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Tracheostomy in COVID-19 Patients: A Retrospective Observational Study

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ABSTRACT

Objective: During the COVID-19 pandemic, many patients require intensive care unit (ICU) hospitalization with mechanical ventilation (MV). There is still no clear information about the timing and indications of tracheostomy in COVID-19 cases. We aimed to evaluate the relationship between the timing of tracheostomy and outcomes of critical COVID-19 cases.

Materials and Methods: This single-center, retrospective, observational study included patients with COVID-19 who were intubated in the ICU between November 1, 2020 and February 1, 2021, and underwent percutaneous tracheostomy. Demographic data of all patients, the day each patient underwent a percutaneous tracheostomy, the complications related to the procedure, laboratory data, mortality, MV duration, and ICU length of stay (LOS) were recorded.

Results: The study included 33 critically ill patients with COVID-19 undergoing tracheostomy. Among these cases, 18 (54.5%) patients who underwent tracheostomy within 14 days after intubation comprised the early group; 15 (45.5%) patients who underwent tracheostomy after 14 days comprised the late tracheostomy group. There was no difference between the two groups in mortality. The median ICU LOS was 33.0 (25.0–37.0) days, and it was longer in late group [35.0 (30.0–37.0) vs. 29.5 (18.8–34.5), p=0.046]. The median duration of MV was 27.0 (18.0–33.5) days, which was longer in late group [29 (25.0–37.0) vs. 19 (12.8–29.0), p=0.004].

Conclusion: In critical COVID-19 cases, there was no difference between groups in terms of mortality. In the early tracheostomy group, ICU LOS and the MV duration were significantly shorter.

Keywords: Tracheostomy, COVID-19, SARS-CoV-2, critical care, respiratory failure

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INTRODUCTION

Severe acute respiratory syndrome virus-2 (SARS-CoV-2), a member of the coronavirus family, and the outbreak that emerged in Wuhan, China, in early 2020, affected all countries of the world caused a pandemic (1). 10%–20% of COVID-19 patients require intensive care hospitalization (2). Approximately 50% of these patients who need intensive care require invasive MV. In severe acute respiratory distress syndrome (ARDS) cases, tracheostomy indications may arise due to prolonged MV. Compared to an endotracheal tube, tracheostomy prevents oropharyngeal lesions, increases patient comfort, and reduces the need for sedative drugs (3). Besides, it reduces the work of breathing, facilitates weaning, reduces the likelihood of developing ventilator-associated pneumonia (4). Because of these advantages, tracheostomy is a frequently preferred method when prolonged MV is required in non-COVID cases. However, there is no clear information in COVID-19 cases about the timing and indications of tracheostomy. The literature presents conflicting information about tracheostomy timing. The American Academy of Otolaryngology recommends delaying the tracheostomy procedure up to 14 days after endotracheal intubation (5). On the other hand, Shultz et al. (6) reported that early tracheostomy would be beneficial. Currently, the data on this subject in the literature are not based on strong evidence and are generally presented as expert opinion.

This study aimed to evaluate the relationship between the timing of percutaneous tracheostomy, mortality, ICU LOS, and MV duration in COVID-19 patients.

MATERIALS and METHODS

Study Design, Data Collection

This research was a single-center, retrospective observational study conducted in a pandemic hospital in Ankara, Turkey. After obtaining ethics committee approval, all patient data were accessed from electronic medical records and patient files. The University of Health Sciences, Ankara City Hospital Clinical Research Ethics Committee approved this study (Approval Date: April 21, 2021; Approval Number: 2021/E2-21-333). The study included patients over 18 years who tested positive for COVID-19 RT-PCR (Reverse Transcriptase polymerase chain reac-

Table 1. Demographic data in COVID-19 patients receiving early and late tracheostomies

	Total (n=33)	Early tracheostomy (n=18)	Late tracheostomy (n=15)	p
Male	25 (75.8%)	16 (88.9%)	9 (60.0%)	0.101[1]
Female	8 (24.2%)	2 (11.1%)	6 (40.0%)	
Age, years	65.24±13.99	62.28±12.84	68.80±14.920	0.187[2]
Duration from intubation to tracheostomy, days	15.24±7.28	9.88±2.29	21.66±5.81	<**0.001**[3]
APACHE II	19.64±5.94	20.72±6.51	18.33±5.09	0.257[3]
SOFA	5.0 (2.0–6.5)	5.5 (2.0–7.0)	4.0 (2.0–6.0)	0.332[4]
GCS	14.0 (12.0–15.0)	14.0 (10.5–15.0)	14.0 (14.0–15.0)	0.307[4]
Comorbidities of patients				
Hipertansiyon	18 (54.5%)	9 (50.0%)	9 (60.0%)	0.823[2]
Diabetes mellitus	7 (21.2%)	3 (16.7%)	4 (26.7%)	0.674[1]
Chronic obstructive pulmonary disease	2 (6.1%)	1 (5.6%)	1 (6.7%)	1.000[1]
Asthma	1 (3.0%)	1 (5.6%)	0 (0.0%)	1.000[1]
Cardiovascular disease	6 (18.2%)	2 (11.1%)	4 (26.7%)	0.375[1]
Malignancy	2 (6.1%)	2 (11.1%)	0 (0.0%)	0.489[1]
Chronic renal disease	1 (3.0%)	0 (0.0%)	1 (6.7%)	0.455[1]
Cerebrovascular disease	6 (18.2%)	2 (11.1%)	4 (26.7%)	0.375[1]
At least one comorbidity	21 (63.6%)	11 (61.1%)	10 (66.7)	1.000[2]

APACHE II: Acute physiology and chronic health evaluation-II scores; GCS: Glasgow Coma Scale; SOFA: Sequential organ failure assessment scores; 1: Fisher's Exact test; 2: Pearson chi-square test; 3: Student's t-test; 4: Mann–Whitney U test

tion) between November 1, 2020, and February 1, 2021, were followed up as intubated in the ICU and underwent a bedside percutaneous tracheostomy due to the prolonged intubation period and whose data could be accessed. Clinicians made the tracheostomy decision. Demographic data of all patients, the day each patient underwent percutaneous tracheostomy, any procedure-related complications, laboratory data, mortality, MV duration, and ICU LOS were recorded. Age, gender, comorbid diseases, acute physiology and chronic health evaluation-II (APACHE II) scores, sequential organ failure assessment (SOFA) scores, Glasgow Coma Scale (GCS), and tracheostomy variables were also reviewed. Then, the patients were divided into two groups. Patients who underwent tracheostomy within 14 days after intubation comprised the "early tracheostomy" group. Those who underwent tracheostomy after 14 days comprised the "late tracheostomy" group. All data were compared to find differences between the two groups.

Statistical Analysis

The Shapiro–Wilk test, skewness and kurtosis values and histogram graphics determined conformity to the normal distribution. The mean±standard deviation of the numerical variables that comply with the normal distribution and the median (25%–75%) values of the variables that did not comply with the normal distribution were presented. Categorical variables were expressed as numbers (percentage distributions). The Student's t-test was used to compare mean values between groups of numerical variables that comply with the normal distribution and the Mann–Whitney U test to compare median values between groups of variables that didn't comply with the normal distribution. Pearson chi-square test and Fisher's exact test compared categorical variables between groups. The Kaplan–Meier method calculated the risk of variables on death. It determined the survival curves, and a Log-rank test compared survival rates between patient groups who underwent early and late tracheostomy. Cox regression analysis determined the hazard ratio values of the variables. The Cox regression model included significant variables in these analyses ($p<0.25$). In the analysis of all tests, a p-value <0.05 was considered statistically significant, and these analyzes were performed using SPSS Statistics software (Statistical Package for the Social Sciences version 25.0; IBM Corporation, Armonk, NY, USA)

RESULTS

Thirty-three COVID-19 critical cases followed up in the COVID-19 ICU and underwent bedside percutaneous tracheostomy were included in the study. Among these cases, 18 (54.5%) patients who underwent tracheostomy within 14 days after intubation comprised the early group, and 15 (45.5%) patients who underwent tracheostomy after 14 days comprised the late group. The mean age was 65.24±13.99 years, and 25 (75.8%) were male. Early and late groups were similar in terms of age and gender. There was no statistical difference. While the mean duration from intubation to tracheostomy was 15.24±7.28 days in all populations, this period was 9.88±2.29 days in the early group, 21.66±5.81 days in the late group ($p<0.001$). All patients' mean APACHE II score was 19.64±5.94, the median SOFA score was 5.0 (2.0–6.5), and the median GCS value was 14.0 (12.0–15.0). There was no difference in these scores between the early and late groups. Twenty-one (63.6%) of the patients had at least one comorbidity. The most common comorbidity was hypertension (54.4%). There was no difference between groups when compared by the comorbid diseases and having at least one comorbidity (Table 1).

Table 2. Laboratory tests in COVID-19 patients at intensive care unit admission

	Total (n=33)	Early tracheostomy (n=18)	Late tracheostomy (n=15)	p
Platelet count, $\times10^9$/L	260.00 (167.50–388.00)	278.50 (194.25–413.75)	180.00 (155.00–329.00)	**0.049**[1]
D-dimer mg/dl	2.59 (1.05–4.80)	3.05 (1.07–4.50)	1.70 (1.00–10.70)	0.744[1]
INR	1.13±0.18	1.18±0.20	1.08±0.16	0.111[2]
Lymphocyte count, $\times10^9$/L	0.48 (0.36–0.68)	0.41 (0.30–0.62)	0.64 (0.37–0.78)	0.133[1]
Hemoglobin, g/L	12.35±2.03	12.48±1.49	12.20±2.59	0.718[2]
White-cell count, $\times10^9$/L	12.84±4.91	12.8±4.09	12.78±5.91	0.951[2]
Neutrophil count, $\times10^9$/L	11.56±4.62	11.73±4.02	11.35±5.40	0.822[2]
C-reactive protein, mg/L	0.12 (0.10–0.18)	0.11 (0.06–0.17)	0.14 (0.11–0.19)	0.247[1]
Procalcitonin, ng/mL	0.17 (0.09–0.49)	0.14 (0.07–0.33)	0.28 (0.12–1.25)	0.086[1]
Ferritin µg/dl	787.00 (398.00–787.00)	758.00 (545.25–1568.25)	868.00 (282.00–1181.00)	0.470[1]
IL-6 pg/ml	46.00 (18.80–115.00)	50.50 (22.72–157.75)	40.00 (17.00–104.00)	0.481[1]
AST U/L	62.12±32.10	50.61±17.89	75.93±39.89	**0.035**[2]
ALT U/L	37.00 (23.00–47.50)	32.00 (20.75–45.50)	40.00 (29.00–51.00)	0.416[1]
Serum creatinine, mg/dl	0.80 (0.68–1.28)	0.79 (0.65–1.01)	1.27 (0.70–4.00)	0.104[1]
Urea mg/dl	56.00 (39.00–78.00)	55.50 (39.75–62.50)	73.00 (34.00–105.00)	0.286[1]

ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; INR: International normalized ratio; IL-6: Interleukin-6; 1: Mann–Whitney U test; 2: Student's t test

Table 3. Respiratory parameters of early and late tracheostomy groups on the tracheostomy day

	Total (n=33)	Early tracheostomy (n=18)	Late tracheostomy (n=15)	p
pH	7.44±0.07	7.41±0.06	7.47±0.07	**0.024**[1]
$PaCO_2$, mmHg	41.06±10.25	44.72±8.59	36.67±10.60	**0.022**[1]
PaO_2, mmHg	79.00 (69.50–90.50)	72.50 (65.00–81.50)	87.00 (73.00–111.00)	**0.016**[2]
Lactate, mmol/L	1.33±0.38	1.41±0.42	1.24±0.33	0.217[1]
PEEP	7.00 (5.00–8.00)	8.00 (6.75–8.50)	6.00 (5.00–7.00)	**0.014**[2]
FiO_2	55.76±12.06	58.61±12.10	52.33±11.47	0.139[1]
PaO_2/FiO_2	160.34±67.42	136.25±46.72	189±78.07	**0.022**[1]

PEEP: Positive end-expiratory pressure; FiO_2: Fraction of inspired oxygen; $PaCO_2$: Arterial partial pressure of carbon dioxide; PaO_2: Arterial partial pressure of oxygen; 1: Student's t-test; 2: Mann–Whitney U test

Table 2 summarizes the comparison of the laboratory values of the patients at admission to the ICU by early and late tracheostomy group.

All tracheostomies were performed by ICU physicians using the percutaneous dilatation technique. The median number of the team's members during the tracheostomy opening procedures was 4 (3.0–4.0). The median size of the used tracheostomy cannula was 8 (7.5–8.0). When evaluated in complications, there was one case of subcutaneous emphysema in the early group, and one case of minor bleeding in the late group.

When the patients' MV settings and the arterial blood gas values on the day of the tracheostomy procedure were compared, the mean values of pH, partial pressure of oxygen (PaO_2), and the ratio of PaO_2 to FiO_2 (PaO_2/FiO_2) of the patients in the late group were higher than those in early group (p=0.024, p=0.016, p=0.022, respectively). The partial pressure of carbon dioxide (PCO_2) value was higher in the early group (p=0.022). When compared in terms of MV settings, the median value of positive end-expiratory pressure (PEEP) was found to be higher in the early group (p=0.014) (Table 3).

Twenty-two (66.7%) of the cases included in the study died during intensive care follow-up, and 12 of them (54.5%) were in the early group. The median ICU LOS was 33.0 (25.0–37.0) days, and it was found to be longer in late group [35.0 (30.0–37.0) vs 29.5 (18.8–34.5), p=0.046]. While the median duration of MV was 27.0 (18.0–33.5) days, this period was 19.0 (12.8–29.8) days in the early group and 29 (25.0–37.0) days in the late group. The difference between the groups was statistically significant (p=0.004) (Table 4).

The estimated median survival duration in the early group was 20 days, while the estimated median survival duration in the late group was 33 days (Plog-rank: 0.156) (Fig. 1).

Table 4. Outcomes of COVID-19 patients receiving early and late tracheostomies

	Total (n=33)	Early tracheostomy (n=18)	Late tracheostomy (n=15)	p
Mortality	22 (66.7%)	12 (66.7%)	10 (66.7%)	1.000[1]
ICU LOS, days	33.0 (25.0–37.0)	29.50 (18.8–34.5)	35.0 (30.0–37.0)	**0.046**[2]
Duration of MV, days	27.0 (18.0–33.5)	19.00 (12.8–29.0)	29.0 (25.0–37.0)	**0.004**[2]

ICU: Intensive care unit; LOS: Length of stay; MV: Mechanical ventilation; 1: Pearson chi-square test; 2: Mann–Whitney U test

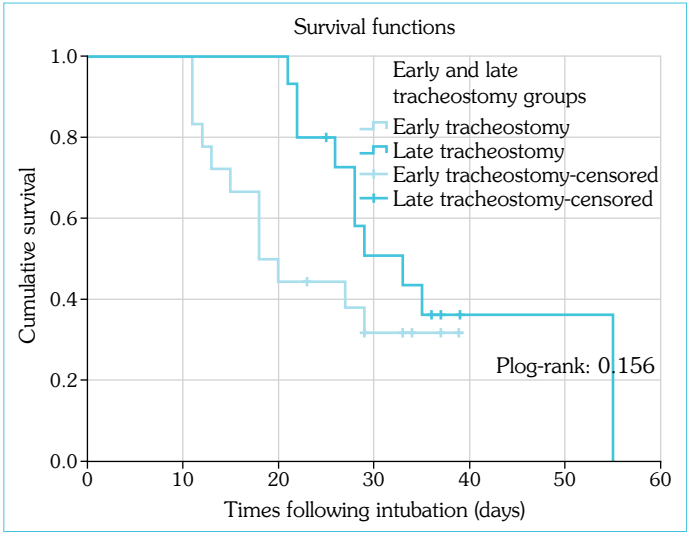

Figure 1. Kaplan–Meier analysis of survival in patients receiving early and late tracheostomies

DISCUSSION

The study aimed to evaluate the relationship between percutaneous tracheostomy timing and mortality in critical COVID-19 cases who needed invasive MV. In our study, there was no significant difference in mortality between the cases for whom percutaneous tracheostomy was performed before 14 days and after 14 days. In the literature, there is no clear information about the timing of tracheostomy in critical COVID-19 cases. Many patients need intensive care and MV during the pandemic, which lasts longer than one year (7). However, there is insufficient information about when the tracheostomy should be performed and which method would be appropriate in these cases requiring prolonged MV support. In a multicenter study conducted by Tang et al. (8), they evaluated 80 cases of COVID-19 who underwent percutaneous tracheostomy. Mortality was higher in those who underwent tracheostomy earlier than 14 days. Breik et al. (9) conducted a prospective observational study with COVID-19 cases requiring MV. They performed tracheostomies in 100 of 164 patients and followed 64 cases on MV without opening tracheostomy. The 64 early tracheostomy (<14 days) patients and the 36 late tracheostomy patients were compared in 30-day survival rates, ICU LOS, and decannulation. The 30-day survival was higher in the early group, ICU LOS was shorter, and decannulation rates were higher (9). This study also evaluated tracheostomy's effects on mortality in COVID-19 patients. The results indicated that patients who did and did not undergo tracheostomies had similar APACHE II scores. The 30-day mortality was lower in patients who underwent tracheostomy. They also stated that performing the tracheostomy in the early period within 14 days was also beneficial in 30-day mortality. There was no significant difference between the early and late groups in terms of mortality in our study. However, similar to the study of Breik et al. (9), the ICU LOS and MV duration were significantly lower in the early group.

Performing the tracheostomy within 14 days has many advantages in non-COVID patients who require prolonged MV. Among these advantages, providing more comfortable pulmonary hygiene, reducing the need for sedation, and ventilator-associated pneumonia (10–12). Tracheostomy has advantages in COVID-19-related ARDS cases, similar to severe ARDS cases developing due to non-COVID-19 reasons (13). However, practitioners who prefer endotracheal intubation due to the frequent application and benefit of prone position in COVID-19-related ARDS cases suggest the difficulties of placing patients in the prone position with tracheostomy as one of the disadvantages of tracheostomy (14). Besides, the risk that it may pose to practitioners due to the constant viral load and high risk of transmission in COVID-19-related ARDS cases is expressed as a disadvantage of opening a tracheostomy (15). In our study, percutaneous tracheostomy was performed by experienced intensive care teams in single rooms with negative pressure, with full compliance with personal protective measures. Depending on the procedure, none of the team members had post-procedure PCR positivity. Also, in our routine practice, tracheostomy is performed after the pre-procedure control PCR test from all patients whose tracheostomy is decided, and PCR tests of all patients were negative before the procedure.

In conclusion, although there was no significant difference between early and late tracheostomy groups in terms of mortality, there was a significant difference in ICU LOS and MV duration. Since percutaneous tracheostomy may be required in the ICU in many patients during the pandemic, we believe that it would be beneficial to carry out larger studies to develop algorithms in this regard.

Ethics Committee Approval: The University of Health Sciences, Ankara City Hospital Clinical Research Ethics Committee granted approval for this study (date: 21.04.2021, number: 2021/E2-21-333).

Informed Consent: Informed consent was obtained from patients' first degree relatives.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – HCD; Design – ST; Supervision – HCD; Resource – ST; Materials – ST; Data Collection and/or Processing – HCD; Analysis and/or Interpretation – HCD; Literature Search – ST; Writing – ST, HCD; Critical Reviews – HCD, ST.

Conflict of Interest: The authors have no conflict of interest to declare.

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REFERENCES

1. Gralinski LE, Menachery VD. Return of the Coronavirus: 2019-nCoV. Viruses 2020; 12(2): 135. [CrossRef]
2. Immovilli P, Morelli N, Antonucci E, Radaelli G, Barbera M, Guidetti D. COVID-19 mortality and ICU admission: the Italian experience. Crit Care 2020; 24(1): 228. [CrossRef]
3. Bösel J, Schiller P, Hook Y, Andes M, Neumann JO, Poli S, et al. Stroke-related early tracheostomy versus prolonged orotracheal intubation in neurocritical care trial (SETPOINT): a randomized pilot trial. Stroke 2013; 44(1): 21–8. [CrossRef]
4. Robba C, Galimberti S, Graziano F, Wiegers EJA, Lingsma HF, Iaquaniello C, et al; CENTER-TBI ICU Participants and investigators. Tracheostomy practice and timing in traumatic brain-injured patients: a CENTER-TBI study. Intensive Care Med 2020; 46(5): 983–94. [CrossRef]
5. American Academy of Otolaryngology and Head and Neck Surgery. AAO Position statement: Tracheotomy recommendations during the COVID-19 pandemic. Available from: URL: https://www.entnet.org/resource/tracheotomy-recommendations-during-the-covid-19-pandemic-2/. Accessed Apr 22, 2021.
6. Schultz MJ, Pattnaik R, Dondorp AM. Walking the line between benefit and harm from tracheostomy in COVID-19. Lancet Respir Med 2020; 8(7): 656–7. [CrossRef]
7. World Health Organization. Clinical management of severe acute respiratory infection when novel Coronavirus (2019-nCoV) infection is suspected: Interim guidance. Available from: URL: https://apps.who.int/iris/handle/10665/330893 Accessed Nov 12, 2020.
8. Tang Y, Wu Y, Zhu F, Yang X, Huang C, Hou G, et al. Tracheostomy in 80 COVID-19 patients: A Multicenter, retrospective, observational study. Front Med (Lausanne) 2020; 7: 615845. [CrossRef]
9. Queen Elizabeth Hospital Birmingham COVID-19 airway team. Safety and 30-day outcomes of tracheostomy for COVID-19: a prospective observational cohort study. Br J Anaesth 2020; 125(6): 872–9. [CrossRef]
10. Rumbak MJ, Newton M, Truncale T, Schwartz SW, Adams JW, Hazard PB. A prospective, randomized, study comparing early percutaneous dilational tracheotomy to prolonged translaryngeal intubation (delayed tracheotomy) in critically ill medical patients. Care Med 2004; 32(8): 1689–94. [CrossRef]
11. Griffiths J, Barber VS, Morgan L, Young JD. Systematic review and meta-analysis of studies of the timing of tracheostomy in adult patients undergoing artificial ventilation. BMJ 2005; 330(7502): 1243. [CrossRef]
12. Young D, Harrison DA, Cuthbertson BH, Rowan K; TracMan Collaborators. Effect of early vs late tracheostomy placement on survival in patients receiving mechanical ventilation: the TracMan randomized trial. JAMA 2013; 309(20): 2121–9. [CrossRef]
13. McGrath BA, Ashby N, Birchall M, Dean P, Doherty C, Ferguson K, et al. Multidisciplinary guidance for safe tracheostomy care during the COVID-19 pandemic: the NHS National Patient Safety Improvement Programme (NatPatSIP). Anaesthesia 2020; 75(12): 1659–70. [CrossRef]
14. McGrath BA, Brenner MJ, Warrillow SJ, Pandian V, Arora A, Cameron TS, et al. Tracheostomy in the COVID-19 era: global and multidisciplinary guidance. Lancet Respir Med 2020; 8(7): 717–25. [CrossRef]
15. Miles BA, Schiff B, Ganly I, Ow T, Cohen E, Genden E, et al. Tracheostomy during SARS-CoV-2 pandemic: Recommendations from the New York Head and Neck Society. Head Neck 2020; 42(6): 1282–90. [CrossRef]