Coronavirus disease 2019 (COVID-19): Team preparation and approach to tracheostomy

Guidelines and Recommendations from Cleveland Clinic COVID-19 Tracheostomy Working Group

Alejandro C. Bribriesco, MD, a Monisha Sudarshan, MD, MPH, a Colin T. Gillespie, MD, b Paul C. Bryson, MD, a Brandon Hopkins, MD, a Donna Tanner, RRT-ACCS, a Siva Raja, MD, PhD, a Usman Ahmad, MD, a Daniel P. Raymond, MD, a and Sudish C. Murthy, MD, PhD, a Cleveland, Ohio

Video clip is available online.

Tracheostomy has become a common surgical intervention performed on patients with severe coronavirus disease 2019 (COVID-19), as mechanical ventilation is required in 10% to 15% of patients.1 High risk of aerosolization during the intervention is a serious concern for personnel involved both during and after tracheostomy placement. We present

| TABLE 1. Pros and cons consideration for tracheostomy in patients with COVID-19 |
|-----------------|-----------------|-----------------|
| **Pros**        | **Patient**     | **Health care system**        | **HCW**                          |
| Comfort         | Decreased vent days | Decreased ICU days | Avoid reintubation HCW exposure |
| Less sedation   | Decreased ICU days | Less nursing care and sedation | Sealed system (avoiding use of CPAP, high-flow nasal cannula) |
| Time to speak   |                 |                             |                                 |
| Time to swallow |                 |                             |                                 |
| Secretion management |             |                             |                                 |
| **Unknown Benefit/Risk** | **HCW**                          |
| PT/OT           | Sedation medication | Disposition out of acute hospitalization | Virus exposure through tracheostomy to HCW on floor/rehab facility |
| Prevent tracheal stenosis if tracheostomy <21 d |                 |                             |                                 |
| **Cons**        |                 | Exposure risk to HCW with difficult to replace specific skill set | Hcw exposure during procedure |
| Derecruitment during procedure |                             |                                 | Possible increased HCW exposure during tracheostomy maintenance/care |
| Possible bleeding |                             |                                 |                                 |
| Possible tracheostomy complications |                 |                             |                                 |

HCW, Health care worker; ICU, intensive care unit; CPAP, continuous positive airway pressure; PT/OT, physical therapy/occupational therapy.
Our experience developing a multidisciplinary algorithm to tracheostomy for COVID-19 respiratory failure. We recognize that this process will vary based on institutional policy and will evolve with further data on transmission and respiratory consequences of COVID-19.

THE ROLE AND BENEFITS OF MULTIDISCIPLINARY TEAM AND SIMULATION

As the COVID-19 crisis unfolded, virtual meetings were held to develop a unified institutional approach for tracheostomy with multidisciplinary stakeholders: Thoracic Surgery, Otolaryngology, Pulmonology, Critical Care, Anesthesiology, and Respiratory Therapy. Discussions centered on indications, contraindications, timeline to tracheostomy, and special procedural considerations (Table 1).

Next, we performed high-fidelity tracheostomy simulation in our laboratory to rehearse and fine-tune procedural details, including proper donning and doffing of personal protective equipment (powered, air-purifying respiratory). Based on our experience and aligned with other groups, we strongly recommend simulation when devising a COVID-19 tracheostomy protocol (Figure 1).

SPECIAL CONSIDERATIONS FOR TRACHEOSTOMY IN PATIENTS WITH COVID-19

A dedicated multidisciplinary team evaluates the patient and employs a standardized pretracheostomy checklist (Table 2). As there is no current evidence to suggest early tracheostomy (<7 days) or delayed tracheostomy (>2-3 weeks) is of particular benefit in this population, we consider tracheostomy a minimum of 7 days after

TABLE 2. Pretracheostomy checklist for patients with COVID-19

| Date of COVID-19 test? | Yes | No | Unknown |
|------------------------|-----|----|--------|
| Location to perform tracheostomy? | Yes | No | Unknown |
| Type of tracheostomy (perc/open)? | Yes | No | Unknown |
| Timing of tracheostomy | | | |
| o Greater than 7 days on vent? | Yes | No | Unknown |
| o Failed extubation? | Yes | No | Unknown |
| o High risk for reintubation? | Yes | No | Unknown |
| Primary team has discussed need for tracheostomy with patient’s family | | | |
| Stable ventilator settings are optimized and patient expected to tolerate lung de-recruitment inherent to performing tracheostomy (FiO2 ≤60%, PEEP ≤10, no inhaled vasodilators) | | | |
| ICU staff determined and documented patient is medically optimized and suitable for procedure (ex: nesescalating pressors or inotropes) | | | |
| Off anticoagulation and/or non-coagulopathic, | | | |
| o If no: a faculty-to-faculty discussion should follow with surgical team placing tracheostomy | | | |
| Does Neurology or Bioethics need to be involved before placement? | | | |
| Previous neck radiation or neck surgery (eg, tracheostomy) | | | |
| Acceptable neck extension and palpable surface anatomy | | | |

COVID-19, Coronavirus disease 2019; FiO2, inspired oxygen fraction; PEEP, positive end-expiratory pressure; ICU, intensive care unit.
TABLE 3. Step-by-step approach to percutaneous tracheostomy in patients with COVID-19

| HCW involved | Key steps of bedside percutaneous tracheostomy |
|--------------|-----------------------------------------------|
| Inside room: 2-3 HCW (to be limited as much as possible) | 1. Patient deeply sedated and paralyzed for procedure |
| Bronchoscopy/airway: staff provider (thoracic surgery, IP, ICU, or ENT) | • Recommend initiating sedation process (under direction of intensivist) before tracheostomy team entering room |
| Operator/tracheostomy insertion: staff provider (thoracic surgery, IP, or ENT) | • Ensure deep sedation before administrating paralysis |
| **Outside room: as needed** | • Administer paralysis at least 3-5 min before insertion of bronchoscopy to subglottic position |
| ICU respiratory therapist (ventilator located outside room) | • Bronchoscopy cart with disposable bronchoscope, ensure proper function |
| • Assist with ventilator including period of apnea | • Shoulder roll for neck extension |
| Bedside/ICU RN (IV pumps outside room) | 2. Preoxygenate with 100% FiO2 for a minimum of 3 min |
| • Administer ordered/prescribed sedation and paralytics | 3. Preparation of equipment outside room |
| • Adjust vasoactive drips as necessary and/or directed | • Tracheostomy tray under sterile condition outside the patient’s room |
| **Intensivist** | • Bronchoscopy cart with disposable bronchoscope, ensure proper function |
| • Ready to don PPE and enter for assistance if required | • Shoulder roll for neck extension |
| • Additional airway provider | 4. Don PPE: (1) PAPRs if available or N95 (not both); (2) full face shield/visor; (3) hair covers, shoe covers; (4) disposable gown; and (5) double gloving |
| • Additional medications for sedation, paralysis and hemodynamic support | 5. Both operator and bronchoscopist enter room |
| *****Team members must coordinate on key signs to convey the following** | 6. Preparation inside room |
| (since verbal communication limited with PAPRs and 2 members will be inside room) | • Operator scrubs in and preps and drapes area |
| • Ventilator on (thumbs up) | • Bronchoscopist positions patient neck in optimally in extension with roll support and packs oropharynx with moist Kerlix roll (not gauge squares to avoid retention) |
| • Ventilator off (thumbs down) | 7. Visualized ETT withdrawal using controlled deflation of cuff over bronchoscope to subglottic position |
| • Need for additional help (wave in) | • Removal of minimal amount of air from cuff may likely be required to withdraw ETT to level needed for appropriate visualization |

(Continued)

**TABLE 3. Continued**

8. Communication through visual cue that ventilation needs to be paused/apnea time starts

9. Insertion of angiocatheter once first tracheal ring identified

- Insertion between first and second or second and third tracheal rings
- Serial dilation (moist gauze available on field to cover neck stoma as needed)
- Insertion of tracheostomy

10. With tracheostomy in place → immediately insert bronchoscopy into tracheostomy for confirmation that tip is above carina and no significant bleeding

11. Remove bronchoscope from tracheostomy → immediately connect HME + in-line suctioning to tracheostomy

12. Connect to ventilator. Hand signal to start ventilation

- Estimated apnea time <1 min

13. After satisfied no issues with procedure → remove endotracheal tube and place immediately into biohazard bag

14. Secure tracheostomy with sutures and strap per routine

15. Proper doffing of PPE before existing

**HCW, Health care worker; IP, interventional pulmonology; ICU, intensive care unit; ENT, ear, nose, and throat; RN, registered nurse; IV, intravenous; PPE, personal protective equipment; PAPRs, powered, air-purifying respiratory; HME, heat and moisture exchanger.**

intubation and preferably after 10 to 14 days to enter the convalescent phase of the disease, gain the benefits of the procedure, and permit time for prognostication of overall recovery. We do not advocate waiting until a repeat negative COVID-19 test, as this could unnecessarily prolong time to tracheostomy, given possibility of persistently positive test (one series with median 20 days, longest 37 days), which likely represents continued noninfectious viral shedding. In addition, we always advocate for maximum available personal protective equipment regardless of a negative COVID-19 tests to protect health care workers (HCWs).

**OUR APPROACH TO TRACHEOSTOMY IN PATIENTS WITH COVID-19**

**Location and Tracheostomy Approach**

Our default location is bedside in intensive care unit (ICU) to minimize patient transport and exposure risk, with the operating room used for particularly high-risk cases. For bedside tracheostomies, an enclosed negative-pressure ICU room is preferred if available and logistically feasible. Our team favors percutaneous over the open technique with deference to operator preference and patient anatomy.
Tracheotomy Details

The type of tracheostomy appliance is largely based on the institutional preference and available supply. Our group favors an appliance without inner cannula to mitigate exposure risk of inner cannula exchange. Step-by-step details of the tracheostomy procedure with modifications to minimize aerosolization are listed in Table 3 and depicted in Video 1.

In patients with COVID-19, we arrange all ventilator control and intravenous lines outside the room so care can be delivered without repeatedly entering the space. The sterile tracheostomy tray is prepared out of the enclosed room.

A moist Kerlix roll is packed in the oropharynx to minimize aerosolization as the endotracheal tube is withdrawn into the subglottis. This obviates the need for a protective box/tent. A disposable bronchoscope is used to avoid exposure during cleaning and processing of a soiled bronchoscope.

The endotracheal tube is pulled back with cuff inflated into the subglottic position. Further retraction can be facilitated by removing the minimal necessary amount of air from the cuff. After guidewire insertion, we perform the remainder of the procedure under apnea and attempt to limit procedural time to 60 to 90 seconds.

CONCLUSIONS

Performing tracheostomy in the COVID-19 era exemplifies how a previously straightforward clinical decision for an essential-elective procedure has been reimagined when the safety of more than just the patient must be considered. The balance of anticipated benefits and risks for major stakeholders (patient, health care system, and HCW) will vary between different locations during various stages of the COVID-19 pandemic as evidenced by a

| Author location/group date published | Timing of trach | COVID neg before? | Approach | PPE | Location |
|-------------------------------------|----------------|-------------------|----------|-----|----------|
| NTSP<sup>6</sup>, UK March 2020     | Until COVID-negative/ noninfectious or At least 14 d | ND       | Either | PAPR | ICU      |
| University of Michigan<sup>7</sup>   | Until absolutely necessary | Neg × 2, 24 h apart and Resolution of fevers | Either | PAPR/N95 | ICU      |
| Takhar<sup>8</sup>, London/UK April 2020 | 14 d       | If testing available and considering before 14 d | PDT > Open | PAPR | Negative-pressure rooms; ICU |
| Tao<sup>9</sup>, UPenn April 2020   | 21 d       | ND                | Open > PDT | PAPR | ICU, negative pressure > OR |
| Pichi<sup>10</sup>, Italy April 2020 | (7 d) Mentioned, not formally recommended | ND       | Open     | N95  | OR > ICU |
| Michetti, AAST April 2020           | Until viral shedding ceased | Recommend against trach with active disease - confirm nontransmissibility | Either | PAPR + N95 | ND      |
| Lamb<sup>12</sup>, CHEST June 2020 | Insufficient evidence to recommend timing | Do not recommend routine RT-PCR testing prior to trach | Either | Enhanced PPE | Neg pressure room; ICU > OR |

COVID-19, Coronavirus disease 2019; PPE, personal protective equipment; NTSP, National Tracheostomy Safety Project; UK, United Kingdom; ND: not discussed; PAPR, powered, air-purifying respiratory; ICU, intensive care unit; PDT, percutaneous dilational tracheostomy; UPenn, University of Pennsylvania; OR, operating room; AAST, American Association for the Surgery of Trauma; RT-PCR, reverse transcription polymerase chain reaction.
A multidisciplinary team is essential in developing a center-specific protocol for COVID-19 tracheostomy with an indispensable role for simulation and team rehearsal. This activity allows providers who may not have previously worked together to pool shared experience and knowledge to develop a tailored, efficient, and safe protocol. Following this protocol, our team has performed more than 20 percutaneous tracheostomies (including 4 patients on extracorporeal membrane oxygenation) in the ICU without untoward patient events or evidence of COVID-19 transmission to HCWs. It is through synergistic collaboration that the optimal delivery of health care can be safely achieved during this continued pandemic.

References

1. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese center for disease control and prevention. JAMA. 2020;323:1239-42.
2. LoSavio PS, Eggerstedt M, Tajudeen BA, Papagiannopoulos P, Revenaugh PC, Batra PS, et al. Rapid implementation of COVID-19 tracheostomy simulation training to increase surgeon safety and confidence. Am J Otolaryngol. 2020;41:102574.
3. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet. 2020;395:1054-62.
4. Sethuraman N, Jeremiah SS, Ryo A. Interpreting diagnostic tests for SARS-CoV-2. JAMA. 2020;323:2249-51.
5. Chiesa-Estomba CM, Lechien JR, Calvo-Hernández C, Fakhry N, Karkos PD, Peer S, et al. Systematic review of international guidelines for tracheostomy in COVID-19 patients. Oral Oncol. 2020;108:104844.
6. National Tracheostomy Safety Project. NTSP Considerations for tracheostomy in the COVID-19 outbreak. Available at: https://www.tracheostomy.org.uk/storage/files/NTSP%20Advice%20for%20patients%20with%20a%20tracheostomy%20on%20the%20Coronavirus%20pandemic.pdf. Accessed May 1, 2020.
7. Michigan Medicine Tracheostomy Working Group. Michigan medicine tracheostomy guidelines in COVID-19 era. Available at: http://www.med.umich.edu/surgery/mcccn/documents/MM-Guidelines-for-Tracheostomy-in-COVID19-era.pdf. Accessed May 1, 2020.
8. Takhar A, Walker A, Tricklebank S, Wynne D, Hart N, Jacob T, et al. Recommendation of a practical guideline for safe tracheostomy during COVID-19 pandemic. Eur Arch Otorhinolaryngol. 2020;277:2173-84.
9. Chao TN, Braslow BM, Martin ND, Chalian AA, Atkins J, Haas AR, et al. Tracheostomy in ventilated patients with COVID-19. Ann Surg. 2020;272:e30-2.
10. Pichi B, Mazzola F, Bonsembiante A, Petruzzi G, Zocchi J, Moretto S, et al. CORONA-steps for tracheotomy in COVID-19 patients: a staff-safe method for airway management. Oral Oncol. 2020;105:104682.
11. Michetti CP, Burlew CC, Bulger EM, Davis KA, Spain DA. Performing tracheostomy during the Covid-19 pandemic: guidance and recommendations from the Critical Care and Acute Care Surgery Committees of the American Association for the Surgery of Trauma. Trauma Surg Acute Care Open. 2020;5:e000482.
12. Lamb CR, Desai NR, Angel L, Chadhia U, Sachdeva A, Sethi S, et al. Use of tracheostomy during the COVID-19 pandemic: American College of Chest Physicians/American Association for Bronchology and Interventional Pulmonology/Association of Interventional Pulmonology Program Directors Expert Panel Report. Chest. 2020;158:1499-514.