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Tracheostomy in Mechanically Ventilated Patients with COVID-19: A Retrospective Case Series

Mekanik Ventilatördeki COVID-19 Hastalarında Trakeostomi: Retrospektif Bir Vaka Serisi

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Abstract

Aim: The Coronavirus Disease 2019 (COVID-19) pandemic has caused a substantial rise in the number of critically ill patients requiring prolonged mechanical ventilation. This increase has been resulting in extended durations of intubation, respiratory failure, and prolonged ventilatory support. The objective of this study is to present our experience with tracheostomy in patients intubated for COVID-19 pneumonia in the intensive care unit during the pandemic.

Material and Method: A retrospective observational analysis was conducted on a case series of critically ill COVID-19 patients requiring prolonged mechanical ventilation. Patient demographics (age, sex), comorbidities, and timing of tracheostomy were recorded. Early and late complications related to ultrasound-guided tracheostomy were also documented.

Results: Tracheostomy was performed at a mean interval of 14 days following intubation. The mean age of the patients was 71 years, most of whom presented with underlying comorbidities, including hypertension, diabetes mellitus, and obesity. No early or late complications were observed following the procedure.

Conclusion: We recommend performing tracheostomy during the second week of intubation, provided that appropriate precautions are taken. Ultrasound-guided tracheostomy appears to be a safe bedside procedure. Further randomized controlled trials are needed to support these findings.

Keywords: COVID-19, percutaneous tracheostomy

Öz

Amaç: Coronavirus hastalığı 2019 (COVID-19), uzun süreli mekanik ventilasyon gerektiren kritik hastalarda dramatik bir artışa yol açmıştır. Bu hastaların çoğu, uzun süreli entübasyon süreleri, solunum yetmezliği ve uzatılmış ventilatör desteği gereksinimi nedeniyle trakeostomiye ihtiyaç duymaktadır.

Gereç ve Yöntem: Uzun süreli mekanik ventilasyona ihtiyaç duyan kritik COVID-19 hastalarının yer aldığı retrospektif bir analiz gerçekleştirildi. Birincil amacımız COVID-19 hastalarında trakeostomi yapma deneyimimizi sunmaktır. Ultrason rehberliğinde perkütan trakeostomi, tüm hastalarda yatak başında gerçekleştirildi.

Bulgular: Tüm perkütan trakeostomiler komplikasyon olmaksızın başarıyla gerçekleştirildi. Trakeostomi işlemi, entübasyondan ortalama 14 gün sonra gerçekleştirildi. Hastaların ortalama yaşı 71 olup, çoğunda hipertansiyon, diyabet mellitus ve obezite gibi altta yatan komorbiditeler mevcuttu.

Sonuç: Uygun önlemler alındığı takdirde, entübasyonun ikinci haftasında trakeostomi yapılmasını öneririz. Ultrason kılavuzluğunda trakeostomi, yatak başında güvenli bir işlem olarak görünmektedir. Bu bulguları desteklemek için daha fazla randomize kontrollü çalışma yapılması gerekmektedir.

Anahtar Kelimeler: COVID-19, perkütan trakeostomi

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INTRODUCTION

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is an RNA-based coronavirus first identified in China in late 2019, which rapidly evolved into a global pandemic.[1]

The outbreak of COVID-19 pneumonia significantly increased the demand for intensive care unit (ICU) admissions and prolonged mechanical ventilation. As a result, tracheostomy became a necessary intervention in the management of these patients. However, since tracheostomy is an aerosol-generating procedure, it posed significant challenges in terms of infection control and increased the risk of transmission to healthcare workers.[2]

To minimize the risk of viral transmission, the Canadian Society of Otolaryngology – Head and Neck Surgery (CSO-HNS) recommends performing tracheostomy only after the patient tests negative for SARS-CoV-2 and is no longer subject to isolation precautions.[3] Tracheostomy is considered a standard intervention for patients requiring prolonged mechanical ventilation, with approximately 24% of intensive care unit (ICU) patients undergoing the procedure.[4,5] Accordingly, strict adherence to standard personal protective equipment (PPE) protocols—including N95 respirators, surgical caps, protective eyewear, fluid-resistant gowns, and gloves—is crucial during the procedure.[6]

To minimize exposure time in high-risk settings, the involvement of a skilled and well-coordinated team is crucial. A dedicated team, including a surgeon, anesthesiologist, and operating room nurse can optimize procedural efficiency by ensuring familiarity with workflow and reducing equipment-related delays. Post-procedural waste disposal and equipment decontamination must be systematically planned to minimize environmental contamination. Whenever possible, single-use instruments are recommended. Personnel tasked with decontamination must also be equipped with appropriate standard personal protective equipment (PPE).[5]

This case series aims to present our clinical experience with tracheostomy in patients diagnosed with COVID-19 pneumonia who underwent endotracheal intubation and were managed in our intensive care unit during the pandemic period.

MATERIAL AND METHOD

This study presents a case series of 17 patients who required mechanical ventilation due to COVID-19 and underwent ultrasound-guided percutaneous tracheostomy over a six-month period. Patients included in this study were admitted to a tertiary-level intensive care unit with a diagnosis of COVID-19 pneumonia. The study was conducted over a six-month period in 2020 and received ethical approval from the University of Health Sciences Gülhane Scientific Research Ethics Committee on November 30, 2020 (project and decision number 2020-447). This retrospective observational case series recorded patient demographics including age, sex, comorbidities and the timing of the tracheostomy procedure. Additionally, both early and late complications associated with the ultrasound-guided tracheostomy were systematically documented.

Traditionally, indications for tracheostomy have included the necessity for prolonged mechanical ventilation and the reduction of complications related to delayed weaning. Additionally, tracheostomy may be warranted in cases of failed extubation caused by factors such as upper airway obstruction, laryngeal edema, respiratory muscle weakness, ineffective cough, thick secretions, or a combination of these difficulties.[2] Tracheostomy was performed on a case-by-case basis, primarily guided by the intensivist's clinical assessment. Patients with high Sequential Organ Failure Assessment (SOFA) scores were generally excluded from tracheostomy consideration, as they were assessed to be too critically ill to derive benefit from additional invasive interventions.

Low molecular weight heparin (LMWH) was discontinued 12 hours prior to the procedure.

The procedural team consisted of an experienced anesthesiologist, an assistant, an intensive care physician responsible for ensuring complete neuromuscular blockade and airway management, as well as nursing and support staff. Comprehensive personal protective equipment (PPE), including eye protection, fluid-resistant disposable gowns, and gloves, were provided to all members. Strict aseptic protocols were followed during preparation. Sterile surgical gowns, caps, and masks were worn over the PPE, and double-layered sterile gloves were used to maintain a sterile field. To avoid confusion and ensure smooth coordination, specific responsibilities were assigned to each team member prior to the procedure. Additionally, oral and endotracheal suctioning was performed in advance to minimize aerosol generation. Patients were fully paralyzed using neuromuscular blockers to ensure immobility. The neck was carefully extended, and the surgical field was thoroughly disinfected with povidone-iodine. Local infiltration with 2% lidocaine combined with epinephrine was administered to control bleeding. Following surgical field preparation, percutaneous tracheostomy was performed at the bedside under ultrasound guidance.

Potential early complications associated with the procedure include hemorrhage, bronchospasm, hypoxia, failure to secure the airway, arrhythmias, malposition of the cannula, esophageal perforation, pneumothorax, pneumomediastinum, subcutaneous emphysema, and posterior tracheal wall injury. Late complications of tracheostomy may include granulation tissue formation, cannula obstruction, wound infection, aspiration, atelectasis, pneumonia, dysphagia, tracheoesophageal fistula, tracheoinnominate artery fistula, tracheomalacia, tracheal stenosis, stridor, and hoarseness. In this retrospective analysis, patient records were systematically reviewed for the occurrence of these potential complications.

Statistical analyses were performed using IBM SPSS Statistics version 25.0. Descriptive statistics included frequencies, percentages, means with standard deviations, medians,

ranges, and interquartile ranges. Variables with normal distribution were presented as means, while categorical variables were expressed as percentages.

RESULTS

Over a six-month period in 2020, a total of 17 tracheostomy procedures were performed on COVID-19 patients in this tertiary care intensive care unit. High-resolution chest computed tomography (CT) scans of all patients were consistent with COVID-19 viral pneumonia. However, only 11 patients tested positive for COVID-19 via polymerase chain reaction (PCR). Comorbidities were identified in 13 patients, with hypertension being the most frequently observed. Four patients had no known comorbid conditions. The majority of patients who underwent tracheostomy were male (**Table 1**). Tracheostomy was performed on average 14 days (14.8±7.6) after the initiation of mechanical ventilation. All procedures were conducted at the bedside under ultrasound guidance. In this retrospective study, both early and late tracheostomy-related complications were systematically documented. No early or late complications were observed following the procedure.

Table 1: Demographic Data

Characteristic	n=17	%
Sex		
Female	5	29.4
Male	12	70.6
Age (years)*	71.3±10.4	72.0 (54.0 – 90.0)
BMI (kg/m^2)*	26.6±3.3	27.0 (20.8 – 32.0)
Comorbidities		
No	4	23.5
Yes	13	76.5
Diabetes Mellitus		
No	14	82.4
Yes	3	17.6
Coronary Artery Disease		
No	12	70.6
Yes	5	29.4
Chronic Obstructive Pulmonary Disease		
No	14	82.4
Yes	3	17.6
Hypertension		
No	9	52.9
Yes	8	47.1
COVID-19 PCR		
Negative	6	35.3
Positive	11	64.7
ICU Length of Stay (days)	30.2±20.7	22.0 (6.0 – 86.0)
Day of Tracheostomy (Post-Intubation)	14.8±7.6	14.0 (3.0 – 31.0)
Mortality		
Deceased	14	82.4
Discharged	3	17.6

BMI: Body Mass Index; PCR: Polymerase Chain Reaction. ICU: Intensive Care Unit, Data are presented as mean±standard deviation or median (minimum–maximum), as appropriate.

DISCUSSION

The novel coronavirus (SARS-CoV-2), first identified in Wuhan, China, in December 2019, rapidly evolved into a global pandemic. At the peak of the pandemic, intensive care units worldwide were overwhelmed with patients experiencing respiratory failure requiring endotracheal intubation and mechanical ventilation. In patients requiring prolonged ventilatory support, tracheostomy was recognized as a critical intervention.[7]

The risk of complications, particularly injury to the posterior tracheal wall, remains a significant concern for surgeons. Although potentially serious, these complications are rare and not specific to the ultrasound-guided percutaneous tracheostomy (UGPT) technique. Studies have shown that UGPT is as safe as percutaneous tracheostomy performed under bronchoscopic guidance.[6,8]

At a time when contamination risks are of critical concern, UGPT appears to retain the advantages of the percutaneous approach without the risks associated with bronchoscopic airway manipulation.[9,10] The ability to perform ultrasound-guided percutaneous tracheostomy with a reduced number of healthcare personnel is particularly advantageous. Since electrocautery is not used, smoke evacuation systems are not required. UGPT can be safely performed at the bedside, thereby avoiding patient transfer to the operating room and minimizing contamination risks and potential complications. However, unfavorable anatomical factors, inability to achieve neck extension, or the presence of large vessels along the puncture trajectory may make UGPT unsuitable. Surgeons should select the technique with which they are most experienced.[9–12]

Tracheostomy maintains a vital role in managing weaning from prolonged mechanical ventilation during the COVID-19 pandemic. McGrath et al. recommended postponing tracheostomy until at least the 10th day of mechanical ventilation, advising intensive care and surgical teams to carefully assess the optimal setting for the procedure while balancing the safety of both patients and healthcare personnel. They also emphasized the importance of enhanced personal protective equipment (PPE), including powered air-purifying respirators (PAPRs), eye protection, and fluid-resistant disposable surgical gowns and gloves. As emphasized by McGrath et al., operators should use techniques and equipment with which they are most experienced. In this retrospective study, all recommended precautions were followed, and the tracheostomy procedures were performed under ultrasound guidance by the same experienced team.[2]

Several studies in the literature have reported that early tracheostomy is associated with shorter durations of mechanical ventilation, lower mortality rates, and reduced length of ICU stay.[4] Although early tracheostomy is generally recommended, in cases of COVID-19 pneumonia, it is typically performed between days 10 and 21, corresponding to the period when viral replication is believed to decline.[2] In our study, the average timing of tracheostomy was 14 days following intubation.

Percutaneous tracheostomy carries a high risk of aerosol generation due to airway manipulation.[13] However, in our study, bedside percutaneous tracheostomy under ultrasound guidance was performed by an experienced team during a period when viral replication was presumed to be reduced. This approach aimed to minimize the risk of contamination.

Both percutaneous and surgical tracheostomy techniques have been extensively studied, and no significant difference was observed in the rates of major complications.[14] Ultrasound-guided tracheostomy has been shown to be effective in preventing various complications and is associated with reduced aerosol exposure compared to bronchoscopic guidance. Integrating ultrasound into the percutaneous tracheostomy technique is a feasible strategy, providing the benefits of the percutaneous method without the logistical challenges and added costs typically associated with bronchoscopic guidance.[15] No complications were observed during or following the ultrasound-guided bedside tracheostomy procedures performed by our experienced intensive care team.

Tenorio et al. also emphasized that ultrasound-guided percutaneous tracheostomy is a safe and standardized technique for ICU patients with COVID-19 and reduces contamination risks for surgeons.[16]

In a retrospective observational study conducted by Veysel G and her team, the average time of tracheostomy opening in 78 intubated patients was stated as the 3rd week after intubation.[17] To minimize aerosolization risk, we recommend performing tracheostomy during the second week following intubation in COVID-19 patients.

The limitation of the study is that comparing tracheostomy procedures performed with different techniques may change the results. Prospective randomized controlled trials are needed .

CONCLUSION

We have reported our experience with ultrasound-guided percutaneous tracheostomy in patients with COVID-19. Based on this retrospective analysis, we conclude that ultrasound-guided tracheostomy is a safe and feasible bedside procedure. We recommend performing tracheostomy during the second week following intubation in COVID-19 patients. Prospective randomized controlled trials are needed to further evaluate tracheostomy-related complications and contribute to existing literature.

ETHICAL DECLARATIONS

Ethics Committee Approval: This study was conducted over a six-month period in 2020 and was approved by the University of Health Sciences Gülhane Scientific Research Ethics Committee on November 30, 2020, with project and decision number 2020-447.

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

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

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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