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ORIGINAL RESEARCH

Laryngoscope Investigative Otolaryngology

Quality tracheotomy care can be maintained for non-COVID patients during the COVID-19 pandemic

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Abstract

Objective(s): To analyze changes in tracheotomy practices at the onset of the COVID-19 pandemic, and determine if quality patient care was maintained.

Methods: This was a single institution retrospective study that included patients undergoing tracheotomy from May 2019 to January 2021. Patients were divided into two groups, pre-COVID and post-COVID. Only three patients tested positive for COVID-19, and they were excluded from the study. Data were collected from the electronic medical record. Statistical analyses were performed using 2-tailed independent *t* tests, Wilcoxon Rank Sum tests, Chi-Square tests, and Kaplan–Meier curves.

Results: There were 118 patients in the pre-COVID group and 91 patients in the post-COVID group. The main indication for tracheotomy in both groups was prolonged intubation. There were no significant differences in overall length of stay, time to tracheotomy, duration of tracheotomy procedure, or time to initial tracheotomy change between the two groups. Due to protocols implemented at our institution to limit viral transmission, there were significant increases in the percent of tracheotomies performed in the OR ($p = .02$), and those performed via open technique ($p = .04$). Additionally, the median time to decannulation significantly decreased in the post-COVID group ($p = .02$).

Conclusion: Several variables regarding the timing of patient care showed no significant differences between groups which demonstrates that quality patient care was maintained. It is important to note that this data was collected early in the Pandemic, and additional trends may become apparent over time.

Level of evidence: 4.

KEYWORDS
airway reconstruction, COVID-19, decannulation, outcomes, tracheotomy

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1 | INTRODUCTION

Coronavirus 2019 (COVID-19) originated in Wuhan, China in late 2019 and quickly spread to other countries, becoming a serious public health concern.[1,2] COVID-19 is spread via contact droplets and aerosolization from human to human.[3,4] Therefore, aerosol-producing procedures, such as endotracheal intubation and tracheotomy placement, put healthcare workers at an increased risk of infection.[5] As a result, guidelines were published to ensure patient and healthcare worker safety.[6] These protocols vary between institutions and continue to evolve throughout the Pandemic. Most recommendations focus on the safest tracheotomy practices for COVID-19 positive patients. However, resources and testing were limited at the onset of the Pandemic. Therefore, patients were presumed to be COVID-19 positive and protocols were applied universally.[7] Some of the widely used guidelines include: (1) limiting the number of personnel involved in the procedure, (2) performing tracheotomy in a controlled environment, with negative pressure capabilities if possible, and (3) wearing personal protective equipment (PPE) that helps guard against airborne transmission.[8–10] The protocols at our institution were adapted from those published by UK-ENT authors.[9] Current literature demonstrates that following safety recommendations decreases the spread of infection to healthcare workers.[6,11,12]

These changes in protocols have shifted treatment paradigms. These shifts, along with increased attention given to COVID-19 patients, left COVID-19 negative patients at risk of receiving suboptimal care.[13] For instance, there were delays in surgery and increased morality reported in elective orthopedic surgeries during the Pandemic for COVID-19 negative patients.[13–15] In addition, there was a decreased number of emergency department visits and hospitalizations for COVID-19 negative patients, which suggests that patients had limited access to care during these times or were avoiding hospitals altogether.[16] With unprecedented times and the implementation of new protocols, it is essential to maintain all aspects of patient care, regardless of COVID-19 status.

Length of stay, time to tracheotomy, duration of tracheotomy procedure, and time to initial tracheotomy change can be used as variables to determine the quality of patient care. Previous literature shows that longer times to tracheotomy were associated with increases in mortality and length of ICU stays.[17] In addition, several reports have demonstrated that prolonged operative time is associated with increased rates of complication.[18] Likewise, a systematic review and meta-analysis demonstrated a 14% increase in the likelihood of complications for every 30 min of additional operative time.[18]

The goals of this study were two fold. The first aim was to determine if guidelines to decrease transmission of COVID-19 were adhered to. The second aim was to determine if those changes in protocols negatively impacted the care of patients without COVID-19. The factors examined include time to tracheotomy, duration of tracheotomy procedure, time to initial tracheotomy change, time to decannulation, and type, location, service, and indication for tracheotomy. Understanding if optimal patient care is maintained helps guide management and determines if adjustments must be made during this Pandemic or for future global crises.

2 | MATERIALS AND METHODS

This was a single-institution, retrospective study that included patients over 18 years of age who underwent tracheotomy between May 2019 and January 2021. Cohorts were created based on the date of tracheotomy placement. March 22, 2020 was designated as the "beginning of the Pandemic" in our study due to dissemination of new tracheotomy guidelines. Therefore, the pre-COVID cohort included patients who had a tracheotomy placed between May 22, 2019 and March 21, 2020. The post-COVID cohort included patients who had a tracheotomy placed

TABLE 1 Patient characteristics

	Pre-COVID	Post-COVID	*p* value
Age[a] (Mean ± SD)	60.8 ± 17.5	60.5 ± 17.4	.88
% female[b]	32.2 (38/118)	30.8 (28/91)	.77
Indication for trach[b] (*n* [% of team])			.49
Prolonged intubation	60 (51%)	42 (46%)	
Airway protection	18 (15%)	18 (20%)	
Airway obstruction	12 (10%)	8 (9%)	
Adjunct to major head and neck surgery	21 (18%)	21 (23%)	
Inability to intubate	6 (5%)	1 (1%)	
More efficient pulmonary hygiene	1 (1%)	1 (1%)	
Service performing tracheotomy[b]			.54
Otolaryngology	39 (33%)	36 (40%)	
Trauma surgery	42 (36%)	29 (32%)	
Thoracic surgery	24 (20%)	19 (21%)	
Pulmonology	11 (9%)	4 (4%)	
Unknown	2 (2%)	3 (3%)	

[a]*t* test assuming unequal variances.
[b]Chi-square tests.

between March 22, 2020 and January 22, 2021. Patients who tested positive for COVID-19 positive were removed from the dataset. The new tracheotomy guidelines recommended tracheotomies be performed in the OR via open technique to decrease the spread of COVID-19. Patients in the study were pulled from the electronic medical record (EMR) using the Business Objects Web Intelligence program, which identified patients with tracheotomy-related CPT or ICD 9 and 10 codes referenced in Table A1. Data was collected and stored in a secure institutional database, REDCap.

The impact of the Pandemic on tracheotomy practices was evaluated using the following variables: length of stay, length of mechanical ventilation, duration of tracheotomy procedure, time to tracheotomy, time to initial tracheotomy change, time to decannulation, and location, type, service, and indication for tracheotomy. Definitions of these variables can be found in Table B1. The indication for tracheotomy variable was categorized as one of six known indications: prolonged intubation, airway protection, airway obstruction, adjunct to major head and neck surgery, inability to intubate, and more efficient pulmonary hygiene. Statistical analyses were completed via (1) 2-tailed independent *t* tests for continuous data with a normal distribution, (2) Wilcoxon Rank Sum tests for continuous data without a normal distribution, (3) Chi-Square tests for categorical data, and (4) Kaplan–Meier survival curves using Microsoft Excel (Redmond, WA, USA) version 10.0.14393 and IBM SPSS (Armonk, NY, USA) version 27. This study was approved by the Institutional Review Board (STUDY00010063).

3 | RESULTS

There was a total of 209 patients that met the inclusion criteria. A total of 118 patients were in the pre-COVID cohort. There were

TABLE 2 Outcome statistics

Outcome	Pre-COVID median in days (min, max)	Post-COVID Median in days (min, max)	*p* value
Length of stay (LOS)[a]	19.4 (4.3, 374.0)	20.5 (3.2, 251.0)	.94
Length of mechanical ventilation[a]	13.0 (0, 92.0)	12.0 (0, 118.0)	.82
Time to tracheotomy[a]	8.0 (0, 65.0)	8.6 (0, 54.5)	.95
Time to initial tracheotomy change[a]	5.0 (1.0, 26.0)	5.5 (2.0, 21.0)	.58
Outcome	**Pre-COVID *n* (%)**	**Post-COVID *n* (%)**	***p* value**
Open tracheotomy[b]	68 (58%)	65 (71%)	.04
Performed in OR[b]	81 (69%)	75 (82%)	.02

[a]Wilcoxon rank sum test.
[b]Chi-square tests.

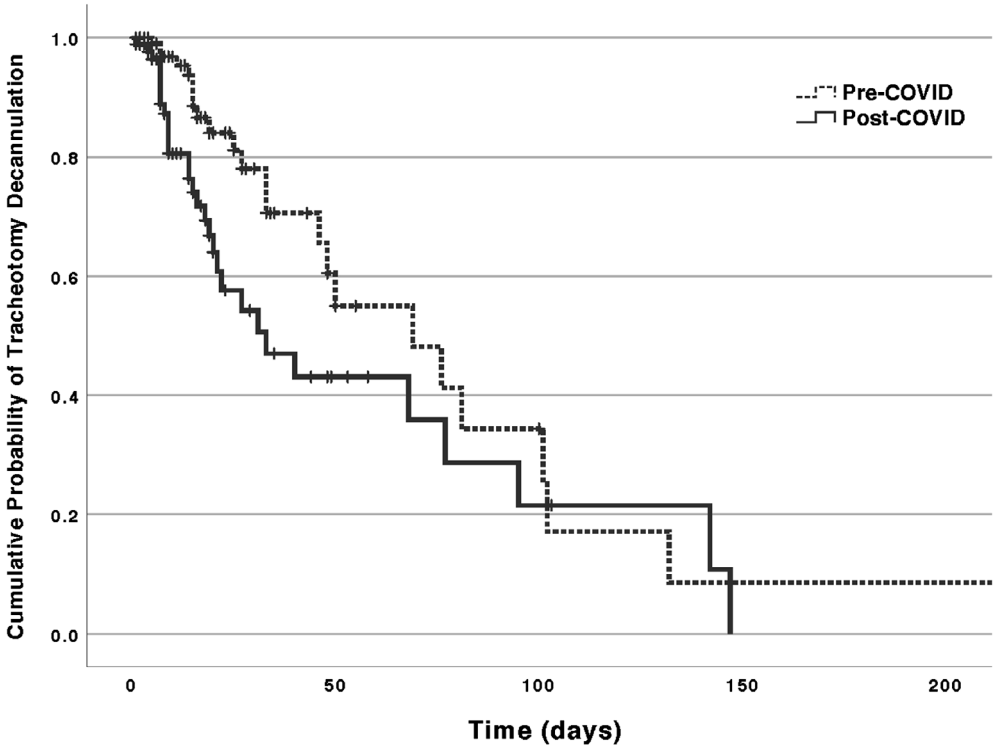

FIGURE 1 Kaplan–Meier Curve for time to decannulation in the pre-COVID cohort and post-COVID cohort ($p = .02$)

91 patients in the post-COVID cohort after three patients who were confirmed to be COVID-19 positive were removed. There was no significant difference in patient characteristics between the groups (Table 1). This study included patients with an average age of 60.7 years (SD = 17.42 years), 32% of which were females (Table 1). The most common reason for tracheotomy was prolonged intubation ($n = 102$, 49%), followed by adjunct to head and neck surgery ($n = 42$, 20%) (Table 1). Otolaryngology ($n = 75$, 36%) performed the most tracheotomies, followed by trauma surgery ($n = 71$, 34%), thoracic surgery ($n = 43$, 21%), and pulmonology ($n = 15$, 7%) (Table 1). The remaining 2% of tracheotomies were performed by unknown services (Table 1).

When comparing the pre-and post-COVID groups, a few variables were significantly different. One was the type of tracheotomy performed which demonstrated an increase in the percent of open procedures (58%–71%, $p = .04$). Not unexpectedly, there was also a significant increase in the percent of procedures performed in the OR (69%–82%, $p = .02$). These results can be referenced in Table 2. A Kaplan–Meier analysis was performed to determine differences in time to decannulation. The results showed that the median time to decannulation before COVID-19 was 20.3 days (95% CI, 29.1–108.9 days), and after COVID-19 was 10.2 days (95% CI, 12.9–53.1 days), as seen in Figure 1 ($p = .02$).

The remainder of the studied variables were not significantly influenced by changes in policies during the COVID-19 pandemic. The duration of procedure slightly increased from 49 to 53 min ($p = .74$) and median length of stay increased from 19.4 to 20.5 days ($p = .94$) (Table 2). Additionally, the median times to tracheotomy ($p = .95$) and initial tracheotomy change ($p = .58$) had a small but insignificant increase (Table 2). The median length of mechanical ventilation showed a decrease from 12.0 to 13.0 days after the start of the COVID-19 pandemic ($p = .82$) (Table 2).

4 | DISCUSSION

Implementation of new protocols can have a significant impact on patient care. Our study differs from current literature in two specific ways. First, to our knowledge, no previous studies assessed changes in tracheotomy practices over time. Whereas most studies reported results from the post-COVID era, our study assessed differences in practices from before the Pandemic to after its onset.[7,19–27] Secondly, the majority of the published literature discusses tracheotomy outcomes in confirmed COVID-19 positive patients.[7,19–27] However, our study only analyzed COVID-19 negative patients.

At the start of the Pandemic, our institution published a protocol, which advised physicians to perform tracheotomies in the OR via open technique due to the higher risk of aerosolization with percutaneous tracheotomy.[28] In addition, it influenced physicians' decisions to decannulate patients sooner due to the risk of transmission with routine tracheotomy care. Our results showed a significant increase in tracheotomies performed in the OR via open technique, as well as faster time to decannulation after the start of the Pandemic. This ultimately demonstrates that the new institutional tracheotomy guidelines were appropriately followed.

Controversy exists over the ideal timing for tracheotomy placement.[29–31] However, Filice et al. demonstrated that patients who underwent tracheotomy placement less than 7 days after intubation had decreased mortality rates compared to patients whose tracheotomies were delayed until 9 to 16 days after intubation. Additionally, another study investigating tracheotomy care found that patients who underwent tracheotomy more than 3 weeks after intubation had increased complication rates and lengths of ICU stay.[32] During the COVID-19 pandemic, delays were considered acceptable due to the high risk of transmissibility and the fear of contracting COVID-19. However, when assessing time to tracheotomy, the current study demonstrates no difference before and after the Pandemic.

In addition to time to procedure, surgeons have been wary of how the Pandemic and the logistics necessary to decrease transmission can influence the duration of surgeries. For example, a recent report observed increases in operative times for head and neck cancer surgeries during the Pandemic.[33] Research has shown that increased durations of surgical procedures have been associated with increased patient complications.[34] Thus, operative times must remain efficient even in the midst of a pandemic. When assessing duration of tracheotomy placement, the current study found there was no difference between patients treated before and after implementation of the COVID-19 protocol.

Post-operative care is another aspect of patient care that may have been impacted by the Pandemic. In order to ensure quality patient care is maintained, the intial tracheotomy change should be completed in a timely manner to reduce the risk of granulation and infection.[35] According to the literature, the initial tracheotomy change typically occurs within three to 14 days.[36,37] Our results showed there was no significant difference in time to initial tracheotomy change before and after the implementation of our COVID-19 protocol, with the median time being approximately five days for both groups. The consistency in time to tracheotomy change is encouraging because it demonstrates that there was no delay in treatment.

While the current study gives insight into changes in tracheotomy practices after the implementation of COVID-19 protocols, there is an inherent limitation due to the study being a retrospective chart review. Some of the constraints of this type of study design include poor documentation in the EMR and the utilization of a convenience sample. Future studies should continue to assess trends over time in tracheotomy practices as protocols adapt. In addition, in order to further assess patient safety, prospective studies should include follow-up data regarding morbidity and mortality.

CONCLUSION

At the onset of the COVID-19 pandemic, protocols were implemented to ensure patient and healthcare worker safety. There were shifts in practices at our institution after the start of the Pandemic, including increases in open tracheotomies and tracheotomies performed in the

OR, as well as decreases in time to decannulation. Most notably, there were no delays in time to tracheotomy, duration of tracheotomy procedure, and time to initial tracheotomy change, which suggests that quality care was kept a priority throughout the Pandemic. Protocols are ever changing during these unprecedented times and it is important to provide patient centered care regardless of COVID-19 status.

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CONFLICT OF INTEREST

The authors have no relevant conflicts of interest of financial disclosures.

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APPENDIX

TABLE A1 Diagnosis codes used to identify patients with tracheotomy

CPT	31600: Tracheostomy, planned (separate procedure) 31601: Tracheostomy, planned (separate procedure); younger than 2 years 31603: Tracheostomy, emergency procedure; transtracheal for a transtracheal approach 31605: Tracheostomy, emergency procedure; cricothyroid membrane 31610: Tracheostomy, fenestration procedure with skin flaps
ICD 10	Z93.0 - Tracheostomy status/tracheostomy dependent Z43.0 - Encounter for attention to tracheostomy J95.0 - Tracheostomy complications
ICD 9	V44.0 - Tracheostomy status V55.0 - Attention to tracheostomy 519.09 - Other tracheostomy complications

TABLE B1 Variable definitions

Variable	Definition
Length of stay	Time from admission to the hospital to discharge
Length of mechanical ventilation	Total number of days spent on a mechanical ventilator
Time to tracheotomy	Time from intubation to tracheotomy procedure
Time to initial tracheotomy change	Time from tracheotomy procedure to first documented tracheotomy change
Location	Whether tracheotomy procedure was performed in the operating room or at the bedside
Type	Whether an open or percutaneous tracheotomy was performed