

Contemporary Review

Utility of Tracheostomy in Patients With COVID-19 and Other Special Considerations

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Introduction: Patients who become severely ill from coronavirus disease 2019 (COVID-19) have a high likelihood of needing prolonged intubation, making tracheostomy a likely consideration. The infectious nature of COVID-19 poses an additional risk of transmission to healthcare workers that should be taken into consideration.

Methods: We explore current literature and recommendations for tracheostomy in patients with COVID-19 and look back at previous data from severe acute respiratory syndrome coronavirus 1 (SARS-CoV-1), the virus responsible for the SARS outbreak of 2003.

Results: Given the severity and clinical uncertainty of patients with COVID-19 and the increased risk of transmission to clinicians, careful consideration should be taken prior to performing tracheostomy. If tracheostomy is performed, we recommend a bedside approach to limit exposure time and number of exposed personnel. Bronchoscopy use with a percutaneous approach should be limited in order to decrease viral exposure.

Conclusion: Thorough preprocedural planning, use of experienced personnel, enhanced personal protective equipment where available, and a thoughtful anesthesia approach are instrumental in maximizing positive patient outcomes while successfully protecting the safety of healthcare personnel.

Key Words: COVID-19, percutaneous tracheostomy, open tracheostomy, bedside tracheostomy.

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INTRODUCTION

The 2019 novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), with its associated disease coronavirus disease 2019 (COVID-19), has been declared a public health emergency and pandemic by the World Health Organization. Patients who become severely ill from COVID-19 may suffer from rapidly progressing acute respiratory distress syndrome (ARDS). Mortality, which is seen in 3.4% of all diagnosed patients,¹ is precipitated by progressive ARDS and other respiratory complications.²

With the rapid development of this worldwide pandemic, there is a paucity of large or longitudinal studies tracking outcomes in these patients and its transmission to healthcare workers. One approach to understanding COVID-19 is to review previous literature regarding the related coronavirus (SARS-CoV-1) that caused the SARS epidemic of 2003. The two coronavirus variants appear to have similar half-life stability both on surfaces and in aerosolized

form,³ but transmissibility of SARS-CoV-2 is much higher. This difference in transmissibility is hypothesized to be due to greater ability of asymptomatic carriers to transmit the disease to others and increased viral load in the upper respiratory tract of those infected.⁴

Like SARS, COVID-19 poses a serious infectious risk to healthcare professionals treating patients with the disease. Thus far, in China at least 3 thousand healthcare workers have been infected with COVID-19, and at least 22 have died.⁵ This data is still incoming, but approximately 1% of healthcare workers who become infected with this highly contagious virus may succumb to it.

One concern for healthcare professionals managing the airways of COVID-19 patients is the risk of viral exposure during aerosol-generating procedures, including intubation and tracheostomy.⁶ The treatment of COVID-19 is supportive at this time, with the sickest of patients requiring invasive mechanical ventilation. One study of 1,099 patients who tested positive for COVID-19 reported that 2.3% required invasive mechanical ventilation.⁷ Among critically ill patients with COVID-19, the rates of invasive ventilation may be as high as 42%.²

Although there is no readily available data on the number of patients requiring tracheostomy, given the volume and prolonged course of mechanically ventilated patients, it is prudent to compile resources and establish recommendations for performing tracheostomy in COVID-19 patients. Multiple professional otolaryngology organizations have established a set of guidelines regarding tracheostomy

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recommendations during the COVID-19 pandemic.^{8,9} The purpose of this article is to explore the utility of tracheostomy in COVID-19 patients and review current literature for insight into other special considerations regarding tracheostomy that should be taken to minimize exposure to healthcare workers and provide positive outcomes for COVID-19 patients.

UTILITY OF TRACHEOSTOMY IN COVID-19 PATIENTS USING ALL-CAUSE ARDS AS A SURROGATE

It is generally accepted that tracheostomy should be considered in patients requiring prolonged mechanical ventilation because it confers benefits including reduced work of breathing, improved weaning, and improved patient communication, and it may help avoid adverse outcomes such as subglottic or tracheal stenosis.^{10–13} However, consideration of tracheostomy in COVID-19 patients necessarily raises the questions of disease course and the likelihood of successful ventilator weaning. Although the benefits of tracheostomy are well established, procedures performed in a severely resource-limited environment and in a patient population with grim prognoses would be ill-advised.

In the absence of long-term COVID-19 epidemiologic data, it may be helpful to consider all-cause ARDS treatment and prognosis as clinical surrogates. The estimated incidence of ARDS in hospitalized COVID-19 patients ranges from 17% to 29%.^{14,15} Yang et al reported that, among critically ill COVID-19 patients, nonsurvivors had an increased rate of ARDS development (81% vs. 45% of survivors) and mechanical ventilation (94% vs. 35%).² In COVID-19 patients who required mechanical ventilation, the median duration of ventilation was 17 days; however, after 28 days, 81% of mechanically ventilated patients had died.^{2,15} Although there are varying definitions, late tracheostomy is generally considered for intubation lasting longer than 10 days.¹⁶ Data suggests that ARDS secondary to COVID-19 carries a worse prognosis than all-cause ARDS, which previously has been reported to have a median duration of invasive ventilation of 8 days and a 28-day mortality of 34.8%.¹⁷ With this in mind, it appears that when the natural course of COVID-19 is projected for well beyond 10 days, mortality is high and aggressive therapy may be futile.

Prior reports indicate that 13% of all-cause ARDS patients underwent tracheostomy as adjunct treatment.¹⁷ However, given the differences in clinical outcomes between all-cause and COVID-19 ARDS patients, this course of action may not be clinically appropriate for COVID-19 patients. Furthermore, in addition to the risk of normal complications such as subcutaneous emphysema, pneumothorax, and tracheal stenosis, tracheostomy of COVID-19 patients poses unique challenges due to its previously discussed transmissibility in the setting of current personal protective equipment (PPE) shortages.^{18–20} SARS-CoV-2 is at least partially transmitted by droplet, and tracheostomy is known to pose a high infectious risk to the surgical team and other healthcare workers.⁶ Studies have shown the presence of SARS-CoV-2 viral load in patients well into the second week of disease, and even

after other clinical signs of disease had passed.²¹ Retesting for active virus prior to proceeding with tracheostomy may provide some insight into risk, although precautions should still be exercised given the contagious, aggressive nature of COVID-19. In light of the known risks and uncertain benefits of tracheostomy in COVID-19 patients, it is prudent for clinicians to consider each individual situation very carefully before proceeding with tracheostomy.

SETTING AND APPROACH OF TRACHEOSTOMY IN COVID-19 PATIENTS

If the decision is made to proceed with tracheostomy, careful consideration regarding the proper setting (bedside vs. operating room [OR]) and approach (open vs. percutaneous) should be made to minimize provider exposure. There is no current data investigating how either of these variables impacts the risk of COVID-19 transmission to healthcare workers. There are, however, several important findings that may help guide clinicians when deciding where and how to perform tracheostomy.

Benefits to bedside tracheostomy include avoiding exposure to additional healthcare workers during transfer to the OR, consolidation of teams without the need of both an intensive care unit (ICU) and OR team, and use of a single ventilator. Additionally, bedside tracheostomy may limit potential viral exposure time by decreasing procedural time and more effectively conserve scarce resources when compared to tracheostomy in the OR. Bedside percutaneous tracheostomy has been shown to be performed more quickly (10–20 minutes) on average than open tracheostomy done in the OR and at a significantly decreased cost,^{22–24} which may reflect a decreased use of resources such as PPE and personnel. However, the time-saving and resource benefits of percutaneous tracheostomy become less apparent when open tracheostomy is also performed at the bedside,^{25,26} indicating that the time and resources saved are more likely a reflection of the setting of the procedure rather than the approach.

There is a plausible risk for increased intraprocedural viral exposure via secretions and aerosolized particles when tracheostomy is performed percutaneously because this technique requires additional manipulation of the airway with multiple, repetitive dilations. Although this is a logical consideration that should be taken into account, there is no currently published literature to establish this claim.

Regarding the use of bronchoscopy during a percutaneous approach, consideration should be taken with respect to its impact on infectious risk to providers. Bronchoscopic evaluation during percutaneous tracheostomy may increase visualization during critical moments, which may help avoid major complications such as posterior tracheal wall puncture or false lumen creation.^{27,28} However, use of bronchoscopy requires the presence of a second clinician, and its use may actually lengthen the time of uncomplicated cases by adding unnecessary steps.^{29,30} If a proceduralist is more comfortable performing percutaneous tracheostomy with the assistance of bronchoscopic evaluation, certain precautions may decrease viral exposure risk. Ventilation should be suspended while the bronchoscope is in the airway to avoid blowback

through the bronchoscopy port. Typically, the need for visualization is only absolutely necessary during placement of the hollow needle for guidewire placement; therefore, judicious use of bronchoscopy only at key moments in the procedure may reduce viral exposure. In the context of low complication rates with or without bronchoscopic evaluation,³¹ the additional resources and prolonged time of viral exposure to an increased number of healthcare workers with bronchoscopic evaluation may not be worth the benefits of increased visualization.

Another major consideration should be the negative pressure capabilities of rooms in the ICU and OR because negative pressure precautions were reported in multiple successful tracheostomies without viral transmission to healthcare workers during the SARS epidemic.^{32,33} Although technically one would recommend the use of a negative pressure room to perform the procedure at bedside, this may be less applicable in closed COVID-19 units.

From the perspective of patient outcomes, multiple studies have demonstrated no difference between open and percutaneous tracheostomy in either periprocedural or overall mortality.^{34–36} However, some studies show poorer mortality for open tracheostomy when performed in the OR compared to percutaneous at the bedside.^{37,38} Importantly, these findings suggest that tracheostomy at the bedside can be performed at least as safely or possibly more safely than in the OR.³⁹

Given this information, we recommend strong consideration of bedside tracheostomy. Open or percutaneous tracheostomy—ideally without bronchoscopic assistance—may be used based on provider comfort, although consideration of plausible increased viral exposure with additional airway manipulation when using a percutaneous approach should be taken into account. This decision should be entertained after multidisciplinary discussion and establishing a definitive need for tracheostomy.

TECHNICAL CONSIDERATIONS

Previously published case reports and protocols for tracheostomy in SARS patients share several considerations for the present-day clinician. In addition to standard contact and droplet precautions, surgical staff heavily utilized enhanced PPE (for example, positive air-powered respirators or Stryker T4 (Stryker Instruments, Kalamazoo, MI) in addition to droplet precautions with N95 mask) with standardized, often supervised removal.^{32,33,40,41} Negative pressure rooms were used when possible, either bedside or in dedicated ORs. Personnel were chosen for their experience; extensive coordination was undertaken to minimize personnel number and procedural time and avoid distractions or unforeseen complications.³² Adequate lighting during bedside procedures was ensured with standing OR lights or headlamps. It is worth noting that space or PPE limitations may restrict these supplemental accommodations.⁴⁰

Anesthesia considerations are of the utmost importance. Rapid sequence intubation, foregoing of bag mask ventilation, and intubation by an experienced anesthesiologist are steps that may be taken to reduce risk of viral transmission during initial intubation in the ICU or emergency department. If tracheostomy is considered medically necessary, total

intravenous anesthesia should also be entertained as indications include anesthesia provided outside the OR and the need to limit laryngospasm with subsequent coughing upon emergence.⁴² Both of these indications are applicable to tracheostomy in the context of bedside ICU procedure and reduction of aerosolized tracheostomy expectorants upon emergence, respectively. To this end, prophylactic dosing of a neuromuscular depolarizing agent such as rocuronium at regular intervals and immediately prior to incision of the tracheostomy helps to reduce risk of coughing.⁴³ Finally, relative contraindications for percutaneous tracheostomy from an anesthesia viewpoint include positive end-expiratory pressure (PEEP) > 18 cm, airway pressure > 45 cm, and $\text{FiO}_2 > 80\%$.³¹

In addition to using SARS protocols, several professional otolaryngology organizations have issued recommendations on safe tracheostomy in COVID-19 patients. Examples of tracheostomy-specific precautions taken in COVID-19 positive patients in the United Kingdom include avoiding high-flow oxygen due to its propensity to increase aerosolization of the virus, using a nonfenestrated tracheostomy tube, pausing ventilation during the window period of the operation and while placing the tube, avoiding circuit disconnection as much as possible, and the use of a certified a heat and moisture exchanger if disconnection is necessary.⁹

CONCLUSION

Given the severity and uncertain clinical outcome of patients with COVID-19, in addition to the increased risk of transmission to clinicians during aerosol generating procedures, careful consideration should be taken prior to performing tracheostomy. If the decision is made to proceed with tracheostomy, we recommend a bedside approach in order to decrease additional exposure in route to the OR and to minimize the number of personnel and procedural time in an attempt to limit viral exposure. Outcomes of percutaneous, and open approaches have been shown to be comparable. Bedside tracheostomies may be performed using an open or percutaneous approach; the decision is left to the discretion and comfort of the performing clinician. Percutaneous tracheostomy poses a theoretical risk of increased exposure to viral secretions and aerosolized particles due to additional airway manipulation with repetitive dilations. Bronchoscopy use with a percutaneous approach should be limited in order to decrease viral exposure. Thorough preprocedural planning, use of experienced personnel, enhanced PPE (where available), and a thoughtful anesthesia approach are instrumental in maximizing positive patient outcomes while successfully protecting the safety of healthcare personnel

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