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Anesthetic Management in Tracheostomy for COVID-19 Patients and Patients under Investigation: A Review Article for Better and Safe Perioperative Care

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Objective: The rapidly, worldwide spreading of COVID-19 assaults the pulmonary system to acute respiratory distress syndrome (ARDS) and prolonged intubation and required tracheostomy. Various recommendations are published with some debating points. This review aims to provide data and suggestion for anesthetic personnel, regarding tracheostomy in patients with positive or unknown COVID-19 results.

Methods: All articles related evidences to this topic were reviewed and compared. A practical guideline was proposed base on the reviewed data.

Result: An organized, detailed recommendation is presented concerning evidence-based and safety concerns. Tracheostomy should be performed in patients with COVID-19, after 14 days of intubation with non-fenestrated tube. Practical steps for anesthesia personnel for tracheostomy are fully paralyze the patient, preoxygenate with 100% oxygen and positive end-expiratory pressure (PEEP), advance the endotracheal tube before opening the trachea, and stop the ventilation without unnecessary disconnection of the circuit. Details of practical steps are listed and integrated for better patients care.

Conclusions: Tracheostomy in patients with COVID-19 is a rare procedure. However, tracheostomy in the patient under investigation (PUI) case seems to be more common. Indication of tracheostomy must be fulfilled to balance the infection risk of health care personnel.

Keywords: Tracheostomy, Anesthesia, COVID-19

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Introduction

The COVID-19 infection spreads globally, with a total confirmed case of over five million patients.[1] The COVID-19 pandemic affects the respiratory tract of the patients with a mortality rate ranges from 12-18.5%.[2] The healthcare worker's risk of COVID-19 infection is 1.1- 3.8%, but the infection rate from tracheostomy is still unknown.[3,4] Tracheostomy is considered to be the second most aerosol-generating procedure due to airway manipulation after tracheal intubation.[5] In presymptomatic patients, the incubation period of COVID-19 infection is 5.2 days.[6] Therefore, healthcare workers may have an increased risk of infection in presymptomatic or asymptomatic COVID-19 cases. In Thailand, we have less capability of the COVID-19 test compare to the developed country. Consequently, there are many patients classified as patient under investigation (PUI), which may require tracheostomy. Respectively, this paper aims to review current practice guidelines and recommendations for appropriate care for tracheostomy for COVID-19 patients and PUI. We summarized and outlined the practical concerns for tracheostomy in COVID-19 patients as below.

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Methods

We performed a literature review of anesthesia and tracheostomy during this pandemic COVID-19 infection through PubMed, Ovid, and Google search with terms tracheostomy, anesthesia, COVID-19. All papers, mostly published in 2019-2020, were screened and reviewed with the relevant aspect of anesthesia with tracheostomy in COVID-19 patients in PUI.

Clinical considerations

Patient consideration

Critically ill COVID-19 patients who presented for tracheotomy is only 0.5% of symptomatic case.[7] However, these specific patients might have a profound hypoxic respiratory failure from ARDS. Hypercapnia is rare. The ventilator setting is high, and positive end-expiratory pressure (PEEP) dependent for good oxygenation.[8] Furthermore, they had multi-organ complications involving cardiac injury, sepsis shock, delirium or encephalopathy, and acute kidney injury required renal replacement therapy. A complete systematic review of patient's history and clinical settings should be thoroughly assessed before the procedure.[9] Anesthesiologists should concern serious drug interactions. According to the recommendation of the department of medical services of Thailand, drugs of choice for the confirmed case are chloroquine or hydroxychloroquine with azithromycin. This combination can cause severe side effects. Hydroxychloroquine and chloroquine, either alone or combined with azithromycin, can cause QT interval prolongation and Torsade De Pointes[10], especially in patients with cardiac and/or kidney disease. Moreover, the drug interactions occur commonly with some drugs such as ondansetron, methadone, tricyclic antidepressants, amiodarone and strict corrected QT interval (QTc) monitoring is recommended.[11] Hydroxychloroquine or chloroquine increases insulin levels and insulin action causing an increased risk of severe hypoglycemia.[12]

Perioperative steps of guidance for modified tracheostomy for COVID-19 patients

Preoperative

Tracheostomy is an aerosol-generated procedure. Tracheostomy in COVID-19 patients considered hazardous for healthcare personnel. Therefore, indications and timing of tracheostomy should be reviewed and confirmed by two consultant intensivists.[13] The current suggestion time for tracheostomy for prolonged intubation in COVID-19 patients is 14 days according to viral load, prognosis, and staff safety.[14] Preparation of high-risk procedure, personal protective equipment (PPE) for aerosol-generating procedures should be checked preoperatively. PPE for aerosol-generating procedures or enhanced PPE consists of N95 mask, surgical cap, goggles, cover all gown, gloves, leg cover, and powered air-purifying respirators (PAPRs) or Stryker hood.[13, 14] A disposable tracheostomy set and optimum size of cuffed, non-fenestrated tracheostomy tube should be checked and prepared before the operation day. A design team consists of a surgeon, an anesthesiologist, a scrub nurse, and a surgical assistance, is necessary. All members of the team should be experienced and familiar with the steps and equipment. Surgical techniques should be discussed in the group. According to recent evidences, open tracheostomy is preferred over percutaneous tracheostomy according to less time of entry.[15, 16] Furthermore, percutaneous tracheostomy is only recommended in selected case with minimal or no bronchoscopy.[17]

Team members should discuss the proper location for the operation. Feasibility and resources should be debated whether the tracheostomy should be done bedside at ICU bed or in an operating room. The advantages of bedside tracheotomy are lower risk of infection spreading due to no transportation, and the patient is already treated in a negative pressure room. This ICU setting has some disadvantages, which are small working space around the patient's bed, the need to move the surgical instrument and team, suboptimal positioning, and unfamiliar environment.[13] Well-planned and team rehearsal should be done before the operation. (Table 1)

Table 1 Criteria for tracheostomy in COVID-19 patients.[14]

Considered for tracheostomy after14 days of intubation, which requires further mechanical ventilation
Review indication and timing by two intensivists
Discuss surgical technique and location for the operation
Confirm suitable ventilation setting (suggest $Fi0_2$ ≤50%, PEEP ≤10)
Consider postpone surgery in unclear prognosis, age more than 70 years, multi-organ involvement patients
Evaluate contraindication for tracheostomy (e.g., unstable cervical spine, uncorrectable coagulopathy)
Result of the latest COVID-19 testing

$Fi0_2$ fraction of inspired oxygen, *PEEP* positive end-expiratory pressure

Alternatively, if the team agrees with tracheostomy in the operating room, the procedure should be performed in the isolation room with negative pressure. Laminar flow should be turned off. The room should have antechamber for donning and doffing of PPE. Patient transportation should be done with delicate routes.[13] Finally, simulation on the site should be done before the operation. The difficulty of communication should be considered under the N95 mask or PAPRs.[13]

Preparation on the day of operation

In the morning, on the day of surgery, the availability of all PPE should be rechecked. Anesthesiologist and intensivist will confirm that patient can tolerate supine position and a brief period of apnea. Team members will be gathered and rehearsed concise steps of airway management of tracheostomy. All the equipment will be prepared and checked. Team members will put on PPE and perform buddy checks. The scrub nurse will attach the syringe to the tracheostomy balloon, ready for inflation and preloading the heat moisture and exchangers (HME) onto the inner tube. The suction line should be a closed in line system and connect with the viral filter. The surgical technique will prefer surgical ties to diathermy to prevent viral-contained vapor plumes. Before transporting patients to the operative room, ensure the readiness of all team members.[14]

About the barrier preventing droplet spreading of COVID-19, there are a few researches mention about the use of a plastic barrier. Various types of retractors or frame were selected to mount with the operative table such as Omni-Tract retractor, Thompson retractor, metallic frame (COVID-box) which combines with a clear plastic sterile drape.[18, 19] This practice can be used with Buffalo Filter attached with two heat moisture and exchangers for better filtering and clearing of viral particle with 99.9% of viral filtration.[18] Several publications suggested preoxygenation before tracheal opening with 100% oxygen and positive end-expiratory pressure (PEEP)[14] or 100% oxygen only.[20]

Intraoperative

There are various recommendations for an alternative type of tracheostomy in COVID-19 patients. The goals of these guidelines are minimal chance of viral spreading, meanwhile, maintaining patient and health care personnel safety. The key concepts mostly focus on the cease of positive pressure ventilation and ensure paralyzed of the patient to prevent coughing. From Table 2, these steps are generally necessary and mentioned in all paper or societies' guideline. According to the Thailand setting, open tracheostomy is preferable among the Thai surgeons. Our recommendation will focus only on open tracheostomy.

We recommended following steps for open tracheostomy[14, 21, 22]

1. Before opening the trachea, the anesthesiologist will confirm the complete paralysis of the patients. Adequate preoxygenation with 100% oxygen and PEEP will be given before tracheal opening. Suction should be avoided as much as possible. Transtracheal injection is not recommended due to an increase in the risk of aerosol-spreading of the virus.

Table 2 Recommendation for tracheostomy in COVID-19 patients' studies, updated May 22, 2020.

Society, author/ country	Last updated	Timing	Surgical technique	Complete paralysis	Stop ventilation before enter trachea	Suction	Advanced ETT before the open trachea	Hyper inflation of ETT cuff	Pre oxygenation before the opening of trachea	Clamp ETT before withdraw ETT	Type of trache-ostomy	Room deconta-mination
ENT UK/UK[22]	Mar 19, 2020	-	-	Yes	Yes	Only closed in line suction	Yes	-	-	-	Cuffed non-fenese trated	Deep clean after 20 minutes
Takhar et al./ UK[14]	Apr 5, 2020	14 days after ETT	PT	Yes	Yes	-	Yes, advance below the tracheal window	Yes	FiO_2 1.0 with PEEP	Yes	Cuff non-fenese trated	Using local infection and guidance
Tay et al./ Singapore [13]	Mar 31, 2020	-	OT	Yes	Just before entering the trachea	Reducing the use, use with close system with viral filter	-	-	-	-	-	-
Xiao et al/ China and USA [25]	Apr 8, 2020	-	-	Yes	Yes	-	Yes, the position of ETT tip close to the carina	-	-	-	-	-
Givi et al/ USA[17]	Mar 31, 2020	14 days after ETT	OT, allow PT only with minimal or no FOB	Sedated include paralysis	Yes, at the end of expiration	Closed system with viral filter	-	-	-	-	Cuff non-fenese trated with smaller size (No.6 for men& woman)	-

ETT endotracheal tube, *PT* percutaneous tracheostomy, *OT* open tracheostomy, *FOB* fiberoptic bronchoscopy

ENT UK British association of Otorhinolaryngology - Head and Neck

Table 3 Recommendation for elective tracheostomy in COVID-19 era studies, updated May 22, 2020.

Society	Last update	Preoperative COVID-19 testing	Delay tracheostomy until COVID-19 disease pass	Operative setting	Type and detail of PPE
ENT UK[22]	Mar 19, 2020	Yes, all patients	Yes	Standard operating procedure	Fluid resistance surgical mask, surgical gown, gloves, and eye protection
AAO-HNS[26]	Apr 2, 2020	Yes, unless emergency Avoid operation if positive result	Yes. In stable patient should delay ≥ 2-3 weeks	-	N95 are necessary
AAST[27]	Apr 2, 2020	Yes, proceed with negative result	Yes	Negative pressure airborne infection isolation room	N95 mask under PAPRs, fluid resistance gown, double gloving

ENT UK British association of Otorhinolaryngology - Head and Neck

AAO-HNS American Academy of Otolaryngology-Head and Neck Surgery

AAST American Association for the Surgery of Trauma

2. Anesthesiologists will advance the cuff of the endotracheal tube beyond the proposed tracheal window. The endotracheal tube cuff should be hyperinflated for surely sealed. Then anesthesiologists should inform all team after adequate preoxygenation, and stop the ventilation just before opening the trachea.

3. The surgeon will communicate with the anesthesiologist for the next step of the opening trachea. Before creating the tracheal window, all flow must be turned off with the open APL valve. Clamp ETT without any disconnection is recommended. Deflate and draw back the ETT proximal to the tracheal window under direct supervision. Synchronous insertion of the cuff, non-fenestrated tracheostomy tube must be done.

4. Immediate inflate the tracheostomy tube cuff is required. The introducer with a non-fenestrated inner tube and HME should be placed. Next, the circuit would be disconnected from the endotracheal tube then connect with a tracheostomy tube and resume ventilation.

5. The confirmation of the position of the tracheostomy tube will be accomplished with end-tidal CO_2 only. Direct contact with a stethoscope must be avoided. The clamped ETT must be withdrawn carefully and throw away in a sealed plastic bag.

6. The tracheostomy tube must be secured with appropriate dressing.

7. Doffing of the PPE with a buddy check is required. Decontamination and disposal process must be done under well-trained and well-protected personnel.

8. Anesthesiologists should be aware of airway fire due to no decrement of FiO_2.

A standard checklist of airway fire prevention should also be prepared.

Post-procedure care

The patient would be transported back to the ICU with delicate and extreme care. The tracheostomy tube will be held while the patient being turned or prone. Periodic check of cuff pressures by ICU nurses should be made. Cuff should not be deflated until the result of the COVID test is negative. The dressing of tracheostomy should not be changed unless there are signs of infection. The operating room should be deep cleaned after 20 minutes of finished operation due to the risk of residual viral in the operating room.[22-24]

Implication for practice

Anesthesiologists and nurse anesthetists must be aware of specific considerations in the particular procedure (tracheostomy) and give patient care accordingly. The risk of all health care workers should be concerned, the appropriate PPE should be used and safety steps should be followed.

Summary

The decision to do tracheostomy in COVID-19 patients should be performed with team based-approach, and tailored-made to each patient. Anesthesiologists must ensure health care worker's safety while giving the patients the best standard of care.

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