BRIEF COMMUNICATION

Percutaneous Tracheostomy in COVID-19 Patients: A Four-step Safe Protocol

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Abstract

Background: Coronavirus disease-2019 (COVID-19) pandemic has inundated healthcare systems globally especially resources in intensive care units (ICUs). Tracheostomy may be required in critically ill COVID-19 patients to facilitate weaning and to optimize resources like ventilator and ICU beds. Percutaneous tracheostomy (PCT) has become the standard of care globally in ICUs; however, it is considered a high-risk procedure in COVID-19 patients because of the inherent risk of aerosol generation.

Materials and methods: Patients with severe COVID-19 who were on mechanical ventilation because of respiratory failure for ≥10 days were evaluated for PCT. We developed a four-step approach from patient selection and timing, preparation, performance, and postprocedure for PCT in these patients.

Results: We evaluated our four-step protocol in four patients. One of them was non-COVID patient and rest three were COVID patients. The procedure was uneventful in all of the patients with median time of procedure and apnea is 10 minutes 30 seconds and 2 minutes 20 seconds, respectively. The tracheostomy was decannulated in two of these patients and one patient is still on ventilator.

Conclusion: We believe our four-step protocol for PCT in critically ill COVID-19 patient is simple, safe, and easily adapted in any setting with limited training and available resources. We recommend further studies to evaluate this approach in selected critically ill COVID-19 patients who need tracheostomy.

Keywords: COVID-19, Percutaneous dilatational tracheostomy, Tracheostomy.

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Introduction

The pandemic of coronavirus disease-2019 (COVID-19) health care has caused an unprecedented surge of critically ill patients requiring respiratory support including mechanical ventilation. These patients have usually prolonged duration of mechanical ventilation and some of them require tracheostomy to enable weaning and to optimize the utilization of healthcare resources. The procedure of tracheostomy is however challenging because of aerosol generation and a high risk of nosocomial transmission to healthcare workers (HCWs).[1] Percutaneous tracheostomy (PCT) though standard of care in many intensive care units (ICUs) has more likelihood of aerosol generation as compared to surgical tracheostomy.[1] There are few expert consensus recommendations released by different group of experts in last few months on approaches and modification of procedures.[1,2] We developed a simplified protocol of PCT, which protects HCWs from nosocomial transmission and does not compromise the quality of care. We tested the protocol initially in a non-COVID patient followed by three COVID patients and found it easier and safe.

Materials and Methods

Percutaneous tracheostomy is a standard procedure in ICU across the world and usually preferred over open tracheostomy in critically ill patients. We developed a stepwise protocol that has four phases (4-P)—patient selection and timing, preparation, performance of procedure, and postprocedure (Fig. 1). The key focus in all the four phases is on safety of patients and the HCWs. After permission from the hospital ethical review committee and the central scientific committee, we set up a dedicated tracheostomy team comprising of two experienced ICU physicians with experience in PCT and fiber-optic bronchoscopy (FOB), two senior staff nurses who had assisted previous PCT in ICU, and a FOB technician. The team was briefed about the protocol with role assignment and training on a mannequin before implementation. A staff of the team was designated to monitor vitals including oxygen saturation (SpO_2), end-tidal carbon dioxide ($EtCO_2$), and blood pressure (BP). The safety cutoff of SpO_2 less than 92%, $EtCO_2$ more than 50 mm Hg, and systolic BP drop less than 100 mm Hg was taken as criteria to warn the team and abandon apnea. The protocol was reviewed after the team performed first tracheostomy using the protocol on a non-COVID critical patient and under videorecording for postprocedure evaluation.

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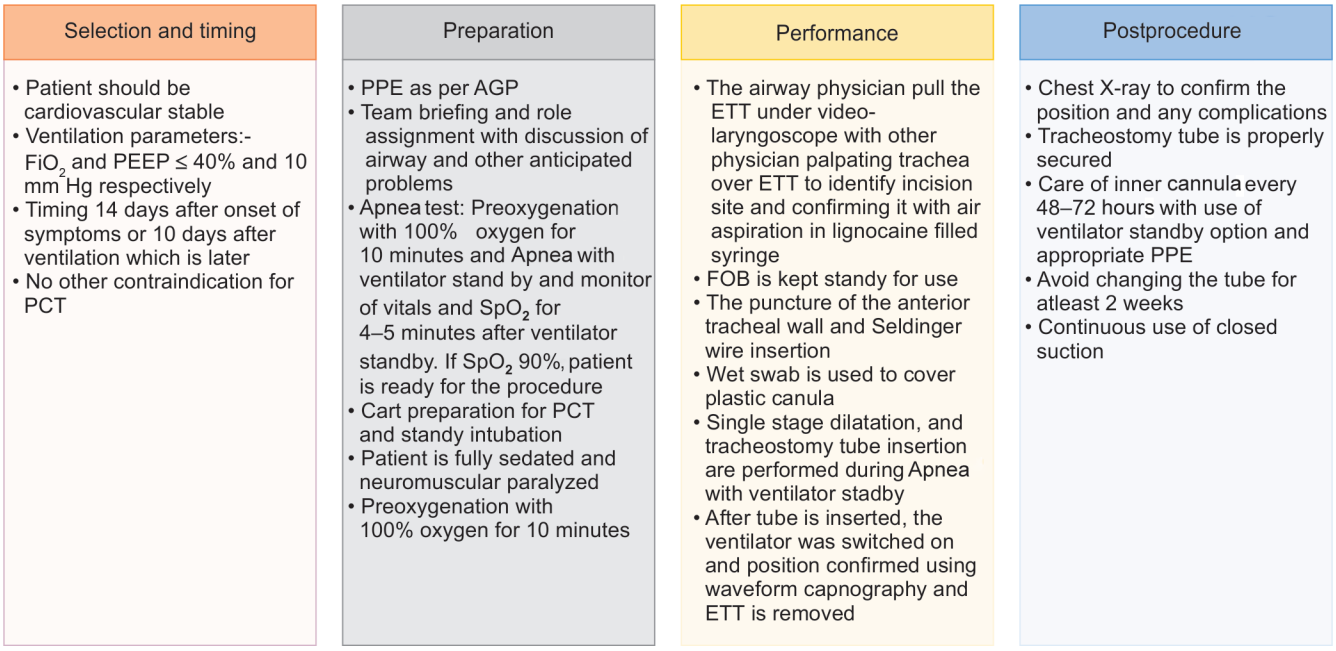

Fig. 1: Four-step protocol for percutaneous tracheostomy (PCT). AGP, aerosol generating procedures; ETT, endotracheal tube; FiO_2, fraction of oxygen concentration; PPE, personal protective equipment; PEEP, positive end-expiratory pressure

Table 1: Patient's details on which four-step protocol was used for percutaneous tracheostomy

Patient	*Diagnosis*	*Sex, age (years), and comorbidities*	*FiO_2 and PEEP*	*Days of mechanical ventilation*	*Tracheostomy duration (min.sec)*	*Apnea duration (seconds)*	*Outcome*
1	Critical COVID-19 with ARDS	Male, 56, hypertension	40%, 8	15	10.31	125	Discharged
2	Critical COVID-19 with ARDS	Male, 38, none	35%, 9	16	11.20	146	Discharged
3	Critical COVID-19 with ARDS	Male, 62, hypertension and diabetes mellitus	40%, 8	14	12.10	131	Still on ventilator

FiO_2, fraction of oxygen concentration; PEEP, positive end expiratory pressure; PCT, percutaneous tracheostomy; ARDS, acute respiratory distress syndrome. Critical coronavirus disease (COVID)-ARDS, sepsis, septic shock, PaO_2/FiO_2 <300

Results

The team performed three tracheostomies in COVID patients without any complication and no HCW being infected. The procedure was uneventful in all three patients with median time of procedure and apnea is 11 minutes 21 seconds and 134 seconds, respectively (Table 1). The tracheostomy was decannulated in two of these patients and one patient is still on ventilator.

Discussion

There is huge cognitive load on intensivists while performing any ICU procedure in COVID-19 patients because of limited field of vision with multiple layers of personal protective equipment (PPE), communication challenge with other colleagues, cross-transmission risk, and finally unstable condition of the patient. The PCT is a preferred technique over surgical tracheostomy for critically ill ICU patients. The conventional PCT in COVID-19 critically ill ventilated patients under the guidance of FOB is a high aerosol-generation procedure and a definite risk to HCWs.[1] The recent guidelines or expert recommendations for COVID-19 patients, however, have not given any particular recommendation on the choice of technique.[1,2] We took the best guidance available in the literature and developed a four-step protocol for PCT in COVID-19 patients.

The tracheostomy consideration in COVID-19 patients should be conservative with generally higher threshold as compared to non-COVID patients.[2] The patient selection for PCT in COVID-19 should be based on clinically stability as it also reduces the risk of procedure complications and occupational transmission. We recommend the patient should be hemodynamically stable without any inotropes and stable ventilator parameters, i.e., $FiO_2 \leq 40\%$ and PEEP ≤10 mm of Hg.

The tracheostomy timing in critically ill patients is based on weak evidence without any outcome benefit on early vs late tracheostomy.[3]

The appropriate timing of tracheostomy in COVID-19 patients should primarily be based on the course of illness in order to minimize the nosocomial transmission risk to HCWs, and on availability of resources like staffing and infrastructure. The infectivity of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) reduces significantly in 7–10 days after the onset of

the symptoms.[4] The period of infectivity, however, in a critically ill patient is difficult to determine as the viral RNA copies detected by reverse transcriptase-polymerase chain reaction (RT-PCR) are higher and decrease slowly.[4,5] The immune response to virus (antiviral antibody) in SARS-COV-2 infection appears around 7 days from the onset of symptoms and by 12 days is detectable in up to 90% of the patients.[5] The consensus recommendation of experts is delay of tracheostomy until at least day 10 of initiation of ventilation and clinical stabilization reduces the occupational risk to HCWs.[1]

We choose the timing at least 14 days from the onset of symptoms or 10 days after ventilation, whichever is later.

The procedure like any aerosol-generating procedure (AGP) should be in negative pressure isolation room. The PPE for all HCWs involved in the procedure should be standard as per recommendation for AGP including N95 mask or equivalent.[6]

There are different modifications in the conventional PCT advised by authors and expert for COVID-19 patients.[1,2,7] These modifications primarily involve FOB placement either with small size endotracheal tube (ETT) in the trachea or using inline suction sheath with FOB. These modifications are on use of FOB in either different insertion sites or use of special devices to reduce production of aerosols.[1,7] The special protection sheaths may not be feasible in all settings and at all times because of supply-chain disruption during pandemic. The use of FOB, however, either through or alongside ETT can still produce aerosols. The FOB placed alongside the tube is not only technically difficult and need expertise but also may displace the ETT during manipulation of the tip of FOB with its dreaded consequence. The FOB use for PCT helps to visualize the incision site and ensures little more safety but FOB is not recommended universally for PCT.[8,9] In our protocol, we chose two basic principles, the appropriate timing of tracheostomy with patient's clinical stability as confirmed by pre-procedure apnea test and least invasive modification of the technique without using FOB, in order to minimalize the production of aerosols and hence transmission risk.

The modifications in our protocol are simple and can be easily adapted in any setting with simple training, no extra resources, and a dedicated team. The use of FOB only in case of unable to identify the space for tracheostomy after two unsuccessful attempts ensures safety of the patients and also HCWs. In our technique, only the needle puncture and guidewire insertion are done with ongoing ventilation and can generate aerosols, which can be further minimized using wet swab. The rest of the procedure from insertion of pre-dilator, tapered dilator, and tracheostomy insertion till the inflation of the cuff is done with apnea. We tested our protocol in three COVID-19 patients and found satisfactory results without compromising safety.

There are few limitations of this protocol. The technique was tested only with Ultraperc Portex Smith PCT set, apnea during procedure, and small number of patients tested. The tracheostomy set should not have major impact in this modified technique of PCT, however need to be validated with other available sets. Apnea is beneficial in terms of no aerosol production and is recommended even during endotracheal intubation to reduce aerosolization. We ensure one staff continuous monitoring SpO_2, $EtCO_2$, and hemodynamic stability with predefined safety limits to abandon the apnea.

In summary, we recommend our four-step protocol for PCT in COVID-19 mechanically ventilated patients as a safe alternative without compromising the quality of care.

Conclusion

We believe our four-step protocol for PCT in critically ill COVID-19 patient is simple, safe, and easily adapted in any setting with limited training and available resources. We recommend further studies to evaluate this approach in selected critically ill COVID-19 patients who need tracheostomy.

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