

Does early tracheostomy affect the duration of mechanical ventilation in patients with severe traumatic head injuries?

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Background and purpose

Tracheostomy is a surgical procedure performed frequently in intensive care units (ICUs). Prolonged mechanical ventilation (MV) is the main indication for tracheostomy in ICUs. This study was conducted to investigate if early tracheostomy affects the duration of mechanical ventilation in patients with severe traumatic head injuries.

Patients and methods

It is a prospective, randomized study in which patients with severe post-traumatic head injuries, with a Glasgow Coma Scale of less than 8, were included. Patients were randomized into two groups; group of early tracheostomy (ET) included 53 patients subjected to tracheostomy before the seventh day of intubation and group of late tracheostomy (LT) included 34 patients subjected to tracheostomy on or after the seventh day of intubation. The total duration of mechanical ventilation, the complications of tracheostomy, and mortality were recorded.

Results

The mean duration of mechanical ventilation of ET group (ET=10.97±6.82) was statistically significantly shorter than the LT group (LT=16.28±8.65) ($P=0.002$). Complications were minor and not life threatening. No mortalities were detected because of tracheostomy.

Conclusion

Tracheostomy is a safe procedure with acceptable rate of minor complications. Early tracheostomy, before the seventh day of intubation, significantly shortens the duration of mechanical ventilation in patients with severe traumatic head injuries.

Keywords:

early tracheostomy, head trauma, mechanical ventilation

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Introduction

The tracheotomy is an old surgical procedure; it dates back to ancient Egypt [1]. From the first tracheostomy until early decades of the 20th century, tracheostomy was done exclusively for laryngeal obstruction [2]. Recently, tracheostomy was performed frequently in ICUs for patients subjected to prolonged intubation and ventilation [3]. Tracheostomy in ICUs is usually a procedure done electively to gain alternative aperture to the airway, instead of endotracheal tubes, to conduct mechanical ventilation (MV) [2]. By reviewing the literature, debates were found about the timing of performing tracheostomy in critically ill patients.

Patients and methods

This prospective, randomized study was conducted in trauma ICUs in Assiut University Hospital, Assiut, in Egypt after obtaining an Institutional Review Board (IRB) approval and issued IRB no: 00008718 from the Committee of Medical Ethics, Faculty of Medicine, Assiut University. It was conducted for 1 year between 1st of June 2015 and 31st of May 2016.

Inclusion criteria

Patients with severe post-traumatic head injuries with a Glasgow Coma Scale (GCS) of less than 8 requiring intubation and MV were included in the study. All age groups and both sexes were included. Before including participants into the study, the purpose and nature of the study were explained to their guardians as all our participants were critically ill patients and incapacitated. Their guardians agreed that they understand the investigational nature of the study benefits. They were free to terminate participation in this study without affection of clinical service or clinical management. They were free to ask about the nature of the study. An informed consent for the tracheostomy procedure was obtained from the guardians.

The patients were randomized according to the willingness of their guardians or families to perform

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early (ET) or late tracheostomy (LT). Patients of the ET group were subjected to tracheostomy before the seventh day of intubation, whereas patients of the LT group were subjected to tracheostomy at or after the seventh day.

Surgical technique

Tracheostomy was done in all patients by an open surgical technique under general anesthesia with hyperextended neck over a roll under their shoulders and was done in ICUs without the need to transfer the patients to the operating theater.

Patients were followed up during their stay in ICUs. Age, sex, timing of tracheostomy, and duration of MV were recorded. Complications of tracheostomy were managed and recorded as well as mortalities during hospital stay. The two groups were compared regarding age, sex, duration of MV, and hospital mortality.

Statistical analysis

The data were tested for normality using the Kolmogorov–Smirnov test and for homogeneity variances before further statistical analysis. Categorical variables were described by number and percent [n (%)]; continuous variables were described by mean and SD. χ^2 and Fisher's exact tests were used to compare between categorical variables. Unpaired t -test was used to compare between continuous variables for normally distributed data and Mann–Whitney U -test for non-normally distributed data. P value less than 0.05 was considered statistically significant. All analyses were performed with the International Business Machines Statistical Package for the Social Sciences IBM SPSS 20.0 software (IBM Corp., New York, USA).

Results

Out of the 237 patients who were intubated and mechanically ventilated in trauma ICUs during the period of the study, 87 patients fulfilled the inclusion criteria of the study and were included in the study (Fig. 1). After randomization, there were 53 patients in the ET group and 34 patients in the LT group.

The mean age of the ET group was 25.4 ± 17.5 years, whereas that of the LT group was 24.05 ± 17.52 years. Men were more than women in both groups with a percentage of 86.7 and 82.5% for the ET and the LT group, respectively. There were no statistically significant difference between the two groups regarding age and sex (Table 1).

The mean duration of intubation before tracheostomy in patients of ET groups was 5.4 days and ranged from 2 to 6 days, whereas that of the LT group was 11 days and ranged from 8 to 20 days. The mean duration of MV of the ET group ($ET = 10.97 \pm 6.82$) was statistically significantly shorter than that of the LT group ($LT = 16.28 \pm 8.65$) ($P = 0.002$) (Table 1).

Complications were recorded in 8% of the patients. They were minor and not life threatening. Tracheostomy stoma wound sepsis was the most common complication (Table 2).

Twenty-four (27.5%) of the studied patients died during hospital stay. Of those deaths, five patients were of the LT group, whereas 19 were of the ET group. Hospital mortality was found statistically significantly associated with early tracheostomy. ($P = 0.0325$) (Table 1). However, no mortalities occurred during the tracheostomy procedure or because of one of the complications of tracheostomy.

Discussion

In this current study, ET before the seventh day of intubation was found to be of significantly shorter duration of MV. In the literature, few studies were found discussing the effect of tracheostomy on the condition of head-injured patients [4–10]. However, most of them recorded a decrease in the duration of MV with early tracheostomy [7,8,10,11]. Lee *et al.* [12] found that tracheostomy increases the success rate of weaning in patients with a low GCS, but not in patients with high GCS. According to meta-analysis done by Griffiths [10], tracheostomy before the seventh day of intubation may lead to reduced duration of ventilation and shorten stays in ICUs in mechanically ventilated critically ill adult patients. A retrospective study reported significantly shorter duration of MV in patients with early tracheostomy before the fifth day of intubation [11]. Sanabria *et al.* [13] found that the probability of weaning patients from MV after the eighth day of intubation without a tracheostomy was low. Lim *et al.* [14] found that tracheostomy significantly improved the measured values of weaning parameters in patients who were difficult to be weaned.

These results can be explained by the fact that tracheostomy decreases dead space, airway resistance and increases tidal volume [14]. ET was associated with a decrease the incidence of ventilator-associated pneumonia and provided an effective way of airway suction [8,14]. In addition,

Figure 1

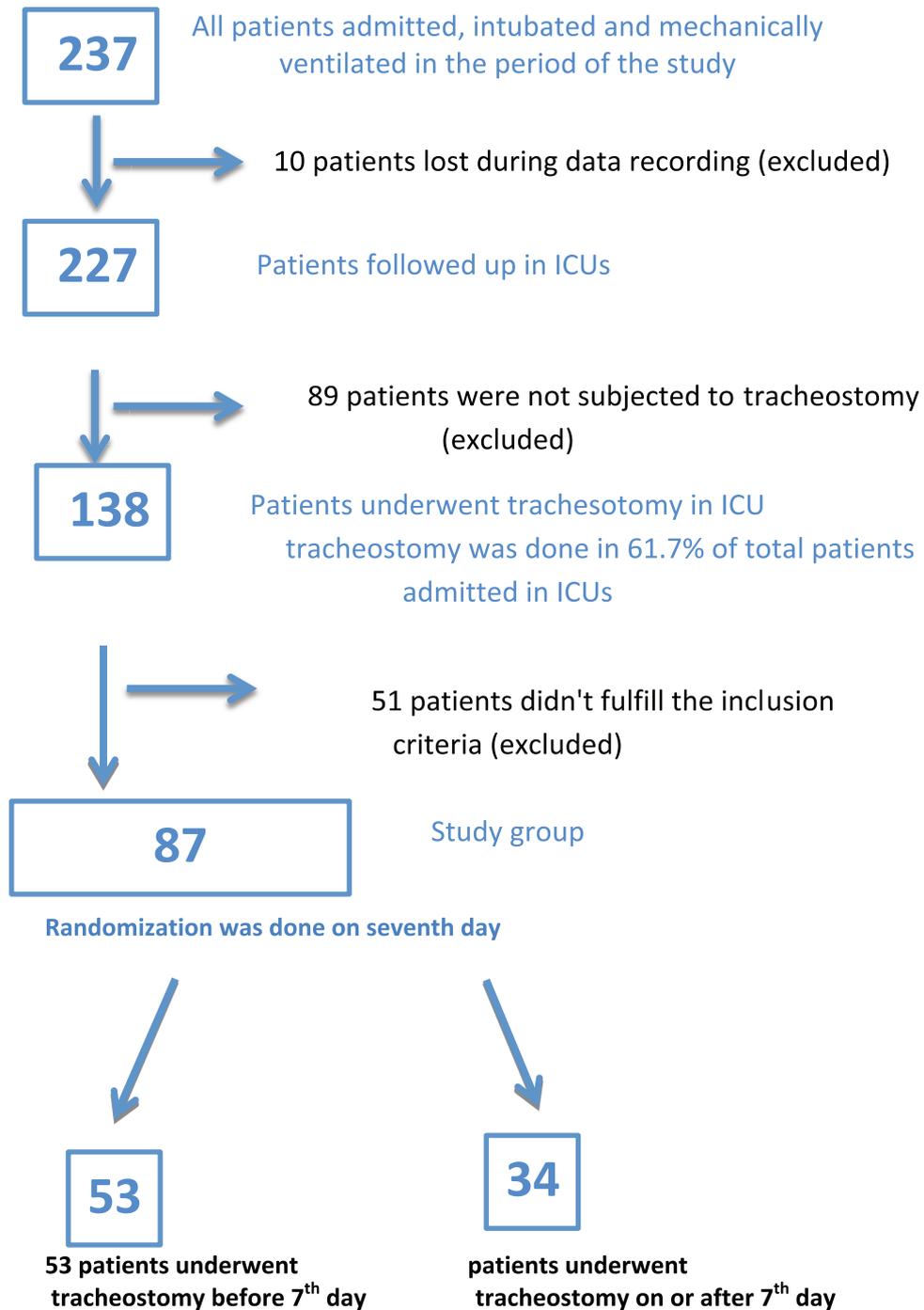


Figure 1 Flow chart of studied patients

Flow chart of studied patients.

Table 1 Demographic and clinical data of the patients in early tracheostomy and late tracheostomy groups

	ET group (n=53)	LT group (n=34)	P value
Age (mean±SD)	25.4±17.5	24.05±17.52	0.726
Sex (male/female)	46/7	28/6	
Duration of mechanical ventilation (days) (mean±SD)	10.97±6.82	16.28±8.65	0.002*
Mortality during hospital stay, [n (%)]	19 (35.8)	4 (14.7)	0.0325*

ET, early tracheostomy; LT, late tracheostomy. * $P < 0.05$ (statistically significant).

it shortens the duration of stay in ICUs as well as the duration of hospital stay [5]. Tracheostomy

improves the patient's comfort and decreases the required sedation [15].

Table 2 Complications of tracheostomy

Complications	No. of patients [n (%)]
Primary hemorrhage	1 (1.1)
Insertion of tracheostomy tube in false passage and patient desaturated	1 (1.1)
Tracheostomy stoma wound sepsis	5 (5.7)
Total	7 (8)

In spite of that most of the published papers recorded a shorter duration of MV with early tracheostomy. There were debates about how early should tracheostomy be performed in critically ill patients especially those with severe brain injury. According to Rodriguez *et al.* [16] and Boudierka *et al.* [8] early tracheostomy should be before the seventh and sixth day of intubation, respectively. However, Zirpe *et al.* [11] considered tracheostomy before the fifth day of intubation as ET. Dunham *et al.* [7] and Rumbak *et al.* [17] considered early tracheostomy before the third and fourth day of intubation. All of them recorded a decreased duration of MV after ET, in spite of the different definition of early tracheostomy according to each of them. Determination of an optimal timing of tracheostomy in severe head-injured patients requires additional multicentric studies. There are many factors affecting the decision of timing of tracheostomy, such as hemodynamic instability, fears of tracheostomy from the side of the guardians, and presence of cervical trauma that hinders neck mobility and may delay the decision of tracheostomy.

This study recorded that tracheostomy was a safe procedure. It was done in ICUs without significant complications. Also, no mortalities were recorded due to the tracheostomy procedure. These results were identical to Pogue *et al.* [18] and Vergas *et al.* [19].

In this study, the mortality rate was lower than other studies [8,11]. Also, no mortalities occurred during the tracheostomy procedure or because of complications of tracheostomy. However, hospital mortality was higher in patients with ET. Higher mortalities in patients with ET were in consistence with meta-analysis conducted by Dunham and colleagues and other studies [5,7,11,20]. However, all of these studies had no clear explanation to this finding. Further investigations and studies are required to explain this finding. In contrast, Koch *et al.* [21] and Siempos *et al.* [22] recorded nonsignificant low hospital mortality after ET.

Conclusion

Tracheostomy is a safe procedure with an acceptable rate of minor complications. ET, before the seventh

day of intubation, significantly shortens the duration of MV in patients with severe traumatic head injuries. Hospital mortality after ET should be investigated in further studies.

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Conflicts of interest

There are no conflicts of interest.

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