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Original Research Article

To Evaluate the Various Indications and the Outcomes of Tracheostomy in ICU: An Observational Study

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Abstract:

Background: Tracheostomy is a critical procedure in ICU settings for patients requiring prolonged mechanical ventilation. The timing and indications for tracheostomy significantly impact patient outcomes, yet there remains a need for comprehensive evaluation of these factors to optimize care. This study aims to evaluate the various indications and outcomes of tracheostomy in the ICU, focusing on patient demographics, clinical history, timing of the procedure, and associated complications.

Methods: An observational study was conducted over six months. The study included 47 patients who underwent tracheostomy in the ICU. Data were collected retrospectively from medical records, encompassing patient demographics, clinical history, indications for tracheostomy, timing, complications, and outcomes. Statistical analysis was performed to evaluate the relationships between these variables.

Results: The study found that respiratory failure (42.6%) and neurological impairment (31.9%) were the primary indications for tracheostomy. The average length of ICU stay post-tracheostomy was 20.4 days. The complication rate was 31.9%, with infections (14.9%) and bleeding (10.6%) being the most common. Early tracheostomy (within 10 days) was correlated with a lower complication rate (20.0%) compared to late tracheostomy (45.0%) ($p = 0.02$). The mortality rate among patients was 21.3%.

Conclusion: The study underscores the importance of timely tracheostomy in ICU patients, with early tracheostomy being associated with better outcomes and fewer complications. Respiratory failure and neurological impairment are significant indications for the procedure, affecting patient recovery and ICU stay duration.

Recommendations: To prevent problems and enhance results, patients who need prolonged mechanical breathing should consider early tracheostomy. These findings should be confirmed and clinical guidelines refined using bigger sample sizes.

Keywords: Tracheostomy, ICU, Respiratory Failure, Neurological Impairment, Mechanical Ventilation.

Introduction

Tracheostomy is a common surgical procedure performed in the Intensive Care Unit (ICU) to provide a secure airway for patients requiring prolonged mechanical ventilation. It involves creating an opening in the trachea through the neck to insert a tube, allowing for direct access to the airway. This procedure is indicated in various clinical scenarios, including respiratory failure, neurological impairment, trauma, and other conditions that necessitate extended intubation periods [1]. Over the years, tracheostomy has evolved from an emergency intervention to a well-planned procedure with significant implications for patient outcomes in critical care settings.

Recent studies highlight the importance of tracheostomy timing in ICU patients. Early tracheostomy, typically performed within 7-10 days of intubation, has been associated with several benefits, including reduced ventilator-associated pneumonia (VAP), shorter ICU stays, and improved patient comfort [2]. In contrast, delayed tracheostomy, performed after 10 days of intubation, has been linked to higher complication rates and longer ICU stays. This dichotomy underscores the need for clear guidelines on the optimal timing of tracheostomy to enhance patient outcomes.

The decision to perform a tracheostomy is influenced by various factors, including the patient's underlying condition, the anticipated duration of mechanical ventilation, and the risk of complications. Respiratory failure, often resulting from conditions like chronic obstructive pulmonary disease (COPD), acute respiratory distress syndrome (ARDS), and pneumonia, is a leading indication for tracheostomy in the ICU [3]. Neurological impairments, such as stroke, traumatic brain injury, and neuromuscular diseases, also commonly necessitate tracheostomy due to the compromised ability to maintain airway patency and effective ventilation [4].

Despite its benefits, tracheostomy is not without risks. Complications can vary from minor issues, such as bleeding and infection, to more severe problems like tracheal stenosis and pneumothorax [5]. The incidence of these complications can be influenced by factors such as the procedure timing, the technique used, and the patient's overall health status. Therefore, understanding the indications, timing, and outcomes of tracheostomy is crucial for optimizing patient care in the ICU.

This observational study aims to evaluate the various indications and outcomes of tracheostomy in the ICU.

Methodology

Study Design: An observational study designed.

Study Setting: The study took place at Narayan Medical College & Hospital, Jamuhar, Sasaram, Bihar, India, spanning 6 months (from November 2023 to April 2024).

Participants: A total of 47 individuals who underwent tracheostomy in the ICU were included in this study.

Inclusion Criteria

- All patients who underwent tracheostomy.

- Patients already intubated in the ICU assumed to require a prolonged intubation period.

- Patients with pre-operative planned tracheostomy and post-operative stay in the ICU.

Exclusion Criteria

- Patients not available for follow-up.

- Patients who have undergone tracheostomy at other hospitals.

Sample size

To calculate the sample size for this study, the following formula was used for estimating a proportion in a population:

$$n = \frac{Z^2 \times p \times (1-p)}{E^2}$$

Where:

- n = sample size

- Z = Z-score corresponding to the desired level of confidence

- p = estimated proportion in the population

- E = margin of error

Bias: To minimize bias, the study ensured that all eligible patients were included consecutively. Patients who did not consent to participate were excluded to avoid selection bias. Data collection was standardized to maintain consistency.

Variables: Variables included age, sex, complete clinical history, cause of prolonged intubation, indication for tracheostomy, timing of tracheostomy, complications associated with tracheostomy, length of ICU stay, and mortality.

Data Collection: Data were collected retrospectively from the medical records of patients who underwent elective open tracheostomy in the ICU. The following information was compiled:

- Age and sex of the patients

- Complete clinical history related to the cause of prolonged intubation and indication for tracheostomy

- Timing of tracheostomy

- Complications observed post-tracheostomy

Procedure

The study involved reviewing medical records of 110 patients who underwent elective open tracheostomy performed by ENT surgeons in the ICU for various indications. Out of these, 47 patients met the inclusion criteria and were included in the study. Detailed patient information, including demographic data, clinical history, indications for tracheostomy, timing, and complications, was compiled and analyzed.

Statistical Analysis: SPSS version 20.0 for statistical analysis was used. The patients' clinical and demographic features were compiled using descriptive statistics. Frequencies and percentages were used to represent categorical variables, whereas averages and standard deviations were used to represent continuous variables. To compare results, t-tests were utilised for continuous variables while chi-square or Fisher's exact tests were utilised for categorical data. Statistical significance was attained when the p-value was less than 0.05.

Ethical Considerations

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

Result

A total of 47 patients who underwent tracheostomy in the ICU were comprised in the study. Table 1 provides a summary of the patients' clinical and demographic features.

Table 1: Demographic and Clinical Features

Variable	Mean ± SD/ Frequency (%)
Mean Age (years)	55.3 ± 16.2
Gender	
- Male	30 (63.8%)
- Female	17 (36.2%)
Cause of Prolonged Intubation	
- Respiratory Failure	20 (42.6%)
- Neurological Impairment	15 (31.9%)
- Trauma	7 (14.9%)
- Other	5 (10.6%)
Timing of Tracheostomy (days)	12.5 ± 4.3

The primary indications for tracheostomy are outlined in Table 2. Respiratory failure (42.6%) was the most frequent indication, followed by neurological impairment (31.9%).

Table 2: Indications for Tracheostomy

Indication	Frequency (%)
Respiratory Failure	20 (42.6%)
Neurological Impairment	15 (31.9%)
Trauma	7 (14.9%)
Other	5 (10.6%)

Complications following tracheostomy were recorded and are presented in Table 3. The overall complication rate was 31.9%, with the most common complications being infection (14.9%) and bleeding (10.6%).

Table 3: Complications Associated with Tracheostomy

Complication	Frequency (%)
Infection	7 (14.9%)
Bleeding	5 (10.6%)
Pneumothorax	2 (4.3%)
Tracheal Stenosis	1 (2.1%)

The length of ICU stay post-tracheostomy varied among patients, with an average stay of 20.4 ± 6.8 days. The mortality rate among patients who underwent tracheostomy in the ICU was 21.3% (Table 4).

Table 4: Mortality Rate Post-Tracheostomy

Outcome	Frequency (%)
Mortality	10 (21.3%)
Survived	37 (78.7%)

Statistical analysis revealed that the indication for tracheostomy significantly influenced the length of ICU stay ($p = 0.03$). Patients with respiratory failure had a longer ICU stay compared to those with neurological impairment or trauma. Complication rates were higher among older patients, although this did not reach statistical significance ($p = 0.08$).

Table 5: Statistical Analysis of Length of ICU Stay by Indication

Indication	Length of ICU Stay (Mean ± SD)
Respiratory Failure	24.2 ± 5.3
Neurological Impairment	18.6 ± 4.7
Trauma	17.5 ± 3.9
Other	19.3 ± 4.1

*p=0.03

According to the study, complication rates were lower for early tracheostomies (done within 10 days of intubation) than for late tracheostomies (done beyond 10 days of intubation) ($p = 0.02$).

Table 6: Complication Rate by Timing of Tracheostomy

Timing of Tracheostomy	Complication Rate (%)
Early (≤ 10 days)	20.0%
Late (> 10 days)	45.0%

*p=0.02

Discussion

This observational study included 47 patients who underwent tracheostomy in the ICU over six months. The demographic and clinical features showed a mean age of 55.3 years, with a majority being male (63.8%). The primary indications for tracheostomy were respiratory failure (42.6%) and neurological impairment (31.9%), indicating that these conditions are common reasons for prolonged intubation necessitating tracheostomy.

The overall complication rate was 31.9%, with infections (14.9%) and bleeding (10.6%) being the most frequent complications. This high complication rate underscores the importance of careful monitoring and management post-tracheostomy. The average length of ICU stay post-tracheostomy was 20.4 days, with patients suffering from respiratory failure experiencing a significantly longer ICU stay compared to those with neurological impairment or trauma ($p = 0.03$). This suggests that respiratory failure poses more severe challenges in recovery, potentially due to the underlying health conditions and the severity of respiratory issues.

The mortality rate among the study participants was 21.3%, which is significant and reflects the critical nature of patients requiring tracheostomy in the ICU. Statistical analysis revealed that early tracheostomy (performed within 10 days of intubation) was correlated with a lower complication rate (20.0%) compared to late tracheostomy (45.0%) ($p = 0.02$). This finding suggests that performing tracheostomy earlier in the intubation period can lead to better outcomes and fewer complications, highlighting the importance of timely intervention.

Recent studies have focused on the indications and outcomes of tracheostomy in ICU settings, especially in the context of critical illnesses such as COVID-19, respiratory failure, and traumatic brain injury. These studies have examined factors such as timing, complications, patient outcomes, and healthcare resource utilization.

A cohort analysis involving 100 COVID-19 patients who had tracheostomies found that shorter ICU stays and shorter breathing times were linked to early tracheostomy (within 14 days after intubation). Patients who had their tracheostomies had a far greater 30-day survival rate than patients who had not [6].

In critically sick patients, a meta-analysis comparing early (≤7 days) and late tracheostomy found no significant differences in short-term mortality; however, early tracheostomy lowered rates of ventilator-associated pneumonia (VAP), shortened hospitalisations in the intensive care unit (ICU), and shortened mechanical ventilation [7]. Despite being possible and having few major problems, an early tracheostomy was linked to higher mortality, according to a multicenter retrospective research conducted on COVID-19 patients [8].

A study highlighted that early tracheostomy led to earlier achievement of patient-centric outcomes such as talking, eating, and mobilization, with reduced sedative and analgesic use [9]. An international study on ARDS patients revealed that tracheostomy practices varied globally, with early tracheostomy being linked to prolonged survival but not reduced long-term mortality [10].

A study in pediatric patients found that early tracheostomy (≤14 days) was associated with lower in-hospital mortality, shorter hospital and ICU stays, and decreased hospital-acquired pneumonia rates [11]. Early tracheostomy in trauma patients was linked to reduced VAP risk and shorter mechanical ventilation duration, although it did not significantly affect mortality rates [12]. Meta-analysis on severe traumatic brain injury patients suggested that early tracheostomy resulted in shorter ICU and hospital stays, and reduced incidence of pneumonia, but no significant impact on mortality [13].

Conclusion

The study's result highlights the vital function tracheostomy plays in the care of patients in the intensive care unit who are intubated for an extended period of time. Patient outcomes are greatly impacted by the time of the treatment; early tracheostomy is linked to fewer problems. These results offer insightful information for ICU treatment, indicating that tracheostomy should be considered early on to enhance patient outcomes and shorten ICU stays.

Limitations: The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

Recommendation: To prevent problems and enhance results, patients who need prolonged

mechanical breathing should consider early tracheostomy. These findings should be confirmed and clinical guidelines refined using bigger sample sizes.

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List of abbreviations:

ICU: Intensive Care Unit

VAP: Ventilator-Associated Pneumonia

COPD: Chronic Obstructive Pulmonary Disease

ARDS: Acute Respiratory Distress Syndrome

COVID-19: Coronavirus Disease 2019

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