ISSN: 2545-2533 DOI: 10.32114/CCI.2020.3.3.13.19

CCI JOURNAL CRITICAL CARE INNOVATIONS

Crit. Care Innov. 2020; 3(3):13-19

ORIGINAL ARTICLE

Novel approaches in the post-tracheostomy care of the COVID-19 patient

Ashish Rai [1] ORCID https://orcid.org/0000-0002-9683-0142, **Anna P. Chang** [2] ORCID https://orcid.org/0000-0003-0743-5050, **Steven Soo** [3] ORCID https://orcid.org/0000-0002-1515-7532, **Joy Thomas** [4] ORCID https://orcid.org/0000-0003-3041-5090, **Judy Ackerman** [4] ORCID https://orcid.org/0000-0002-3128-7935, **Brian Mitzman** [5] ORCID https://orcid.org/0000-0002-8129-0067, **Michael T. Bender** [1] ORCID https://orcid.org/0000-0001-6674-2101.

[1] *Division of Pulmonary Critical Care Medicine, Department of Medicine, NYU-Long Island School of Medicine, Mineola, NY, USA*
[2] *Division of Internal Medicine, Department of Medicine, NYU-Long Island School of Medicine, Mineola, NY, USA*
[3] *Medical School, NYU-Long Island School of Medicine, Mineola, NY, USA*
[4] *Department of Respiratory Therapy, NYU-Long Island School of Medicine, Mineola, NY, USA*
[5] *Division of Thoracic Surgery, Department of Surgery, NYU-Long Island School of Medicine, Mineola, NY, USA*

ADDRESS FOR CORRESPONDENCE:

Steven Soo;

New York University Long Island School of Medicine 259 1st Street, Mineola, NY 11501;

e-mail: Steven.Soo@nyulangone.org

ABSTRACT

INTRODUCTION: SARS-CoV-2 is a novel strain of coronavirus that has caused illness in over 6 million people worldwide as of June 2020. Patients with severe illness are treated with invasive mechanical ventilation, as such, tracheostomy has become a topic of interest. Traditional schema employed during independent breathing trials in patients with tracheostomies employ the use of a collar mask attached to flexible corrugated tubing with humidified oxygen from a wall source. One drawback of this arrangement is the creation of an open circuit with the potential for viral aerosolization.

MATERIAL AND METHODS: We adapted high flow oxygen (HFO) therapy to patient's tracheostomy tube and devised a rapid decannulation protocol for patients recovering from Covid-19. Corrugated flexible tubing with a heating element is attached to the HFO meter-blender/heated humidifier apparatus and then connected directly to one end of a Y-adapter. An in-line suction kit specified for tracheostomy patients is also placed. Humidified air is delivered to the patient using the heating element of the HFO system obviating the need for a heat moisture exchanger. A second corrugated tube is attached to the free end of the Y-adapter and a non-conductive viral particle filter is attached to its free end to limit viral aerosolization.

RESULTS: The mean time to tracheostomy placement is 18 days from initiation of mechanical ventilation (5-39 days). To date 20/52 (38%) patients have undergone tracheostomy tube removal, and of those 13 have been discharged. The mean time to decannulation is 15 days (8-32 days). Three patients failed decannulation requiring repeat endotracheal intubation (5.7%). SARS-CoV-2 was not detected in 22/24 patients undergoing repeat polymerase chain reaction testing on day 45 after initial positive test.

CONCLUSIONS: Utilizing HFO to tracheostomy scheme creates a closed circuit theoretically reducing the risk of COVID-19 exposure, while also helping patients breathe independently. This schema coupled with a rapid decannulation protocol is a reasonable alternative in select patients recovering from severe Covid-19.

KEY WORDS: Covid-19, high flow oxygen delivery, tracheostomy, decannulation.

INTRODUCTION

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is a novel strain of coronavirus causing illness in over 6 million people worldwide as of June 2020 [1]. Approximately 79% of patients with severe Covid-19 are treated with invasive mechanical ventilation for a median duration of 27 days amongst survivors [2]. Given this prolonged course, at times complicated by failed extubation attempts, tracheostomy has become a keen topic of interest. Although current literature is ripe with descriptions of techniques and safety considerations while performing tracheostomy in Covid-19 patients, best care practices of the tracheostomized Covid-19 patient are lacking [3,4]. In order to address clinical questions and safety challenges during the pandemic we adapted high flow oxygen (HFO) therapy to patient's tracheostomy tube and devised a rapid decannulation protocol for patients recovering from Covid-19.

Traditional schema employed during independent breathing trials in patients with tracheostomies employ the use of a collar mask attached to flexible corrugated tubing with humidified oxygen from a wall source. One drawback of this arrangement is the creation of an open circuit with the potential for viral aerosolization. Proposed methods to reduce COVID-19 exposure include attaching viral filters to the free end of a T-piece, which is directly connected to the inner cannula of the tracheostomy tube along with placement of a heat moisture exchanger (HME) [5]. While literature supports the use of HFO via tracheostomy as it optimizes oxygenation, secretion clearance, and patient comfort during weaning from mechanical ventilation, its use during this pandemic is controversial owing to uncertainty of virus aerosolization [6,7]. However, a systematic review of severe acute respiratory distress syndrome (ARDS) caused by COVID-19 placed the odds of aerosol generation from nasal HFO delivery lower than other high risk procedures at 0.4 (95% CI 0.1, 1.7) [8].

Furthermore, a model of fugitive aerosols released into the environment during nasal HFO illustrated that as the flow rate increased peak aerosol concentration decreased [9]. Together these data suggest that HFO via tracheostomy may be a safe alternative to traditional tracheostomy mask collar schemes. Below we describe our approach for caring for post-tracheostomized Covid-19 patients.

MATERIAL AND METHODS

High-Flow Oxygen to Tracheostomy Scheme

Our scheme utilizes a pole mounted HFO delivery system to provide air via patient's tracheostomy tube (Table 1). Corrugated flexible tubing with a heating element is attached to the HFO meter-blender/heated humidifier apparatus and then connected directly to one end of a Y-adapter. An in-line suction kit specified for tracheostomy patients is also placed. Humidified air is delivered to the patient using the heating element of the HFO system obviating the need for a HME. A second corrugated tube is attached to the free end of the Y-adapter and a non-conductive viral particle filter is attached to its free end to limit viral aerosolization (Figure 1). In light of concerns of increased viral exposure with higher flow rates we limit the oxygen flow rate to less than 40 liters per minute [10].

Benefits of this set-up are manifold. Paramount is the potential to decrease aerosol generation as dry humidified air is provided via a closed circuit along with use of viral filters. The ability to perform in-line suctioning and apply positive end expiratory pressure to decrease work of breathing are additional benefits. Lastly the apparatus is mobile allowing for enhanced physical therapy participation.

Table 1. Delivering Heated High Flow Oxygen via Tracheostomy Tube.

Supply	Manufacturer
Max Venturi high flow meter/blender (pole mounted)	Maxtec
MR850 heated humidifier	Fisher Paykel
Sensor of MR 850	Fisher Paykel
Heated air adaptor for heated breathing circuit	Fisher Paykel
Adult ventilator circuit dual heated with MR290	Fisher Paykel
Non-conductive respiratory filter Bacterial/Viral retentive	Airlife
Corrugated flexible polyethylene and EVA tubing 6 inch	Airlife
Isothermal adult omni-flex connector	Airlife
Sterile water for inhalation	Airlife
Closed circuit catheter for adult tracheostomy	Halyard

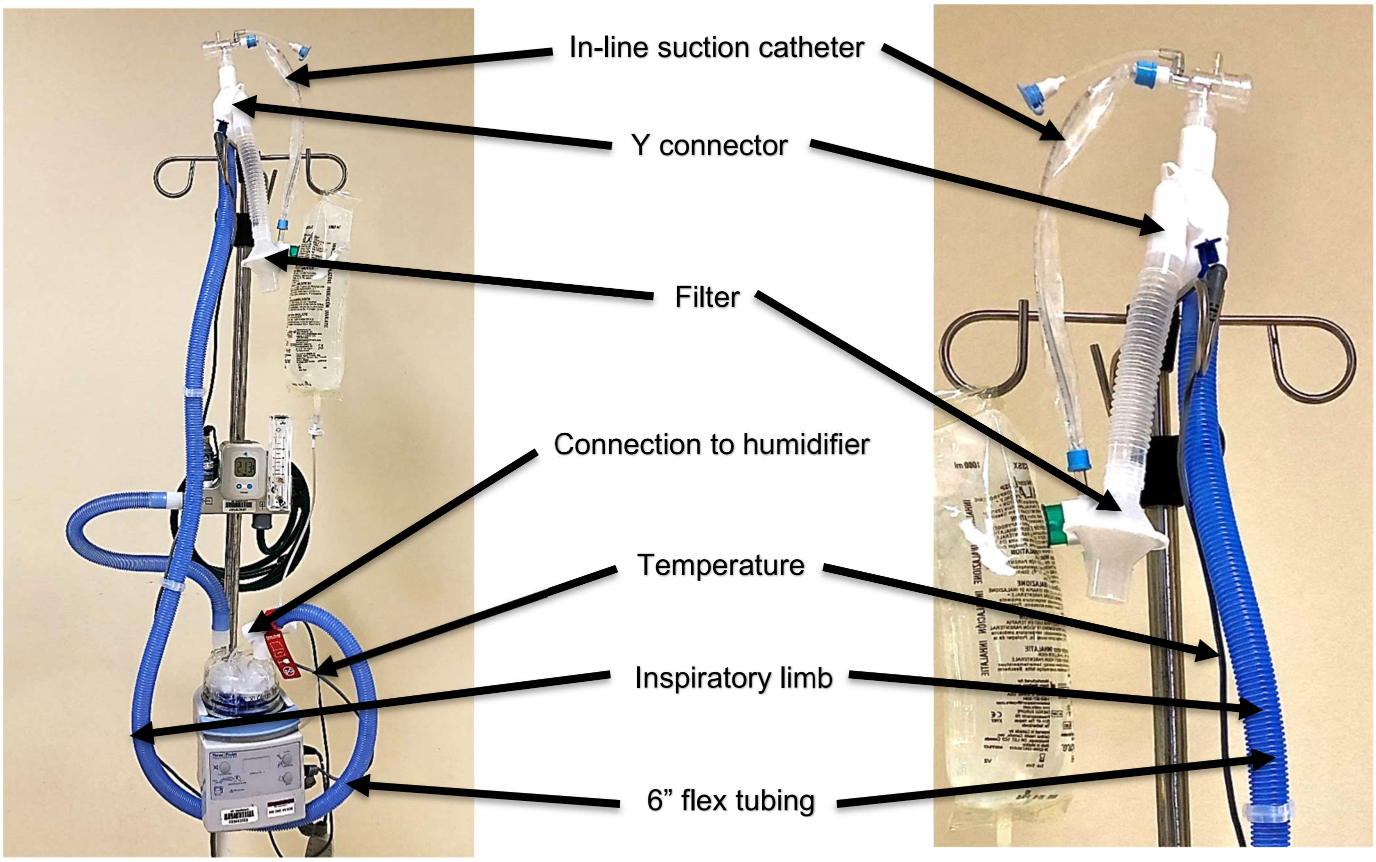

Figure 1. Schema of High Flow Oxygen Delivery to Tracheostomy.

Rapid Decannulation Protocol

In patients with minimal secretions and supplemental oxygen needs who can breathe independently, we remove the inner cannula and cover the site with a surgical mask to prevent exposure. We apply supplemental oxygen via nasal cannula for a saturation goal greater than 92%. The patient breathes in this fashion for an additional 6 hours, upon which if there have been no significant clinical events, the patient is assessed for ability to phonate and clear secretions. Once through this phase the provider removes the tracheostomy tube. Speech and swallowing evaluation is finally performed. We advocate this approach in recovering patients over downsizing during the early tracheostomy period when patients are at increased risk of false tract formation. Repeated downsizing may also expose providers to viral exposure.

RESULTS

52 tracheostomies were performed on Covid-19 patients between April 1, 2020 and May 10, 2020 (Table 2). The mean time to tracheostomy placement is 18 days from initiation of mechanical ventilation (5-39 days). To date 20/52 (38%) patients have been decannulated, and of those 13 have been discharged. The mean time to decannulation is 15 days (8-32 days). Three patients failed decannulation requiring repeat endotracheal intubation (5.7%). SARS-CoV-2 was not detected in 22/24 patients undergoing repeat polymerase chain reaction testing on day 45 after initial positive test.

The use of HFO devices for all tracheostomized Covid-19 patients may lead to misallocation of HFO devices while placing additional stress on a system's oxygen sources, both important considerations during the pandemic. Frequent monitoring viral filters for condensation - which decreases the filter's function – and filter changes at least twice per day not only burdens staff, but is costly. The generally accepted tracheostomy removal protocol calls for downsizing until achieving a tube diameter that can be capped. Initially placed tracheostomy tubes are often too large to be occluded as the diameter occupies a large portion of the patient's trachea causing difficulty with ventilation. Decannulation performed prior to a capping as well as a swallowing evaluation could lead to unforeseen clinical deterioration if patients have not been evaluated thoroughly.

Table 2. Summary of patient characteristics and outcomes.

Characteristics	All patients (N=52)
Age-years*	57 (34-83)
Male-no. (%)	32 (62)
Intubation to Tracheostomy Time [days]*	18 (5-39)
Time to decannulation [days]*	15 (8-69)
Early Tracheostomies [≤10 days]-no.	8
Outcomes	
Patients decannulated –no. (%)	20 (38)
Discharge to home/rehabilitation-no. (%)	13 (25)
Deaths-no. (%)	12 (23)
Negative repeat SARS-CoV-2 on day 45 (n=24)- no.(%)	22 (92)

**Mean (Range)*

CONCLUSIONS

Post-tracheostomy care among Covid-19 patients remains challenging. Utilizing HFO to tracheostomy scheme creates a closed circuit theoretically reducing the risk of COVID-19 exposure, while also helping patients breathe independently. This schema coupled with a rapid decannulation protocol is a reasonable alternative in select patients recovering from severe Covid-19. We believe that more data is needed to illustrate the safety and effectiveness of our approach compared to traditional methods of post-tracheostomy management.

Disclosure statement

The authors did not report any potential conflict of interest.

REFERENCES

[1] COVID-19 Map. Johns Hopkins Coronavirus Resource Center.
[WWW]: https://coronavirus.jhu.edu/map.html
(accessed 19 May 2020)

[2] Cummings MJ, Baldwin MR, Abrams D, Jacobson SD, Meyer BJ, Balough EM, et al.. Epidemiology, clinical course, and outcomes of critically ill adults with COVID-19 in New York City: a prospective cohort study. Lancet, 2020; 395(10239): 1763-1770.
doi: https://doi.org/10.1016/S0140-6736(20)31189-2

[3] Meng L, Qiu H, Wan L, Ai Y, Xue Z, Guo Q, et al.. Intubation and Ventilation amid the COVID-19 Outbreak: Wuhan's Experience. Anesthesiology, 2020; 132(6): 1317-1332
doi: https://doi.org/10.1097/ALN.0000000000003296

[4] Angel L, Kon ZN, Chang SH, Rafeq S, Shekar SP, Mitzman B, et al.. Novel percutaneous tracheostomy for critically ill patients with COVID-19. Ann Thorac Surg. 2020. [Ahead of print]
doi: https://doi.org/10.1016/j.athoracsur.2020.04.010

[5] Goldman RA, Swendseid B, Chan JY, Lewandowski M, Adams J, Purcell M, et al.. Tracheostomy management during the COVID-19 pandemic. Otolaryngol Head Neck Surg. 2020; 163(1): 67-69.
doi: https://doi.org/10.1177/0194599820923632

[6] Hernández G, Vaquero C, González P, Subira C, Frutos-Vivar F, Rialp G, et al.. Effect of postextubation high-flow nasal cannula vs conventional oxygen therapy on reintubation in low-risk patients: a randomized clinical trial. JAMA. 2016; 315(13): 1354-1361.
doi: https://doi.org/10.1001/jama.2016.2711

[7] Lyons C, Callaghan M. The use of high-flow nasal oxygen in COVID-19. Anaesthesia. 2020; 75(7): 843-847.
doi: https://doi.org/10.1111/anae.15073

[8] Tran K, Cimon K, Severn M, Pessoa-Silva CL, Conly J. Aerosol generating procedures and risk of transmission of acute respiratory infections to healthcare workers: a systematic review. PLoS One, 2012; 7(4): e35797.
doi: https://doi.org/10.1371/journal.pone.0035797

[9] McGrath JA, O'Toole C, Bennett G, Joyce M, Byrne MA, MacLoughlin R. Investigation of fugitive aerosols released into the environment during high-flow therapy. Pharmaceutics, 2019; 11(6): 254.
doi: https://doi.org/10.3390/pharmaceutics11060254

[10] Hui DS, Chow BK, Lo T, Tsang OT, Ko FW, Ng SS, et al.. Exhaled air dispersion during high-flow nasal cannula therapy versus CPAP via different masks. Eur Respir J. 2019; 53(4): 1802339.
doi: https://doi.org/10.1183/13993003.02339-2018