INDONESIAN JOURNAL OF ANESTHESIOLOGY AND REANIMATION
Volume 4 (2), July 2022: 115-119

Case Series

EARLY TRACHEOSTOMY IN PROLONGED MECHANICAL VENTILATION DUE TO SEVERE HEAD INJURY TO PREVENT VENTILATOR-ASSOCIATED PNEUMONIA (VAP)

Pratama Ananda[1a], **Sony** [1]

[1] Department of Anesthesiology and Intensive Care, Faculty of Medicine Riau University, Arifin Achmad Hospital, Pekanbaru, Indonesia

[a] Corresponding author: pratama.anestesi@gmail.com

ABSTRACT

Introduction: Early tracheostomy needs to be considered if a ventilator is expected to be used for an extended period of time. Early tracheostomy is recommended since it improves the respiratory function, reduces the risk of ventilator-associated pneumonia (VAP), improves patients' comfort level, cleanses secretions in the throat, reduces laryngeal ulceration, improves mobilization and speech efforts, and allows treatment outside the intensive care unit (ICU). **Case Series**: Four cases of severe head injury with early tracheostomy, which illustrate the prevention of VAP, were reported. In these four cases, early tracheostomy was performed (≤ 4 days) considering the initial critical GCS, the location of the lesion, and that mechanical ventilation was expected to be used for an extended period of time. During treatment, no VAP signs were detected, evidenced by Clinicial Pulmonary Infection Score (CPIS), rontgen thorax and sputum culture examinations. Based on a meta-analysis study, early tracheostomy reduces mortality due to VAP by up to 50% and reduces the length of stay in ICU compared to delayed/late tracheostomy (> 10 days) or prolonged intubation (> 14 days). **Conclusion:** In the study cases, early tracheostomy (<4 days) was found to be associated with reduced ventilation time and shortened ICU and hospital stays without an increased risk of VAP. VAP prevention efforts are carried out by applying early tracheostomy and VAP bundle as well. Early tracheostomy offers more benefits than prolonged intubation or delayed/late tracheostomy.

Keywords: Early Tracheostomy; Prolonged Mechanical Ventilation; Severe Head Injury; Ventilator-Associated Pneumonia (VAP)

ABSTRAK

Pendahuluan: Trakeostomi dini perlu dipertimbangkan jika penggunaan ventilator diperkirakan akan digunakan untuk waktu yang lama. Trakeostomi dini direkomendasikan karena dapat meningkatkan fungsi pernapasan, mengurangi Pneumonia terkait Ventilator (VAP), meningkatkan kenyamanan pasien, membersihkan sekresi di tenggorokan, mengurangi ulserasi laring, meningkatkan upaya mobilisasi dan bicara, dan memungkinkan perawatan di luar Unit Perawatan Intensif (ICU). **Serial Kasus:** Kami melaporkan empat kasus cedera kepala berat dengan trakeostomi dini yang dapat menggambarkan pencegahan VAP. Pada empat kasus tersebut, trakeostomi dini dilakukan (≤ 4 hari) dengan pertimbangan GCS awal, lokasi lesi, dan penggunaan ventilasi mekanik yang diperkirakan untuk jangka waktu yang lama. Selama perawatan tidak ada tanda-tanda VAP yang terjadi dibuktikan dengan *Clinicial Pulmonary Infection Score (CPIS),* pemeriksaan rontgen thorax dan kultur sputum. Berdasarkan studi meta-analisis didapatkan bahwa trakeostomi dini (≤ 4 hari) dapat mengurangi angka kematian akibat VAP hingga 50% dan mengurangi lamanya perawatan di ICU, dibandingkan dengan trakeostomi lama (> 10 hari) atau intubasi yang lama (> 14 hari). **Kesimpulan:** Pada kasus serial ini ditemukan bahwa trakeostomi dini (<4 hari) berkaitan dengan pengurangan waktu menggunakan Ventilator serta perawatan ICU dan RS tanpa disertai peningkatan resiko VAP. Upaya pencegahan VAP dapat dilakukan dengan menerapkan Bundle VAP dan Trakeostomi dini. Trakeostomi dini memberikan manfaat lebih banyak daripada intubasi berkepanjangan atau trakeostomi lama.

Kata kunci: Trakeostomi dini; Ventilasi Mekanik lama; Cedera Kepala Berat; *Ventilator Associated Pneumonia* (VAP)

Article info: Received February 17th 2022, Revised March 23rd 2022, Accepted July 27th 2022, Published July 28th 2022

Available at https://e-journal.unair.ac.id/IJAR | **DOI:** https://doi.org/10.20473/ijar.V4I22022.115-119

INTRODUCTION

Tracheostomy is a surgical measure to open the anterior wall of the trachea to allow mechanical ventilation through a tracheostomy tube. Tracheostomy is one of the most common procedures performed in intensive care unit (ICU) (1). Early tracheostomy (< 4 days) is considered if a ventilator is expected to be used for an extended period of time (more than 14 days). It is also recommended since it improves the respiration function, reduces the risk of nosocomial infection (ventilator-associated pneumonia/VAP), encourages quicker weaning from mechanical ventilation, increases patients' comfort, safety, and ability to communicate, cleans secretions in the throat, reduces laryngeal ulceration, increases mobilization and talking effort, as well as allows treatment outside the ICU (2-4). Hence, patients may expect shorter ICU stays, shorter days of mechanical ventilation, and shorter length of stay (LOS) in hospital. This case study aims to describe the advantages of early tracheostomy in several cases of severe head injury with prolonged mechanical ventilation.

CASE SERIES

A. Child D, 13 years old, did not wear helmet, the injury mechanism was unknown. In resuscitation room, vital signs were recorded as follows: blood pressure was at 112/54 mmHg, pulse rate was at 113x/minute, respiratory rate was at 12x/minute, temperature was at 38.7^{o} C. GCS of E1M3V1, bilateral isochoral pupils and a light reflex were detected. Head CT-scan without contrast showed contusion in the left frontal, bleeding in the intraventricular (IVH) and subarachnoid (SAH), and sinistra media fossa cranii base fracture. Non-operative management was decided. The patient was subsequently moved to ICU in an intubated state. Pressure control mode ventilator was installed and mannitol and anticonvulsants were administered.

B. Mr. S, male, 45 years old, found lying on the side of the road, wearing helmet. The injury mechanism was unknown. In resuscitation room, vital signs were recorded as follows: blood pressure was at 110/75 mmHg, pulse rate was at 120x/minute, respiratory rate was at 13x/minute, temperature was at 36.5^{o} C. GCS of E1M2V1, anisocoria pupils 2/5 mm, and a slow light reflex were detected. Head CT-scan without contrast showed bleeding in the intracerebral (ICH) dextra and sinistra basal ganglia region, as well as intraventricular (IVH). Neurosurgery decided a conservative therapy. The patient was subsequently intubated and connected to the ventilator and moved to the ICU.

C. Mrs. N, female, 55 years old, hit by a car, wearing helmet. In resuscitation room, vital signs were recorded as follows: blood pressure was at 147/88 mmHg, pulse rate was at 95x/minute, respiratory rate was at 14x/minute, temperature was at 36.5^{o} C. GCS of E1M1V4, isochoral pupils 3/3 mm, and a slow light reflex were detected. Head CT-scan without contrast showed ICH of dextra temporal front region. Neurosurgery decided to perform dextra ICH evacuation craniotomy. After operation, patient was observed in the ICU.

D. Mr. M, male, 42 years old, motorcycle-motorcycle collision, with a history of vomiting (+). In resuscitation room, vital signs were recorded as follows: blood pressure was at 100/80 mmHg, pulse rate was at 90x/minute, respiratory rate was at 20x/minute, temperature was at 36.5^{o} C. GCS of E1M1V3, isochoral pupils 3/3 mm, and a light reflex were detected. Head

Available at https://e-journal.unair.ac.id/IJAR | **DOI:** https://doi.org/10.20473/ijar.V4I22022.115-119

CT-scan without contrast showed frontal thin EDH (D), occipital parieto impression fracture (D) as well as cerebral edema (D). Neurosurgery decided to perform EDH evacuation craniotomy, reconstruction and ICP monitor. After operation, patient was observed in the ICU.

Management

On the 3rd day of treatment of patient Child D, early tracheostomy was performed since a long-term ventilator use (more than 14 days) was expected. On the 5th day of treatment, a repeat head CT was performed and indicated infarction at the sinistra temporal base. After 7 days of broad-spectrum antibiotic use, no bacteria growth was found in culture results of blood, urine and sputum. Thorax photo was also obtained to ensure that there was no infection and weaning from ventilator was able to be performed on the 9th day. On the 10th day, patient was moved to generic ward with GCS of E3M6Vx. Patient was discharged on the 30th day of treatment with GCS of E4M6V4.

On the 4th day of treatment of patient Mr. S, early tracheostomy was performed since there was no significant increase in consciousness and a ventilator would be used in a long period of time. Subsequently, a repeat head CT was performed on the 5th day and no additional bleeding occurred. However, the edema around the bleeding increased. No bacteria growth was found in the culture results of blood, urine and sputum and no infection signs were detected from thorax photo. Hence, the use of broad-spectrum antibiotic was continued until the 7th day (based on the recommendation of pneumonia management by ATS and IDSA). Weaning from ventilator was performed on the 16th day and patient was later moved to generic ward with GCS of E3M5Vx. Patient was discharged on the 33rd day of treatment with GCS of E4M6V2.

Dextra ICH evacuation craniotomy was decided to be performed on patient Mrs. N, immediately followed by early tracheostomy considering patient's critical initial GCS. It was expected that the improvement of GCS would take time and ICU treatment as well as long-term mechanical ventilation were required. After two days of treatment in ICU, the weaning from ventilator was performed. On the 4th day, the patient was able to be moved to HCU with GCS of E2M4Vx. Rontgen thorax and culture were obtained and no infection signs were detected. The culture results of blood and sputum indicated that there was no bacteria growth found during treatment. Patient was discharged on the 49th day of treatment with GCS of E4M6Vx.

On the 3rd day of treatment of patient Mr. M, early tracheostomy was performed, during which there was no increase in consciousness and a lot of sputum production was detected. After the tracheostomy, the weaning from ventilator was able to be performed on the 5th day of treatment. Patient was subsequently moved to HCU with GCS of E2M2Vx. A broad-spectrum antibiotic was continued after the treatment. The culture results of blood and sputum indicated that no bacteria found and the laboratory result as well as thorax photo suggested that antibiotic use could be stopped. Patient was discharged on the 54th day of treatment with GCS of E4M6Vx.

DISCUSSION

Based on observation of the above cases, several potential advantages of tracheostomy over endotracheal intubation were proposed. It improves the respiration function, reduces the risk of nosocomial infection (ventilator-associated pneumonia/VAP), enables more rapid weaning from mechanical ventilation, increases patients' comfort and safety, encourages patients' ability to communicate,

Available at https://e-journal.unair.ac.id/IJAR | **DOI:** https://doi.org/10.20473/ijar.V4I22022.115-119

cleans secretions in the throat, reduces laryngeal ulceration, increases mobilization and talking effort, as well as allows treatment outside the ICU. Based on the meta-analysis study results, early tracheostomy (<4 days) reduces mortality rate due to VAP up to 50% and shortens the treatment duration in ICU and hospital (length of stay/LOS) compared to late tracheostomy (>10 days) or prolonged intubation (>14 days) (2-4). Early tracheostomy is performed in critical III patients who are expected to use long-term mechanical ventilation or prolonged mechanical ventilation (more than 10-14 days) (1, 5, 6, 7). Patients are categorized in prolonged mechanical ventilation if the use of mechanical ventilation in the ICU is >5 days (8). Early tracheostomy offers numerous advantages compared to late tracheostomy or prolonged intubation, such as reduction in VAP, shortened duration of ventilator use and duration of ICU treatment. VAP is one of the leading causes of nosocomial death (9). VAP Bundle is performed on ICU patients using ventilators, and it is scientifically proven that VAP Bundle reduces the incidence rate of VAP by 25%. Early tracheostomy is performed on patients who are expected to be on a ventilator for an extended period of time, and one of the advantages is that it reduces the incidence of VAP. The VAP prevention efforts can be carried out by implementing VAP Bundle as follows:

1. Elevation head of bed is set at 30-45^{o}
2. Oral care with chlorhexidin is administered every 4-6 hours
3. Sedation vacation is carried out daily, allowing patients to wake up once every 24 hours
4. Readiness assessment of mechanical weaning from ventilation is carried out daily
5. Stress ulcer prophylaxis is administered in the first 24 hours of the use of mechanical ventilation
6. Deep vein thrombosis (DVT) prophylaxis is administered in the first 24 hours of the use of mechanical ventilation (10-12)

CONCLUSION

In this case study, early tracheostomy (<4 days) was found to be associated with reduced ventilation time as well as shortened ICU and hospital stays without an increased risk of VAP. Early tracheostomy offers advantages compared to prolonged intubation or late tracheostomy, namely reduction of VAP incidence rate, improvement of patients' comfort, more effective airway suctioning, decreased airway resistance, enhanced patient mobility, reduction of ventilator use duration, reduction of length of stay (LOS) in the ICU as well as reduction in hospital costs. Future studies with more cases to analyse are needed to draw definitive conclusions regarding early tracheostomy.

Acknowledgement
Not applicable.

Conflict of Interest
All authors stated there is no conflict of interest in this study.

Funding
This research did not receive any funding.

Authors' Contributors
All authors have contributed to all process in this research.

REFERENCES:

1. Ahmed, N. and Kuo, Y.H. Early versus late tracheostomy in patients with severe

Available at https://e-journal.unair.ac.id/IJAR | **DOI:** https://doi.org/10.20473/ijar.V4I22022.115-119

traumatic brain injury. Surgical Infections. 2007; 343–347.
2. Lu Q, Xie Y, Qi X, Li X, Yang S, Wang Y. Is Early Tracheostomy Better for Severe Traumatic Brain Injury? A Meta-Analysis. World Neurosurg. 2018 Apr; 112: 324-30.
3. Sheehan BM, Grigorian A, Gambhir S, Maithel S, Kuza CM, Dolich MO, Lekawa ME, Nahmias J. Early Tracheostomy for Severe Pediatric Traumatic Brain Injury is Associated with Reduced Intensive Care Unit Length of Stay and Total Ventilator Days. J Intensive Care Med. 2020 Nov; 35(11): 1346-51.
4. Marra A, Vargas M, Buonanno P, Iacovazzo C, Coviello A, Servillo G. Early vs. Late Tracheostomy in Patients with Traumatic Brain Injury: Systematic Review and Meta-Analysis. *J. Clin. Med.* 2021; 10(15): 3319.
5. Wang HK, Lu K, Liliang PC, Wang KW, Chen HJ, Chen TB, Liang CL. The impact of tracheostomy timing in patients with severe head injury: an observational cohort study. Injury. 2012 Sep; 43(9): 1432-36.
6. Andriolo BN, Andriolo RB, Saconato H, Atallah ÁN, Valente O. Early versus late tracheostomy for critically ill patients. Cochrane Database Syst Rev. 2015 Jan 12;1(1).
7. Meng L, Wang C, Li J, Zhang J. Early vs late tracheostomy in critically ill patients: a systematic review and meta-analysis. Clin Respir J. 2016 Nov; 10(6): 684-92.
8. Dunham CM, Cutrona AF, Gruber BS, Calderon JE, Ransom KJ, Flowers LL. Early tracheostomy in severe traumatic brain injury: evidence for decreased mechanical ventilation and increased hospital mortality. Int J Burns Trauma. 2014 Feb 22; 4(1): 14-24.
9. Li Y, Liu C, Xiao W, Song T, Wang S. Incidence, Risk Factors, and Outcomes of Ventilator-Associated Pneumonia in Traumatic Brain Injury: A Meta-analysis. Neurocrit Care. 2020 Feb; 32(1): 272-285.
10. Chrysochoou, G., Zikos, A. and Quigley, M. Early Vs Late Tracheostomy In Critically Ill Neurology And Neurosurgery Patients Chest. 2007; 132(4): 572A.
11. T. Szakmany, P. Russell, A. R. Wilkes, J. E. Hall, Effect of early tracheostomy on resource utilization and clinical outcomes in critically ill patients: meta-analysis of randomized controlled trials, *Brit. J. Anaes. 2015 Mar:* 114(3): 396–405.
12. Boyer AF, Schoenberg N, Babcock H, McMullen KM, Micek ST, Kollef MH. A prospective evaluation of ventilator-associated conditions and infection-related ventilator-associated conditions. Chest. 2015 Jan; 147(1): 68-81.

Available at https://e-journal.unair.ac.id/IJAR | **DOI:** https://doi.org/10.20473/ijar.V4I22022.115-119