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Early or late tracheotomy in patients after multiple organ trauma

Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

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ABSTRACT:

Introduction: Prolonged mechanical ventilation in patients after multiple organ trauma is an indication for a tracheotomy procedure being performed i.a. to ensure proper hygiene of patient's airways. Recommendations regarding the optimum timing for the procedure remain ambiguous. Procedures performed before post-operative day 10 are beneficial for the further course of the treatment and patient's health.

Aim: The main objective of the study was to analyze the relationship between the timing of tracheotomy and the length of mechanical ventilation in patients with multiple organ trauma. Secondary objectives included the assessment of the relationships between the timing of tracheotomy and the lengths of intensive care unit (ICU) stay and total hospitalization as well as the incidence of pneumonia and mortality.

Material and methods: A retrospective analysis was carried out in 543 patients in whom tracheotomy had been performed at the Clinical Intensive Care Unit of the Military Institute of Medicine in years 2015–2019. Patients were divided into two groups: (1) those subjected to early tracheotomy (prior to hospitalization day 10); and (2) those subjected to late tracheotomy (at day 10 or later).

Results: Duration of mechanical ventilation was shorter in patients subjected to early tracheotomy (by 20.3 days on average). The ICU stay and overall hospitalization lengths were also significantly shorter (by the average of 39.4 and 43.1 days, respectively). The mortality rate in patients subjected to early tracheotomy was lower (2%) than in those subjected to late tracheotomy (9%). Pneumonic complications were more common in patients subjected to tracheotomy at hospitalization day 10 or later.

Conclusions: Tracheotomy performed within up to 10 days of hospitalization significantly shortens the lengths of mechanical ventilation, ICU stay, and total hospitalization while simultaneously reducing the risk of pneumonia. No correlation has been observed between the timing of tracheotomy and patient mortality rates.

KEYWORDS: mechanical ventilation, multi-organ trauma, tracheotomy

ABBREVIATIONS

GCS – Glasgow Coma Scale
ICU – Intensive Care Unit
MIM – Military Institute of Medicine
WHO – World Health Organization

INTRODUCTION

Tracheotomy is a common procedure carried out to replace endotracheal intubation if prolonged mechanical ventilation is required in patients who had suffered multiple organ trauma. According to the statistical data from the World Health Organization (WHO), injuries are estimated to cause some 5.8 million deaths annually, their number increasing every year [1, 2]. Trauma-related mortality and morbidity rates are a major public health problem [2, 3]. Patients requiring long-term mechanical ventilation qualify for a tracheotomy procedure. Compared to prolonged intubation, tracheotomy has numerous advantages, including reduced risk of laryngeal injury, facilitation of patient being fed orally, and facilitation of nursing care [4]. Tracheotomy provides a stable and well-tolerated access to the respiratory tract, facilitating proper hygiene and improving the quality of patient care. Consequently, tracheotomy seems to reduce the rates of ventilator-associated pneumonia [5]. Tracheotomy is an invasive procedure carried out mainly by means of two operational techniques: a conventional open surgery and a percutaneous procedure with tracheotomy being performed between tracheal cartilages under tracheobronchoscopic guidance [6, 7]. Irrespective of the operating technique, the procedure involves a minimal risk of complications such as bleeding, subcutaneous edema, local infection, or tracheal stenosis [4, 8]. It is considered to be a safe procedure, frequently carried out in a bedside setting at the intensive care unit (ICU) [9]. Tracheotomy is recommended in cases of prolonged mechanical ventilation. In addition, it also provides better conditions for future discontinuation of mechanical ventilation in patients [10].

Considerable differences can be found in available data regarding the optimum timing for the tracheotomy procedure [11, 12]. Late tracheotomy (i.e. procedure performed at 10 or more days after the trauma and establishment of endotracheal intubation), being preferred to early tracheotomy (i.e. procedure performed within up to 10 days after the trauma and intubation) in patients with serious brain injuries remains controversial [5, 13]. Most of the most recent scientific reports suggest the benefits of early tracheotomy. Performed within up to 10 days after intubation, the procedure may shorten the length of mechanical ventilation [14] and lower the cost of treatment of patients in critical conditions [15].

AIM

The main objective of the study was to analyze the relationship between the timing of the tracheotomy procedure and the length of mechanical ventilation in patients with multiple organ trauma. Secondary objectives included the assessment of the relationships between the timing of tracheotomy and the length of ICU stay and overall hospitalization as well as the incidence of pneumonia as a complication of mechanical ventilation treatment and mortality. The relationships between the baseline level patient's consciousness as expressed using the Glasgow Coma Scale (GCS) and the timing of tracheotomy procedure and hospitalization length were also assessed to determine whether individuals with lower baseline GCS scores should be qualified for early tracheotomy more frequently.

MATERIAL AND METHODS

This is a retrospective analysis of patients in whom tracheotomy had been performed in the course of the management of multiorgan trauma at the Intensive Care Unit of the Military Institute of Medicine in years 2015–2019. In the total population of 543 patients with multi-organ trauma, tracheotomy was performed in 124 patients (20 women and 104 men). Subjects were divided into two groups – G1 and G2 – according to the timing of tracheotomy. G1 consisted of patients in whom tracheotomy was performed before hospitalization day 10 (early tracheotomy), whereas G2 consisted of patients in whom tracheotomy was performed on hospitalization day 10 or later (late tracheotomy). G1 consisted of 46 patients (7 women and 39 men) aged 19 to 73 years (average of 40 ± 15 years) while G2 consisted of 78 patients (13 women and 65 men) aged 18 to 89 years (average of 44 ± 18 years.

Statistical analysis was performed using the Dell Statistica 13.0 software package.

RESULTS

The analysis of the study group of 124 patients revealed a statistically significant shortening of mechanical ventilation requirement period in patients in whom tracheotomy had been performed before hospitalization day 10 (G1). The average length of mechanical ventilation was shorter by 20.3 days in G1 as compared to G2. On average, the duration of ICU stay was shorter by 39.4 days in G1 as compared to G2. Total hospitalization time was also significantly shorter in this group of patients (G1). The overall length of hospital stay for patients in whom tracheotomy had been performed prior to hospitalization day 10 was on average 43.1 days shorter as compared to patients in whom the procedure had been performed at a later date. Tab. I. provides the comparison of the results obtained in both study groups. Statistically significant differences ($p < 0.05$) were demonstrated between G1 and G2 regarding the length of the mechanical ventilation, the length of ICU stay, and length of hospitalization.

Tab. I. Comparison of mechanical ICU stay and hospitalization lengths in study groups.

	MECHANICAL VENTILATION [DAYS]	ICU STAY [DAYS]	HOSPITALIZATION [DAYS]
	G1		
Mean ± SD	11.3 ± 6.1	25.4 ± 16.1	42.9 ± 31.2
	G2		
Mean ± SD	31.6 ± 21.6	64.8 ± 41.3	86.0 ± 50.1

Tab. II. Comparison of the incidence of pneumonia in the study groups.

PATIENT GROUP	PATIENTS WITH PNEUMONIA	PNEUMONIA-FREE PATIENTS
G1	13% (6)	87% (40)
G2	34% (26)	66% (51)

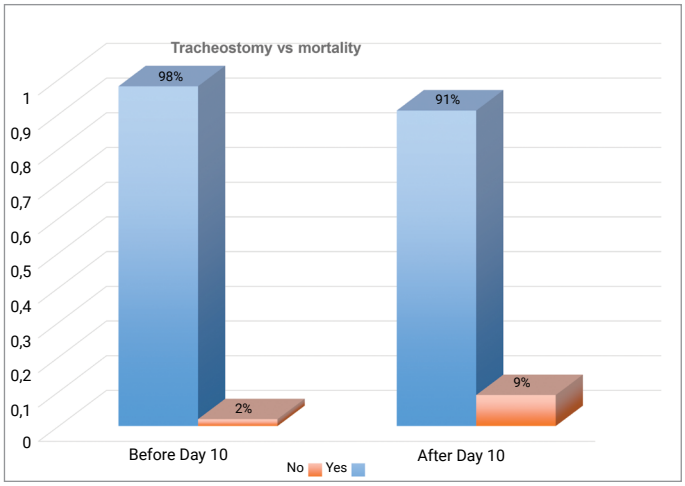

Fig. 1. Comparison of patient mortality in the study groups.

No statistically significant differences were observed in mortality rates between the study groups (Fig. 1.) ($P = 0.256$). The mortality rate in early tracheotomy group (G1) was lower and amounted to 2%. In patients in whom tracheotomy was performed on day 10 or later (G2), the mortality rate was slightly higher and amounted to 9%. In some patients, initiation of treatment was required due to pneumonia developing as a complication in mechanically ventilated patients and referred to as ventilator-associated pneumonia. This complication developed in 6 patients in G1 and 26 patients in G2. The study assessed the relationship between the occurrence of this complication and the timing of tracheotomy. Pneumonia was significantly more frequent in patients in whom tracheotomy had been performed on hospitalization day 10 or later ($P = 0.011$).

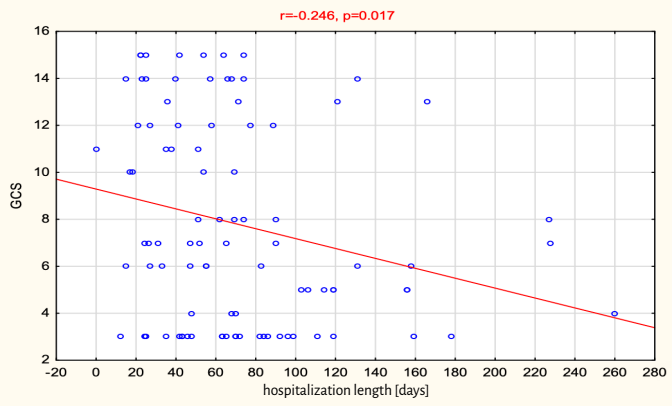

Fig. 2. Correlation between the GCS score and the length of hospitalization in the study patients

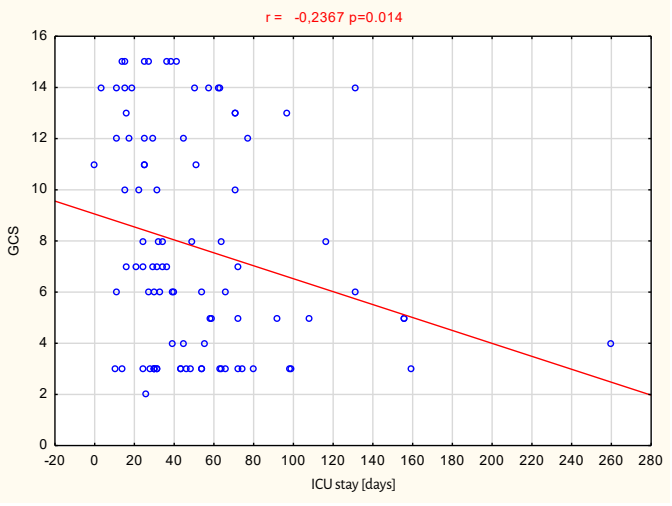

Fig. 3. Correlation between the GCS score and the length of the ICU stay in the study patients.

The comparison of results is presented in Tab. II.

Another analyzed aspect of the study consisted in the results obtained by the patients in the baseline evaluation of the level of consciousness as assessed using the Glasgow Coma Scale (GCS). Data were checked for potential correlation between the GCS scores and the timing of the tracheotomy and the lengths of mechanical ventilation, ICU stay, and hospitalization. Correlation between GCS scores and the duration of stay within the ICU was demonstrated with a statistically significant correlation coefficient (Spearman's rank coefficient in the range of –0.4 to –0.2).

ICU stay and total hospitalization lengths were shorter in patients with higher baseline GCS scores compared to patients with lower baseline GCS scores. The results are illustrated graphically (Fig. 2., 3.).

DISCUSSION

Tracheotomy is a common surgical procedure performed in patients after multiple organ trauma requiring prolonged mechanical ventilation. In our study, a total of 78 patients (63% of the study population) had undergone late tracheotomy as opposed to the remaining 46 patients (37% of the study population) who had undergone early tracheotomy (before hospitalization day 10). The lengths of mechanical ventilation, ICU stay, and overall hospitalization were shown to be significantly shorter in the early tracheotomy group. This observation is consistent with the literature data [13, 12]. Herritt et al. [15] demonstrated that hospital stays were shorter in early tracheotomy group (average of 16.1 days) as compared to late tracheotomy group (21.5 days); the same was observed for ICU stays, with the average length of the stay being 35.8 days in patients with early tracheotomy vs 51.7 days in patients with late tracheotomy.

As shown by Liu et al. [16], early tracheotomy was associated with lower numbers of mechanical ventilation days; in addition, early tracheotomy was shown to be capable of significantly reducing the direct and probably also total costs of ICU treatment (due to shortening the length of patient's stay at the ICU). However, contradictory scientific reports were also published; for example, the meta-analysis by Meng et al. [4] revealed no significant relationship between the timing of tracheotomy and the lengths of mechanical ventilation and ICU stay. No relationship was demonstrated in our study between the timing of tracheostomy and the total mortality rate.

These results are in line with those from a large randomized study by Young et al. [14] where no such relationship was demonstrated as well.

The study showed that ventilator-associated pneumonia as developing in tracheotomy patients was more frequent in those in whom the procedure had been performed later rather than earlier (i.e. at day 10 or later). Similar results were reported by Siepmpos et al. [17] and Koch et al. [6]; early tracheotomy was associated with a reduction in the incidence rates of pneumonia (38% early vs 64% late tracheotomy), and it appears that people with lower baseline consciousness levels (lower GCS scores) should be more often qualified for early tracheostomy due to the potentially longer ventilation and OIT stay days.

During the COVID-19 pandemic, tracheotomy is frequently performed in ventilated COVID-19 patients [18–20]. Kwak et al. [21] demonstrated shorter ICU stays in COVID-19 patients win whom tracheotomy had been performed early (within up to 10 days). The median ICU stay was 40 days in patients subjected to early tracheostomy (within 10 days of endotracheal intubation) and 49 days in those who subjected to late tracheostomy. In addition, the likelihood of discontinuation of mechanical ventilation due to improvement in the overall condition was 16% lower in the late tracheotomy group. Due to the low number of scientific reports, no clear guidelines are currently available regarding the recommended timing for tracheotomy procedures in patients receiving mechanical ventilation due to COVID-19 [21–23]. Due to the lack of unambiguous literature data, further multi-center studies or meta-analyses may be required.

CONCLUSIONS

1. Early tracheotomy (prior to hospitalization day 10) has a statistically significant effect on reducing the lengths of mechanical ventilation, ICU stay, and overall hospitalization;

2. The risk of pneumonia as one of the possible complications of mechanical ventilation is lower in patients undergoing early tracheotomy;

3. No statistically significant correlation was observed between the timing of tracheotomy and patient mortality rates;

4. The higher the baseline GCS score of the patient, the shorter their total hospitalization and ICU stay lengths. It seems appropriate that tracheotomy is performed early in patients with initial GCS scores of less than 8 points.

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