The Impact of Time to Tracheostomy Placement on Covid-19 Morbidity and Mortality

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Abstract

Objective: This study aims to evaluate patient outcomes based on the timing of tracheostomy following intubation: early (<7 days), standard (8–14 days), and late (>15 days). Identifying the optimal timing can help enhance patient care while reducing mortality and morbidity.

Methods: The National (Nationwide) Inpatient Sample (NIS) database was used to identify patients who underwent tracheostomy in 2019-2020. Patients were selected based on ICD-10 codes for tracheostomy placement and were then stratified by COVID-19 diagnosis. Tracheostomy placement timing was recorded relative to the duration between intubation and tracheostomy, with patients categorized into early, standard, and late groups. Demographic and clinical characteristics, including comorbidities, were also extracted for analysis.

Results:

Among 21,000 patients who underwent tracheostomy, 3,715 were diagnosed with COVID-19. Of these, 2,972 underwent tracheostomy more than 15 days after intubation, with a mortality rate of 25.8% (n = 767, 95% CI: [24.5%, 27.1%]). The mortality rate in the standard group, which included 434 patients, was 33.2% (n = 144, 95% CI: [30.0%, 36.4%]). In the early group, consisting of 296, the mortality rate was 31.4% (n = 93, 95% CI: [27.6%, 35.2%]). Regression analysis identified significant risk factors for increased mortality ($p<0.05$), including age, hypothyroidism, depression, obesity, and diabetes without chronic complications.

Conclusion:

Most tracheostomies were performed more than 15 days after intubation, with the fewest occurring within 7 days. The late tracheostomy cohort had the lowest mortality rate compared to the standard and early cohorts. Several comorbidities were significantly associated with higher mortality rates. While much of the existing literature supports early tracheostomy to improve outcomes, these findings suggest that later tracheostomy may be associated with better survival in certain COVID-19 patients. Additional research is needed to reconcile these differences, identify optimal timing, and determine patient-specific factors influencing outcomes.

Introduction

The timing of tracheostomy placement is not standardized and continues to be evaluated in clinical research. The COVID-19 pandemic put critical care management under extraordinary strain, and tracheostomy became a source of clinical doubt due to its classification as an Aerosol-Generating Procedure (AGP)[1-3] and concerns about aerosolization. Previously, in non-COVID patient populations, earlier management (<8-10 days after intubation) was associated with decreased ICU stay and ventilator reliance.[4,5]

Early tracheostomy (<10 days) was linked to shorter ICU stays and duration of mechanical ventilation. However, paradoxically, it was also linked to poorer 30-day survival than later timing, according to McGrath et al. 10 Similarly, early tracheostomy (<14 days) decreased ICU stay by about 9 days. However, mortality was not significantly different, according to Breik et al.[6] Benito et al. found that tracheostomy after 10 days was associated with lower mortality, indicating potential harm with very early intervention.[7] Other studies suggest earlier tracheostomy may reduce ventilator-associated pneumonia and facilitate earlier weaning, though evidence quality remains low.[8,9] Overall, subsequent studies have yielded mixed results, with some showing improved outcomes with early tracheostomy[10] and others showing no significant difference,[11] highlighting ongoing uncertainty.

Methods

Study Design and Data Source:

This was a retrospective cohort study utilizing the largest publicly available all-payer inpatient database in the United States, The National (Nationwide) Inpatient Sample (NIS), to stratify patients' tracheostomy timing relative to COVID-19 diagnosis. The database was used to identify patients who underwent tracheostomy in 2019-2020. Rowan University's Research Institutional Review Board determined this study to be except due to the de-identified public data **(IRB: PRO-2024-449).**

Patient Selection and Variables:

Patients from the NIS database from 2020 were selected based on ICD-10 procedure codes for tracheostomy placement and were then stratified by COVID-19 diagnosis. Tracheostomy placement timing was recorded as the interval between intubation and tracheostomy, with patients categorized into three groups: early tracheostomy (≤7 days), standard tracheostomy (8–14 days), and late tracheostomy (≥15 days). Demographics such as age, socioeconomic status, and comorbidities were also extracted for analysis.

Inclusion criteria: To be included in the study, records must contain the ICD-10-PCS codes for tracheostomy and meet the Clinical Classifications Software Refined (CCSR) description for tracheostomy.

Exclusion Criteria: Participants were excluded from the study if they did not have any ICD-10-PCS codes indicating a tracheostomy procedure. Additionally, patients who lacked data tracheostomy timing were excluded.

Statistical analysis:

All data analysis was completed via IBM SPSS. Pearson's chi-square test and binary logistic regression were utilized to compare the association between tracheostomy timing and mortality. Multivariable linear regression was used to determine the association between the length of stay and total charges.

Results

A total of 21,000 patients who underwent tracheostomy, 3,715 were diagnosed with COVID-19. Of these, 2,972 underwent tracheostomy more than 15 days after intubation, with a mortality rate of 25.8% (n = 767, 95% CI: [24.5%, 27.1%]). The mortality rate in the standard group, which included 434 patients, was 33.2% (n = 144, 95% CI: [30.0%, 36.4%]). In the early group, consisting of 296, the mortality rate was 31.4% (n = 93, 95% CI: [27.6%, 35.2%]).

Multivariate logistic regression analysis indicated lower odds of mortality in the late tracheostomy group compared with early or standard groups (OR = 0.798; 95% CI: 0.711-0.897; $p < 0.001$). Older age was associated with high odds of mortality ($p<0.001$), with each additional year of age increasing mortality by approximately 1.9%. Several comorbidities were also with lower odds, including depression (p=0.025; OR 0.71), obesity (p=0.017; OR 0.71),

Regression analysis showed independent risk factors that increased mortality which include older age ($p < 0.001$), obesity ($p = 0.017$), depression ($p = 0.025$), hypothyroidism ($p = 0.037$), and Diabetes without chronic complications ($p = 0.001$).

Variable	p-value	Exp(B)	95% C.I. Lower	95% C.I. Upper
Timing of Trach	0.00	0.80	0.71	0.90
Age in years at admission	0.00	1.02	1.01	1.03
Median household income national quartile for patient ZIP Code	0.28	0.96	0.90	1.03
Acquired immune deficiency syndrome	0.81	0.88	0.32	2.43
Alcohol abuse	0.98	0.99	0.60	1.65
Autoimmune conditions	0.27	1.29	0.82	2.04
Lymphoma	0.09	1.89	0.90	3.95
Leukemia	0.79	1.12	0.49	2.55
Metastatic cancer	0.03	0.19	0.04	0.84
Solid tumor without metastasis, malignant	0.78	0.90	0.44	1.84
Dementia	0.02	0.61	0.40	0.93
Depression	0.03	0.71	0.52	0.96
Diabetes without chronic complications	0.58	0.93	0.70	1.22
Diabetes with chronic complications	0.70	1.03	0.88	1.22
Drug abuse	0.00	0.41	0.23	0.71
Hypertension, complicated	0.49	0.93	0.77	1.13
Hypertension, uncomplicated	0.04	0.82	0.68	0.99
Chronic pulmonary disease	0.73	0.97	0.80	1.17
Obesity	0.02	0.82	0.70	0.97
Peripheral vascular disease	0.57	1.12	0.77	1.63
Hypothyroidism	0.56	1.08	0.84	1.38
Other thyroid disorders	0.05	0.42	0.18	1.02
Constant	0.00	0.29		

Table 1. Multivariate Logistical Regression Analysis of Mortality Associated Risk Factors. Presents adjusted odds ratios (OR), 95% confidence intervals, and p-values for significant predictors of in hospital mortality in COVID-19 patients who underwent tracheostomy

		Alive	Deceased	Total
Early (≤ 7 days)	Count	203	93	296
	% within Timing of Trach	68.6%	31.4%	100.0%
	% within Died during hospitalization	7.5%	9.2%	8.0%
	% of Total	5.5%	2.5%	8.0%
Standard (8-14 days)	Count	290	144	434
	% within Timing of Trach	66.8%	33.2%	100.0%
	% within died during hospitalization	10.7%	14.3%	11.7%
	% of Total	7.8%	3.9%	11.7%
Late (≥15 days)	Count	2203	769	2972
	% within Timing of Trach	74.1%	25.9%	100.0%
	% within Died during hospitalization	81.4%	76.1%	80.0%
	% of Total	59.3%	20.7%	80.0%

Table 2. Mortality rates of patients undergoing early, standard, or late tracheostomy with COVID-19 Diagnosis

Conclusions

In this large retrospective cohort of COVID-19 patients from the 2020 NIS database, late tracheostomy (>15 days post-intubation) was associated with the lowest in-hospital mortality compared with standard (8–14 days) and early (<7 days) timing. Regression analysis identified older age, hypothyroidism, depression, obesity, and uncomplicated diabetes as independent predictors of increased mortality. While early tracheostomy has shown benefits in general ICU populations, our findings suggest that later tracheostomy may confer a survival advantage in well-selected COVID-19 patients. These results highlight the importance of patient-specific factors in determining tracheostomy timing and underscore the need for prospective studies to define optimal strategies in COVID-19 and future respiratory pandemics.

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References