Percutaneous tracheostomy in patients with COVID-19 infection and acute respiratory failure

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ABSTRACT

Background: *Tracheostomy is often performed in patients who need prolonged intubation. COVID-19 brought unforeseen challenges, thus altering previously established norms. In this study, the outcomes of the patients undergoing tracheostomy for respiratory failure due to COVID-19 were studied.*

Methods: *This is a single center retrospective observational cohort study of patients who underwent percutaneous tracheostomies between March 1, 2020, and September 30, 2021, due to respiratory failure secondary to COVID-19. Inclusion criteria included performance of percutaneous tracheostomies on patients with confirmed diagnosis of COVID-19. Exclusion criteria included patients undergoing surgical tracheostomies, extubation prior to the performance of a tracheotomy, and death prior to the performance of the tracheotomy.*

Results: *The study included 49 patients after reviewing the records of 101 patients who underwent tracheostomies during the study period. The average age of the population was 59 $\pm$ 11 years; 33 patients (67%) were men. The median Sequential Organ Failure Assessment (SOFA) score on admission was 2. The median duration of mechanical ventilation prior to tracheostomy was 18 days; the median positive end expiratory pressure was 10 cm H_2O and the median fraction of inspired oxygen (FiO_2) was 0.45. Two patients died during the procedure, one secondary to cardiac arrest and one secondary to bleeding. Eighteen patients (38%) died after the procedure during hospitalization; the median length of mechanical ventilation for all patients was 32.5 days. Eleven patients (22%) were eventually decannulated. Twenty patients (40%) were discharged to rehabilitation, and nine patients (18%) were discharged home. Eighteen patients (36%) were alive at the end of 90 days. Twelve patients (26%) were lost to follow up after discharge from the hospital. At the time of the tracheostomy, 16 patients (32%) had moderate ARDS as per the Berlin definition, and 12 (24%) had severe ARDS.*

Conclusion: *Tracheostomy is an important therapeutic intervention in critically ill patients requiring mechanical ventilation. The COVID-19 pandemic raised important concerns and uncertainties about the management of these patients and the safety of healthcare workers. In this study, 29 patients (59%) undergoing tracheostomies recovered enough to be discharged to rehabilitation or to their homes. The risks to patients and to healthcare workers seem reasonable, but the optimal timing is uncertain and is best tailored to each patient based on his/her clinical status and prognosis.*

Keywords: COVID-19, tracheostomy, mechanical ventilation, acute respiratory failure

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Introduction

The COVID-19 pandemic affected millions around the world. As of May 5, 2023, the State of Texas recorded approximately 6.6 million people with confirmed infection and approximately 90,000 fatalities.[1] Studies show that approximately 10%–15% of the patients develop respiratory failure requiring invasive mechanical ventilation[2–4] and may require prolonged mechanical ventilation.[5] Tracheostomy has been used in these patients to reduce the dead space, decrease the need for sedation, provide better pulmonary hygiene, and possibly decrease the ICU length of stay. However, this procedure generates aerosols and could increase the risk of transmission of infection to the health care workers (HCW). In addition, considering the overall poor prognosis of the patients recorded in the early studies, this might be a futile procedure.[6,7] However, later studies showed that it was relatively safe and effective for the patients and safe for the HCW when adequate personal protective equipment was used.[8,9]

The study hospital is located in Northwest Texas and provides health care to regional communities in Texas, Eastern New Mexico, and Southern Oklahoma. At the beginning of the pandemic, there were no clear guidelines on optimal management strategies, and individualized treatment protocols were based on our resources. This study reviews the outcomes of patients who underwent percutaneous tracheostomies during the period of March 2020 to September 2021.

Methods

Study design and patient selection

A single institution, retrospective, observational cohort study was conducted on the patients who were mechanically ventilated secondary to COVID-19 pneumonia between March 2020 and September 2021. All the patients had a confirmed diagnosis of COVID-19 pneumonia. The Berlin definition of acute respiratory distress syndrome (ARDS) was used to classify the severity of the patients' respiratory failure. Only patients who underwent tracheostomies were included in the study, and patients who underwent surgical tracheostomies were excluded. The procedures were performed by the trainee pulmonary and critical care medicine subspecialty physicians under supervision of a pulmonary and critical care medicine physician certified in performing percutaneous tracheostomy. They were performed at the bedside in negative pressure rooms. Universal sterile precautions were followed, and the operators wore personal protective equipment. This study (L2-043) was approved by the Institutional Review Board at Texas Tech University Health Sciences Center, Lubbock, Texas.

Data collection

The electronic medical records were reviewed to collect demographic and clinical data on the patients who underwent percutaneous tracheostomies during the study period. This included age, sex, race, SOFA score, days on the ventilator prior to tracheostomy, complications during and after tracheostomy, total number of days on mechanical ventilator, and the final status of the patient 30 days and 90 days after tracheostomy, including decannulation, discharge, or death.

Data analysis

Data are presented as count (percentage, %), medians plus interquartile ranges, and means plus standard deviations.

Results

One hundred and one patients underwent tracheostomies during this study period between March 2020 to September 2021. Patients who underwent surgical tracheostomies were excluded, and 49 patients were identified who had percutaneous tracheostomies in the medical intensive care unit. The study included 33 men (67%) and 16 women (33%). The ethnic distribution included 25 Hispanic patients (51%), 14 white patients (28%), and 10 patients (20%) with no information in the medical records. The mean age of the study group was 59 ± 11 years; the median body mass index (BMI) was 33.7 kg/m^2 (Q1-29.6, Q3-39.2). The median duration on the ventilator prior to tracheostomy

was 18 days (Q1-15, Q3-25) (range 8–36 days). Ten patients (20%) underwent tracheostomies within 14 days after intubation. The median positive end expiratory pressure during mechanical ventilation was 10 cm of water (Q1-8, Q3-15), and the median fraction of inspired oxygen (FiO_2) was 0.45 (Q1-0.40, Q3-0.6) before tracheostomy. The median duration of total mechanical ventilation for all patients in the study was 32.5 days (Q1-32, Q3-46.5). Three patients (6%) had mild ARDS, 23 patients (46%) had moderate ARDS, and 23 patients (46%) had severe ARDS at the time of tracheostomy. The most common complication was easily controlled bleeding. Two patients died during tracheostomy due to procedure related complications.

Nineteen patients (40%) were discharged to rehabilitation centers, and nine patients (18%) were discharged home. Ten patients (20%) were weaned off the ventilator while in the hospital. Eleven patients (22%) were eventually decannulated. The mean duration of mechanical ventilation prior to decannulation was 37 days.

Seventeen patients (36%) were alive 30 days after the procedure. Twelve (26%) were lost to follow up. Nine patients (20%) were alive 90 days after tracheostomy. Seventeen patients (36%) died during the study. The figure provides a summary of the outcomes in these patients based on the Berlin ARDS classification.

Discussion

The study reports outcomes in patients in a West Texas hospital during the peak pandemic. Over 90% of our patients had PaO_2/FiO_2 ratios <200 mm Hg. The average patient in this study with COVID-19 pneumonia in our hospital was obese with a BMI of 34 kg/m^2, which made prone positioning more difficult. Chest radiographs showed extensive parenchymal opacities and often with a pneumothorax and/or pneumomediastinum. It was often hard to sedate and paralyze patients due to their high respiratory drives and intense inflammatory responses.[10] This further contributed to prolonged mechanical ventilation.

At the start of the pandemic, resources were limited, and careful selection of patients for tracheostomy was based on the severity, overall prognosis, and associated risks. This was in concordance with consensus working group recommendations.[11] All the procedures were performed at the bedside while the mean PEEP ≤ 12 cm of H_2O and FiO_2 ≤ 0.45. Over 95% of the procedures were performed by pulmonary and critical care medicine fellows under the direct supervision of a pulmonary and critical care medicine attending physician who is certified in percutaneous tracheostomy. The optimal timing of tracheostomy remains controversial.[12] In this study, patients were

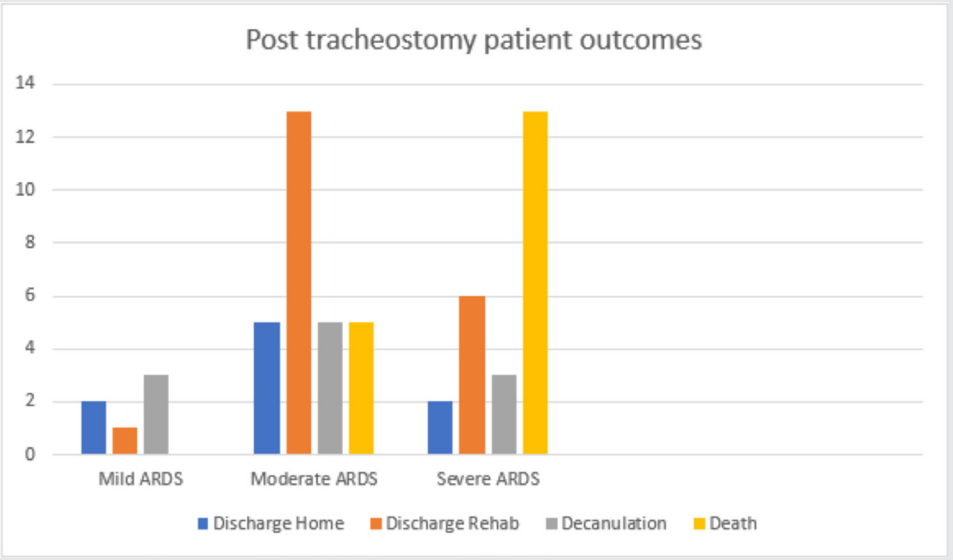

Figure. Outcomes of patients who underwent percutaneous tracheostomy classified by ARDS category.

intubated for an average of 20 days prior to getting a tracheostomy. The patients undergoing tracheostomies had reasonable gas exchanges based on FiO_2 and PEEP levels and did not require prone positioning at the time.

A study by Carmichael et al. performed during March to June in 2020 included 26 patients, and the procedure was performed about 25 days after intubation.[13] Early (within 10 days of intubation) tracheostomy has the advantages of reduced need for sedation, thus reduced muscle wasting, improved pulmonary hygiene, and possibly quicker liberation from the ventilator and earlier rehabilitation.[12] In a retrospective study of 148 patients, Kwak et al. reported in December 2020 that early tracheostomy was noninferior to late tracheostomy and maybe associated with improved outcomes.[14] However, Yun Tang et al. published a study with 80 patients that showed a higher 60-day mortality in patients who had tracheostomies within 14 days of intubation.[15] Flinspach et al. published a study in September 2022 that included 117 patients from March 2020 to June 2021 and reported that early tracheostomy was associated with significant increase in mortality.[16] They also noted that the timing of tracheostomy became earlier as the pandemic progressed and more studies[12] confirmed the risk of viral transmission to HCW was less than previously thought and as resources became more easily available. A smaller study involving 47 patients by Battaglini et al. in August 2022 reported that timing did not really affect patient outcomes.[17] Mahmood's study included 118 patients and found that outcomes were improved with percutaneous tracheostomy compared to surgical tracheostomy if it was performed within 14 days.[18]

In this study, patients who showed potential for recovery and were on a PEEP less than 14 cm of H_2O and FiO_2 < 0. 50 underwent tracheostomies. This reduced the risk associated with the procedure. The most common complication was bleeding, which was easily controlled by application of local pressure in most cases. Patients who needed anticoagulation were placed on heparin drip, which was discontinued a few hours prior to the procedure. One patient had a cardiac arrest during the procedure and could not be resuscitated. This patient had severe ARDS with PaO_2/FiO_2 ratio <0.6 mmHg. Another patient with a PaO_2/FiO_2 ratio of 0.8 mmHg had significant bleeding during the procedure and could not be controlled. More information is needed to decide the optimal timing for performing tracheostomy. Our outcomes are comparable to the studies reported during the same period.[13–15,17–19]

Conclusions

It is now well established that performing tracheostomy in COVID-19 patients with complete PPE poses minimum risk of transmission to HCW. Therefore, tracheostomy should be considered in these patients after careful review of the clinical status and prognosis. The best timing is unclear and should be based on patient characteristics and overall prognosis.

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