Tracheostomy During the COV-SARS-CoV-2 pandemic: Recommendations from the New York Head and Neck Society

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Background

The rapid spread of SARS-CoV-2 in 2019 and 2020 has resulted in a worldwide pandemic.[1-4]The dramatic proinflammatory effects of COV-SARS-CoV-2 results in a wide variety of clinical presentations, however severe pulmonary inflammation, effusions, and rapid respiratory compromise are a hallmark of this disease.[5-7]Subsequent pneumonia, acute respiratory distress syndrome and death have been reported not infrequently. The result of this pandemic is a large and increasing number of patients requiring endotracheal intubation and prolonged ventilator support.[8-13] Certainly, the rapid rise in endotracheal intubations coupled with prolonged ventilation requirements will lead to an increase in tracheostomy procedures in the coming weeks and months.[14, 15]

While generally a well-tolerated and safe procedure, the risks and benefits of tracheostomy in terms of outcomes, pulmonary care, and risks to the health care team remain unknown [16, 17]. Fortunately, while not perfect, rapid testing protocols have allowed us the ability to detect active infection in patients who are affected by SARS-CoV-2.[18-21] What is clear is that the upper aerodigestive tract, the nasopharynx and the trachea harbor a high viral load during the acute stages of the infection.[22-24] Therefore, performing tracheostomy in the setting of active COV-SARS-CoV-2 when necessary, poses a unique situation, with unique risks and benefits for both the patient and the health care providers. The risk of this procedure has to be balanced with the known risks of prolonged intubation, primarily tracheal and subglottic stenosis the management of which can be problematic if significant mucosal injury and subsequent stenosis occurs.

The New York Head and Neck Society is a non-profit organization founded in 1979, which encourages the exchange and advancement of scientific knowledge relative to the management of head and neck cancer and includes several member institutions including Columbia University Medical Center, Cornell Medical College, Icahn School of Medicine at Mount Sinai, Memorial Sloan Kettering Cancer Center, New York University Medical Center, Montefiore Medical Center Albert Einstein College of Medicine, and has several other affiliate institutions in the greater New York City area. The New York Head and Neck Society has collaborated on this document to provide guidance on the performance of tracheostomy during the SARS-CoV-2 pandemic.

Recommendations:

1. **Monitor endotracheal and tracheostomy tube cuff pressures Q4 hours.**

   In patients who are intubated, especially in prolonged intubations >72 hours the risk of tracheal stenosis increases over time. Teams managing these patients should stress that all intubated patients have Q4 hour cuff pressure check with goal of approximately 30mm Hg if feasible given the vent parameter requirements, as pressures higher than 30mmg Hg may result in pressure necrosis. Certainly, adequate pressure to avoid cuff leakage and aerosolization is critical when managing SARS-CoV-2 patients, but it should be recognized that unnecessarily high cuff pressures are also problematic. The minimum cuff pressure required to create an adequate seal should be individualized for each patient and verified frequently by care providers. This is a dynamic process and frequent adjustments may be indicated depending on ventilation parameters. Prevention of tracheal mucosal pressure necrosis, resulting tracheal and cricoid chondritis, and subsequent stenosis is critical in the SARS-CoV-2 population.[25] [26] In addition the size of the ETT should be considered to avoid unnecessary trauma to the airway, in general size 7.0-7.5 for males, and 6.5-7.0 for females.

   SARS-CoV-2 testing via RT-PCE detection platform for SARS-CoV-2 and pan-sarbecovirus detection is recommended for all patients who are under consideration for tracheostomy. Keeping in mind that that data surrounding accuracy of the test during the pandemic is forthcoming, and false negatives are a real possibility.[27] The test may be performed a second time if clinical suspicions or institutional policy warrants repeat testing prior to high risk procedures.

2. **Delay timing of tracheostomy until 21 days after the onset of symptoms if feasible.**

   When determining the appropriate time of tracheostomy in the SARS-CoV-2 patient a variety of factors are considered, and certainly individual cases may have mitigating circumstances which lead to the decision to perform

tracheostomy. However, for the majority of patients, health care teams should seek to capitalize on the intersection of the risk of contamination/infection and decreasing viral load in the upper and lower airway over time with the risks of prolonged intubation(i.e. tracheal stenosis, weaning issues, etc). While the overall risk of tracheal stenosis secondary to prolonged intubation depends on a variety of factors, reported rates of severe, symptomatic stenosis are generally in the 1-2% range when modern low-pressure cuffs are utilized.[28-32] Therefore in light of the relatively low risk of clinically relevant stenosis, and despite the traditional 10-day cutoff for increased stenosis risk used by many practitioners in the general population, when dealing with a SARS-CoV-2 patient, this low rate risk for tracheal stenosis is acceptable in light of the significant risks of tracheostomy in the acute phase of the infection, during higher viral loads. The decreasing viral load, while logarithmic in nature is somewhat variable and high viral loads have been observed somewhat late in the course of the infection in critically ill patients.[23, 24, 33](**Figure 1,2)** Therefore waiting until approximately 21 days after the onset of symptoms is recommended prior to consideration of tracheostomy for the majority of cases in order to avoid exposing health care teams to increased risk if feasible. Certainly, earlier tracheostomy may be medically indicated in some situations depending on the clinical situation, or health care system issues, and we recognize the potential need to perform tracheostomy more urgently. Tracheostomy should not be delayed regardless of SARS-CoV-2 status in life saving situations, or in situations where the tracheostomy would significantly improve the prognosis of the patient. And certainly the timing of tracheostomy remains a controversial issue and data is limited related to SARS-CoV-2. [34] Alternative emerging strategies in the management of SARS-CoV-2 critically ill patients, such as extracorporeal membrane oxygenation, antiviral therapy, and convalescent plasma therapy may also be considered by the team but the available data and decision making regarding this is beyond the scope of these recommendations.[35-39] Clearly these are multidisciplinary decisions which will be individualized depending on the patient and institutional expertise.

In addition, it should be noted that avoiding tracheostomy in high mortality risk patients is critical. If the primary team managing the patient determines that there is an extremely high risk of mortality in the near future, or that the patient has a high likelihood of withdrawal of care, the risks of tracheostomy should be avoided in this situation. Patients, with significant medical comorbidities, ARDS/severe respiratory failure, and a low chance of recovery who are infected with SARS-CoV-2, should be carefully evaluated, and discussions with family members, consultants, institutional ethics committees, and the treating team should focus on overall prognosis and goals of care, prior to performing tracheostomy. These decisions are highly individualized and rely on solid communication amongst team members managing these high-risk patients.

3. Tracheostomy Technical Considerations and Recommendations.

While the exact technical details regarding tracheostomy will depend on the situation and procedural protocols and technical expertise, there are some specific technical aspects related to the SARS-CoV-2 (and other viral pandemics) which should be considered. Ideally the procedure should be performed at bedside in the ICU in a negative pressure room or using a portable HEPA filtration system to avoid patient transportation and contamination of other areas in the medical center. If it is necessary to perform the procedure in the OR, a specific OR cluster should be designated to avoid contamination of additional OR resources for non-infected patients. In addition to standard airborne and droplet precautions, techniques to minimize aerosolization of the virus during the procedure include the following: paralysis to prevent coughing, consider glycopyrrolate to reduce secretions, preoxygenation and cessation of ventilation during the tracheostomy procedure, utilization of closed suctioning systems, avoiding monopolar electrocautery and using cold instrumentation when feasible, minimizing suctioning and bronchoscopy during the procedure, and ensuring the cuff is inflated prior to resuming ventilation so the circuit is closed.

In addition to standard open tracheostomy, percutaneous/dilational tracheostomy techniques have been evaluated extensively in the literature and have been shown to be a safe alternative to traditional open surgical tracheostomy.[40-42] Understandably, the techniques utilized when performing tracheostomy will vary based on patient characteristics, provider expertise, and institutional experience. While data is limited, techniques which avoid opening the airway and are closed such as a percutaneous dilational technique, may be preferential in the setting of active SARS-CoV-2 infection athough this remains to be clarified.[43, 44] Therefore if there are no anatomical or other contraindications, percutaneous dilational tracheostomy may be considered if the expertise is available. It should be kept in mind that the decrease in aerosolization during percutaneous tracheostomy only holds true if airway manipulation (i.e. bronchoscopy) is not performed, and while there have been some associated higher complication rates with blind percutaneous tracheostomy compared to bronchoscopic technique, ultrasound guided techniques have been shown to be non-inferior to bronchoscopic techniques.[45-47]. Therefore, if considering a percutaneous tracheostomy, a closed ultrasound guided technique is recommended for SARS-CoV-2 patients.

4. **Use of appropriate PPE during tracheostomy procedures for active SARS-CoV-2.**

While there is limited data on the current pandemic to fully inform current recommendations, certainly performing tracheostomy in an actively infected SARS-CoV-2 patient is a high-risk procedure for health care workers.[48] Health care personnel performing the tracheostomy should wear at minimum: Waterproof cap, goggles with an anti-mist screen, N95 mask, impermeable operating room surgeon's gown and gloves, and a transparent plastic facial shield worn outside the goggles and N95 effective to filter 99.5% particles larger than 0.75 μm.[49] The minimum number of health care workers required to perform the procedure should be present to prevent unnecessary exposures.

The effectiveness of the N95 mask in the prevention of SARS-CoV-2 infection during tracheostomy procedures remains unknown, but given the high risk consideration for power air purifying respirator (PAPR) systems for personnel performing tracheostomy should be entertained, and these systems should be used when available in situations of active infection, or suspicion of high viral loads, as there is some evidence of superior protection (PAPR provides 2.5 to 100 times greater protection than the N95, when staff are appropriate trained.[48, 50, 51] Certainly the effectiveness of N95 and PAPR in this situation has not been compared in a head to head trial, and therefore the use of PAPR vs. N95 will depend on institutional resources and policy, and the clinical situation.

5. **Avoid emergent tracheostomy if possible.**

Techniques to manage the acute airway with endotracheal intubation, video laryngoscope and fiberoptic intubation should be utilized if possible to avoid emergent tracheostomy in SARS-CoV-2 patients due to the high risk of unsafe conditions and health care worker contaminations.[49] Similarly, intubation techniques (i.e. rapid sequence intubation) which avoid mask ventilation, prolonged open airway manipulation are recommended when feasible. When life threatening airway obstruction occurs in a setting in which intubation is not possible, healthcare workers should perform the procedure with the above noted PPE keeping in mind that PAPR respirator use is often not feasible or available in emergent situations. In situations where CPR is being performed, chest compressions should be held at the time the airway is entered, until the airway is secured and the cuff inflated on the device, to minimize health care worker exposure.

6. **Appropriate post tracheostomy management.**

The post-tracheostomy management should also be mentioned, as in addition to routine tracheostomy care, there are some considerations for SARS-CoV-2 patient. Securing circuits properly and avoiding unnecessary humidification may reduce the risk of unexpected circuit disconnection and aerosolization leading to exposure. The circuit should remain closed as much as possible, and closed line suctioning should be used. Heat moister exchangers with viral filters and HEPA filtration should be used when possible. Tracheostomy tube changes should be avoided, and only performed in cases of cuff failure, or emergent situations.

7. **Organize an appropriate team.**

While the members of the health care team performing tracheostomy vary across institutions, team members may include surgeons, medicine/intensivists, anesthesiologists, respiratory therapists, nurses, and other ancillary staff required during these procedures. The importance of appropriate PPE/PAPR training and usage cannot be overstated in the setting of active SARS-CoV-2 infection. Teams who perform the procedure regularly will be more efficient and less likely to be unfamiliar with the procedure or appropriate health care protective measures and infection control. The inclusion of trainees such as residents and fellows during these procedures requires careful consideration and will vary based on institutional policies.

Currently there is limited data on the host innate immune status of SARS-CoV-2 infected patients.[52] Consideration of the inclusion of health care workers who have previously been exposed and subsequently recovered from documented SARS-CoV-2 infection may be warranted. While the exact timing of immunity and subsequent safety for the return of health care providers infected with SARS-CoV-2 remains unknown, sufficient antibody responses have been documented to occur between days 15-20, or approximately two weeks after the onset of symptoms.(**Figure 3**)[23] Inclusion of these individuals on these teams may allow for high risk procedures to be performed by health care workers who have mounted an immune response to the virus, depending on institutional quarantine policies. Similarly, these individuals should not be involved in tracheostomy procedures or other airway procedures in non-infected patients due to the risk of iatrogenic infection with SARS-CoV-2 due to limited available data about the risks.[53]

Conclusion:

Tracheostomy in the SARS-CoV-2 infected patient represents a unique situation, with a unique set of risks and implications. When compared to traditional tracheostomy procedures in the setting of prolonged ventilation, SARS-CoV-2 represents a unique entity in terms of timing, indications, and infection control considerations which must be kept in mind when performing

these procedures and managing patient's post-tracheostomy. Additional resources are listed below.

Summary Points:

- **Careful consideration of "who" and "when" when tracheostomy is planned.**
- **Careful consideration of the location and technique to avoid unnecessary risks to health care providers.**
- **When clinically appropriate, delay of tracheostomy procedures is recommended to allow for reduced viral load and decrease the risk of nosocomial infection to critical health care providers.**
- **Selecting appropriately sized ETT, and careful monitoring of ETT cuff pressures to maintain appropriate seal to avoid aerosolization, while mitigating the risk of long-term tracheal complications.**
- **Appropriate PPE training and utilization, including N95 or PAPR when indicated is recommended for all patients undergoing tracheostomy, regardless of SARS-CoV-2 status, during the pandemic.**
- **Avoidance of unnecessary airway manipulation such as bronchoscopy, trach changes, with a focus on a closed-circuit ventilation, and utilizing ultrasound guidance for percutaneous tracheostomy.**

Resources:

American Academy of Otolaryngology-Head and Neck Surgery

Tracheostomy Recommendations during COVID-19 Pandemic.

https://www.entnet.org/content/tracheotomy-recommendations-during-covid-19-pandemic

American Head and Neck Society Guidance for Tracheostomy during COVID-19 Pandemic.

https://www.ahns.info/wp-content/uploads/2020/03/Guidance-for-Surgical-Tracheostomy-and-Tracheostomy-Tube-Change-during-the-COVID.pdf

Percutaneous Tracheostomy Technique:

https://www.hopkinsmedicine.org/tracheostomy/about/how.html

https://www.vumc.org/trauma-and-scc/sites/vumc.org.trauma-and-scc/files/public_files/Protocols/Tracheostomy%202019.pdf

Open Tracheostomy Technique:

https://www.mayoclinic.org/tests-procedures/tracheostomy/about/pac-20384673

https://my.clevelandclinic.org/health/treatments/17568-tracheostomy-care

https://medicine.uiowa.edu/iowaprotocols/tracheotomy-tracheostomy

Figures:

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Figure 1. SARS-CoV-2 Viral Load of throat and nasal swabs relative to days since onset of symptoms. [24]

Figure 2. Temporal profile of serial viral load from all patients (n=23). [23]

Figure 3. Temporal profiles of serum IgM and IgG against NP and spike protein RBD, as ascertained by EIA [23]

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