

Tracheotomy in ventilated patients with COVID-19

Guidelines from the COVID-19 Tracheotomy Task Force, a Working Group of the Airway Safety Committee of the University of Pennsylvania Health System

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Background

The novel coronavirus (COVID-19) global pandemic is characterized by rapid respiratory decompensation and subsequent need for endotracheal intubation and mechanical ventilation in severe cases^{1,2}. Approximately 3-17% of hospitalized patients require invasive mechanical ventilation³⁻⁶. Current recommendations advocate for early intubation, with many also advocating the avoidance of non-invasive positive pressure ventilation such as high-flow nasal cannula, BiPAP, and bag-masking as they increase the risk of transmission through generation of aerosols⁷⁻⁹.

Purpose

Here we seek to determine whether there is a subset of ventilated COVID-19 patients for which tracheotomy may be indicated, while considering patient prognosis and the risks of transmission. Recommendations may not be appropriate for every institution and may change as the current situation evolves. The goal of these guidelines is to highlight specific considerations for patients with COVID-19 on an individual and population level. Any airway procedure increases the risk of exposure and transmission from patient to provider. In such a rapidly escalating pandemic, the aim in treating patients with COVID-19 disease is to maximize the likelihood of recovery for the greatest number of patients as quickly as possible in a way that minimizes the risk to the provider. In these rapidly-changing times, the “standard” of care may not be one to which providers are accustomed, but the authors feel that it is critical to apply and carefully adapt the best existing evidence on this topic to the current pandemic.

Standard indications for tracheotomy

In a typical non-COVID-19 intensive care unit patient cohort, early tracheotomy (typically defined as within 7 days of intubation) is often recommended for critically ill ventilated patients¹⁰. Benefits include:

- Increased liberalization from the ventilator and decreased time on mechanical ventilation by 8.5 days¹¹.
- Decreased ICU length of stay¹⁰.
- Associated with a reduction in mortality in some studies¹².

- Decreased risk of developing subglottic stenosis¹³.
- Decreased use of sedation¹⁰.
- Improved pulmonary toilet.

Specific considerations for COVID-19 patients

Resource allocation

As observed in other countries who are encountering ventilator shortages from a rapidly accelerating number of cases, a shortened ventilator requirement and ICU length of stay may be useful in the allocation of limited resources.

Prognosis of intubated patients with COVID-19

However, early data suggests that mortality is high in patients requiring mechanical ventilation. In a study of 52 critically ill patients, non-survivors compared with survivors were more likely to receive mechanical ventilation (30 [94%] vs 7 [35%]). Thirty (81%) of 37 patients requiring mechanical ventilation had died by 28 days. Three of the 20 patients who were survivors were invasively intubated. However, all three patients remained intubated at 28 days at the conclusion of the study. There were no patients who were intubated and then successfully extubated and survived by the conclusion of the study¹⁴. In a cohort of 191 hospitalized patients, 54 were non-survivors and 137 were survivors. 32 (17%) were invasively mechanically ventilated, of which 31 were non-survivors (57% of all non-survivors) and only 1 was a survivor (1% of all survivors)⁶.

Unpublished data from Europe suggests that in the most critically ill patients, the duration of invasive ventilation can be as long as 21 days¹⁵. In a cohort of 101 non-survivors in Wuhan, China, the median duration of intubation was 5 days, with an interquartile range of 2-8 days and a total range of 1-31 days¹⁶. This raises the question as to whether there are patients who were intubated for prolonged periods of time that may have had improved outcomes with a tracheotomy.

Recommendations for determining candidacy for tracheotomy in COVID-19 patients

1. Tracheotomy may be considered in patients with prolonged periods of intubation, defined as greater than 21 days, who are otherwise without significant comorbidities and would be expected to have a good prognosis if recovery is achieved.
 - a. A multidisciplinary discussion should be held between the primary team, procedure team, palliative care team, and family to establish the goals of care, overall prognosis, and expected benefits of tracheotomy.
 - b. At each institution, a single individual should serve as the primary point of contact for all COVID-19 tracheotomy consults and thus minimize exposure to multiple team members. This person may in turn consult with the multidisciplinary tracheotomy working group as needed.
2. Tracheotomy before 21 days should not be routinely performed in COVID-19 patients solely for prolonged ventilator dependence, given the high risk of transmission and poor prognosis of

patients requiring intubation and ventilation in the existing literature. It may be considered before 21 days in patients with increased requirement for pulmonary toilet or high levels of sedation, or if incoming data from Europe suggests an improved prognosis over the current data cited herein.

3. Other indications for tracheotomy in COVID-19 patients should be considered on a case-by-case basis, such as patients with a known difficult airway.
4. Due to the substantial number of pre-, minimally-, or asymptomatic patients with COVID-19, all patients for which a tracheotomy consult is placed should be ruled out for COVID-19 in whatever fashion is appropriate for that institution (e.g. PCR testing, chest CT, etc.) prior to the procedure¹⁷.

Recommendations for performing tracheotomy in COVID-19 patients

If a tracheotomy is deemed necessary in a COVID-19 patient, an open surgical tracheotomy is recommended over a percutaneous dilational tracheotomy (PDT) for the minimization of aerosol generation. PDT may also be considered if the patient has favorable anatomy; however, performing PDT with bronchoscopic guidance may increase aerosolization through the bronchoscope port¹⁸. There are several essential considerations for preoperative planning, intraoperative procedures, and postoperative care.

Location

The procedure should be performed at bedside in a negative pressure room to minimize the risk of transmission during patient transport, if feasible. Otherwise the procedure may be performed in the operating room, in a specifically designated negative pressure room.

Personnel

Tracheotomy has been shown to be an aerosol generating procedure that increases the risk of transmission to healthcare workers, with an odds ratio of 4.15 for transmission in those who performed tracheotomies during the SARS epidemic¹⁹, though it is unclear as to whether this may be due in part to inadequate personal protective equipment (PPE). Regardless, proper protection of the operative team is paramount.

- Team members in the room should be kept to the minimal critical number, and preferably with highly experienced personnel.
 - o If open surgical tracheotomy is performed, three people should be present (two highly experienced surgeons, one to manage ventilator/endotracheal tube (ETT)).
 - o If percutaneous dilational tracheotomy is performed, 2 people should be present if performing without bronchoscopy (one to manage ventilator/ETT and one highly experienced proceduralist). If performing with bronchoscopy, one additional person would be warranted.
- Proper donning and doffing of PPE for each person in the room is essential.
 - o As a tracheotomy is considered an aerosol-generating procedure, airborne and droplet precautions should be followed.
 - o Each person should wear a head covering, a powered air-purifying respirator (PAPR), gown, and gloves. If a PAPR is not available, it is strongly recommended to delay the

procedure until one is. If a PAPR will not be available in a reasonable amount of time, a properly fitted N95 mask, closed eye protection, and a face shield could be used. Higher rates of transmission in healthcare workers has been shown in groups who did not wear PPE for airborne precautions²⁰.

Procedure

Minimizing aerosolization during the procedure itself is critical. A non-fenestrated cuffed tracheotomy tube with a disposable inner cannula should be used.

Open surgical tracheotomy:

- The patient should be fully paralyzed to minimize cough reflex during airway entry.
- In addition to standard surgical instruments used for tracheotomy, electrosurgical equipment should be set up in the room while minimizing contamination of the electrosurgical generator
- The ETT cuff should be advanced distal to the tracheotomy site to the level of the carina.
 - o When the tube position is adjusted, ventilation should be held before the cuff is deflated until it is fully reinflated.
 - o Confirmation of the ETT position should be performed by palpation of the tube and cuff through the anterior tracheal wall immediately before the trachea is incised.
- Ventilation should be held prior to incision of the trachea.
 - o If ventilation needs to be resumed via the ETT after the trachea is incised, the cuff should be inflated. Prior to resuming ventilation, the cuff should be assessed for rupture. If ruptured, ventilation should remain held.
 - o Ventilation should again be held as the ETT is withdrawn in preparation for tracheotomy tube insertion.
 - o If cuff position could not be previously confirmed via palpation, ventilation should be held and the cuff fully deflated while the trachea is incised. The cuff position can then be adjusted through the tracheal opening before reinflation.
- A Björk flap is recommended to avoid false passage in the event of accidental decannulation.
- Insertion of the tracheotomy tube should be accurate and quick to minimize open airway time.
 - o The cuff should be immediately inflated and connected to a closed circuit, after which ventilation may resume.
 - o Tube placement should be confirmed with end tidal CO₂ and appropriately secured.

Percutaneous dilational tracheotomy

- The patient should be fully paralyzed to minimize cough reflex during airway entry
- A disposable percutaneous dilational tracheotomy kit should be used, as well as a disposable flexible bronchoscope with monitor (if using).
- If the patient has very favorable anatomy, performing the procedure without the use of bronchoscopic guidance may be considered for conservation of resources and elimination of a potential pathway for aerosolization.
 - o For patients undergoing the bronchoscopic-assisted approach, ventilation should be held when the bronchoscope adaptor is added to the circuit. The hypopharynx should be packed and a Yankauer suction placed in the mouth to reduce aerosols when the ETT is high with the balloon at or above the glottic aperture.

- Prior to inserting the bronchoscope, ventilation should be held, the scope entered, ventilation resumed, and any distal airway secretions cleared from the lower tracheobronchial tree.
- Ventilation should be held prior to adequate minimal cuff deflation to retract the ETT to the point of insertion site visualization, and the cuff re-inflated prior to resuming ventilation.
- Once the airway is entered and access is secured with the guidewire, a surgical sponge should be used to cover the area during insertion and removal of the dilator and tracheotomy tube to minimize the spray of aerosols.
- If tolerated, ventilation should be held prior to the insertion of the dilator until the tracheotomy tube is in place, the cuff is inflated, and the tube is connected to a closed circuit.
 - Tube placement should be confirmed with end tidal CO₂ and appropriately secured.

Follow hospital protocol for decontamination of non-disposable equipment exposed to secretions of COVID-19 patients upon completion of the procedure.

Postoperative care

PPE should be worn in the postoperative setting according to the recommendations for enhanced droplet and airborne precautions²¹, but extra precautions may be warranted if a high level of exposure to respiratory secretions is expected.

Patients on mechanical ventilation

- A viral filter should be used in line with the ventilator circuit.
- Closed in-line suction should be used
- Disposable inner cannulas should be disposed of and replaced per the manufacturer's guidelines. They should not be cleaned and replaced.

Patients off mechanical ventilation

- Even after ventilator weaning, a closed system, such as a heat-moisture exchange device with a viral filter, should be used to minimize aerosolized secretions^{8,22}. Trach collar should be avoided.
- Unnecessary suctioning and pulmonary lavage should also be avoided¹⁷. Closed in-line suction should be used even after the patient is weaned from the ventilator.
- Tracheotomy tube change should be deferred until the patient is no longer infectious after consultation with the Infectious Disease team²³.

Summary of recommendations

Patients with COVID-19 severe acute respiratory syndrome often require endotracheal intubation and mechanical ventilation. While the prognosis of intubated patients is poor based on currently available data, some studies demonstrate a subset of patients requiring prolonged periods invasive mechanical ventilation. Tracheotomy may be indicated for those intubated greater than 21 days who otherwise have a good prognosis and few comorbidities. A multidisciplinary discussion of the patient's goals of care, overall prognosis, and expected benefits of tracheotomy is a critical part of the decision-making process. If

tracheotomy is performed, specific measures to mitigate the risk of transmission to healthcare personnel must be enforced.

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