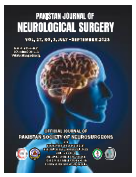

PAKISTAN JOURNAL OF NEUROLOGICAL SURGERY (QUARTERLY) – OFFICIAL JOURNAL OF PAKISTAN SOCIETY OF NEUROSURGEONS

Original Article

Frequency of Ventilator-Associated Pneumonia among ICU Admitted Patients with Early Versus Delayed Tracheostomy

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ABSTRACT

Objective: Patients on mechanical ventilation in the intensive care unit (ICU) frequently develop ventilator-associated pneumonia (VAP), an acquired lung infection. The incidence of VAP varies highly in different setups. This study aimed to determine the incidence of VAP in the surgical ICU and the associated costs.

Materials & Methods: An observational cross-sectional study was conducted and included 116 patients who had a tracheostomy in the surgical ICU of Lahore General Hospital. They were observed for the occurrence of VAP, mortality, ICU stay in days, and cost of the ICU stay. Tracheostomies done before 7 days from mechanical ventilation with the expectation of needing extended ventilatory support were classified as early tracheostomies (Group E), whereas those performed after 7 days owing to failure to wean were classified as late tracheostomies (Group L).

Results: Patients in the early tracheostomy group had a mean age of 45.16 years, while those in the late tracheostomy group had a mean age of 50.00 years. Compared to the early tracheostomy group, the late tracheostomy group had a greater incidence of VAP, 8(25.8%) and 24(53.33%), and mortality, 8(25.8%) and 22(48.88%), respectively. Mean values like pre-tracheostomy ventilation were 4.70 & 12.17 days, ICU stay was 9.54 & 16.64 days and total cost in PKR was 796774.19 & 1438888, respectively among early tracheostomy & late tracheostomy groups. The difference in mean values of all parameters was significant across groups with P-value < 0.05.

Conclusion: The occurrence of VAP and mortality is significantly lower in patients who have undergone early tracheostomy.

Keywords: Ventilator, Pneumonia, Tracheostomy, Mortality, Early, Late, Cost.

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Date of Submission: 12-05-2023
Date of Revision: 20-09-2023
Date of Acceptance: 25-09-2023
Date of Online Publishing: 30-09-2023

Date of Print: 30-09-2023

DOI: 10.36552/pjns.v27i3.911

INTRODUCTION

Among patients admitted to critical care units (ICU), ventilator-associated pneumonia (VAP) is linked to high mortality and morbidity rates. Picture of pneumonia on chest x-ray that develops after mechanical ventilation for 48 hours with endotracheal intubation is considered to be (VAP).[1] The incidence of VAP among patients on mechanical ventilation ranges from 9-27% in different setups. It also prolongs the hospital stay days and superimposes the economic burden on healthcare facilities.[2] Prevention from colonization of the lower respiratory tract remains the mainstay to reduce the incidence of VAP.

Tracheostomy is a commonly performed surgical intervention to maintain airway patency and avoid complications related to the prolonged placement of an endotracheal tube (ETT).[3] With the development of recent advances in ICU, the number of patients with mechanical ventilation has increased, along with the number of tracheostomies also increased. Around 7% of patients who require mechanical ventilation require tracheostomy. Most common cause of tracheostomy is acute respiratory failure. Some of the other causes are obstructed upper airway, anticipated prolonged need of mechanical ventilation, failure of intubation, and major traumas. Increasing number of tracheostomies is a potential economic burden for the health.[5]

No precise time limit can be used to determine if a tracheostomy is early or late. Seven days and 10 days after the mechanical ventilation are common cutoff times in the literature. To decide whether to conduct an early or late tracheostomy, each patient must be evaluated individually concerning their general condition and risk against benefit.[5-6] Controversial results are prevalent regarding the outcome of early and late tracheostomies in literature. In a meta-analysis, early tracheostomy only helped patients to minimize the time of sedation but didn't significantly affect mortality, ICU stay, and incidence of VAP.[7] Another recent analysis concluded that early tracheostomy is beneficial in terms of mortality, ICU stay, and occurrence of VAP in comparison with late tracheostomy.[8] Also, its incidence, length of hospital stays, and mortality differ among ICU setups and facilities available. So, we conducted this study in the surgical ICU of Lahore General Hospital, to know the prevalence of VAP and associated mortality among patients on mechanical ventilation with early or late tracheostomy.

MATERIALS AND METHODS

Study Design & Setting

It was an observational comparative study, conducted in the surgical ICU of Lahore General Hospital, Lahore, Pakistan to find out the incidence of VAP among ICU-admitted patients who underwent early and late tracheostomy after mechanical ventilation. Approval from the ethical review board of the hospital was taken before conducting the study and written consent was taken from immediate family members of participants.

Sampling

It included all 116 candidates who had a tracheostomy in the surgical ICU of Lahore General Hospital from 01/06/2022 to 31/12/2022.

Inclusion Criteria

Patients aged ≥ 18 years, who have undergone surgical tracheostomy.

Exclusion Criteria

Patients with bleeding disorders, patients who developed VAP before tracheostomy, and

patients with COPD, pulmonary tuberculosis, and carcinoma of the lungs were excluded from the study.

Methodology & Data Collection

Tracheostomies performed before 7 days from mechanical ventilation, anticipating the need for prolonged ventilatory support were grouped in early tracheostomy (Group E) and those tracheostomies performed after 7 days due to failure to wean were allocated to the late tracheostomy group (Group L). For all the patients, surgical tracheostomy was performed in an ENT operation theater by an ENT surgeon under general anesthesia. After tracheostomy patients were shifted back to ICU and mechanically ventilated. Patients were evaluated for 30 days maximum or till the day of discharge from ICU, either of which was earlier for any occurrence of VAP and mortality and days of need of mechanical ventilation. Patient data like age, sex, weight, diagnosis, comorbidities total days of mechanical ventilation (MV), MV before tracheostomy in days, need of MV after tracheostomy in days, mortality, and incidence of VAP were recorded.

Data Analysis

Data was analyzed with SPSS Ver.25 software. For continuous variables, mean and standard deviation were computed, and for categorical variables, frequency and percentage. To find the difference regarding ICU stay, total cost, and days of ventilation before tracheostomy among the two groups, a T-test was performed. A chi-square test was carried out to know the difference in frequencies of VAP and mortality. P-value < 0.05 was considered statistically significant.

RESULTS

Gender Distribution

Among 76 patients, 43 (56.57%) were males and 33 (43.43%) were females who had tracheostomy within the duration of the study.

Age Distribution

Patients in the early tracheostomy group had a mean age of 45.16 ± 12.86 years, while those in the late tracheostomy group had a mean age of 50.00 ± 10.02 years. The ages of the two groups were comparable.

Weight

The mean weight of patients with an early and late tracheostomy was 70.16 ± 9.59 kg and 68.84 ± 9.01 kg respectively.

Time of Tracheostomy

In 31 cases, an early tracheostomy was done, and in 45 patients, a late tracheostomy. An intensivist consultant decided when to perform a tracheostomy.

Systemic Diagnosis

The total count of the systemic diagnoses of the patients at the time of admission were, Neurological (n=6), Cardiac (n=4), Sepsis (n=31), Trauma (n=24), Tetanus (n=3), Guillain-Barré syndrome (n=6) and others (2), where n indicates the number of patients.

Outcome Variables

The average number of days that early and late tracheostomy groups spent on mechanical breathing with endotracheal tubes before tracheostomy was 4.70 ± 1.27 days and 12.17 ± 2.89 days, respectively. Among 31 patients who had an early tracheostomy, 8 (25.8%) developed ventilator-associated pneumonia which was significantly lower than those in the late tracheostomy group, 24, (53.33%) with P value ≤ 0.05. Mortality was also observed higher in the group with late tracheostomy than in those with

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early tracheostomy, 22, (48.88%) and 8, (25.8%), respectively with P-vale ≤ 0.05. ICU stay was prolonged in patients with late tracheostomy, 16.64 ± 4.48 days compared with patients with early tracheostomy, 9.54 ± 3.54 days. Early tracheostomy patients' total cost of ICU hospitalization was substantially lower than that of late tracheostomy patients, at PKR 796774.19 ± 330387.52 and PKR 1438888 ± 431947.08, respectively.

Two groups (early tracheostomy & late tracheostomy) were statistically different for VAP (p-value: 0.017) and mortality (0.043). Significant differences exist (p-value: 0.001) between mean values for pre-tracheostomy ventilation, ICU stay, and total cost for groups (early tracheostomy & late tracheostomy).

Table 1: Patient's characteristics and diagnosis at the time of admission.

Parameters	Early Tracheostomy (n=31) Mean±SD	Late Tracheostomy (n=45) Mean±SD
Age (mean ± SD) in years	45.16 ± 12.86	50.00 ± 10.02
Weight in kilogram	70.16 ± 9.59	68.84 ± 9.01
	Frequency (%)	**Frequency (%)**
Male (n, %)	19, 61.30 %	24, 55.33%
Female (n, %)	12, 38.70%	21, 46.67%
Systemic Diagnosis n (%)		
Neurological	2 (6.45%)	4 (8.89%)
Cardiac	1 (3.23%)	3 (6.67%)
Sepsis	14 (45.16%)	17 9 (37.78%)
Trauma	7 (22.58%)	17 (37.78%)
Tetanus	2 (6.45%)	1 (2.22%)
Guillain-Barré syndrome	5 (16.13%)	1 (2.22%)
Others	0 (0)	2 (4.44%)
Total	31 (100%)	45 (100%)

Table 2: Incidence of VAP, ICU stay, and Total Cost during treatment of patients.

Parameters	Early Tracheostomy (n=31)	Late Tracheostomy (n=45)	P-value	
Ventilator-associated pneumonia (VAP)	8, (25.8%)	24, (53.33%)	0.017	*
Mortality	8, (25.8%)	22, (48.88%)	0.043	*
	Mean ±SD	**Mean ±SD**		
Pre-tracheostomy ventilation (days)	4.70 ± 1.27	12.17 ± 2.89	0.001	*
ICU stay (days)	9.54 ± 3.54	16.64 ± 4.48	0.001	*
Total Cost (PKR)	796774.19 ± 330387.52	1438888 ± 431947.08	0.001	*

Note:*Significant difference of P-value < 0.05. P value of ICU stay, total cost, and days of ventilation before tracheostomy among two groups is calculated by t-test whereas the chi-squared test was carried out to know the difference in frequencies of VAP and mortality

DISCUSSION

Our study consisted of 76 patients, 31 patients underwent early and 45 underwent late tracheostomies. The decision of the tracheostomy was based on the clinical condition and outcome of patients and was made by a consultant intensivist. In the late tracheostomy group, we discovered a high rate of VAP compared to the early groups, 24, (53.33%), and 8 (25.8%). However, the current literature contains contentious findings that demonstrate a significant difference in data amongst ICUs. Mecker et al's, study similarly discovered a decreased incidence of VAP in the early tracheostomy group (27.2% vs. late 42.3%), with a P-value of 0.05.[9] Another study that came to a similar conclusion found that patients with early tracheostomies had a reduced chance of developing tracheal aspiration pneumonia (VAP)

than those with late tracheostomies, 665 (54.95%) patients and 725 (59.91%) patients (p = 0.013).[10] The findings of Shen et al's, study, which indicated that early tracheostomy considerably reduces the occurrence of VAP than late tracheostomy validates the findings of our investigation.[11] However, a different experiment found that patients' incidence of VAP was not significantly different depending on when their tracheostomy was placed (early or late). Instances of VAP were reported in 14% of patients with early tracheostomies and 21% of individuals with late tracheostomies. It was higher in the late tracheostomy group, but with a P-value of 0.07, it was not statistically significant.[12]

In our study, we found a higher mortality rate, 48.88%, longer ICU stay (16.64 ± 4.48) days and more ICU expenses, PKR 1438888 ± 431947.08 among patients with late tracheostomy than those with early tracheostomy. A Randomized controlled trial by Tillo et al, found early tracheostomy significantly reduced the incidence of VAP but did not reduce mortality in ICU. In his study incidence of ICU mortality was 2.5% and 4.65% and the incidence of VAP was 38% and 64% in early versus late tracheostomy groups respectively.[13] In many studies, the total cost of ICU stay for patients with late tracheostomy is higher than for early tracheostomy. Nasim et al, found a median cost of 292,329 dollars vs. 332,601 dollars; p = 0.26, and Brook et al, found mean expenses of USD 86,189 +/- 53,570 and USD 124,649 +/- 54,282 with P-value 0.001. Early tracheostomy was linked to shorter ICU and hospital stays by 15 and 22 days, respectively, in research comprising 549 patients from 13 institutions in four countries. The length of mechanical ventilation was also reduced by 12 days, which is also comparable with our findings.[14]

CONCLUSION

With the findings of our study, we could conclude that the incidence of VAP and mortality is lower in the early tracheostomy group than late tracheostomy group. Overall ICU stay expenses are also lower in the early tracheostomy group.

RECOMMENDATIONS

Early tracheostomy should be preferred to those patients who are supposed to need prolonged ventilatory support.

LIMITATION

It is a single-center study and consists of a small number of patients. So, more research with a large number of patients should be conducted to broaden the existing knowledge.

ACKNOWLEDGMENT

Special thanks to Dr. Parshal Bhandari for the guidance for the conduction of the study.

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Additional Information

Disclosures: Authors report no conflict of interest.
Ethical Review Board Approval: The research was a retrospective study.
Human Subjects: Consent was obtained by all patients/participants in this study.
Conflicts of Interest:
In compliance with the ICMJE uniform disclosure form, all authors declare the following:
Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

AUTHOR CONTRIBUTIONS

Sr. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of
1.	Sidrah Batool	Study Design, Methodology, and Paper Writing.
2.	Hassan Raza & Sidrah Batool	Data Calculation and Data Analysis.
3.	Wajiha Haq	Interpretation of Results.
4.	Vandana Kafle & Anjana Kafle	Statistical Analysis.
5.	Hassan Raza	Literature Review.
6.	Wajiha Haq, & Sidrah Batool	Literature Review and Quality Insurer