# Outcome of tracheostomy among COVID-19 patients in a tertiary hospital setting: Our experience

**Abdul Razak Mohamed Ismail, MS ORL-HNS, Hari K S Krishnan, MD, Azlul Syakirah Uyainah Zaghlol, MBBS, Mohamad Saiful Azreen, MBBCh, Shahrul Hitam, MS ORL-HNS**

Department of Otorhinolaryngology, Hospital Ampang, Selangor, Malaysia

## ABSTRACT

**Introduction: The COVID-19 pandemic is unprecedented. Amongst those who contracted COVID-19, a number required intubation and prolonged ventilation. This increased the number of ventilated patients in the hospital and increased the requirement for tracheostomy of severe COVID-19 patients. Our objective is to study the outcome of patients with COVID-19 who underwent tracheostomy.**

**Materials and Methods: This study is a novel retrospective study in a tertiary centre in Malaysia. Case notes of COVID-19 patients who underwent tracheostomy in Hospital Ampang were collected using the electronic Hospital Information System. Data were analysed using the SPSS system.**

**Results: From a total of 30 patients, 15 patients survived. All patients underwent either open or percutaneous tracheostomy. The median age is 53 (range: 28–69) with a significant p-value of 0.02. Amongst comorbidities, it was noted that diabetes mellitus was significant with a p-value of 0.014. The median time from the onset of COVID-19 to tracheostomy is 30 days. The median duration of intensive care unit (ICU) stay is 30.5 days, with the median duration of hospital length of stay of 44 days (p = 0.009 and <0.001, respectively). No complications that contributed to patient death were found. Survivors had a median of 29.5 days from tracheostomy to oxygen liberation.**

**Conclusion: Tracheostomy in COVID-19 patients that requires prolonged ventilation is unavoidable. It is a safe procedure and mortality is not related to the procedure. Mortality is primarily associated with COVID-19.**

**KEYWORDS:**
*COVID-19; tracheostomy; survivors; non-survivors; prognosis*

## INTRODUCTION

The COVID-19 pandemic caused by SARS-CoV-2 has affected more than 500 million and caused the death of more than 6 million people.[1] As of September 2022, the number of cases in Malaysia had reached 4.8 million with 36,270 deaths.[2] As its name suggests the SARS-CoV-2 is known to affect the lungs, often including acute respiratory distress syndrome (ARDS), which is its primary morbidity.[3] Due to its transmissibility and sheer number of infected patients, COVID-19 placed a major burden on healthcare facilities, with 5–12% of cases requiring critical care and prolonged mechanical ventilation. Tracheostomy is traditionally performed to improve the chance of successful ventilation weaning and lower the risk of complications and mortality when compared to long-term endotracheal intubation.[4] Because tracheostomy is an aerosol-generating procedure, specific guidelines were denoted by the Ministry of Health Malaysia in select cases for proper donning of personal protective equipment and intraoperative procedures to reduce the risk of transmission to healthcare workers during the procedure.[5,6] Hospital Ampang was converted into a hospital devoted exclusively to the treatment of COVID-19 patients from January 2021 to February 2022. In this article, we would like to set forth our experience performing tracheostomies in a single hospital dedicated to COVID-19 and review tracheostomy outcomes in this population.

## MATERIALS AND METHODS

This retrospective observational study evaluated adult COVID-19-positive patients who underwent tracheostomy between January 2021 and February 2022 (13-month period) in a single tertiary care hospital setting (Hospital Ampang). Patients were included if they had a positive polymerase chain reaction or antigen rapid test kit, whose primary diagnosis is COVID-19, and underwent either open tracheostomy or percutaneous tracheostomy from otorhinolaryngology or intensive care teams in the ICU or operating theatre setting. The indications for tracheostomy were prolonged ventilation and failure to wean off ventilation. Universal sampling was used. A total of 30 patients were included.

*Data Collection*

The electronic Hospital Information System was used to identify patients and review patient's notes. Patients who underwent tracheostomies were identified via their operative notes and intensive care unit (ICU) notes. Notes were reviewed by researchers for demographical data, comorbidities, vaccination status, hospital length of stay, ICU length of stay, days from intubation to tracheostomy, days from COVID-19 diagnosis to tracheostomy, days from tracheostomy to decannulation, days from tracheostomy to death and tracheostomy complications.

*Data Analysis*

Data were expressed as count (percentage, %) and median (interquartile range, IQR). Chi-squared test was used for categorical variables and Mann–Whitney U test/Wilcoxon rank-sum test for continuous variables. Survivability graphs

*This article was accepted: 28 November 2022*
*Corresponding Author: Hari K S Krishnan*
*Email: harikrish300@gmail.com.*

**Table I: Summary statistics including patient demographics, comorbidities, vaccination, CT values and tracheostomy types (n=?)**

| | Total (n=30) (%) | | Survivors (n=15) (%) | | Non-survivors (n=15) (%) | | *p* value |
|---|---|---|---|---|---|---|---|
| Age, years | 53.5 | (28.0–69.0) | 36.0 | (28.0–69.0) | 60.0 | (35.0–69.0) | 0.002 |
| BMI, overall | 28.7 | (21.8–50.5) | 28.4 | (21.8–45.0) | 29.0 | (23.3–50.5) | 0.836 |
| BMI, Subgroups | | | | | | | 0.361 |
| Normal weight (BMI < 25.0) | 6 | 20.0 | 4 | 26.7 | 2 | 13.3 | |
| Overweight/obese (BMI > 25.1) | 24 | 80.0 | 11 | 73.3 | 13 | 86.7 | |
| Race | | | | | | | 0.440 |
| Malay | 20 | 66.7 | 9 | 60.0 | 11 | 73.3 | |
| Chinese | 8 | 26.7 | 5 | 33.3 | 3 | 20.0 | |
| Indian | 1 | 3.3 | - | - | 1 | 6.7 | |
| Others | 1 | 3.3 | 1 | 6.7 | - | - | |
| Sex | | | | | | 1.0 | |
| Male | 20 | 66.7 | 10 | 66.7 | 10 | 66.7 | |
| Female | 10 | 33.3 | 5 | 33.3 | 5 | 33.3 | |
| Tracheostomy Type | | | | | | | 0.456 |
| Open Tracheostomy | 18 | 60.0 | 8 | 53.3 | 10 | 66.7 | |
| Percutaneous Tracheostomy | 12 | 40.0 | 7 | 46.7 | 5 | 33.3 | |
| Vaccination | | | | | | | 0.068 |
| Vaccinated | 3 | 10.0 | 3 | 20.0 | - | - | |
| Unvaccinated | 27 | 90.0 | 12 | 80.0 | 15 | 100 | |
| CT Value, overall | 23.6 | (8.0–38.0) | 23.7 | (15.0–36.0) | 23.51 | (8.0–38.0) | 0.457 |
| Smoking | | | | | | | 1.0 |
| Smokers | 4 | 13.3 | 2 | 13.3 | 2 | 13.3 | |
| Non-smokers | 26 | 86.7 | 13 | 86.7 | 13 | 86.7 | |
| Comorbidities (Total) | | | | | | | |
| n = 0 | 7 | 23.3 | 4 | 26.7 | 3 | 20.0 | |
| n = 1 | 8 | 26.7 | 5 | 33.3 | 3 | 20.0 | |
| n = 2 | 8 | 26.7 | 4 | 26.7 | 4 | 26.7 | |
| n = 3 | 4 | 13.3 | 2 | 13.3 | 2 | 13.3 | |
| n = 4 | 3 | 10.0 | - | - | 3 | 20.0 | |
| Hypertension | | | | | | | 0.256 |
| No | 19 | 63.3 | 11 | 73.3 | 8 | 53.3 | |
| Yes | 11 | 36.7 | 4 | 26.7 | 7 | 46.7 | |
| Diabetes mellitus | | | | | | | 0.014 |
| No | 25 | 83.3 | 15 | 100% | 10 | 66.7 | |
| Yes | 5 | 16.7 | - | - | 5 | 33.3 | |
| Cardiovascular illnesses | | | | | | | 0.068 |
| No | 27 | 90.0 | 15 | 100 | 12 | 80.0 | |
| Yes | 3 | 10.0 | - | - | 3 | 20.0 | |
| Respiratory illnesses | | | | | | | 0.143 |
| No | 28 | 93.3 | 15 | 100 | 13 | 86.7 | |
| Yes | 2 | 6.7 | - | - | 2 | 13.3 | |
| Other comorbidities | | | | | | | |
| No | 21 | 70.0 | 10 | 66.7 | 11 | 73.3 | |
| Yes | 9 | 30.0 | 5 | 33.3 | 4 | 26.7 | |

CT - cycle threshold
BMI - Body mass index

**Table II: Tracheostomy complications by mortality status**

| | Overall | | Survivors | | Non-survivors | |
|---|---|---|---|---|---|---|
| | n | (%) | n | (%) | n | (%) |
| Complications | | | | | | |
| Major | - | - | - | - | - | - |
| Minor | 3 | 11.1 | 1 | 6.7 | 2 | 13.3 |
| None | 27 | 88.9 | 14 | 93.3 | 13 | 86.7 |
| Minor Complications | | | | | | |
| Tracheostomy bleed | 2 | 6.7 | - | - | 2 | 13.3 |
| Tracheostomy tube blockage | 1 | 3.3 | 1 | 6.7 | - | - |
| None | 27 | 90.0 | 14 | 93.3 | 13 | 86.7 |

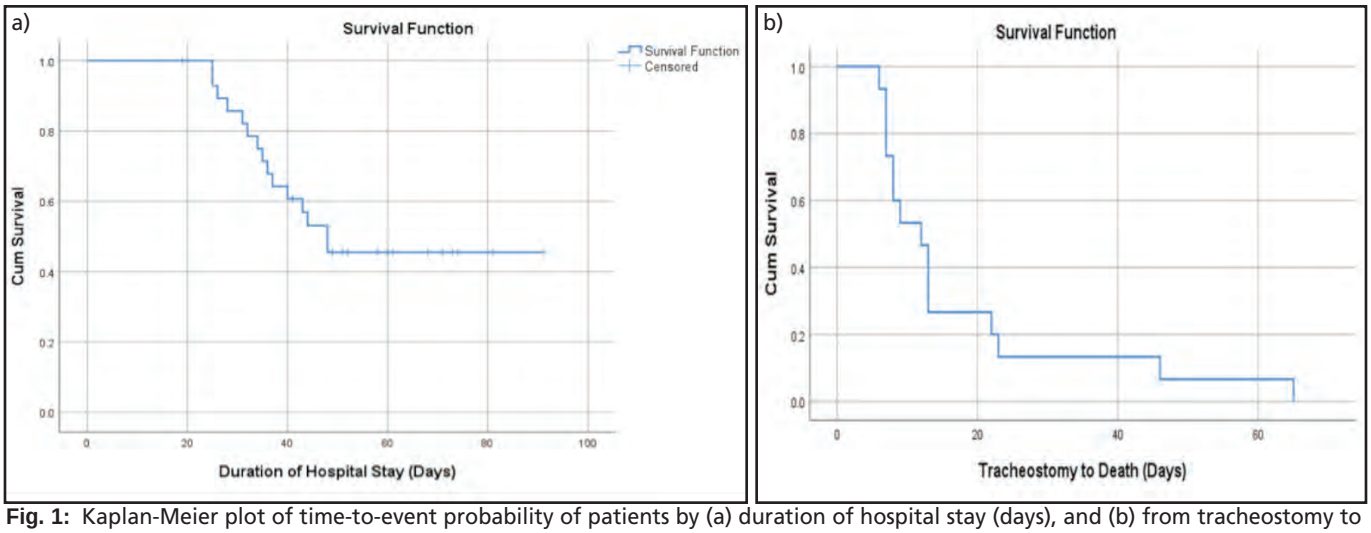


**Fig. 1:** Kaplan-Meier plot of time-to-event probability of patients by (a) duration of hospital stay (days), and (b) from tracheostomy to death (days)

were plotted using Kaplan–Meier method for duration of hospital stay and tracheostomy to death. Statistical analysis was performed using the SPSS version 26. A significant *p* value was taken at alpha < 0.05.

## RESULTS

There were 30 patients who were COVID-19 positive, requiring mechanical ventilation, and underwent open or percutaneous tracheostomy between January 2021 and February 2022 in Hospital Ampang. The indications for tracheostomy were prolonged ventilation and failure to wean off ventilation. The median age was 53.5 (IQR 34.8–61.8) ($p$=0.002). Most patients were of the Malay race (66.7%) and male. Only three patients were fully vaccinated, and all non-surviving patients were unvaccinated. Of the comorbidities, diabetes mellitus had significance ($p$=0.014). All surviving patients had no underlying diabetes mellitus, cardiovascular disease, or prior respiratory disease. There was no significance ($p$=0.456) between percutaneous tracheostomy performed by the critical care team, and open tracheostomy performed by the otorhinolaryngology team in relation to death (Table I). The percutaneous tracheostomies were performed by a senior anaesthetist bedside in the ICU without scope guidance. Patients who had a higher BMI, hence thicker necks, or patients in deemed the critical care team as difficult for a percutaneous tracheostomy, were referred to the otorhinolaryngology team for an open tracheostomy. The median days from COVID-19 illness to tracheostomy was 30.0 (IQR 25.0–34.0), which is equal for survivors and non-survivors. The median ICU stay of 30.5 days (IQR 25.5–43.0) ($p$=0.009) and the median hospital stay duration of 44.0 days (IQR 33.0–60.5) ($p$=0.000) was significantly higher for patients who survived compared to non-survivors. Kaplan–Meier curves summarise the time-to-event data among COVID-19 patients, including probabilities of hospital length of stay and days from tracheostomy to death (Figures 1 A and 1B). There were only minor complications (n=3, 11.1%) of tracheostomy bleed (n=2) and tracheostomy tube blockage (n=1). No major complications such as haemorrhage, pneumothorax, tracheitis and/or tracheobronchitis, tracheal stenosis, or trachea-oesophageal fistula were noted (Table II). It is worth mentioning that no surgeons, anaesthetists or operating staff involved in the tracheostomy procedures developed COVID-19 symptoms.

## DISCUSSION

This study shows our experience of open and percutaneous tracheostomies for patients who had COVID-19 that required prolonged ventilation and failed to wean off ventilation during the COVID-19 pandemic in a tertiary hospital dedicated solely to COVID-19 patients at the time. This is a novel study in Malaysia to the best of our knowledge. Mortality of COVID-19 patients who underwent tracheostomy in Spain was 20%,[7] in the United states 6–33%[8,9] and in Dubai 23.7%/.[10] Our study shows a mortality rate of 50%. The majority of non-survivors were non-vaccinated, had higher BMIs, comorbidities and higher risk of complications.[11–13] Our study also showed that age ($p$=0.002) and diabetes mellitus ($p$=0.014) were significant factors relating to the death of tracheostomised COVID-19 patients. All five patients in our study who had diabetes mellitus were non-survivors, as diabetes mellitus has been shown to be a factor for poorer prognosis.[14] In keeping with our data, it would be preferable to select patients for tracheostomy who are vaccinated, have a lower BMI, younger and without diabetes mellitus, as these patients had been shown to have a better outcome. Our patients underwent tracheostomy between 17 and 25 days from intubation. Due to this, we are unable to advise if performing a tracheostomy earlier or later is preferable. Similarly to Rovira et al. and Botti et al., our study does not show significance ($p$=0.456) between open and percutaneous tracheostomies in relation to death.[15,16] Selection of patients for percutaneous and open tracheostomy should be done on a case-by-case basis. We would recommend performing open tracheostomies in patients who have thicker necks, neck mass or risk of bleeding. When performing percutaneous tracheostomy, it should be performed by a senior anaesthesiologist and preferably scope guided. In our study, the duration of ICU stay and the duration of hospital stay is

double for that of survivors than non-survivors. With a median ICU stay of 20 days post-tracheostomy for survivors, it is likely tracheostomy did not assist in weaning the patient off the ventilator. However, this could possibly be due to several factors, including a difference in ventilator weaning thresholds by the critical care team, significant lung fibrosis, secondary bacterial infections and exacerbations of comorbidities that affected patient ventilation. The decreased length of stay for non-survivors is likely due to the overall poor prognosis of the patient. A study by Ahmed et al. found 9% of patients had minor complications and 9% of patients had major complications.[9] Another study by Tang et al. showed peristomal bleeding and tracheal bleeding were more common in COVID-19 patients at 13%.[17] Our study had only three minor complications and no major complications. For survivors, it took a median of 29.5 days to reach oxygen liberation from tracheostomy. It is recommended to have a multidisciplinary team approach when selecting a patient for tracheostomy to better evaluate the prognosis of the patient prior to performing a tracheostomy, which is an aerosolised procedure that may increase the risk of COVID-19 infection to health staff.

## LIMITATIONS

This is a retrospective study with a small sample size and may not show some significant statistical values. Our study is performed in a single centre. The duration is only 13 months.

## CONCLUSION

Tracheostomy in COVID-19-positive patients is essential for those dependent on a ventilator for an extended period. The tracheostomy procedure itself is safe to perform. However, the outcome of post-tracheostomised patients varies depending on multiple factors such as comorbidities, obesity, age and prognosis of COVID-19. A collaborative and cohesive multidisciplinary team approach is recommended. We propose tracheostomy (percutaneous or open) in select patients who are younger, vaccinated, with lower BMI and fewer comorbidities.

## REFERENCES


1. WHO Coronavirus (COVID-19) Dashboard. https://covid19.who.int
2. COVIDNOW in Malaysia. COVIDNOW. https://covidnow.moh.gov.my/
3. Machhi J, Herskovitz J, Senan AM, Dutta D, Nath B, Oleynikov MD, et al. The natural history, pathobiology, and clinical manifestations of SARS-CoV-2 infections. J Neuroimmune Pharmacol 2020; 15(3): 359-86.
4. Piazza C, Filauro M, Dikkers FG, Nouraei SAR, Sandu K, Sittel C, et al. Long-term intubation and high rate of tracheostomy in COVID-19 patients might determine an unprecedented increase of airway stenoses: A call to action from the European Laryngological Society. Eur Arch Otorhinolaryngol 2021; 278(1): 1-7.
5. Rohaizam J, Tham YS, Zakinah Y, Mohd Razif MY, Marina MB. Tracheostomy during the COVID-19 pandemic in Malaysia: A revised guideline. Med J Malaysia 2021; 76(Suppl 4): 23-6.
6. American Academy of Otolaryngology—Head and Neck Surgery (AAO-HNS). Tracheotomy Recommendations During the COVID-19 Pandemic [cited May 2022]. Accessed from: https://www.entnet.org/resource/tracheotomy-recommendations-during-the-covid-19-pandemic-2/
7. Martin-Villares C, Perez Molina-Ramirez C, Bartolome-Benito M, Bernal-Sprekelsen M, COVID ORL ESP Collaborative Group (*), Perez-Fernandez A, et al. Outcome of 1890 tracheostomies for critical COVID-19 patients: A national cohort study in Spain. Eur Arch Otorhinolaryngol 2021; 278(5): 1605-12.
8. Chao TN, Harbison SP, Braslow BM, Hutchinson CT, Rajasekaran K, Go BC, et al. Outcomes after tracheostomy in COVID-19 patients. Ann Surg 2020; 272(3): e181-86.
9. Ahmed Y, Cao A, Thal A, Shah S, Kinkhabwala C, Liao D, et al. Tracheotomy outcomes in 64 ventilated COVID -19 patients at a high-volume center in Bronx, NY. The Laryngoscope 2021; 131 (6).
10. Nadeem R, Zahra AN, Hassan M, Parvez Y, Gundawar N, Hussein MAM, et al. Prevalence and timing of tracheostomy and its impact on clinical outcomes in COVID-19 pneumonia patients in Dubai hospital. Dubai Med J 2021; 4(2): 151-55.
11. Ismail SN, Abdul Halim Zaki I, Noordin ZM, Md Hussin NS, Ming LC, Zulkifly HH. Clinical characteristics and risk factors for mortality in patients with COVID-19: A retrospective nationwide study in Malaysia. Proc Singap Healthcare 2022: 20101058221085744.
12. Assal HH, Abdel-hamid HM, Magdy S, Salah M, Ali A, Elkaffas RH, et al. Predictors of severity and mortality in COVID-19 patients. Egypt J Bronchol 2022; 16(1): 18.
13. Dessie ZG, Zewotir T. Mortality-related risk factors of COVID-19: A systematic review and meta-analysis of 42 studies and 423,117 patients. BMC Infect Dis 2021; 21(1): 855.
14. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. JAMA 2020; 323(20): 2052-59.
15. Rovira A, Tricklebank S, Surda P, Whebell S, Zhang J, Takhar A, et al. Open versus percutaneous tracheostomy in COVID-19: A multicentre comparison and recommendation for future resource utilisation. Eur Arch Otorhinolaryngol 2021; 278(6): 2107-14.
16. Botti C, Lusetti F, Neri T, Peroni S, Castellucci A, Salsi P, et al. Comparison of percutaneous dilatational tracheotomy versus open surgical technique in severe COVID-19: complication rates, relative risks and benefits. Auris Nasus Larynx 2021; 48(3): 511-17.
17. Tang L, Kim C, Paik C, West J, Hasday S, Su P, et al. Tracheostomy outcomes in COVID-19 patients in a low resource setting. Ann Otol Rhinol Laryngol 2021: 00034894211062542.