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Role of Early Tracheostomy for Preventing Ventilator-Associated Pneumonia at the Intensive Care Unit-Our Experiences at a Tertiary Care Teaching Hospital of Eastern India

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ABSTRACT

Introduction: Ventilator-associated pneumonia (VAP) is a nosocomial infection that occurs in patients with mechanical ventilation (MV). Tracheostomy is a surgical procedure that improves the respiratory mechanics and comfort of the patient which helps with the secretions and weaning. Tracheostomy also reduces the risk for the development of the VAP in comparison to translaryngeal intubation.

Objective: The aim of this study is the assess the role of the tracheostomy in preventing VAP in the intensive care unit (ICU) with mechanical ventilation.

Materials and Methods: This is a retrospective study conducted at the neuro-critical ICU of a tertiary care teaching hospital. This study was done in the period from December 2019 to February 2021. The study included 244 ICU patients who underwent tracheostomy and was divided into two groups early and late tracheostomy. All the tracheostomies were performed at the bedside of the patients. The demographic outcomes, ventilator-associated pneumonia, ICU stay, hospital stay and mortality rate of the participating patients were evaluated.

Result: The early tracheostomy group (continuous intubation less than 7 days) included 112 patients and 132 patients were included in the late group. A statistically significant difference was found in ventilator-associated pneumonia in the early versus late tracheostomy group. There was no statistically significant difference in the demographics of the two groups. The early tracheostomy has less ICU stay, less hospital stay. But there was no significant difference in mortality rate in comparison to the late tracheostomy group.

Conclusion: Early tracheostomy is associated with less ventilator-associated pneumonia, less ICU stay and a higher number of intubation in the early group of tracheostomy.

Keywords: Tracheostomy, Nosocomial infection, Ventilator-associated pneumonia, Intubation, Mechanical ventilation, Intensive care unit

INTRODUCTION

Tracheostomy on critically ill patients with mechanical ventilators in the ICU has several advantages. The ideal timing for performing tracheostomy is often a question for both otolaryngologists and intensivists. The decision for performing tracheostomy and considering its risk and benefits are often challenging to the patient's recovery. The important benefits of the tracheostomy are reduced damage to the larynx, early weaning from mechanical ventilation, decreased stay in the ICU and enhanced patient comfort. [1] The potential risk of tracheostomy are infections, subglottic stenosis, loss of airway and even death of the patient. [1] (1aa) The use of mechanical ventilation (MV) results in several changes in the airway of the patient.VAP is an important clinical entity for outcomes among critically ill patients. Patients those present with VAP may show a greater risk of death in comparison to patients without such diseases. [2] Once the patient is intubated; the airway loses its sterility and gets infection within a few hours

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after starting the MV. [3] In these situations, several complications may occur. Ventilator-associated pneumonia (VAP) is an important infectious complication found in the patients under MV which contributes to 8% to 28% of the patients admitted in the ICU. [4] The chances of the VAP is always present through the MV period. One study shows that the risk of the VAP is approximately 3% per day in the first week of the MV, 2% per day in the second week and 1% per day later. [5] However, this period is very important for preventing VAP. Each component from the ventilator to the lungs are important when considering the care of the patients during MV. The risk for VAP in intubated patients at ICU include age more than 60 years old, multiple intubations, changing the ventilator circuit and even the timing of the tracheostomy. [6, 7] There is always an ongoing debate on the risk and benefits of early tracheostomy on critically ill patients in the ICU. Here, we are studying the incidence of VAP concerning the early tracheostomy on the intubated patients with the ventilator.

MATERIALS AND METHODS

This is a retrospective study done from December 2019 to February 2021. This study was conducted at the neuroscience intensive care unit (ICU) of the tertiary care teaching hospital. This study was approved by the Institutional Ethical Committee (IEC) with reference number IEC/IMS/SOAU/18/12.10.2018. The patients included in this study were neurological and neurosurgical patients with mechanical ventilation and underwent tracheostomy. There were 244 patients enrolled in this study. The data collected in this study included age, gender, the timing of tracheostomy, termination of ventilator support and VAP. All participants were tracheostomised patients and divided into the early and late tracheostomy. The early tracheostomy group is defined as patients who had seven or fewer days of continuous ventilation whereas the late tracheostomy group had more than seven days of continuous ventilation. The primary outcome measure was the incidence of VAP. VAP is defined by the presence of the new progressive radiographic infiltrates related to the different criteria such as fever, increased leukocyte count, purulent tracheal aspirate and positive culture data starting at more than 48 hours from the time of intubation. [8]

RESULT

There were 244 patients enrolled in this study. This study included 112 patients who underwent the early tracheostomy group and the rest of the 132 patients who underwent late tracheostomy. Out of the 244 patients, 112 received early tracheostomy (continuous intubation time < 7days) and 132 received late tracheostomy (continuous intubation time> 7days). Early and late tracheostomy groups did not show significant differences in terms of age, gender (Table.1). In this study, patients included were evaluated for total ICU stay, time from tracheostomy to ICU discharge and the total number of days in ICU. The median duration of hospital stay was 19 days in the early tracheostomy group and 30.5 days in the late tracheostomy group (Table.1). All the patients in this study were evaluated for the presence of ventilator-associated pneumonia during their admission by the criteria described in the materials and methods section. All the enrolled patients were screened for the presence of the VAP during their admission period as per the criteria described in the methods section. A significant decrease in the rate of VAP incidence was found in the early tracheostomy group in comparison to the late tracheostomy group (Table.1). Early tracheostomy results from 24.2 % VAP whereas 48.5% showed VAP in the late tracheostomy group. The early tracheostomy group patients showed improvement of ventilator-free days (1.8 additional days off the ventilator) and shorter ICU stay (6.2 days shorter time on average). However, the mortality of the patients was not affected by the early tracheostomy in this study. Early and late tracheostomy groups did not significantly differ in terms of age, sex, diagnosis at the time of admission and medical co-morbidities. No significant effect was found for admission diagnosis (one way ANOVA, p= 0.623), age (one way ANOVA, p =0.672). The mean number of endotracheal intubations that occurred before performing tracheostomy was calculated for each group. There was a significantly higher number of intubations in the early tracheostomy group in comparison to the late tracheostomy group. However, the number of intubations did not affect the incidence of VAP (p=0.35). All the patients in this study were examined for mortality of the patients during the hospitalization. Mortality was determined based on the death during present admission. There was no significant difference found in the mortality when comparing the early versus late tracheostomy groups (p=0.145).

DISCUSSION

Ventilator-associated pneumonia (VAP) is defined as pneumonia seen in a mechanically ventilated patient after 48 hours of endotracheal intubation. [9] Although there is advancement for management of the intubated patients at the ICU, VAP remains a fatal complication in the ICU. [10] Tracheostomy is one of the commonly done procedures on critically ill patients those requiring prolonged mechanical ventilation at the intensive care unit (ICU). [11] The patients who require mechanical ventilation often undergo trans-laryngeal intubation for an initial period, after which a tracheostomy is undertaken. However, the optimum timing for performing the tracheostomy remains a challenge for the intensivist. VAP is a frequent complication found in intubated and mechanically ventilated patients. VAP is the second most common infection among the patients admitted to the ICU. [12] This infection

is usually associated with prolonged mechanical ventilation and ICU stay which increases the need for human resources and also increase the cost in the ICU. [13]

A tracheostomy gives benefit to the patients with the prolonged requirement for mechanical ventilation and may protect from the VAP. [14] Tracheostomy play a crucial role for the airway management of the ICU patients. [15] There are several advantages of the tracheostomy over the endotracheal tube intubation such as avoidance of the injury to the larynx, provide a stable airway, facilitates pulmonary toilet, increased patient comfort and facilitating for ventilation. [16] The presence of the endotracheal tube for a long time may contribute to VAP through two mechanisms such as first through micro-aspiration of secretion which contains pathogenic micro-organisms and secondly via the formation of a biofilm. The prevention of these infections can be done by interrupting these mechanisms like removal of the subglottic secretions, the elevation of the bed head and use of the antimicrobial coated endotracheal tubes. The endotracheal tube after intubation breaches the anatomical barriers formed by the larynx and glottis. Suppression of the cough reflexes is usually due to sedation which further hampers the natural reflexes. [17] The nasal cavities, paranasal sinuses, oropharynx and the stomach have been proposed as reservoirs of infective materials. [18]

The aspiration of contaminated secretions leads to lower airway colonization and subsequent infection of the lungs. [19] In addition to this, it is thought that liberation of the vocal folds in tracheostomised patients favours normal vocal fold closure and so reduces the risk of aspiration of the secretions from the oropharynx. Tracheostomy also facilitates the clearance of the airway from the secretions and weaning from the mechanical ventilation and so reduces the duration of mechanical ventilation and ICU stay which are two important risk factors for VAP. [20] Dental plaques also act as an important reservoir for the respiratory pathogens associated with VAP. [21] In the transoral endotracheal tube, it hides the oral cavity and prevents access to proper oral care. Nurses also avoid oral care for fear of dislodgement of the endotracheal tube. The transoral endotracheal tube keeps the mouth open and predisposes to xerostomia which leads to poor oral hygiene. [21] Tracheostomy also reduced the use of sedation which is also an important factor for preventing VAP. [22]

VAP is often acquired in patients approximately 48 to 72 hours after mechanical ventilation. [23] The main objective of mechanical ventilation is to help towards gas exchange without resulting in injury to the lungs. However, mechanical ventilation can cause injury to the lungs by stress and strain developed in the lungs. High pressure and high volume can lead to barotrauma and volutrauma to the lungs which are again followed by biotrauma and atelectrauma. [24] Normally the respiratory system clears the secretions from the pharynx and larynx either by cough reflex or mucociliary action. However, the mechanically ventilated patients are unconscious and there is clearance of the secretions of the oropharynx because of the failure of the physiological mechanism. The immune mechanism is also not effective in patients with lower immune responses. [25] The normal bacterial colonies of the oral cavity increases in number. These colonies along with secretions pass along the endotracheal tube. It also forms a biofilm and reaches the distal part of the airway resulting in pneumonia. [26] Early tracheostomy may help for rapid weaning from the mechanical ventilation, which reduces the duration of the mechanical ventilation. In one randomized trial in patients with a head injury, the duration of mechanical ventilation needed after VAP was reduced significantly in patients with those who underwent tracheostomy on the fifth ICU day in comparison to the 15th ICU day. [27]

Repeated intubations are associated with a high chance of VAP. [28] However, our data failed to reveal such a similar association. However, the early tracheostomy group had a higher average number of intubations and a lower rate of VAP. It is not fully understood why the patients those underwent early tracheostomy had a higher number of intubations. It may be due to aggressive treatment done with early extubation trials and these successive failures tempted for doing tracheostomy. The late tracheostomy group could have been up of more severely sick patients who were too swollen or had higher ventilator settings for considering either extubation or tracheostomy. Because of the retrospective study, it was difficult to determine the severity of illness and its impact on the decision for multiple intubations. Tracheostomy when performed early in the course of mechanical ventilation may allow for rapid weaning from mechanical ventilation, which may affect the duration of mechanical ventilation. American College of Chest Physicians consensus conference recommended for perfuming tracheostomy after 3to 7 days in patients with the ventilator when expectations for prolonged intubation. There are several studies and meta-analyses have addressed the timing of the tracheostomy among ICU patients. Few studies have revealed a benefit for performing an early tracheostomy. [29, 30] One study was also not in favour of early tracheostomy. [31] In one prospective study of the timing of tracheostomy, the incidence of the VAP reduced when the tracheostomy was done within 48 hours of intubation in comparison to those done at 14 to 16 days. [32] After placement of the tracheostomy enabled the patients to be shifted out of the ICU to a ventilator step-down unit. Mortality was not significantly decreased in the early tracheostomy group in comparison to late tracheostomy in this study. However, the mortality was not found to be significantly reduced in the previous meta-analysis of the timing for tracheostomy at less than seven days. [33]

CONCLUSION

Patients requiring prolonged mechanical ventilation have a significant reduction in the incidence of VAP after performing the tracheostomy. An early tracheostomy provides important benefits in comparison to continued tarns-laryngeal intubation including improved patients comfort, less requirement of sedation, easier weaning and potentially less time spent for mechanical ventilation and in the ICU. This study demonstrates that early tracheostomy is independently associated with a lower rate of VAP. Performing early tracheostomy is associated with less chance of VAP and mortality at ICU. It also reduces the duration of MV and the ICU stay of the patient in comparison to the patient with late tracheostomy.

Limitations of the study

The present study is limited by its retrospective nature. Although the demographic evaluation of the two groups such as early and late tracheostomy failed to reveal any statistically significant difference, a bias in favour of the early tracheostomy group could certainly exist. The exact timing for performing tracheostomy is mainly based on the discretion of the intensivist and the selection process for early tracheostomy likely happens. This bias would be best addressed by a prospective randomized trial.

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REFERENCES

1. Swain SK, Sahu MC, Choudhury J, Bhattacharyya B. Trcacheostomy among pediatric patients: Our experiences at a tertiary care teaching hospital in eastern India.Pediatria Pol 2018;93(4):312-17.
2. Nguile-Makao M, Zahar JR, Français A, Tabah A, Garrouste-Orgeas M, Allaouchiche B, et al. Attributable mortality of ventilator-associated pneumonia: respective impact of main characteristics at ICU admission and VAP onset using conditional logistic regression and multi-state models. Intensive Care Med. 2010;36(5):781-9.
3. Ewig S, Torres A, El-Ebiary M, Fabregas N, Hernandez C, Gonzalez J, et al. Bacterial colonization patterns in mechanically ventilated patients with traumatic and medical head injury: incidence, risk factors, and association with ventilator-associated pneumonia. Am J Respir Crit Care Med. 1999;159(1)):188-98.
4. Chastre J, Fagon JY. Ventilator-associated pneumonia. Am J Respir Crit Care Med. 2002;165(7):867-903.
5. Cook DJ, Walter SD, Cook RJ, Griffith LE, Guyatt GH, Leasa D. Incidence of and risk factors for ventilator-associated pneumonia in critically ill patients. Ann Intern Med. 1998;129(6):433-40.
6. Kollef MH.Ventilator-associated pneumonia: a multivariate analysis.J Am Med Ass. 1993;270(16):1965-70.
7. Torres A, Gatell JM, Aznar E. Re-intubation increases the risk of nosocomial pneumonia in patients needing mechanical ventilation. Am J Respir Crit Care Med.1995;152:137-41.
8. Meduri GU. Diagnosis and differential diagnosis of ventilator-associated pneumonia.Clin Chest Med. 1995;16(1):61-93.
9. Kollef MH. What is ventilator-associated pneumonia and why is it important? Respir Care. 2005;50(6):714-21.
10. Chastre J, Fagon JY.Ventilator-associated pneumonia. Am J Respir Crit Care Med.2002; 165(7):867-903.
11. Swain SK, Behera IC, Sahu MC. Bedside opens tracheostomy at intensive care unit-Our experiences of 1000 cases at a tertiary care teaching hospital of eastern India. Egypt J Ear Nose Throat Allied Sci. 2017;18(1):49-53.
12. Chastre J, Fagon JY. Ventilator-associated pneumonia. Am J Respir Crit Care Med. 2002;165: 867(7)-903.
13. Safdar N, Dezfulian C, Collard HR, Saint S. Clinical and economic consequences of ventilator-associated pneumonia: a systematic review. Crit Care Med. 2005;33(10):2184-93.
14. Swain SK, Sahu A.Performing tracheostomy on COVID-19 patients at intensive care unit: Our experiences.Indian J Health Sci Biomed Res. 2021;14(1):131-6.
15. Eló G, Pénzes I. Role of percutaneous tracheostomy in intensive care: a review. Orv Hetil. 2002;143(17): 875-9.
16. Koh WY, Lew TW, Chin NM, Wong MF. Tracheostomy in a neuro-intensive care setting: indications and timing. Anaesth Int Care. 1997;25(4):365-8.
17. Ben Lakhal H, M'Rad A, Naas T, Brahmi N. Antimicrobial Susceptibility among Pathogens Isolated in Early-versus Late-Onset Ventilator-Associated Pneumonia. Infect Dis Rep. 2021;13(2):401-10.
18. Niederman MS. The clinical diagnosis of ventilator-associated pneumonia. Respir Care. 2005;50(6):788-96.
19. Torres A, Ewig S, Lode H, Carlet J. Defining, treating and preventing hospital-acquired pneumonia: European perspective. In Care Med. 2009;35(1):9-29.
20. Terragni PP, Antonelli M, Fumagalli R, Faggiano C, Berardino M, Pallavicini FB, et al. Early vs late tracheotomy for prevention of pneumonia in mechanically ventilated adult ICU patients: a randomized controlled trial. J Am Med Ass. 2010;303(15):1483-9.
21. Robriquet L, Fourrier F. Oral hygiene and ventilator-associated pneumonia. Curr Respir Med Rev. 2010;6(1):65-71.
22. Nieszkowska A, Combes A, Luyt CE, Ksibi H, Trouillet JL, Gibert C, et al. Impact of tracheotomy on sedative administration, sedation level, and comfort of mechanically ventilated intensive care unit patients. Crit Care Med. 2005;33(11):2527-33.
23. Swain SK, Acharya S, Das S. Social impact of tracheostomy: Our experiences at tertiary care teaching hospital of eastern India. J Sci Soc. 2020;47(3):148-52.
24. Swain SK, Das A, Behera IC, Bhattacharyya B. Trcaheostomy among pediatric patients: A review. Indian J child health 2018;5(9):557-61.

25. Hunter JD. Effects of anaesthesia on the human immune system. Hosp Med. 1999;60(9):658-63.
26. Sottile FD, Marrie TJ, Prough DS, Hobgood CD, Gower DJ, Webb LX, et al.Nosocomial pulmonary infection: possible etiologic significance of bacterial adhesion to endotracheal tubes. Critical care Med.1986;14(4):265-70.
27. Young D, Harrison DA, Cuthbertson BH, Rowan K, TracMan Collaborators. Effect of early vs late tracheostomy placement on survival in patients receiving mechanical ventilation: the TracMan randomized trial. J Am Med Ass. 2013;309(20):2121-9.
28. Torres A, Gatell JM, Aznar E. Re-intubation increases the risk of nosocomial pneumonia in patients needing mechanical ventilation. Am J Respir Crit Care Med. 1995;152(1):137- 41.
29. Freeman BD, Borecki IB, Coopersmith CM, Buchman TG. Relationship between tracheostomy timing and duration of mechanical ventilation in critically ill patients. Crit care Med. 2005;33(11):2513-20.
30. Frutos-Vivar F, Esteban A, Apezteguía C, Anzueto A, Nightingale P, González M, et al. Outcome of mechanically ventilated patients who require a tracheostomy.Crit Care Med. 2005;33(2):290-8.
31. Blot F, Similowski T, Trouillet JL, Chardon P, Korach JM, Costa MA, et al. Early tracheotomy versus prolonged endotracheal intubation in unselected severely ill ICU patients. Intens Care Med. 2008;34(10):1779-87.
32. Rumbak MJ, Newton M, Truncale T, Schwartz SW, Adams JW, Hazard PB. A prospective, randomized, study comparing early percutaneous dilational tracheotomy to prolonged translaryngeal intubation (delayed tracheotomy) in critically ill medical patients. Crit care med. 2004;32(8):1689-94.
33. Griffiths J, Barber VS, Morgan L, Young JD. Systematic review and meta-analysis of studies of the timing of tracheostomy in adult patients undergoing artificial ventilation. B Med J. 2005;330(7502):1243-8.

Table 1: Patient outcome based on the timing of tracheostomy

Clinical parameters	Early tracheostomy (n=112)	Late tracheostomy (n=132)	P value
Average days on ventilator	4	16	<0.001
VAP (%)	24.2	48.5	<0.001
The average age of the patient	55.6	58.7	0.558
M:F ratio	1.24	1.13	0.667
Median days in ICU	19	30.5	<0.001
Number of intubations	2.24	1.45	<0.001
Mortality (%)	20.2	32.4	0.154