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Comparison Between Early and Late Tracheostomy in ICU Patients

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ABSTRACT

Tracheostomy remains a pivotal procedure in the management of critically ill patients requiring prolonged mechanical ventilation. This descriptive case series aimed to compare the clinical outcomes of early (<10 days) versus late (>10 days) tracheostomy among ICU patients at Lahore General Hospital over a six-month period. A total of 96 patients were included, with 54 undergoing early tracheostomy and 42 receiving late tracheostomy. Outcomes assessed included duration of mechanical ventilation, ICU and hospital stay, incidence of ventilator-associated pneumonia (VAP), subglottic stenosis, and mortality. Patients in the early tracheostomy group experienced significantly reduced durations of mechanical ventilation (7.3 ± 2.1 vs. 11.5 ± 3.2 days, $p < 0.001$), ICU stay (10.2 ± 2.9 vs. 14.7 ± 4.1 days, $p < 0.001$), and total hospital stay (15.6 ± 3.7 vs. 20.8 ± 4.6 days, $p < 0.001$). The incidence of VAP was notably lower in the early group (5.6%) compared to the late group (21.4%, $p = 0.02$). Although subglottic stenosis and mortality did not differ significantly between groups, a lower mortality trend was observed in the early tracheostomy cohort (13% vs. 26.2%, $p = 0.09$). These findings align with previous evidence suggesting early tracheostomy facilitates earlier weaning, reduces infectious complications, and improves resource utilization. The results advocate for the integration of early tracheostomy into ICU care protocols, while emphasizing individualized patient assessment. Further large-scale studies are needed to substantiate these findings and guide standardized timing recommendations.

INTRODUCTION

Tracheostomy is used to describe the creation of a stoma at the skin surface which leads into the trachea [1]. It is one of the oldest surgical procedures and most widely used surgical procedure in intensive care units (ICUs) [2]. There are four main general indications for tracheostomy: long term mechanical ventilation, weaning failure, upper airway obstruction and airway protection [3]. In the intensive care unit, access for mechanical ventilation (prolonged) is the most common reason for tracheostomy that ranges from 10% to 24% [4].

Open surgical tracheostomy and percutaneous tracheotomy are methods of performing a tracheostomy in patients. Open surgical tracheostomy may be required if percutaneous tracheotomy technique is contraindicated due to anatomic or other patient-related problems [5]. Tracheostomy reduces oropharyngeal irrigation, minimizes the work of breathing, secures airway patency, decreases the risk of ventilator-associated pneumonia or lung injury, and improves weaning from ventilator or sedative drug use [6].

The timing for tracheostomy among ICU patients undergoing mechanical ventilation is an important question regarding the clinical outcomes. Tracheotomy should be used when the duration of mechanical ventilation exceeds 14 days. Another recommendation is that the patient should be endotracheally intubated within 10 days, and tracheotomy should be performed if the duration of mechanical ventilation is predicted to be exceeding 21 days. However, the optimal timing for tracheotomy in critically ill patients undergoing mechanical ventilation remains uncertain [7]. In deciding for the timing of tracheostomy one has to be very careful that early tracheostomy might lead to unnecessary

surgery in some cases whereas late tracheostomy might lead to prolonged endotracheal intubation and its disadvantages leading to potentially prolonged weaning from mechanical ventilation [8].

A study carried out at Agha Khan University Hospital, Pakistan, showed that out of 100 patients of severe head injury requiring mechanical ventilation, 49 patients who underwent early tracheostomy showed lesser incidence of ventilator associated pneumonia, shorter ICU stay and lower mortality [9]. The frequency of early tracheostomy was 49 % [9].

A study by Qureshi M. et al. carried out in Islamabad showed that early tracheostomy is associated with shorter ICU stay (4.2% in early tracheostomy group had more than 12 days stay vs 39.6% in late tracheostomy group) lesser morbidities, in terms of ventilator associated pneumonia (6.3% in early tracheostomy group vs 43.8% in late tracheostomy group) and carries lesser mortality rate as compared to late tracheostomy [10].

Several studies have compared early and late tracheostomy to assess various outcomes, but those studies have shown inconsistent outcomes, or their outcomes do not provide strong evidence due to heterogeneity of the study populations and outcome variables. Most of the studies focused on trauma patients or were conducted at surgical care unit, and several studies have included critically ill medical patients. Furthermore, those studies included patients with various reasons for intubation [11]. So, current study is carried out to compare the outcome of early and late tracheostomy among patients admitted in intensive care unit. The objective of this study is to determine the frequency of early and late tracheostomy among ICU patients, and to compare their outcomes in terms of mean duration of mechanical ventilation, ICU length of stay, incidence of complications such as subglottic stenosis and ventilator-associated pneumonia, and overall mortality. In this context, tracheostomy is defined as a surgical procedure to create an opening in the trachea and insert a tube to aid in breathing. Early tracheostomy refers to the procedure being performed within the first ten days of hospital stay, whereas late tracheostomy is defined as being performed after more than ten days. The outcomes are defined as follows: length of ICU stay refers to the total days in ICU post-tracheostomy while on assisted ventilation; duration of mechanical ventilation is the number of hours a patient remains on mechanical support post-procedure without meeting weaning criteria; subglottic stenosis is the narrowing of the airway below the vocal cords observed on direct laryngoscopy after extubation; ventilator-associated pneumonia refers to pneumonia occurring after 48 hours of ICU stay while on ventilation; and mortality is defined as death directly attributed to the tracheostomy procedure, either intraoperatively or within 30 days of ICU stay.

METHODOLOGY

This descriptive case series was conducted at Lahore General Hospital, Lahore, over a period of six months following the approval of the study synopsis from 21-10-2024 to 20-04-2025. A total of 96 critically ill patients admitted to the Intensive Care Unit (ICU) and selected for tracheostomy were included in the study. The sample size was calculated at a 95% confidence interval, with a 10% margin of error, based on an anticipated frequency of early tracheostomy of 49%. A non-probability consecutive sampling technique was employed. Inclusion criteria comprised patients aged 18 to 65 years, of either gender, undergoing tracheostomy during ICU admission. Patients with a history of previous tracheostomy, coagulation disorders, soft tissue infections of the neck, or hemodynamic instability were excluded.

Data were collected using a structured proforma, developed by the principal investigator and finalized after pre-testing. Each patient was evaluated personally by the investigator. Participants were stratified into two groups based on timing of tracheostomy: early tracheostomy (<10 days post-admission) and late tracheostomy (>10 days post-admission). Demographic data including age and gender, along with clinical variables such as duration of mechanical ventilation post-tracheostomy, ICU stay, total hospital stay, occurrence of ventilator-associated pneumonia (VAP), incidence of subglottic stenosis, and in-hospital mortality were recorded.

All data were entered and analyzed using SPSS version 24.0. Quantitative variables such as age, ICU stay, and duration of mechanical ventilation were expressed as mean ± standard deviation, while categorical variables including gender, cause of ICU admission, VAP, subglottic stenosis, and mortality were presented as frequencies and percentages. The chi-square test was employed to assess the association of tracheostomy timing with outcomes such as VAP, subglottic stenosis, and mortality. Independent samples t-test was applied to compare mean differences in hospital stay and duration of mechanical ventilation between early and late tracheostomy groups, following verification of parametric assumptions. To address potential confounders, data were stratified for age, gender, and primary cause of ICU admission, and post-stratification, appropriate statistical tests were applied. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 96 patients undergoing tracheostomy in the ICU were enrolled in this study. Among them, 54 patients (56.3%) underwent early tracheostomy (<10 days of ICU admission), whereas 42 patients (43.7%) underwent late tracheostomy (>10 days). The mean age of the participants was 45.8 ± 12.4 years. There was a predominance of male patients, with 62 (64.6%) males and 34 (35.4%) females.

The mean duration of mechanical ventilation was significantly shorter in the early tracheostomy group (7.3 ± 2.1 days) compared to the late tracheostomy group (11.5 ± 3.2 days), with a p-value <0.001. Similarly, ICU stay and total hospital stay were significantly reduced in the early tracheostomy group (ICU stay: 10.2 ± 2.9 vs. 14.7 ± 4.1 days, $p < 0.001$; hospital stay: 15.6 ± 3.7 vs. 20.8 ± 4.6 days, $p < 0.001$).

Ventilator-associated pneumonia (VAP) occurred in 12 patients (12.5%), with a significantly lower incidence in the early tracheostomy group (5.6%) compared to the late group (21.4%, $p = 0.02$). Subglottic stenosis was noted in 5 patients (5.2%), with no significant difference between the groups ($p = 0.45$). Overall mortality was observed in 18

patients (18.8%), with the early tracheostomy group showing a lower mortality rate (13%) than the late tracheostomy group (26.2%, p = 0.09), though the difference did not reach statistical significance.

Table 1
Demographic and Clinical Characteristics of Study Participants

Variable	Total (n = 96)	Early Tracheostomy (n = 54)	Late Tracheostomy (n = 42)	p-value
Age (years), mean ± SD	45.8 ± 12.4	46.1 ± 12.1	45.4 ± 12.9	0.78
Gender (Male), n (%)	62 (64.6%)	34 (63.0%)	28 (66.7%)	0.71
Duration of Mechanical Ventilation (days), mean ± SD	9.1 ± 3.2	7.3 ± 2.1	11.5 ± 3.2	<0.001
ICU Stay (days), mean ± SD	12.2 ± 4.1	10.2 ± 2.9	14.7 ± 4.1	<0.001
Hospital Stay (days), mean ± SD	17.8 ± 4.6	15.6 ± 3.7	20.8 ± 4.6	<0.001

Table 2
Clinical Outcomes by Tracheostomy Timing

Outcome	Early Tracheostomy (n = 54)	Late Tracheostomy (n = 42)	p-value
Ventilator-Associated Pneumonia, n (%)	3 (5.6%)	9 (21.4%)	0.02
Subglottic Stenosis, n (%)	2 (3.7%)	3 (7.1%)	0.45
Mortality, n (%)	7 (13.0%)	11 (26.2%)	0.09

Stratified analysis did not reveal significant interaction effects based on age, gender, or cause of ICU admission. Early tracheostomy consistently showed better clinical outcomes across most subgroups.

DISCUSSION

This descriptive case series evaluated the timing of tracheostomy in critically ill patients and its impact on various clinical outcomes. The findings of our study suggest that early tracheostomy, performed within 10 days of ICU admission, is associated with significantly shorter durations of mechanical ventilation, ICU stay, and overall hospital stay compared to late tracheostomy. These results are consistent with previous literature, which has reported that early tracheostomy may facilitate weaning from mechanical ventilation, reduce sedation requirements, and promote earlier mobilization and rehabilitation.

The incidence of ventilator-associated pneumonia (VAP) was significantly lower in the early tracheostomy group, indicating a potential protective effect of earlier airway stabilization against lower respiratory tract infections. Although the precise mechanism remains multifactorial, early tracheostomy is thought to reduce microaspiration and biofilm formation by minimizing the duration of endotracheal intubation. Our findings are in agreement with a meta-analysis by Wang et al., which demonstrated a statistically significant reduction in VAP rates among patients undergoing early tracheostomy.

Mortality was lower in the early tracheostomy group compared to the late group (13% vs. 26.2%), though this difference did not reach statistical significance. The lack of significance may be attributed to the relatively small sample size or potential confounding factors such as baseline severity of illness, comorbidities, and differences in ICU management strategies. However, the trend toward reduced mortality is clinically relevant and highlights the need for further large-scale randomized trials to explore this association more robustly.

Subglottic stenosis, a rare but serious complication, was observed in a small number of patients in both groups without a statistically significant difference. This suggests that timing of tracheostomy may not play a major role in the development of this complication, which is more likely influenced by technical factors and prolonged intubation duration prior to tracheostomy.

Strengths of our study include prospective data collection, consistent methodology, and focus on clinically meaningful outcomes. However, certain limitations must be acknowledged. Being a single-center study, generalizability is limited. Additionally, the use of non-probability consecutive sampling may introduce selection bias. Finally, although statistical adjustments were made for effect modifiers, residual confounding cannot be completely excluded.

In conclusion, our findings reinforce the clinical benefits of early tracheostomy in ICU patients, particularly in reducing ventilator days, ICU and hospital length of stay, and potentially decreasing the risk of VAP. While mortality differences were not statistically significant, the trend observed warrants further investigation. These results support the incorporation of early tracheostomy into ICU protocols where appropriate, with individualized patient assessment remaining paramount.

CONCLUSION

This study demonstrates that early tracheostomy in ICU patients is associated with significantly improved clinical outcomes, including reduced duration of mechanical ventilation, shorter ICU and hospital stays, and a lower incidence of ventilator-associated pneumonia. Although mortality reduction did not achieve statistical significance, the observed trend suggests potential survival benefits. The incidence of subglottic stenosis did not differ significantly between early and late tracheostomy groups, indicating that this complication is likely influenced by other factors. These findings support the adoption of early tracheostomy as part of ICU management strategies where clinically appropriate. Nonetheless, decisions should remain individualized, considering patient-specific variables and institutional protocols. Future multicenter randomized controlled trials are warranted to validate these observations and further clarify the optimal timing of tracheostomy in critically ill patients to enhance care quality and resource efficiency.

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