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Retrospective Study

Tracheotomy in Severe Head Trauma: Early *vs.* Late

Nada Benabdelouahab*, Hajar Moujtahid, Larbi Aberouch, Jaouad Tadili, Ali Kettani and Mamoun Faroudy

Surgical Emergency Intensive Care Unit, Ibn Sina Hospital, Rabat, Morocco

Summary

Introduction: The evolution of a patient with severe traumatic brain injury may require the use of a tracheostomy as part of respiratory weaning. The central question revolves around the optimal timing to replace intubation with tracheostomy. The aim of this study is to evaluate the hypothesis that early tracheostomy reduces the incidence of ventilator-associated pneumonia (VAP), the duration of mechanical ventilation (MV), and the length of stay in the intensive care unit (ICU).

Materials and methods: This was a retrospective study including all patients admitted to the department over a period of 08 months. Various historical, demographic, clinical, biological, and progression-related covariates were collected upon admission.

Results: Among the 69 patients included in the study who underwent surgical tracheostomy, two groups were formed: those who underwent early tracheostomy (within the first 8 days of mechanical ventilation) and those with late tracheostomy (after 8 days). The early group showed a significant reduction in the duration of mechanical ventilation (16 ± 3 days) and length of stay in the intensive care unit (17 ± 3 days) compared to the late group (23 ± 6 days and 30 ± 11 days, respectively). No significant differences were observed regarding the incidence of ventilator-associated pneumonia (VAP) and mortality between the two groups.

Conclusion: This study strengthens the existing literature by demonstrating that early tracheostomy is associated with a reduction in the duration of MV and length of stay in the ICU.

More Information

***Address for Correspondence:**
Nada Benabdelouahab, Surgical Emergency Intensive Care Unit, Ibn Sina Hospital, Rabat, Morocco,
Email: nadabenabdelouahab2@gmail.com

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Introduction

The initial management of a patient with severe head trauma aims to ensure patency of the airways and prevent hypoxia through mechanical ventilation [1].

The recovery time of these patients is variable and difficult to predict, extubation often remains uncertain and exposes them to a major risk of complications due to possibly impaired management of the aero-digestive crossroads. Delay in extubation is associated with an increased risk of ventilator-acquired pneumonia while failure to extubate leads to the development of pneumonia [2,3], in both situations. Respiratory damage is burdened with significant morbidity and mortality, especially in this particular intensive care population [4].

It is a therapeutic project that can be long, hence the indication of tracheotomy which facilitates weaning in patients under long-term mechanical ventilation also reduces the length of stay in the care unit. Intensive Care Units (ICU) and avoid complications of prolonged tracheal intubation [5,6]. The central question revolves around the optimal timing to replace intubation with tracheostomy, with delays ranging from 3 to 10 days according to the literature and no standardized definition to date.

The main indications for tracheotomy in patients with severe head trauma are failure of weaning, absence of protective airway reflexes, impairment of respiratory function, and difficulty in taking charge of secretions. However, the beneficial effects, timing, and indications for tracheotomy in patients with severe head trauma are still debated [7].

Tracheotomy has numerous advantages over endotracheal intubation: it allows protection against laryngeal lesions secondary to prolonged intubation [8] and reduction of airway resistance, dead space, and labor. respiratory, greater ease of aspiration which allows better pulmonary hygiene [6,9], oral hygiene and greater comfort for the patient (resumption of oral food and articulate language, etc.) and finally tracheostomy essentially accelerates weaning from mechanical ventilation.

Despite all its potential benefits, the procedure is associated with several complications, including bleeding, stoma infection, tracheal stenosis, and tracheoesophageal fistula. Therefore, risk-benefit analysis is important in the decision to proceed. Recommendations from American consensus conferences state that tracheostomy is the preferred method of artificial airway if the patient must be on a ventilator for more than a week in head trauma patients. This same report suggests that early tracheostomy in critically ill patients can significantly reduce the incidence of ventilator-associated pneumonia, ventilator days, length of intensive care unit (ICU) stay and total hospital stay [10].

The interest of this study is to compare two groups of tracheotomized patients and to evaluate the hypothesis which states that early tracheotomy makes it possible to reduce the duration of mechanical ventilation and the incidence of pneumonia acquired under mechanical ventilation.

Materials and methods

This is a single-center retrospective observational study, which was carried out in a surgical emergency intensive care unit at the Ibn Sina Hospital in Rabat, over a period of 8 months, from January to August 2022.

Patients with severe head trauma, aged over 18 years, who were under mechanical ventilation (defined by a MV > 48 hours) and who had undergone a tracheotomy, using a surgical technique during their stay in intensive care. No patient underwent percutaneous tracheostomy.

The factors related to the decision to perform a tracheotomy have been identified: age, a Glasgow Coma Scale (GCS) score of < 8 at the initial assessment, non-reactivity of at least one pupil, the presence of thoracic trauma, and hypoxemia at the initial assessment.

The time for performing the tracheotomy was chosen following the recommendations of the Consensus Conference of the French Society of Resuscitation (SRLF): the experts of this conference recommend performing the tracheotomy when weaning from mechanical ventilation is prolonged: weaning during more than 7 days after the first attempt at spontaneous breathing [11], experts also recommend not performing tracheotomy in intensive care before the fourth day of mechanical ventilation (strong agreement) [12].

The surgical technique performed in the department is carried out on a patient in a supine position, under general anesthesia, with the neck in extension. The skin incision is made horizontally, extending 3 cm - 4 cm 2 cm below the cricoid cartilage. The parathyroid muscles are vertically separated along the midline to avoid bleeding and then retracted laterally. Tracheal access is achieved horizontally at C2-C3 or C3-C4 levels until the posterior membrane. The trachea will only be opened after preparing the chosen tracheostomy tube on the operating table. The patient will be pre-ventilated with pure oxygen, then the endotracheal tube will be removed, and the tracheostomy tube inserted. The cuff will be inflated, and the pressure checked with a manometer: maximum 35 cm H_2O or 25 mm Hg. A chest X-ray is routinely performed at the end of the procedure.

At admission, demographic data including age, gender, as well as IGS II (Simplified Severity Index), APACHE II (Acute Physiology And Chronic Health Evaluation) severity scores, and Glasgow (GCS) were recorded including tracheostomy time (in days) for each patient. The patients were then divided into two groups by tracheostomy time: early tracheotomy (performed within the 8th day after the start of MV), and the late group (tracheotomy performed beyond the 8th day). The number of days between admission to intensive care and tracheostomy, the duration of sedation, mechanical ventilation (MV) as well as the length of stay in intensive care (DS) were calculated.

The occurrence of nosocomial pneumonia (NP) and the mortality rate were also collected. The diagnosis of pneumonia was made on the basis of fever, leukocytosis, positive culture in tracheobronchial aspirates, and new radiopacity or #39; worsening of opacity on chest radiograph, as described by Johanson, et al.

The mechanical ventilation weaning process followed a standard protocol. Prerequisites for initiating weaning included an inspired oxygen fraction below 50% and a positive end-expiratory pressure below 5 cm H_2O, along with hemodynamic stability without the need for inotropic or vasopressor support. These criteria were assessed daily by the healthcare team. Weaning commenced with a spontaneous breathing trial conducted using a T-piece or with the assistance of inspiratory support. A patient was considered successfully weaned after a period of 48 hours without the need for mechanical ventilation.

Data analysis was conducted using the Jamovi software. Tests were employed to compare the two groups of patients: for qualitative variables, the chi-square test or Fisher's exact test, and for quantitative variables, the Student's *t* - test or Mann-Whitney *U* test. Data are presented as the mean ± standard deviation for variables following a normal distribution and as the median and interquartile range for variables with a skewed distribution. A two-tailed *p* - value < 0.05 was considered significant.

Ethical considerations

The study was conducted in accordance with the Helsinki Declaration. Informed consent was obtained.

Results

From January to August 2022, 286 patients were admitted to intensive care. Of these, 240 patients (83%) were on VM. 73

patients had head trauma, and only 69 were included in this study based on eligibility criteria: Adult patient > 18 years old, serious head trauma having undergone a tracheotomy during his stay in intensive care. The prevalence of tracheostomy was therefore 28% in patients on mechanical ventilation.

The tracheotomy was performed on average 9 ± 5 days after initiation of MV (median = 10 days) with extremes ranging from 7 days to 17 days. We note a clear reduction in the duration of ventilation in the early tracheotomized group, by definition on the eighth day (Group 1) compared to the rest of the patients (Group 2).

No differences were observed between the two groups with regard to age, sex, comorbidities, GCS and APACHE II and IGS II severity scores (Table 1).

The duration of mechanical ventilation was described in group 1 at 16 days compared to group 2 whose duration exceeded 23 days on average ($p < 0.01$). The length of stay is also reduced with an average of 17 days *vs.* 30 days ($p = 0.02$).

The delay in tracheostomy had no influence on the prevalence of nosocomial pneumonia (24% (Group 1) *vs.* 32% (Group 2) $p = 0.14$, nor on patient mortality (34 *vs.* 35%, $p = 0.093$), (Table 2). Early tracheostomy was associated with a significant reduction in MV duration (16 ± 3 *vs.* 23 ± 6 days, $p = 0.01$) and length of stay in intensive care (17 ± 3 *vs.* 20 ± 11 days, $p = 0.04$).

Discussion

Tracheotomy is probably the oldest procedure known in medical literature, as described by Asclepiades of Bithynia in the 2nd century BC [13]. It is the most frequently performed operation in intensive care patients. Despite centuries of experience, controversy still exists regarding the timing.

Our work demonstrated that early tracheostomy (≤ 8 days) was associated with a reduction in the duration of MV and LOS in intensive care. On the other hand, the delay in tracheostomy had no influence on the prevalence of PN or on the survival of these patients.

In our study, tracheostomy was performed with a median of 10 days after initiation of MV, which is quite early compared to certain studies, such as the French multicenter study by Blot, et al. (median: 20 days). In contrast to the Chinese team of Wenchao & Al who were more aggressive and performed a tracheotomy quite early (median: 5 days) [14,15]. We note that the results in the literature differ depending on the timing of the tracheotomy.

At Blot & Al, early tracheotomy (defined at 10 days) had no influence on the duration of ventilation, the length of stay, nor the incidence of VAP or mortality, on the other hand, Wenchao and Al showed after their study that early tracheotomy (defined at 3 days) significantly reduced the duration of ventilation and the length of stay ($p < 0.01$), the incidence of VAP ($p = 0.05$), and the duration of antibiotic therapy, without having any influence on mortality ($p = 0.62$). Our study provided consistent results compared to the literature. We conclude that the timing of tracheostomy and the definition of early tracheostomy are correlated with the results on ventilation times, length of stay, and the incidence of VAP.

Very few reports in the literature address the ideal timing for tracheostomy in ventilated head trauma patients. The first randomized was a multicenter study conducted by Rodriguez, et al. in the late 1984s [16], they included non-cerebral trauma patients, who were randomized into an early group, with an average ventilation duration of 4 days before the tracheostomy, and a late group, with 11 days of ventilation, they concluded that early tracheostomy reduced the length of ICU stay and hospital days. Sugerman, et al. conducted another randomized trial [17], their classification of early tracheostomy was 3-5 days *vs.* late tracheostomy 10-14 days, they included GCTs, non-cranial injuries, and patients in surgical intensive care. Their results showed no significant benefit of early tracheotomy on pneumonia incidence, length of ICU stay, or mortality rate.

Moulay, et al. prospectively collected patients with GCT who had an initial GCS of 8 and a brain contusion confirmed by computed tomography (CT) [18], the patients were divided into an early group (fifth day) and a group with intubation prolonged endotracheal. Patients who underwent early tracheostomy showed a decrease in the duration of mechanical ventilation, as well as the duration of ventilation after the diagnosis of pneumonia. There were no significant differences in the length of ICU stay.

Table 1: Comparison of demographic characteristics of tracheostomized patients.

	Early tracheotomy (N = 29}	Late tracheotomy (N = 40)	*p* value
Age (mean, SD)	46 ± 15	43 ± 14	0.16
Gender (M/F)	42/15	34/12	0.25
IGS II (mean, SD)	29 ± 13	25 ± 11	0.14
ISS	17 ± 5	15 ± 3	0.31

Table 2: Outcome of tracheostomized patients: Early *vs.* late.

	Group 1: Early tracheotomy (N = 29)	Group 2: Late tracheotomy (N = 40)	*p* - value
Total ventilation time mechanical (j) (Median, standard deviation)	16 ± 3	23 ± 6	< 0.01
Duration of mechanical ventilation before tracheostomy (d) (median, standard deviation)	8 ± 2	11 ± 6	< 0.01
Duration of mechanical ventilation after tracheostomy (d) (median, standard deviation)	8 ± 1	11 ± 3	0.05
Total length of stay in intensive care (d) (median, standard deviation)	17 ± 3	30 ± 11	0.02
Pneumonitis acquired by mechanical ventilation (N%)	7 (24%)	13 (32.5%)	0.14
Mortality (N(%)	10 (34%)	14 (35%)	0.09

That said, the literature is mainly in favor of early tracheotomy in patients with severe head trauma. Several meta-analyses have proven the advantage of early tracheotomy in reducing the length of stay and the duration of mechanical ventilation in intensive care, without demonstrated effects on patient mortality and the incidence of VAP [19].

We have methodological limitations with a relatively small and retrospective sample involving a heterogeneous population. Moreover, as there is still no consensus on the precise timing of early tracheostomy (No consensus exists), we are nonetheless considering expanding our sample size and implementing a prospective study with earlier tracheostomy timelines to monitor for improved outcomes.

Conclusion

We have methodological limitations with a fairly small and retrospective sample with a heterogeneous population. Especially since there is still no proper definition of the timing of early tracheotomy.

Thus our present study reinforces the data from the literature in showing that performing an early tracheotomy is associated with a reduction in the duration of mechanical ventilation and therefore the length of stay in intensive care.

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