2 (SARS-CoV-2).¹ This patient often presents with cough, sore throat and

fever. Indications for tracheostomy include emergent airway and prolonged mechanical ventilation. COVID-19 patients sometime require tracheostomy for prolonged ventilation in the ICU. Otolaryngologists, intensivists and nursing staffs in the ICU play an indispensable role for performing this procedure. Performing tracheostomy and post-tracheostomy care are usually considered as high chance for contamination of health care personnel during COVID-19 pandemic due to corona virus (SARS-CoV-2).² Anticipating the rapid spread of the infection in case of the tracheostomy, all patients should be considered

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as potential candidates for virus infection. Appropriate protective measures can be taken for preventing the transmission of this viral infection to the health care workers.

Method of literature search

We performed a literature review of tracheostomy during the SARS pandemic consisting data base of PubMed, Medline, SCOPUS and Google scholar search with the terms COVID-19, SARS and tracheostomy. We reviewed the different current articles and recommendations from national and international medical societies and decisions from several government medical councils. This manuscript reviews the details of tracheostomy along with preventive measures for transmission of infection. This review article presents a baseline from where further prospective trials for safe technique of tracheostomy could be designed and helps as a spur for further research in the COVID-19 pandemic and so prevent transmission of the infections to the health care professions and other patients during this procedure.

Epidemiology

COVID-19 is a highly infectious disease of the respiratory system due to novel virus SARS-CoV-2. The first patient of COVID-19 was reported in Wuhan, China in late December 2019 by novel corona virus now called as SARS-CoV-2 (severe acute respiratory syndrome corona virus 2) and now spreaded worldwide. By 27th February, 2020, more than 82,000 COVID-19 positive cases and more than 2800 deaths have been documented of which around 95% of the cases and 97% of deaths were in China.³ By the march 26th, 2020, there were 462684 cases of the COVID-19 reported in 199 countries.⁴ At the time of drafting the manuscript i.e. 25th April, more than 50000 persons were died due to COVID-19 in United States. In the hospital setting, critically patients with respiratory failure often require endotracheal intubation and changed to tracheostomy in case of prolonged ventilation. In one study, 6.30% patients need tracheostomy during the COVID-19 outbreak.⁵ Study showing 7.3-32% of the patients with COVID-19 progress to severe respiratory failure or critical ill condition, where patient may subsequently need tracheostomy for different reasons.^{6,7}

Transmission of the COVID-19 infection

Open or surgical tracheostomy is usually an aerosol producing procedure with a high risk for contamination by exposing the secretions from the airway to the health care personnels.⁸ The novel SARS-CoV-2 virus is transmitted

from one person to another by respiratory droplets or contact with infected person. The procedures which deals with nose, nasopharynx, oral cavity, pharynx, larynx and trachea which generate respiratory droplets lead to high risk for infections. The common clinical symptoms of the COVID-19 patients are cough, fever, fatigue and dyspnea. There are some patients those are asymptomatic and considered as silent carriers in this pandemic. Symptoms like an osmia and taste alterations are two important clinical features often associated with these patients. So health care workers should be aware about these symptoms and so can prevent them from transmission to other patients.

Suspecting the COVID-19 patients

The most commonly found symptoms in patient of the hospitalized patients are fever (77-98%), dry cough (46-82%), fatigue, myalgia (11-52%) and dyspnea (3-315) at the onset of the COVID-19 infections.⁹ Another study shows fever in 44% at the time of hospitalized COVID-19 patients whereas it goes to 89% during the period of hospitalization.¹⁰ Other less commonly found symptoms in COVID-19 infections are sore throat, headache, cough with sputum production with or without hemoptysis. Few cases present with gastrointestinal upsets like diarrhea and nausea before development of the fever and lower respiratory airway symptoms and signs. There is established symptom such as anosmia/hyposmia in COVID-19 infection. In German, it was documented that more than two thirds of positive patients of COVID-19 infections presented with an osmia whereas in South Korea, 30% patients with COVID-19 infections showed symptom of the anosmia.¹¹

Indications of tracheostomy

The progressive rise of the COVID-19 patients will expect more requirements of the orotracheal intubation and prolonged ventilation. In this clinical scenario of ICU, tracheostomy can be considered by health care professionals. Performing tracheostomy on COVID-19 patients or suspected patients for COVID-19 impose challenges not only to Otorhinolaryngologists but also to the entire health care team. If the trachesotomy is not an emergency, this can be reviewed by a multidisciplinary team and risk versus benefits of this surgery and also the associated health care team should be assessed. Unlike the bacteriogenic pneumonia, cases of COVID-19 present with dry cough and produce little mucus secretions, so it makes tracheostomy for pulmonary toilet less critical.¹² Bedside tracheostomy at the ICU with negative pressure is ideal for performing this procedure for needy patients.

Bed side tracheostomy avoids unnecessary transport of the patients and frequent connections and disconnections of the ventilator circuits during transfer.¹³ The bedside tracheostomy should be well planned at the ICU because of the limited space, below optimal positioning of the patient and limited transfer of the surgical instruments. In case of planning tracheostomy at the operating room (OR), it should be undertaken in negative pressure at well demarcated area inside the OR complex with proper route for transferring the patients. During tracheostomy, provide adequate sedation including paralysis which eliminates the chance of coughing during the time of the procedure. Ventilation should be paused (apnea) at the end-expiration when making the opening on the trachea where the ventilation circuit is disconnected. A non-fenestrated cuffed tracheostomy tube is better and it keeps the cuff inflated to stop the spread of the virus through the upper airway. Tracheostomy suctioning should be done by a closed suction system with a viral filter. Heat moisture exchanger device can be used instead of tracheostomy collar at the time of the weaning for preventing virus spread or re-infection of the patient. Tracheostomy tube changing should be avoided until the viral load is as low as possible.

Surgical steps

The COVID-19 pandemic is highly infectious and performing the tracheostomy in such pandemic is highly contagious to other patients and health care workers. The classical tracheostomy should not be done and it must be modified to minimize the chance of the viral transmission.¹⁴ For successful tracheostomy, the whole procedure is divided into 5 steps (5Ts) such as theater set up/area in ICU, team briefing, transferring the patient, tracheostomy and team doffing and De-brief.¹⁵ Tracheostomy should be done in dedicated COVID theatre or designated area in ICU. The OR should under negative pressure with reverse laminar flow around the operating table. In team briefing, all the team members should be explained about their role during the procedure. All the equipments including suction probe should be ready before performing the tracheostomy. The tracheostomy tube can be sprayed with 5% lidocaine then aspiration for a few minute later is helpful. If the ventilation is done with tracheostomy tube, then anesthesiologist should sedate the patient and perform the neuromuscular block for decreasing chance of the cough at the time of the tube change. The patient must be completely paralyzed for the period of the procedure and the closed suction is connected to the endotracheal tube before beginning of the procedure. Before starting the tracheostomy,

anesthetist/intensivist should perform suctioning the endotracheal tube including the subglottic area. Before making a window over the trachea, anesthetist is to stop the ventilator and deflate the cuff of the endotracheal tube. Then the surgeon creates a window on the second or third ring of the trachea. Minimal suctioning can be done at the window site and the endotracheal tube is advanced further below the window and the cuff is re-inflated/over-inflated and so establish a closed circuit.¹⁶ This is a very crucial step for preventing spread of the infection. In this stage, patient is at risk of alveolar derecruitment and may need aggressive recruitment after inflation of the cuff. So two number of anesthetists or intensivist are useful to deal with endotracheal tube and one will manage the ventilator.

Tracheostomy tube

The tracheostomy tube should be non-fenestrated, cuffed and the smaller side to make the tracheostomy smaller opening on the trachea. Shiley size of 6 for male and female is often adequate. The cuff of the tracheostomy tube should be inflated for preventing the spread of the virus via the upper airway.

Operating place/ICU

The place for this high risk procedure should be properly designated with negative pressure.¹⁷ Unprotected health care workers should not be allowed to the site of the tracheostomy because of the high aerosol generating procedure. Appropriate PPE should be worn by the Otolaryngologist and the assisting personnel. The team for tracheostomy includes a consultant surgeon and two experienced assistant along with a scrub nurse and a floor nurse. Different case series of Open tracheotomies were done at the time of COVID-19 pandemic showing techniques and preventing measures (Table1).^{18,19,20}

Benefits versus risk of tracheostomy at the ICU

Study of non-COVID-19 infected patients of critically ill reveal that early tracheostomy (within ten days of intubation) is associated with longer ventilator free days, lesser ICU stays, lesser duration of sedation and lower long-term mortality rates, although other studies document that timing of the tracheostomy does not affect the clinical outcomes.^{21,22} In another study, 66.7% of the patients those underwent tracheostomy did not achieve the clinical benefit after the tracheostomy.²³ Another report from China is also against the positive outcome for tracheostomy in COVID-19 patients.²⁴ There is also another report from SARS treatment suggests that tracheostomy was not related to the significant better

TABLE 1. Different case series of Open tracheostomies done at the time of COVID-19 pandemic.^{18,19,20}

Parameters	Wei et al ¹⁸	Chee et al ¹⁹	Tien et al ²⁰
Hospital	Queen Mary Hospital, Hong Kong SAR,	Tan Tock Seng Hospital, Singapore	Sunnybrook and China Women's College Health Sciences Centre, Toronto, Ontario, Canada
Number of tracheostomies done	3	15	3
Barrier precautions at time of surgery	Standard PPE, shoecovers, faceshield, goggles	Standard PPE, Shoecovers, powered air-purifying respirator system	Standard PPE, Stryker T4 protection system
Setting	Negative pressure room in ICU or OR	Negative pressure room in ICU	Negative pressure room in ICU
Intraoperative steps to minimize aerosolization	Complete paralysis of patient, mechanical ventilation stopped before tracheostomy, no suction used during procedure, diathermy avoided as much possible	Complete paralysis of the patient, mechanical ventilation stopped before tracheostomy, limited suction used during procedure, no specific avoidance of diathermy other than during tracheostomy	Complete paralysis of the patient, mechanical ventilation stopped before tracheostomy, no suction used once trachea opened, diathermy avoided as much as possible
Surgical team	Single surgeon, one intensive care specialist, one standby medical or nursing staff	An experienced surgeon, an experienced anesthesiologist, one scrub nurse and one surgical assistant	Senior attending trauma surgeon, most senior surgical staff member available, attending ICU anesthesiologist and no circulating nurse or scrub nurse.

outcome.¹⁸ Sometimes the tracheostomy is associated with potential complication such as tracheal bleeding. Without doing specific treatment for this infection, the mortality rate goes to severe or critical ARDS is very high as around 70%, which goes against for performing the tracheostomy on patients with COVID-19 related ARDS.²⁵ These clinical experiences from China suggest that prolonged intubation should not be alone an indication for doing tracheostomy in COVID-19 patients, as there are risk for patients and health care providers likely show any marginal benefits in this pandemic. Rather the procedure like tracheostomy should only be done in specific condition such as airway obstruction where the successful extubation is compromised or certain situation where tracheostomy placement has positive impact on patient's potential for successful weaning of the ventilatory support. So, it needs careful consideration when the health resources like ventilators are in limited supply in present COVID-10 pandemic. Agreement with current recommendations by ENT UK, clinicians should believe the situations and evaluations by multidisciplinary fashion like consensus among the specialists for clinical benefits after tracheostomy as weighed against the risk of this procedure.²⁶

Post-tracheostomy care

Patient with tracheostomy tube should be covered by trach collar for preventing aerosol from trachea.²⁷ The tracheostomy patients at the ICU those are connected with a closed ventilator circuit, standard precautions should be used for an patient who endotracheally intubated with ventilator. This type of closed strategy has been also used in Hong Kong in this current outbreak.¹¹ The suctioning of the tracheostomy should be done by a closed suction system with presence of the viral filter. Tracheostomy tube change should be avoided until the viral load is as low as possible. A heat moisture exchanger (HME) device is used instead of the trach collar during the weaning for preventing the virus spread or re-infection of the patients.

Pediatric tracheostomy

In the children, the tracheal intubation is often better tolerated. The ideal timing for performing the tracheostomy is not established but some authors suggest if there is no chance of weaning by two weeks, then tracheostomy can be considered.² During prolonged intubation, optimum care must be given for adequate size of the endotracheal tube with low pressure cuff and avoid movement of the tube.

Percutaneous dilatational tracheostomy

Percutaneous tracheostomy affects extensive airway manipulation like bronchoscopy and or serial dilations at the time of the tracheal entry. Patient having high ventilatory settings may need repeated disconnection and connection from the ventilatory support. There is increased chance of aerosolization in comparison to the open tracheostomy.²⁸ In open tracheostomy, the tracheostomy tube is entered quickly by making an opening of the trachea so aerosolization has less chance to spread. The open tracheostomy is more favorable than percutaneous tracheostomy during COVID-19 pandemic.²⁸ However, as per recommendation of French Anesthesiology and ENT Societies, percutaneous tracheostomy is preferable to minimize the aerosolization and chance of viral contamination of the surrounding health care personnel.²⁹ The surgical tracheostomy is performed in case of anatomical contraindication, failure of the percutaneous tracheostomy or exhaustion of the percutaneous kits. Two techniques are possible, the Percutaneous technique and the open technique. In accordance with the recommendations of French Anesthesiology and ENT Societies (SFAR and SFORL), in the COVID-19 context²⁸, the percutaneous technique is to be preferred to reduce aerosolization and the risk of viral contamination for the nursing staff and to avoid having to move the patient to an operating room.

Use of personal protection equipment during tracheostomy

The surgeon, assisting surgeon and nursing staff should wear proper personal protection equipment (PPE) (Fig 1). Head protection should be done by a hood cap



Fig 1. Surgeon with PPE before performing tracheostomy.

rather than with a simple cap for better protection of the exposed skin in head and neck area. The protective eye glass should be used for preventing exposure of the infection to the eye. Face mask must be FFP (N95) or FFP3. The head light used for light source during tracheostomy should be covered by a head cap. An impermeable protective apron or an overcoat must be worn under the surgical gown because it is sterile. After removal tracheostomy, the appropriate time to doff the PPE is at least 20 minutes. This doffing should be done at a designated area with standard practice of current guidelines.

Prognosis

Some patients with tracheostomy during COVID-19 pandemic may develop some complications such as ulcers in the pharynx and bleeding from the stoma or tracheostomy tube which need further care by Otorhinolaryngologists. Tracheostomy should be avoided or delayed even beyond two weeks because of the high chance of the infections during the procedure and subsequent tracheostomy care.²⁹ When the acute phase of infection is subsided or the likelihood of the recovery of infection is high, tracheostomy can be done for less likelihood of infection transmission. Early tracheostomy should be avoided in case of COVID-19 patients because of the higher viral load. Early tracheostomy is not related to the improved mortality or less ICU stay.²⁹

Preventing measures

The primary method of transmission of the infections during tracheostomy is droplets from the tracheal airway via the tracheostomy tube which carry the virus particles. PPE is known to be very effective measures for reducing the transmission of the infections from the tracheostomy. Although the safety recommendations for health care personnel have continued to change depending on the resources. The center for disease control and prevention (CDC) and WHO recommended the gown, gloves, goggles, head shield and N95 mask for preventing the transmission of the droplets from the tracheostomy.³⁰ Health care personnel should learn proper technique for donning and doffing of the PPE effectively to protect them. If the post-tracheostomy care is done in a health care facility or in home, there is no diagnostic facility and the care givers do not know whether patient is infected with SARS-CoV2 or not. So the precautions are justified and must be with FFP2 (N95) mask, protective glasses, head shield and gown. All the disposable materials that have been in touch with tracheostomy tube or tracheal filters and suction probes must be removed from this

infectious waste. The overall surgical procedure for tracheostomy should thoroughly and appropriately planned, explained to all concerned staffs and executed in order for ensuring the safety of the staff and patients.³¹

CONCLUSION

COVID-19 is a real challenge for global medical community. Acute respiratory distress syndrome and respiratory failure need mechanical ventilation. As the COVID-19 infection escalates, the staying of the patient in ICU extended with ventilator. So, tracheostomy is required in prolonged ventilation. It is thus crucial for ICU teams and surgical personnel and they should be well prepared for performing the tracheostomy when required. As surgeon perform tracheostomy closely with anesthetist/intensivist and nursing staff, so the surgery should be done in safely manner for preventing transmission of infections. This worldwide pandemic reinforced the requirement of the adaptable and reflective surgical practice. The need of surgical tracheostomy will increase in coming time so for this reason, we have to manage this in a robust, repeatable and safe manner.

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