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ORIGINAL RESEARCH

Laryngoscope Investigative Otolaryngology

A retrospective analysis of COVID-19 tracheostomies: Early versus late tracheostomy

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Abstract

Objectives: To assess the impact of early tracheostomy (ET) versus late tracheostomy (LT) placement on mortality and decannulation rates of COVID patients.

Methods: A retrospective chart review was performed of all patients infected with COVID-19 who underwent tracheostomy tube placement in an Ochsner-affiliated hospital from March 2020 to May 2022. Patients were identified using the electronic medical record and data was collated using the "Epic SlicerDicer" tool. Descriptive statistics were gathered and compared between patients who underwent ET placement and those who underwent LT placement. Patient demographics, previous medical history, tracheostomy procedural details, arterial blood gases, complications, and outcomes including time to wean from the ventilator, and time to decannulation were recorded.

Results: Two-hundred nineteen patients were included in the study. There were no statistically significant differences in liberation from mechanical ventilation rates between early and LT (62% vs. 55%, $p = .19$), or in decannulation rates (40% vs. 32%, $p = .14$). The mean duration of time to liberation from mechanical ventilation for early trach was 13.88 versus 18.17 days for late trach, however, no statistically significant difference was found ($p = .12$). Similarly, mean duration of time to decannulation was 41.17 days for early versus 47.72 for late trach ($p = .15$).

Conclusion: Contrary to some studies in the literature, the results presented here suggest ETs are not associated with hastened liberation from mechanical ventilation or increased decannulation rates. Further prospective studies may be warranted in assessing the impact of early versus LT in the COVID patient population.

Level of Evidence: III.

KEYWORDS

acute respiratory distress syndrome, COVID-19, decannulation, early, late, tracheostomy, ventilator

1 | INTRODUCTION

With the rapid emergence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the number of critically ill patients requiring mechanical ventilation exponentially increased. SARS-CoV-2 has been shown to have a higher rate of infectivity and transmission than Middle Eastern respiratory syndrome and severe acute respiratory syndrome.[1] The rapid spread has led to one of the largest viral pandemics with a death toll of over 6 million people worldwide.[2]

A tracheostomy is as a surgically created opening in the anterior tracheal wall, between the second and third tracheal rings. This stoma allows for the passage of air into the distal respiratory tract, bypassing the nose, mouth, oropharynx, and larynx. This procedure, the creation of the tracheostomy is most commonly performed by otolaryngologists, but can also be performed by general surgeons, as well as oral surgeons. There are several indications for tracheostomy which include prolonged intubation/mechanical ventilation, upper airway obstruction, pulmonary toilet, copious secretions, and inability to protect the airway due to neurologic sequelae.[3] Open tracheostomy is the conventional method by which a surgical incision is created in the neck, facilitating placement of the tracheostomy tube.[4] However, early in the pandemic, fear of aerosolization of viral particles and infection to healthcare workers arose. Multiple guidelines from academic journals including otolaryngology, anesthesia, and thoracic surgery contained opinions and recommendations for delaying tracheostomy to minimize the risk of infection to healthcare staff.[5]

Tracheostomy is commonly used for long-term ventilation and weaning, early in the pandemic, fear of aerosolization of viral particles and infection in healthcare workers arose. Hence, percutaneous dilatation tracheostomy (PDT), which is commonly done in the ICU setting, increased during the pandemic due to reasonable tolerance among high-risk patient populations, minimization of aerosolized particles, culminating in reduced ICU length of stay, decrease in ventilator-associated pneumonia rate, and reduced duration of mechanical ventilation. Perhaps one of the more notable benefits of PDT is the accessibility, and ability to perform at bedside. In addition, it is minimally invasive compared to the alternative method.

COVID-19 is a novel virus that entered the world stage in 2020. Tracheostomy timing has become a topic of intense interest throughout the pandemic. It is estimated that between 8% and 20% of patients who are admitted to the hospital with COVID-19 required intubation, many of whom required prolonged invasive mechanical ventilation.[6] However, the timing of tracheostomy in these critically ill COVID-19 patients is still equivocal—there is still much conflicting data within the literature. Further research is necessary to ascertain the ideal timing of tracheostomy to optimize outcomes, minimize exposure to healthcare personnel, and minimize healthcare burden. Both early tracheostomy (ET) and late tracheostomy (LT) tube placement can be justified in this population. However, the true benefit of either approach has not been proven. Theoretically, LT tube placement would allow additional time for those patients to recover from a respiratory and systemic standpoint before undergoing an invasive procedure. However, ET placement can be justified for improved pulmonary toilet, improved oral care, and reduced ventilatory requirements. As no clear benefit has been identified within the literature. There is a role for this large multicenter retrospective study to elucidate and compare the impact of variable tracheostomy timing on patient outcomes. The purpose of this investigation is to examine the impact of ET versus LT placement on the outcomes of those patients infected with COVID-19. Given the lack of consensus within the literature, the investigators hypothesize a significant benefit due to ET tube placement.

2 | METHODS

A retrospective chart review was performed including all SARS-CoV-2 positive patients who underwent tracheostomy tube placement in a hospital within the health system between March 2020 and May 2022. As seen in Figure 1, there were 230 patients with a history of invasive mechanical ventilation due to COVID-19 respiratory failure who subsequently underwent tracheostomy tube placement. Patients were excluded from the study if tracheostomy preceded the diagnosis of COVID-19. The study was approved by the medical center's Louisiana State University institutional review board. Patient records were accessed through the electronic medical record system, Epic (Epic Systems Corporation) and identified using the SlicerDicer tool. Patient demographics, previous medical history, tracheostomy procedural details, arterial blood gases, complications, and outcomes, were all noted. P/F ratios were also calculated from the patients' arterial blood gases. The P/F ratio is used as a powerful objective tool to identify acute hypoxemic respiratory failure—a parameter that is often employed in the treatment of critically ill intensive care unit patients.[7] A P/F ratio of less than 300 indicates acute respiratory failure. Descriptive statistics were performed on ETs, defined as tracheostomy placement less than 14 days on ventilator support, compared to LT placement. A tracheostomy performed within 14 days of intubation was considered early, and anything beyond this was considered LT. The concept of ET was conceived over the past 30 years; consequently, the definition of what constitutes an ET has been variable within the literature.[8] A meta-analysis of randomized controlled trials failed to show any significant benefit of tracheostomy within 10 days of intubation.[9] The timing of tracheostomy remains controversial.

The primary endpoints in question were all-cause mortality rates. Secondary endpoints included the percentage of patients able to be liberated from mechanical ventilation, time to wean off the ventilator, percentage decannulation, time to decannulation, and various complications. A chi-squared test was performed to analyze the correlation between categorical variables. A Student's *t*-test was performed to analyze the means of independent groups with assumed normal distributions. A Bonferroni correction was performed to reduce the effect of multiple comparisons.

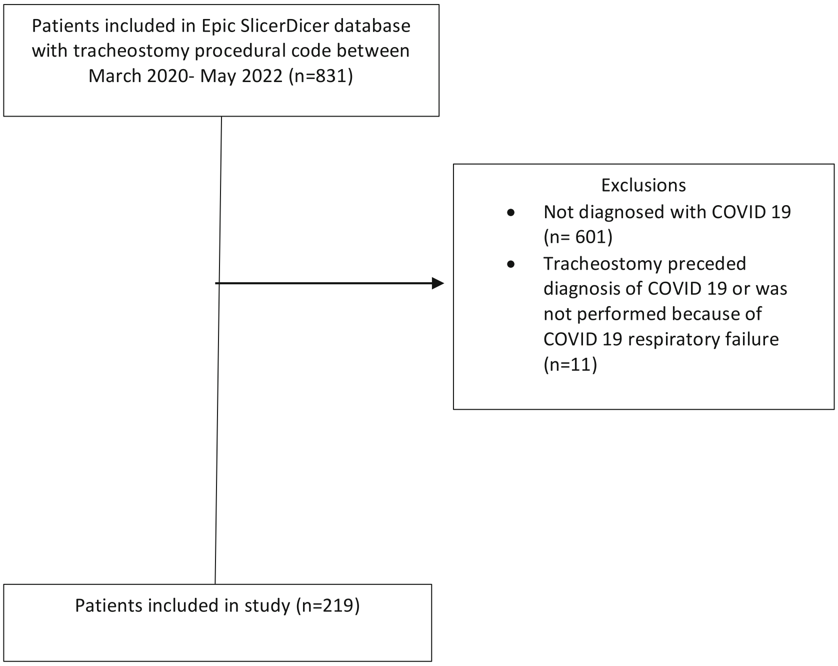

FIGURE 1 Flow diagram of inclusion and exclusion criteria.

3 | RESULTS

Between March 2020 and May 2022, 219 elective open tracheostomies were performed at Ochsner-affiliated hospitals on patients who were intubated and ventilated due to acute respiratory distress syndrome precipitated by SARS-CoV-2 infection. ET, defined as within 14 days of intubation, was performed in 50 patients (22.8%), and LT, occurring after 14 days of intubation, was performed in 169 patients (77.2%).

Patients ranged in age from 0 to 85 years old. The average age of patients who underwent ET versus LT was 52 and 58 years old, respectively ($p = .01$). As seen in Table 1, there were no statistical differences between the ET and LT groups with respect incidence of significant past medical history including preexisting cardiac, renal, and pulmonary conditions. Following tracheostomy tube placement 124 patients (56.6%) were able to be liberated from ventilation, 74 (33.8%) were decannulated from tracheostomy, and 75 (34.2%) died. Of the 50 ET patients, 31 (62%) were able to be liberated from ventilation within 13.88 ± 16.21 days, 20 (40%) patients were decannulated from tracheostomy within 41.17 ± 21.07 days, and 16 (32%) patients died. Of the 169 LT patients, 93 (55%) were able to be liberated from ventilation within 18.17 ± 19.15 days, 54 (31.9%) patients were decannulated from tracheostomy within 47.72 ± 25.51 days, and 59 (34.9%) of patients died. On average, patients who underwent ET were able to be removed from mechanical ventilation 4.29 days earlier $p = .12$ and decannulated 6.55 days earlier; these values were not statistically significant ($p = .15$). There was no statistically significant difference in mortality rate between the two groups. Similarly, utilizing an unpaired Student *t*-test, there was no statistically significant difference in $\Delta PaO_2/FiO_2$ between ET and LT groups ($p = .19$).

In regards to secondary outcomes of postoperative complications for ET patients, six experienced bleeding (12%) and one misplacement (which was defined as false tracking or dislodgement). Postoperative complications in the LT patient population demonstrated eight bleeding (4.73%), nine hypoxia, and four misplacement. There was no statistically significant difference in bleeding ($p = .09$), odds ratio 2.744 [0.8790, 8.675], in misplacement ($p > .99$) between ET and LT. All deaths in the cohort were due to sequelae of COVID-19 infection. There were no tracheostomy-related deaths.

4 | DISCUSSION

This is a multicenter study examining the impact of ET versus LT tube placement in patients infected with the COVID-19 virus. There was no statistically significant difference among patients who underwent ET (<14 days) or LT (>14 days) in relation to the time of liberation from mechanical ventilation or time to decannulation. Similarly, there was no statistically significant difference in mortality or complications related to the timing of the tracheostomy placement. Those who underwent ET tended to be younger patients 52 versus 58 years of age for LT ($p = .01$). This may have been attributed to a general perception that younger patients may have been viewed as more robust in health, and hence, ET was sought for more expediently. There were no other statistically significant differences in patient characteristics between the two groups.

There was a male predominance in both early and tracheostomy patients, corresponding to 58.8% and 65.1%, respectively.

The timing of tracheostomy in COVID-19 patients has been a topic of debate that precedes the pandemic. A Cochrane review from 2015 by Andriolo et al., did not suggest any mortality benefit or significant difference between ET and LT.[10] Other studies have demonstrated a possible benefit to ET performance in non-COVID patients.[11,12] However, since the COVID-19 pandemic, there has been much conflicting data within the literature. Ji et al. performed

TABLE 1 Demographics and patient outcomes for all patients who underwent tracheostomy placement between March 2020 and May 2022 in an Ochsner-affiliated facility.

Variable[a]	Early tracheostomy ($N = 50$)	Late tracheostomy ($N = 169$)	p Value[b]
Age, years	52.34	58.03	.01*
BMI	33 [29.76, 36.24]	34.25 [33.34,35.15]	.51
INR	1.164 [1.08, 1.25]	1.15 [1.12, 1.17]	.79
Platelets	264.48 [230.60,298.36]	281.64 [271.34, 291.93]	.42
Gender			.14
Male	29 (58%)	110 (65.1%)	
Female	21 (42%)	59 (34.9%)	
Pa/FiO_2			
Prior to tracheostomy	226.09	184.87	
After tracheostomy	216.36	194.94	
$\Delta PaO_2/FiO_2$	−9.73 [−26.88, 7.42]	10.07 [2.70, 17.44]	.19
Duration of mechanical ventilation prior to tracheostomy	7.4 [0.98, 13.82]	25.50 [6.08, 44.92]	<.001
Liberation from ventilator	62.70%	55%	.18
Time to liberation from the ventilator (days)	13.88 [0, 30.09]	18.17 [0, 37.32]	.11
Decannulation	41.18%	32%	.14
Time to decannulation (days)	41.17 [26.1, 62.24]	47.72 [22.21, 73.23]	.15
Death	32%	34.9%	.70

[a]Most data were represented as mean [95% confidence interval], and others were presented as *n* (%).
[b]*t*-Test was used to compare the mean data between the two groups; the chi-squared test was used for comparisons on others (gender, liberation from ventilator, decannulation).
*Statistically significant data with predetermined $p < .05$.

the first systematic review on the timing of tracheostomy and clinical outcomes in COVID-19 patients.[13] The study did find a significant reduction in the duration of invasive mechanical ventilation and duration of ICU stay. The presumed benefits of ET on clinical outcomes of COVID-19 patients are the weaning of sedation, decreasing mechanical ventilatory support, conferring mobility and rehabilitation, as well as performing more efficacious pulmonary toilet. The benefits would understandably reduce the duration of mechanical ventilation and the duration of ICU stay. ET also decreases the duration of prolonged intubation and will be accompanied by reduced laryngeal dysfunction and injury and possibly decrease the incidence of subglottic stenosis. The data presented here did not reveal any statistically significant difference in mortality. Conversely, a systematic review performed by Battaglini et al., which compiled data from January 1, 2020 and January 10, 2022, did not reveal any significant impact on time to decannulation.[14] In addition, there was no association between tracheostomy timing and duration of mechanical ventilation in the study. These findings were also supported by the COVID study performed by Staibano et al.[15] This may suggest that even when ET has been performed, these critically ill patients are still subject to prolonged periods of ventilatory support due to protracted severe respiratory failure.

The primary limitation of the study is the small sample size of 219 patients within the multi-hospital system. Given the heterogeneity of the course of the COVID-19 infection, this small sample size limits the ability to generalize the findings reported here. The retrospective nature of the study also lends itself to inherent residual confounding. It is possible that more medically complicated patients underwent tracheostomy tube placement later. Consequently, the clinical outcomes between ET and LT should be compared in a prospective randomized controlled trial. Given the current milieu of the pandemic, this is not feasible.[16] Given that this is a retrospective cohort study, it is vulnerable to selection bias. Possible confounders in the study would include patient comorbidities, such as chronic kidney disease, congestive heart failure, and coronary artery disease. In addition, after performing a thorough literature review, it is apparent that there is not a singular, concrete definition of ET. This may induce rather significant clinical heterogeneity in the evaluation of these studies and make it difficult to draw conclusions regarding optimal timing. An inherent strength of the study is that the data was collected from several institutions and it adds to the growing body of literature on tracheostomy timing in these critically ill COVID-19 patients. Timing of tracheostomies in this patient population is certainly an evolving paradigm and this data aids in providing some additional clarity.

5 | CONCLUSION

This multi-institutional retrospective study suggests that there is no statistically significant difference in mortality, time to liberation from the ventilator, or time to decannulation between those COVID-19-infected patients who underwent ET tube placement and those whose tracheostomy tube was placed later. Decisions regarding the timing of tracheostomy on this group of critically ill patients should be patient-centric, and several considerations must be made, such as goals of care, family wishes, while minimizing the risk of infection and detriments to healthcare workers.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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