



“A Systematic Review on Guidelines and Recommendations for Tracheostomy During COVID-19 Pandemic”

Rahulkumar Shah¹ · G Priyadarshini¹ · Monil Parsana²

Received: 25 September 2020 / Accepted: 15 March 2021
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Abstract World is under threat of COVID-19 pandemic, associated with many numbers of critically ill patients. To manage these intubated patients there are need of more ventilators but world is not prepared for this type of situation and there are lacunae of such arrangements in most of the countries. As we know patients cannot be intubated for long time and they should be given preference to alternative airway in the form of tracheostomy. COVID-19 is aerosol transmitted disease which lead to indeed challenge to health care providers to safely perform tracheostomy and provide post tracheostomy care to these patients with minimising risks of nosocomial transmission to themselves and accompanying nursing staff. There are so many guidelines and recommendations for the timing, desired place of tracheostomy, change in tracheostomy steps related to conventional method and the subsequent management of patients. So, the aim of this systematic review is to give a brief review of available data on COVID-19 related to the timing, personal protections, operative steps modifications, and subsequent post tracheostomy care during this pandemic.

Keywords COVID-19 · Tracheostomy · Personal protective equipment

Abbreviations

PAPR Powered air purifying respirators

PPE Personal protective equipment
HME Heat and Moisture exchanger
HEPA High efficiency particulate air
PEEP Positive end expiratory pressure
APL Adjustable pressure limiting valve
ET Endotracheal tube
DOP Date of publication

Introduction

The COVID-19 pandemic caused by the SARS-CoV-2 virus is big health related issue faced by many doctors across world since it began in late 2019 [1]. Till date COVID-19 has infected more than 30.6 million people and cause 950 000 deaths [2]. The Doctors are in search for definite treatment and methods for reduction of transmission. Tracheostomies are commonly done in critically ill patients which are on mechanical ventilation to facilitate their weaning from ventilation and to increase the availability of intensive care unit (ICU) beds for new infected patients. However, as we know tracheostomy is an aerosol generating procedure, so health-care workers are at risk of infection during procedure and post tracheostomy care even though appropriate personal protective equipment (PPE) is used. So COVID-19 positive patients are challenge for tracheostomy procedure to be done safely. There are many Conflicting recommendations exist about the timing, ideal place, performance of tracheostomy and the subsequent management of patients.

✉ Rahulkumar Shah
rahulshah.1010october@gmail.com

¹ Department of ENT, Pramukhswami Medical College, Karamsad, Anand, Gujarat 388325, India

² Department of ENT, Pandit Dindayal Upadhyay Medical College, Rajkot, Gujarat, India

Methodology

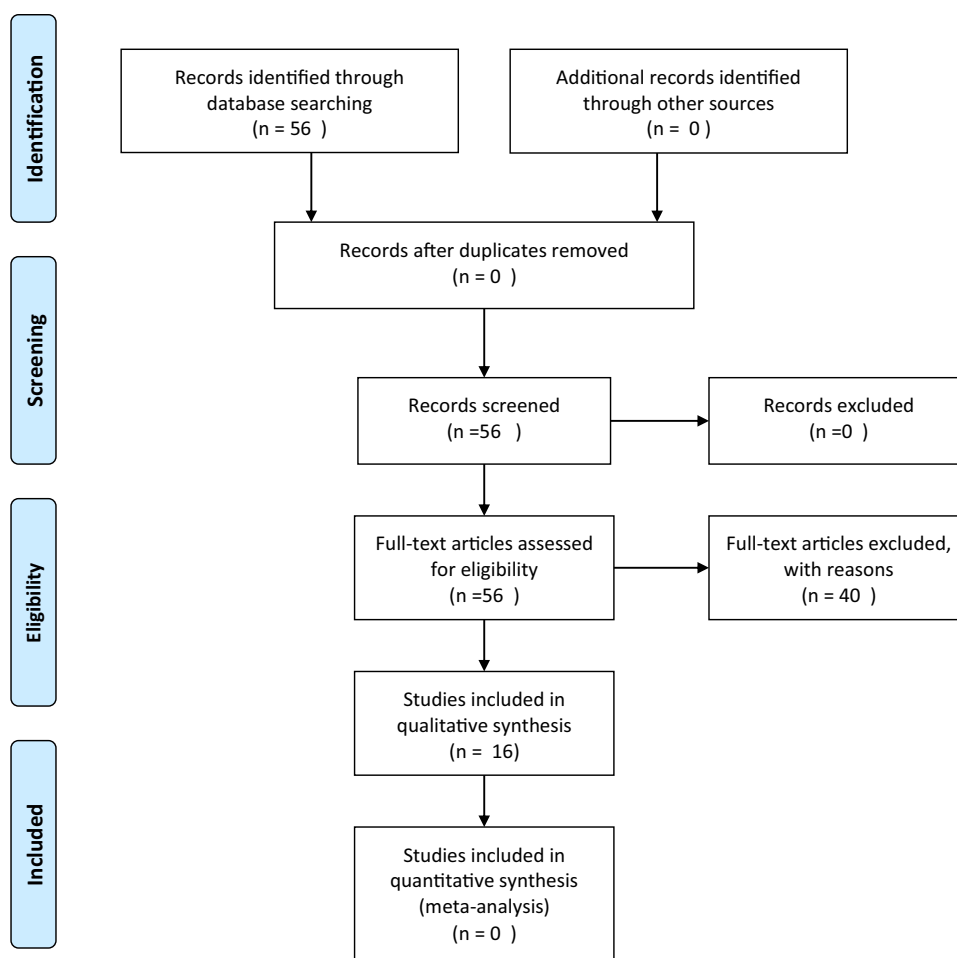
The report of this systematic review was made according to the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Fig 1). The review protocol was not previously registered. MEDLINE (accessed from PubMed) from 6 august 2019 to 7 august 2020 were systematically searched for related published articles. In electronic databases, the following search strategy was implemented and these key words (in the title/abstract) were used: “COVID 19” OR “CORONAVIRUS” OR “SARS COV-2” AND “TRACHEOSTOMY”. Articles written in English and available full text were all included in this search. All authors participated through each phase of the review independently (screening, eligibility, and inclusion). They independently screened the titles and abstracts yielded by the search

against the inclusion criteria. They resolved any disagreement through discussions. Neither of the authors were blind to the journal titles or to the study authors or institutions. The following data were extracted from the included studies: study authors, study designs, main results. We included only human studies and articles with clearly defined clinical outcome. The exclusion criteria was animal studies and review articles. The search was performed at specified date and time on 7/08/2020 at 11:30 Am.

Results

Total of 56 full article studies were obtained on PubMed database search, out of which 40 studies were excluded due to not relevant title, not relevant content, review articles, head neck oncology related tracheostomy. Finally, we

Fig. 1 PRISMA flow chart



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit www.prisma-statement.org.

reviewed the final 15 articles based on our selection criteria to extract the following information from each: first author, date of publication, study design, main results data related to tracheostomy guidelines for COVID-19. The extracted data is jotted in Table 1.

Discussion

General Recommendations for Tracheostomy in COVID-19 positive Patients based on systemic analysis of included articles are developed as under in different headings:

Timing of Tracheostomy

Timing of tracheostomy should be between ventilator [post intubation] days 14–21 when viral load is expected to be decreasing and 21–30 days after onset of symptoms.

Place of Procedure

The ideal location for performing a tracheostomy on a COVID-19 positive patient should be an isolated room with lower pressure than the corridor with closed doors-windows and no laminar flow. If not possible, Operating room or ICU room with negative pressure using a portable high efficiency particulate air (HEPA) filtration system can be beneficial.

Preparation and Safety

Personal protective equipment-PPE should include: Fitted respiratory mask [N95 OR PAAR OR PFF3], surgical cap, impermeable sterile gown, shoe covers, goggles, and full-face shields, sterile double gloves and additional surgical mask (in front of the N95 or PFF3). There should be minimum number of people in the room (2 procedural staff-ENT surgeon and anaesthetic). Use only a conventional cuffed tracheostomy tube, avoiding the fenestrated models. If shifting of patient is needed to isolated room or operating room then do deep suctioning of the chest and oral cavity using the closed suctioning circuit to reduce the amount of secretions at the time of opening the trachea. During transfer of patient, Security staff should have to close the corridor temporarily and the patient should be transferred along the back corridor of the theatre [not through the main theatre entrance] and transfer team should have to take all personal protection measures.

Operative Steps/Technique Modification

- Deep neuromuscular blockade and sedatives should be given for adequate paralysis with glycopyrrolate to reduce tracheal secretions.
- Avoid electrocautery usage during tracheostomy procedure to reduce risk of smoke formation and viral transmission via aerosol. After trachea identification, Pre oxygenate the intubated patient with PEEP and then stop ventilation and turn off flows of ventilation.
- Allow time for passive expiration with open APL valve.
- To avoid the aerosol transmission- clamp ET tube, deflate cuff and push down the ET tube beyond [up to carina] the site chosen for the tracheal stoma at the beginning of the procedure.
- Create appropriate tracheal window opening, deflate the cuff of ET tube and pull the ET tube until the tip is proximal to the tracheal window opening.
- Tracheal or wound suctioning of blood or secretions should not be done, to avoid aerosol generation.
- Insert the tracheostomy tube quickly into the opening, inflate tracheostomy tube cuff almost simultaneously and the tracheostomy tube is rapidly connected to the ventilator with immediate resumption of the ventilation.
- Confirm position of the tracheostomy tube with end tidal CO₂ only to avoid contamination of stethoscope by auscultation.
- An HME type filter (Heat and moisture exchanger) must be placed on the tracheostomy tube to reduce the exposure of the virus, in case of accidental disconnection of circuit and if patient is not on mechanical ventilation.
- Suspension of ventilation support should be minimum, with satisfactory oxygen saturation [do quick tracheostomy].

Post Procedural care and Rehabilitation

- Team involved in the procedure should use a shower for body cleaning.
- Avoid humidified oxygen, use only HME filters.
- Do suctioning always in a closed circuit.
- Tracheostomy Cuff should be always inflated.
- Avoid tracheostomy stoma dressing changes unless there are clear signs of infection.
- Avoid tracheostomy tube change before 7–10 days, giving preference to a period of lower viral load. During tracheostomy tube change the anaesthesiologist should have to sedate the patient and perform a neuromuscular block to reduce any risk of coughing.

Table 1 Analysis of all included studies

Serial number. DOP	Author and type of article	Timing of tracheostomy and place	Preparation	Operative steps	Post tracheostomy care
1 12-05-2020	Menegozzo CA et al. [3] Technical note	After 14 days of intubation. Isolated room with lower pressure than the corridor. If unavailable, use a room. With closed doors and no laminar flow or operating room.	Wear a hat, foot protection, PFF3 or N95 mask and a face shield OR goggles, Apron and gloves (sterilized). Additional surgical mask (in front of the N95 or PFF3) can be used.	Avoid electrocautery-risk of smoke formation Ensure Adequate paralysis Stop ventilation, advance the occluded orotracheal tube below the site proposed for the tracheostomy. Create the tracheal window, minding the cuff, deflate ET cuff and pull the tube until the tip is proximal to the tracheal window. After insertion of the cannula, immediately inflate the cannula cuff with the syringe already attached to the cuff channel. Remove the introducer and attach connection with the antiviral filter to the cannula and the circuit. Restore ventilation and confirm positioning with capnography (avoid using the stethoscope) Confirm adequate paralysis	Use a shower for body cleaning after tracheostomy Avoid humidified oxygen Suctioning always in a closed circuit Cuff always inflated Avoid dressing changes unless there are clear signs of infection Avoid switching the cannula before 7 to 10 days, giving preference to a period of lower viral load Use full PPE for exchanges Deflate the cuff only with the flow off and inflate the cuff of the new cannula immediately after insertion Use of cannulas without fenestrations until the COVID exam is negative Humidified oxygen to be avoided, use only HME Use only in line closed suction circuit all times. Periodic check cuff pressure Cuff should not deflated Do not change dressings unless frank sign of infection Delay first tube change for at least 7–10 days Follow same sequence of pause in ventilation with flows off before deflating cuff and inserting new tube with immediately re-inflation of cuff and reconnection of circuit Cuffed non fenestrated tube to be used until patient is covid-19 negative Subsequent planned tube change at least 30 days interval
2 04-Apr-20	Jacob T et al. [4] Letter TO EDITOR	Negative pressure theatre or isolated room. If not available consider a normal theatre with closed doors during the procedure. Consider turning off laminar flow [if present]	Surgeons must wear full PPE Consider additional protection – powered air purifying respirator-PAPR	Pre oxygenation with PEEP then stop ventilation and turn off flows. Allow time for passive expiration with open APL valve Consider clamping of ET then deflate cuff and advance beyond proposed tracheal window. Make tracheal window, insert cuffed, non-fenestrated tracheal tube. Immediately inflate cuff, establish oxygenation with PEEP again. Confirm position with end tidal CO2 only to avoid contamination of stethoscope by auscultation. Initial advance of the endotracheal tube beyond proposed tracheostomy window is performed to reduce aerosol elimination	

Table 1 continued

Serial number. DOP	Author and type of article	Timing of tracheostomy and place	Preparation	Operative steps	Post tracheostomy care
3	Lima DS et al. [5]. technical note		<p>Reduce team members to just the essential required professionals.</p> <p>Use the FFP3 / N95 mask, integrated visor/ full face shield / disposable sterile gowns resistant to liquids / fluids (waterproof).</p> <p>Consider using “two gloves”.</p> <p>Use a conventional tracheostome, avoiding the fenestrated models.</p>	<p>If possible, stop ventilation while the tracheal incision is being performed, and check that the cuff is already inflated before restarting ventilation;</p> <p>Ventilation should be stopped before the insertion of the tracheostomy tube, and perform a fast and accurate placement of the tracheostomy tube with immediate inflation of the cuff;</p> <p>Confirm the adequate placement, preferentially, with capnography, if available</p> <p>An HME type filter (Heat and moisture exchanger) must be placed on the tracheostomy tube to reduce the exposure of the virus, in case of disconnection</p>	<p>Avoid changing the tracheostomy tube until the patient has a COVID-19 negative report.</p> <p>Only closed-circuit suction should be used</p>
4	Botti C et al. [6] case report	ICU room with negative pressure	<p>Sterile gown, cap, shoe covers, double gloves, N95 mask, goggles and face mask</p>	<p>Paralyse the patient</p> <p>Establish adequate preoxygenation,</p> <p>Avoid electrocautery.</p> <p>Stop mechanical ventilation before tracheotomy.</p> <p>Deflate the cuff of the endotracheal tube,</p> <p>Push the tube forward 3 cm,</p> <p>Perform tracheotomy with cold knife</p> <p>No tracheal or wound suctioning of blood or secretions should be attempted if not needed, to avoid aerosol generation.</p> <p>Pull the endotracheal tube just above the tracheal incision under direct vision,</p> <p>Insert the tracheal cannula, correctly inflate.</p> <p>Give ventilation again.</p>	<p>Careful removal of personal protective equipment with supervision.</p> <p>Take a shower after procedure.</p>

Table 1 continued

Serial number. DOP	Author and type of article	Timing of tracheostomy and place	Preparation	Operative steps	Post tracheostomy care
5 06-04-2020	Pichi B et al. [7] editorial	Provisional operating room set up in the ICU. If not available, aerial-isolated room (ie doors and windows closed).	Cap and shoe covers. Mask: FFP3 (Europe) or N99 (US) mask. Goggles or face shield. Use of double gown is preferable Use of double nitrile gloves is suggested.	No more than two expert surgeons per procedure should be involved. A single anaesthetist would be suffice for mechanical ventilation and tube removal after tracheal incision. Non-fenestrated cuffed tracheostomy tube should be used. use deep neuromuscular blockade in order to avoid swallowing and cough reflexes. Once the anterior wall of the trachea is exposed, the anaesthetist: 1. Reduces the oxygen-percentage of the inflated air to 21%; 2. Pushes the tube as caudally as possible, so as to avoid cuff breach, 3. Hyper-inflates the tube cuff to ensure lower airway isolation, 4. Ventilation is stopped entirely, the endo tracheal tube is lifted, without extubating the patient, until its bottom side passes the tracheal window, then cannula is inserted in the tracheal lumen. Promptly, the cannula cuff is inflate at the appropriate pressure level and heat and moisture exchanger is positioned; only then the ventilation is resumed by close airway circuit attachment. Tracheal cannula should be considered correctly positioned until CO2 value is displayed, avoiding stethoscope contamination by thoracic auscultation.	No dressing change should be performed unless there is evidence of local infection and cannula cuff should be checked regularly and do not be deflated unsafely. The cannula should be held during any passive movement of the patient to avoid air leakage from the stoma. Cannula change can be planned 7–10 days later using the same standards (PPE utilization and airflow interruption) or cannula change can be delayed up to 30 days.
6 04-Apr-20	Kligerman MP et al. [8] SPECIAL ISSUE		PPE- N95 mask, face shield, gown, and gloves.	Closed circuit ventilation. Cuffed tracheostomy tubes should be used to decrease leaks in the circuit. Use of in-line suction, even for patients who may not require chronic closed-circuit ventilation may also decrease risk of aerosolization and droplets. Nebulizer treatments should be avoided or used with caution as well to minimize risk of aerosolization.	Patients not on a closed ventilation circuit should wear a surgical mask over their stoma if tolerated as this may decrease spread of droplets from leakage around the stoma and/or HME. Tube change should be postponed and manipulation of the tracheostomy site should be minimized. All nonurgent clinic visits should be postponed and/or converted to telehealth visits when possible.

Table 1 continued

Serial number. DOP	Author and type of article	Timing of tracheostomy and place	Preparation	Operative steps	Post tracheostomy care
7 31-Mar-20	Kowalski LP et al. [9] SPECIAL ISSUE		Wearing PPE such as N95 or FFP2 mask or PAPR, gown, cap, eye protection, and gloves to decreasing the risk of aerosolization.	Stop ventilation while the tracheostomy window is being performed, and only resume ventilation when the cuff of the tracheostomy tube has been inflated.	
8 31-Mar-20	Vargas M et al. [10] SPECIAL ISSUE		Full protective wearing including N95 respirator, gown, cap, eye protection, and gloves.	To avoid the aerosol, push down the endotracheal tube beyond the site chosen for the tracheal stoma at the beginning of the procedure. The endotracheal tube should reach the tracheal carina so the cuff is surely distal to the tracheostomy site. Procedures should be performed under general anaesthesia, with deprivation of spontaneous respiration and application of muscle relaxants regardless of whether patients had spontaneous breathing or not, to restrain the cough reflex caused by tracheal stimulation.	
9 08-Apr-20	Xiao H et al. [11] LETTER TO THE EDITOR				After the cervical trachea is exposed and immediately before an incision is made in the trachea, the endotracheal tube (ETT) is inserted deeper, positioned with the tip close to carina of the trachea This step would prevent the ETT cuff leak due to an accidental damage to the cuff when making the tracheal opening When the opening is complete, brief interruption of the ventilator is essential Then the ETT is pulled out, and subsequently the tracheostomy tube quickly inserted into the opening almost simultaneously, the tracheostomy tube cuff is inflated and the tube rapidly connected to the ventilator with immediate resumption of the ventilator. Suspension of ventilation support was usually not more than 15 s, with satisfactory oxygen saturation.

Table 1 continued

Serial number. DOP	Author and type of article	Timing of tracheostomy and place	Preparation	Operative steps	Post tracheostomy care
10	Miles BA et al. [12] 08-Apr-20. SPECIAL ISSUE	21 days after the onset of symptoms if feasible. Ideally, the procedure should be performed at bedside in the intensive care unit in a negative pressure room or using a portable high efficiency particulate air (HEPA) filtration system to avoid patient transportation and contamination of other areas in the medical center. Tracheostomy should not be delayed regardless of SARS-CoV-2 status in life-saving situations or in situations in which the tracheostomy would significantly improve the prognosis of the patient. If it is necessary to perform the procedure in the operating room (OR), a specific OR cluster should be designated to avoid contamination of additional OR-operating room resources for noninfected patients.	Waterproof cap, goggles with an antimicrobial screen, impermeable operating room surgeon's gown and gloves and a transparent plastic facial shield worn outside the goggles and N95. The minimum number of health care workers required to perform the procedure should be present to prevent unnecessary exposures. Consideration for power air-purifying respirator (PAPR) systems for personnel performing tracheostomy should be entertained.	<p>Ensure adequate Paralysis to prevent coughing.</p> <p>Use Glycopyrrolate to reduce secretions.</p> <p>Preoxygenation and cessation of ventilation during the tracheostomy procedure.</p> <p>Utilization of closed suctioning systems.</p> <p>Avoiding monopolar electrocautery, or harmonic technology, and using cold instrumentation when feasible.</p>	<p>Securing circuits properly and avoiding unnecessary humidification systems may reduce the risk of unexpected circuit disconnection and aerosolization leading to exposure.</p> <p>The circuit should remain closed as much as possible, and closed-line suctioning should be used.</p> <p>Heat moister exchangers with viral filters and HEPA filtration should be used when possible.</p> <p>Tracheostomy tube changes should be avoided and should only be performed in cases of cuff failure or emergent situations.</p>
11	David AP et al. [13] 09-Apr-20. SPECIAL ISSUE	21 day postintubation. Ventilator parameters to qualify for safe tracheostomy placement include positive end expiratory pressure (PEEP) < 12 and fraction of inspired oxygen (FiO2) < 0.60. ICU preferred or negative pressure room.	N95 mask or PAPR, head covering, eye protection, gown, and two pairs of gloves.	<p>Minimizing suctioning during the procedure.</p> <p>Ensuring the cuff is inflated prior to resuming ventilation, the circuit should be close type.</p> <p>Limit number of providers in the room during the procedure.</p> <p>Use of adequate paralysis to prevent coughing.</p> <p>Holding ventilation when the ETT cuff is deflated and when the trachea is opened until cuff inflated and circuit reconnected.</p> <p>Avoid use of laryngotracheal topical anaesthesia.</p>	<p>Use of closed, inline suctioning.</p> <p>Closed circuit with HEPA filter if on mechanical ventilatory support.</p> <p>HME when off ventilatory support.</p> <p>Delaying the first tracheostomy change to 1 month or after deisolation occurs for COVID-19 positive patients.</p>

Table 1 continued

Serial number. DOP	Author and type of article	Timing of tracheostomy and place	Preparation	Operative steps	Post tracheostomy care
12	Skoog H et al. [14] 14-Apr-20. SPECIAL ISSUE	> 30 days from diagnosis. Negative pressure room. Procedures should be completed in the ICU at bedside to avoid risk of exposure during transport.	Minimal PPE worn by staff should include N95, mask with shield, surgical gown, double gloves PAPR. HEPA filter “air scrubber” should be placed in the room.	<p>Patients were completely paralyzed to minimize air movement and coughing and thus viral dissemination via aerosolization.</p> <p>Just prior to airway entry, the patients were pre-oxygenated, ventilation was held, and the cuff on the endotracheal tube was dropped to minimize air movement over the respiratory mucosa.</p> <p>While the patient was apneic, the tracheotomy incision was performed.</p> <p>Open suctioning of the trachea was avoided</p> <p>Instead, a closed suctioning system with a viral filter was used.</p> <p>Ventilation only with cuff inflation, avoiding suctioning once the trachea is incised due to the risk of aerosolization of high viral load secretions.</p> <p>Minimizing cautery due to concerns of aerosolization of viral particles in the smoke plume.</p> <p>The patient should be fully paralysed.</p> <p>Keep a closed circuit until the tracheostomy tube is inserted in the trachea.</p> <p>Prior to tracheal window, stop the ventilator and deflate the balloon/cuff,</p> <p>Afterwards, the surgeon makes the window in the trachea and Minimal suctioning is used.</p> <p>Once the window is achieved the ET tube is advanced further (past the window) and the balloon/cuff is re-inflated (over-inflated),thus establishing a closed circuit.</p> <p>At this stage the patient is ventilated and the tracheal window lies above the level of the ET cuff allowing ample time for the surgeon to check haemostasis and insert a rescue-suture.</p> <p>The ventilator is then stopped again, the cuff is deflated and the ET tube is withdrawn slowly to allow the insertion of the tracheostomy and inner tube.</p> <p>The tracheostomy cuff is inflated and the circuit is connected. The capnography CO2 trace is confirmed.</p>	<p>Closed suction system with viral filter.</p> <p>Keep cuff inflated.</p> <p>Delay first tracheotomy tube change to 3–4 weeks, if possible avoid changing tracheotomy tube until after COVID has passed.</p>
13	Damian B et al. [15] 16-Apr-20	Dedicated “Covid Theatre”, operates under negative pressure. Reverse laminar flow in the perimeter around the operating table is estimated to exchange 90% of air (removing the generated aerosol) in 6 min.	<p>PPE- FFP3 face mask, surgical hood, goggles or visor and double gloves. Consider deep suctioning of the chest and oral cavity using the closed suctioning circuit prior to transfer to minimise the amount of secretions at the time of opening the trachea.</p> <p>Security staff has to close the corridor temporarily during transfers, and the anaesthetic team needs to put on PPE prior to entering ICU.</p> <p>The patient is transferred along the back corridor of the theatres and not through the main theatre entrance.</p> <p>Viral filter should remain on the endotracheal tube.</p>	<p>A closed suctioning is used.</p>	

Table 1 continued

Serial number. DOP	Author and type of article	Timing of tracheostomy and place	Preparation	Operative steps	Post tracheostomy care
14	Schultz P et al. [16] Consensus		<p>Limitation of the number of caregivers present in the operating room.</p> <p>Full face shield/visor or airtight protective glasses</p> <p>FFP2 (N95) or FFP3 mask;</p> <p>Headlight covered by a head cap;</p> <p>an impermeable protective apron or an overcoat that must be worn under the surgical gown as it is not sterile.</p>	<p>Minimize the use of electrocoagulation which can generate aerosolization of the virus when the trachea is open;</p> <p>When possible, use a sterile transparent interface between the patient and the surgeon, in order to limit the risk of contamination;</p> <p>If possible: carry out a drug assisted neuromuscular block to reduce any risk of coughing when opening the trachea;</p> <p>Stop ventilation just before the trachea is incised;</p> <p>Tracheostomy under local anaesthesia is not recommended.</p> <p>However, if it is necessary, it is recommended to inject 5 cc of Lidocaine 5% intratracheally through the tracheal wall, before the incision of the trachea is performed in order to reduce the cough reflex.</p>	<p>Surgical hand scrub and/or friction with hydro-alcoholic solution before and after each treatment.</p> <p>For tracheostomy change, abundant spraying of 5% lidocaine into the tracheostomy tube, followed by an aspiration a few minutes later, is useful.</p> <p>If the patient is ventilated on the tracheostomy cannula, the anaesthesiologist is asked to sedate the patient and perform a neuromuscular block to reduce any risk of coughing during the change of the cannula.</p> <p>All disposable material that has been in contact with the cannula or trachea (filters, suction probes) during the post-tracheostomy care must be eliminated through the infectious waste circuit. It is possible to use a room without air treatment provided that the bedroom door is kept closed; the patient's room is regularly ventilated; the air pressure in the room is maintained at zero the cannula should ideally be connected to an HME filter and covered by a surgical mask.</p>
15	Foster P et al. [17] April 6, 2020 Novel approach	Negative pressure operating room.	<p>PPE-boot covers, sterile gown, gloves, surgical mask, powered air-purifying respirators.</p> <p>Use of the Ecolab Scope Pillow Warmer Drape -is a clear plastic material that is stretched over the retractor arms, forming a barrier between the operative field and the surgeon, while still allowing for good visualization of the operative field</p> <p>The drape is then secured with snaps to the self - retaining retractor to maintain the tightness of the drape; this will improve visibility.</p> <p>The operator and assistant will proceed with hands underneath the drape.</p>	<p>Avoid bipolar electro coagulator to prevent droplet aerosolization.</p> <p>Injection of sedatives and neuromuscular blockers needed.</p> <p>Prior to opening of the second tracheal ring, the FIO2 was lowered to 0.4 and the balloon was temporarily overinflated</p> <p>The balloon was below the level of the tracheal opening</p> <p>No droplets escaped the opening due to the repositioned and overinflated balloon. The ET tube was withdrawn until the tip of the tube reached above the tracheal opening.</p> <p>During withdrawal, to prevent the spread of droplets, pausing the ventilator was considered before balloon deflation. Immediately after ET tube tip repositioning, a hole was made on a transparent film dressing with scissors and a tracheostomy tube was immediately inserted.</p>	

Table 1 continued

Serial number. DOP	Author and type of article	Timing of tracheostomy and place	Preparation	Operative steps	Post tracheostomy care
16	Youn SH et al. [18] Jul 2, 2020 Case report	At bedside in a negatively pressured ICU room to minimize the risks of transmission during transfer and worsening of the patient's condition.	(PPE) consisting of a Level C powered air-purifying respirator (PAPR) with an aseptic waterproof surgical gown and gloves.	After a quick check of tracheostomy tube patency with a rubber catheter, the ventilator was connected, the tidal volume was checked, and the existing ET tube was removed.	

- Follow same sequence of pause in ventilation with flows off before deflating cuff and inserting new tube with immediately re-inflation of cuff and reconnection of circuit.
- Use full PPE for tracheostomy tube change.
- Next Subsequent planned tube change should be at least 30 days interval.
- Patients not on a closed ventilation circuit should wear a surgical mask over their stoma if tolerated as this may decrease spread of droplets from leakage around the stoma and/or HME. Use Closed circuit with HEPA filter if on mechanical ventilatory support.
- Manipulation of the tracheostomy site should be minimized. Use of tracheostomy tube without fenestrations until the COVID exam is negative.
- All nonurgent clinic visits should be postponed and/or converted to telehealth visits when possible.
- Nebulizer treatments should be avoided to minimize risk of aerosolization.
- All disposable material that has been in contact with the cannula or trachea (filters, suction probes) during the post-tracheostomy care must be eliminated through the infectious waste circuit.
- Avoid circuit disconnection as much as possible during tracheostomy and post tracheostomy care.

Conclusion

Our recommendations on the use of tracheostomy during the COVID-19 pandemic are presented in above mentioned panel. There are limited data related to corona virus infectivity risk in each step of tracheostomy and many other questions remain unanswered which require prospective analysis in near future. Increases in the number of patients with COVID-19 positive status requiring long term ventilation will definitely require tracheostomy to facilitate recovery. As we know Tracheostomies in COVID-19 patients are extremely high-risk procedures for all members of the procedural team. At present, there is no high-level evidence upon which to make definitive recommendations, but we have made our proposed recommendations based on currently available literature to form a safe approach which would be helpful to involved physicians in management of critically ill COVID-19 patients. It is advised for every institution to make its own guidelines for tracheostomy in COVID-19 and follow strictly. There is no doubt that as more rapidly emerging higher-level evidence becomes available and our recommendations will be refined and improved.

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