Original Article

Correlation between timing of tracheostomy and duration of mechanical ventilation in patients with potentially normal lungs admitted to intensive care unit

Mehrdad Masoudifar, Omid Aghadavoudi[1], Lida Nasrollahi

Department of Anesthesiology and Critical Care, [1]Anesthesiology and Critical Care Research Center, Isfahan University of Medical Sciences

Abstract

Background: There is insufficient evidence to conclude that the timing of tracheostomy alters the duration of mechanical ventilation, hence this study was designed to investigate the correlation between timing of tracheostomy and duration of mechanical ventilation for patients admitted to intensive care unit (ICU) with potentially normal lungs.

Materials and Methods: In a retrospective study for a period of 2 years, all adult patients admitted to the medical ICU of Al-Zahra Hospital in Isfahan University of Medical Sciences who needed endotracheal intubation and prolonged mechanical ventilation were considered for inclusion in this study. Data of underlying disease, causes of respiratory failure, age and gender, duration of mechanical ventilation, and interval between intubation time and tracheostomy were collected. The correlations between intubation period and ventilation period were analyzed using a Pearson correlation test.

Results: Sixty-six percent of patients (100 patients) were men. The mean ± SD of age of patients was 56.2 ± 20.8 years (18–90 years.). The timing of tracheostomy (duration of endotracheal intubation until tracheostomy) did not exhibit any correlation with the length of mechanical ventilation ($P = 0.43, r = 0.08$). The timing of tracheostomy had not any correlation with the age of patients ($P = 0.20, r = 0.129$). The length of mechanical ventilation had not any correlation with the age of patients ($P = 0.83, r = 0.02$). The timing of tracheostomy was similar in men and women ($P = 0.5$). Mechanical ventilation period was not significantly different in both genders ($P = 0.89$).

Conclusion: Our study with mentioned sample size could not show any relationship between timing of tracheostomy and duration of mechanical ventilation in patients under mechanical ventilation with good pulmonary function in ICU.

Key words: Critical illness, intensive care unit, mechanical ventilation, tracheostomy

Address for correspondence:
Prof. Omid Aghadavoudi, Anesthesiology and Critical Care Research Center, Isfahan University of Medical Sciences, Isfahan, Iran. E-mail: aghadavoudi@med.mui.ac.ir

Received: 04-03-2012, Accepted:12-03-2012

Access this article online	
Quick Response Code:	Website: www.advbiores.net
	DOI: 10.4103/2277-9175.98148

INTRODUCTION

Patients in intensive care unit (ICU) with respiratory failure or decreased level of consciousness often require mechanical ventilation for long periods. The reasons for endotracheal intubation and mechanical ventilation include inadequacy of spontaneous ventilation and inability to protect airways. If the

How to cite this article: Masoudifar M, Aghadavoudi O, Nasrollahi L. Correlation between timing of tracheostomy and duration of mechanical ventilation in patients with potentially normal lungs admitted to intensive care unit. Adv Biomed Res 2012;1:25.

patient could not be extubated within 10–14 days or more, tracheostomy is suggested in the process of airway management in these patients, because of adverse effects of prolonged trans-laryngeal tracheal intubation, such as laryngeal stenosis. Meanwhile, opinions and protocols are controversial about the timing of tracheostomy.[1] Tracheostomy has become a progressively more common practice in patients requiring lengthened mechanical ventilation in ICU. Tracheostomy is among the most frequently performed procedures in critically ill patients and sometimes up to 24% of patients need this procedure at the ICU. Respiratory insufficiency and prolonged mechanical ventilation are the most common causes of tracheostomy.[2] Data and information gathered over recent years specify that patients who undergo tracheostomy surgery may possibly have healthier outcomes than those receiving extended durations of mechanical ventilation not undergoing tracheostomy. Tracheostomy has several advantages over endotracheal intubation, including lower airway resistance, smaller dead space, less movement of the tube within the trachea, greater patient comfort, and more efficient suction.[3] Although other studies have shown that tracheostomy can be a safe procedure in the ICU,[4] it could lead to serious complications, including tracheal stenosis and hemorrhage. The timing of tracheostomy depends on different factors, such as patients' clinical conditions, physician judgment, and communication with patients' families.[5] In the recent American College of Chest Physicians (ACCP) guidelines,[6] some physicians suggest that tracheostomy should be considered after an initial period of stabilization on the ventilator, when it becomes apparent that the patient will require prolonged ventilator assistance.

Romero *et al.* reviewed tracheostomy timing in traumatic spinal cord injury and concluded that early tracheostomy is better in such patients with prolonged duration of mechanical ventilation.[7] There are different results about the relationship between timing of tracheostomy and duration of mechanical ventilation.[3-5,7-10] Also there has been little evidence in this relationship among patients with potentially normal lungs. Therefore, we tried to show how the timing of tracheostomy and duration of intubation and mechanical ventilation based on gender could influence the duration of mechanical ventilation.

MATERIALS AND METHODS

Over a period of 24 months, all adult patients admitted to the medical ICU of AL-Zahra Hospital in Isfahan, Iran, and required prolonged mechanical ventilation were considered for inclusion in this retrospective study. Patients were excluded if the tracheostomy was performed in an emergency situation because of difficulties with the airway or other causes, organic problems other than neurologic or neuromuscular problem, pulmonary disorders (acute lung injury coefficient over 2) and those younger than 18 years. Tracheostomy was performed using standard surgical bedside procedure in the ICU, and no patients underwent percutaneous tracheostomy. The timing of tracheostomy depended on the attending physicians' decision. Indications to initiate an attempt to wean a patient from mechanical ventilation were stable hemodynamic status, improved oxygenation [arterial oxygen tension (PaO_2)/fractional inspired oxygenation > 150] controlled infection, and lack of need for further intervention.[1-3]

The weaning process was begun with intermittent mandatory ventilation with pressure support mode. Then patients underwent continuous positive airway with pressure support or intermittent T-piece for a spontaneous breathing trial when clinical conditions improved. Successful weaning was defined as weaning from mechanical ventilation for more than 72 h.[1] Data of underlying disease, including diabetes mellitus, hypertension, and hyperlipidemia, causes of respiratory failure, intracranial hemorrhage (ICH), intraventricular hemorrhage (IVH), meningitis, cerebrovascular accident (CVA), head trauma, Guillain–Barré syndrome, Duchenne disease, postoperative conditions, subarachnoid hemorrhage, age, gender, duration of mechanical ventilation, and interval of tracheostomy from intubation time were collected.

Values are expressed as mean ± standard deviation (continuous variables) or as a percentage of group frequency (categorical variables). Only variables with complete data were analyzed in the study. Timing to tracheostomy and duration of mechanical ventilation based on gender were analyzed using *t* test. The correlations between the timing tracheostomy and ventilation period were analyzed using Pearson correlation test. $P < 0.05$ was statistically significant.

RESULTS

A total of 100 patients who underwent tracheostomy in the ICU were included in the study. Sixty-six percent of patients were men. The mean ± SD of age of patients was 56.2 ± 20.8 years (18–90 years). The indications for intubation in the 100 patients were almost due to neurologic disorders (84%). Common underlying disorders were head trauma (24%), ICH or IVH (22%), CVA (20%), and surgery (16%).

The mean duration of endotracheal intubation until tracheostomy was 384 ± 191.9 h (range: 31–1151 h). The mean duration of mechanical ventilation, either intubated or with tracheostomy, was 754 ± 456 h (range: 215–3323 h). The duration of endotracheal intubation until tracheostomy did not exhibit a correlation with the length of mechanical ventilation ($P = 0.43$, $r = 0.08$) [Table 1]. The timing of tracheostomy and the length of mechanical ventilation had no correlation with age of the patients ($P = 0.20$, $r = 0.129$) and $P = 0.83$, $r = 0.02$, respectively) [Table 1]. The timing of tracheostomy was similar in men and women ($P = 0.5$). Mechanical ventilation period was not significantly different in both genders ($P = 0.89$) [Table 2].

DISCUSSION

The present study showed that patients who had longer timing tracheostomy had no longer mechanical ventilation period. Previous studies[2,3,7,11] conducted in surgical ICUs have shown that tracheostomy performed within 1 week after intubation may be beneficial in lowering the rates of pneumonia and in shortening the duration of mechanical ventilation and length of ICU stay. However, other studies reported a higher incidence of ventilator-associated pneumonia[12] and longer length of ICU stay[13] in association with tracheostomy. Our study with mentioned sample size could not show any relationship between timing of tracheostomy and duration of mechanical ventilation in patients under mechanical ventilation with good pulmonary function in ICU. The most common causes of respiratory failure in our study were neurologic disorders. In a neurologic ICU, tracheostomy is usually performed if there is a depressed level of consciousness and poor ability to protect the airway. One study by Brook *et al.* demonstrated that early tracheostomy in patients in a medical ICU shortened the length of hospital stay and lowered hospital costs.[14] Another study by Hsu *et al.* demonstrated that late tracheostomy may predispose to failure to wean and ICU mortality, especially when the intubation period is longer than 3 weeks. They also showed that the duration of intubation before tracheostomy was correlated with the length of ICU stay in patients who weaned successfully.[5]

Table 1: Correlation between age, duration of tracheal intubation, and mechanical ventilation in ICU patientsa

Variables		Age	Time - INT	Time - VEN
Age	r	1	0.129	0.02
	P	0	0.2	0.8
	N	100	100	100
Time - INT	r	0.29	1	0.08
	P	0.2	0	0.4
	N	100	100	100
Time -VEN	r	0.02	0.08	1
	P	0.8	0.4	0
	N	100	100	100

a Pearson correlation test. r, Correlation coefficient; P, *P* value; N, number; Time – INT, the duration of endotracheal intubation until tracheostomy; Time – VEN, the duration of mechanical ventilation

Table 2: Comparing duration of endotracheal intubation and mechanical ventilation based on gender

	Female	Male	t*	*P* value
The duration (h) of endotracheal intubation until tracheostomy	402.14 ± 203.7	374.8 ± 186.6	0.67	0.502
The duration (h) of mechanical ventilation	745.7 ± 532.3	758.2 ± 416.5	0.13	0.89

*Based on t test

Our study demonstrated that there were no obvious differences based on gender for timing of tracheostomy and mechanical ventilation period, and no correlation between age and timing of tracheostomy and mechanical ventilation period similar to the study conducted by Hsu *et al.* A longer intubation period was shown that causes failure to wean and late tracheostomy may predispose to poor weaning outcome.[5] A prolonged intubation period may impair the local barrier and bronchial hygiene, increasing the risk for bacterial colonization and results in a higher rate of post-tracheostomy pneumonia—an association that was found in the failure-to-wean group. In the present study, we found that the timing of tracheostomy does not correlate with mechanical ventilation period, but Hsu *et al.* in a multivariate analysis found that only late tracheostomy, pretracheostomy poor oxygenation, and post-tracheostomy pneumonia during the weaning period were independent predictors of unsuccessful weaning and longer mechanical ventilation period. This difference probably is caused by the type of ICU and medical patients' condition. In our study, all the patients had good pulmonary conditions but in Hsu's study some patients had chronic obstructive pulmonary disorder.

The 1989 ACCP consensus conference on artificial airways in patients receiving mechanical ventilation[15] suggested that tracheostomy is preferable if the anticipated need for mechanical ventilation is for more than 21 days. Recent ACCP guidelines[6] encourage early tracheostomy after patient stabilization if the patient needs prolonged mechanical ventilation.

CONCLUSION

In our study we found that in patients with good pulmonary function, the timing of tracheostomy could not influence the duration of mechanical ventilation.

REFERENCES

1. Esteban A, Anzueto A, Alia I, Gordo F, Apezteguia C, Palizas F, *et al.* How is mechanical ventilation employed in the intensive care unit? An international utilization review. Am J Respir Crit Care Med 2000;161:1450-8.
2. Ahmed N, Kuo YH. Early versus late tracheostomy in patients with severe traumatic head injury. Surg Infect (Larchmt) 2007;8:343-7.
3. Arabi YM, Alhashemi JA, Tamim HM, Esteban A, Haddad SH, Dawood A, *et al.* The impact of time to tracheostomy on mechanical ventilation duration, length of stay, and mortality in intensive care unit patients. J Crit Care 2009;24:435-40.
4. Kahveci SF, Goren S, Kutlay O, Ozcan B, Korfali G. Bedside percutaneous tracheostomy experience with 72 critically ill patients. Eur J Anaesthesiol 2000;17:688-91.
5. Hsu CL, Chen KY, Chang CH, Jerng JS, Yu CJ, Yang PC. Timing of tracheostomy as a determinant of weaning success in critically ill patients: A retrospective study. Crit Care 2005;9:R46-52.
6. MacIntyre NR, Cook DJ, Ely EW Jr, Epstein SK, Fink JB, Heffner JE, *et al.* Evidence-based guidelines for weaning and discontinuing ventilatory support: A collective task force facilitated by the American College of Chest Physicians; the American Association for Respiratory Care; and the American College of Critical Care Medicine. Chest 2001;120(6 Suppl):375S-95S.
7. Romero J, Vari A, Gambarrutta C, Oliviero A. Tracheostomy timing in traumatic spinal cord injury. Eur Spine J 2009;18:1452-7.
8. Bsel J, Schiller P, Hacke W, Steiner T. Benefits of early tracheostomy in ventilated stroke patients? Current evidence and study protocol of the randomized pilot trial SETPOINT (Stroke-related Early Tracheostomy vs. Prolonged Orotracheal Intubation in Neurocritical care Trial). Int J Stroke 2012;7:173-82.
9. Koch T, Hecker B, Hecker A, Brenck F, Preuß M, Schmelzer T, *et al.* Early tracheostomy decreases ventilation time but has no impact on mortality of intensive care patients: A randomized study. Langenbecks Arch Surg 2012.
10. Mascia L, Terragni P. Tracheostomy in ICU patients: Question of timing is question of indication. Minerva Anestesiol 2011;77:1137-8.
11. Diehl JL, El Atrous S, Touchard D, Lemaire F, Brochard L. Changes in the work of breathing induced by tracheotomy in ventilator-dependent patients. Am J Respir Crit Care Med 1999;159:383-8.
12. Ibrahim EH, Tracy L, Hill C, Fraser VJ, Kollef MH. The occurrence of ventilator-associated pneumonia in a community hospital. Chest 2001;120:555-61.
13. Kollef MH, Ahrens TS, Shannon W. Clinical predictors and outcomes for patients requiring tracheostomy in the intensive care unit. Crit Care Med 1999;27:1714-20.
14. Brook AD, Sherman G, Malen J, Kollef MH. Early versus late tracheostomy in patients who require prolonged mechanical ventilation. Am J Crit Care 2000;9:352-9.
15. Plummer AL, Gracey DR. Consensus conference on artificial airways in patients receiving mechanical ventilation. Chest 1989;96:178-80.

Source of Support: Isfahan University of Medical Sciences, **Conflict of Interest:** None declared.