



## Relationship between Airway Management and Duration of Mechanical Ventilation in Cervical Spine Trauma

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### Abstract

**Objectives:** The aim of this work is to study the relationship between the early airway management and duration of mechanical ventilation, in the context of improving the prognosis of cervical spine trauma patients.

**Patients and Methods:** Exhaustive descriptive-type study with prospective collection, carried out over a period of three and a half years at the level of several structures of Tlemcen University Hospital, namely the medical and surgical emergencies, multipurpose resuscitation and neurosurgery departments. It focuses on cervical spine trauma patients treated from the accident scene to the neurosurgery and/or medico-surgical resuscitation departments of Tlemcen University Hospital. All admitted for cervical spine trauma, whatever the level reached; the mechanism of the accident; the therapeutic decision (surgical or orthopedic), with or without neurological lesions and over 16 years old.

**Results:** Orotracheal intubation was performed in 32.81% of the 128 patients identified in our study, it should be noted that two patients arrived already intubated. 25% were intubated in the first day and 3.1% in the second day. The last patient to be intubated, was on the 16th day following his hospitalization. The ventilatory parameters were regulated in such a way as to have a SpO<sub>2</sub> > 90%. The sedation of our patients in the intensive care units was ensured by the combination of Midazolam and Fentanyl with an electric syringe, and maintained until clinical and radiological improvement. All were sedated and placed on mechanical ventilation. Of all intubated patients, 7.81% received a tracheostomy while in hospital. The median survival is  $3 \pm 5.47$  days in the group of patients who have been intubated and  $74 \pm 1.42$  days in the group who have not been.

**Conclusion:** It is concluded that the occurrence of infectious broncho pulmonary complications in 31% of intubated patients (13/42 intubated) was correlated with the duration of hospitalization of our cervical spine trauma patients at Tlemcen University Hospital, establishing thus a statistically significant relationship between them ( $P = 0.000$ ).

**Keywords:** Cervical Spine Trauma; Airway Management; Mechanical Ventilation; Infectious Respiratory; Length of Hospitalization

### Introduction

Cervical spine trauma is a disabling pathology due to motor deficit and the sphincter disorders caused, but also fatal, respiratory

and/or hemodynamic disorders [1], requiring early and effective intensive care.

Respiratory complications quickly require ventilatory assistance and remain among the most important causes of morbidity and mortality for this type of patient [2].

The trauma of the cervical spine poses problems of multidisciplinary management in the acute phase because of the functional severity of the spinal cord prognosis, the frequency of lesional associations, and the heaviness of emergency surgery to be expected [3,4].

The main objective of our work is to study the relationship between the early management of airway management and the reduction of the duration of mechanical ventilation in the context of improving the prognosis of patients with cervical spine trauma.

**Patients and Methods**

Our research work consisted in carrying out an exhaustive descriptive type study with prospective collection, carried out over a period of three and a half years extending from July 2013 to December 2016 at the level of several structures at Tlemcen University Hospital Center, including medical and surgical emergency services, multi-purpose resuscitation and neurosurgery.

It focused on the cervical spine trauma patients treated from the scene of the accident to the neurosurgery and/or medico-surgical resuscitation departments at our University Hospital Center, where, all admitted for cervical spine trauma, whether superior (C0-C2) or inferior (C3-C7) or mixed, whatever the mechanism of the accident, whatever the therapeutic decision (surgical or orthopedic), with or without neurological lesions, with or without signs of seriousness on admission and over 16 years old.

We excluded from our study all subjects with other associated traumatic spinal injuries, namely dorsal, lumbar and/or sacral.

**Results**

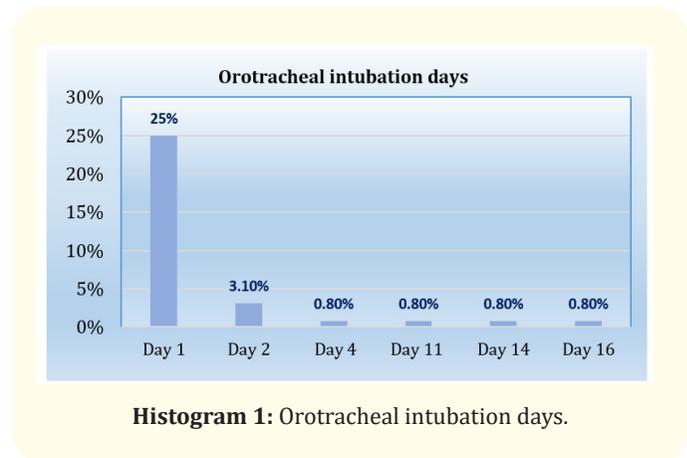
Orotracheal intubation was performed in 32.81% of the 128 patients identified in our study, it should be noted that two patients arrived already intubated.

25% were intubated on the first day and 3.1% on the second day. The last patient to have it, was on the 16th day following his hospitalization (Histogram 1).

Our main indications were:

Signs of respiratory, neurological and/or cardiorespiratory distress, Complete Motor Deficit (Complete Tetraplegia) and GCS ≤ 8/15.

The ventilatory parameters were regulated in such a way as to have a SpO2 > 90%.



**Histogram 1:** Orotracheal intubation days.

Sedation of our intensive care patients was provided by the combination of Midazolam (Hypnovel®) and Fentanyl® by electric syringe, and maintained until clinical and radiological improvement. They were all sedated and placed on mechanical ventilation.

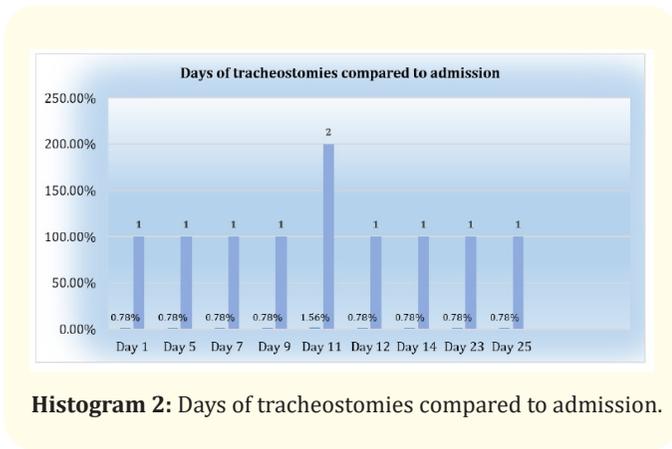
Patients were sedated by intravenous administration of Fentanyl using an electric syringe pump, at a dose of 100 to 150 µg/h (2 - 3 ml/h), we opted for 2 ml/h. The prescription of Midazolam was 4 mg/h.

No major haemodynamic effects were reported during patient sedation, apart from bradycardia and slight drops in blood pressure when changing positions during physiotherapy sessions.

Of all intubated patients, 7.81% received a tracheostomy while in hospital (Histogram 2).

A physical rehabilitation was started early in our patients, mainly at the level of the neurosurgery and multipurpose resuscitation services. 22.65% received respiratory physiotherapy.

Overall strengthening of the deficient muscles (32.03%) and joint maintenance (37.50%) were also undertaken by our teams of physiotherapists aimed at preventing respiratory complications from decubitus and joint stiffness.



**Histogram 2:** Days of tracheostomies compared to admission.

The biological results of the samples taken at the level of the tracheal intubation tube or the tracheostomy on 18 patients revealed that 13 patients were carriers of different germs, sometimes combined.

*Pseudomonas aeruginosa* was identified in the majority (11.90%) in our patients, followed by *Staphylococcus aureus* (7.14%) and an association of several germs was noted in three patients. (The results of the respiratory and urinary infections identified are the subject of a new publication, which is why I could not detail them further).

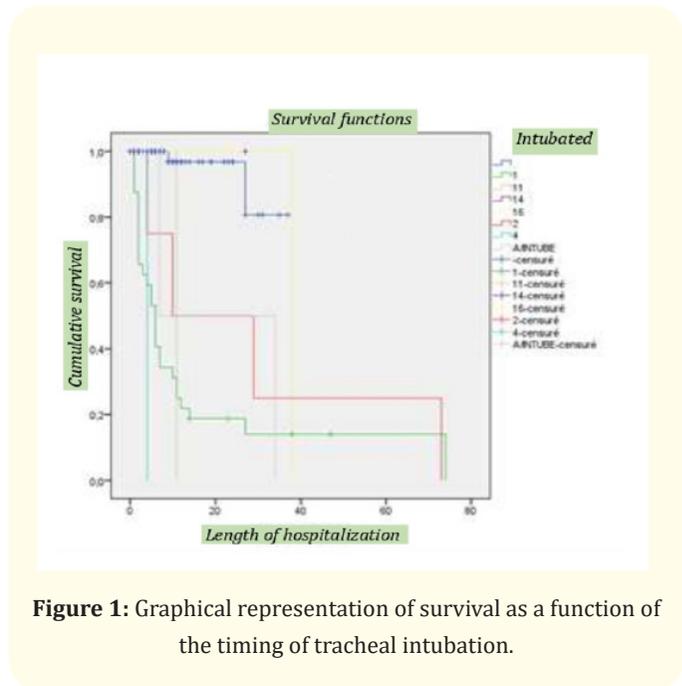
The occurrence of nosocomial infections in our intensive care and neurosurgery departments has contributed to the aggravation of the often-precarious hemodynamic state in this type of patient, due to the extension of the duration of hospitalization parallel to that mechanical ventilation.

The median survival is  $3 \pm 5.47$  days in the group of patients who have been intubated and  $74 \pm 1.42$  days in the group who have not been (Figure 1).

**Discussion:**

Cervical spinal cord injury is a devastating event that has a profound effect on respiratory function. Respiratory involvement is one of the most common complications in cervical spine trauma patients.

In most studies, it is recognized that this is a pathology that involves the functional prognosis [5] and the vital prognosis (8.63%



**Figure 1:** Graphical representation of survival as a function of the timing of tracheal intubation.

of death) when it comes to cervical spine trauma with respiratory problems [6,7]. It is a major cause of prolonged mechanical ventilation in critically ill patients [8].

Of all the patients admitted (42 patients) to the intensive care departments of the University Hospital Center, 90.47% of patients had a hospital stay of  $\geq 48$  hours.

Intubation was orotracheal in all of our patients who required it. It was a period of risk for worsening cervical spinal cord injuries and it was therefore necessary to maintain the physical means of restraint (rigid neck collar). This was the case of 7 patients (5.46%), who presented at least one of the four main predictive criteria of difficult intubation (history of difficult intubation, thyromental distance < 60 mm, mouth opening < 35mm, Mallampati class 3 or 4 were successfully intubated with the classical method.

The use of Airtraq® could have been a great alternative, even more advantageous than the Macintosh laryngoscope. Indeed, a randomized study carried out in 2011 by TRIMMEL, *et al.* evaluating this device showed more success of intubation with the classic method (47% VS/99%) in 56 patients requiring a difficult planned intubation.

Patients undergoing intubation were more severely debilitated than those who did not require intubation. The occurrence of infectious broncho pulmonary complications in 31% of intubated patients (13/42 intubated) was correlated with the duration of

hospitalization of our cervical spine trauma patients at Tlemcen University Hospital, thus establishing a statistically significant relationship between them (P = 0.000) (Table 1).

	Evolution					P-value
	Improvement	Aggravation	Death	Stability	Total	
Tracheal intubation						
Not intubated	27	2	2	55	86	0,000
Intubated	1	2	37	2	42	
Tracheostomy on the day of surgery						
Yes	0	1	1	0	2	0,006
No	20	2	17	31	70	
Ventilatory state at the end of the operation						
Yes	20	2	5	30	57	0,000
No	0	1	13	1	15	
Hemodynamic parameters on discharge from the operating room						
Total	28	4	39	57	128	

**Table 1:** Airways management.

The international study by Jean-Louis VINCENT [9] found a higher rate of exposure to mechanical ventilation than ours (67.5%) and cases of secondary neurological worsening. However, a review of the literature did not find evidence of worsening neurological lesions in cervical trauma patients intubated orally under direct laryngoscopy [10].

The South African study by SOTHMANN, *et al.* [11] identified the obligation of mechanical ventilatory support in 32.2% of cases (23.4% required mechanical ventilation and 8.8% non-invasive ventilation). 64.6% of spinal cord injuries had been operated on in this series. Among ventilated patients, 91.5% were successfully weaned, and 0.9% remained dependent on the ventilator. 7.6% died for an average length of stay of 28 days.

These respiratory complications are obviously an important factor in the duration of mechanical ventilation (MV).

In a large cohort of patients with spinal injuries, the occurrence of respiratory complications in an intensive care unit (ICU) was a more important determinant of length of hospital stay than level of injury [12]. Consequently, a prolonged hospital stay would also

increase the risk of iatrogenic complications inherent in heavy resuscitation techniques [13], and the longer the hospital stay the higher the cost of management [13].

The patient eventually falls into the vicious circle of intubation, infectious pneumonia, difficulties with weaning and the risk of re-intubation or tracheotomy with all the consequences we know.

The same observations were made by KALLEL, POLDERMAN, and FAILLI, *et al.* according to which, the acquired pneumonia is frequent and formidable because it increases the duration of MV as well as the length of stay in intensive care [14], the temperature in patients cerebral lesions, and therefore affect the neurological state [15].

They also increase the number of episodes of intracranial hypertension and degrade the GCS in cervical injuries associated with a head trauma [16], as well as the rate of tracheostomy, mainly in quadriplegics and that of respiratory complications which are more determinants of length of stay and hospital costs than the level of injury itself [17,18].

A review of the literature reported that 78% of all patients had VM-related complications during the first 2 weeks of hospitalization [19].

Healthcare-associated pneumonia [20] appeared in this study primarily in the first 4 weeks after trauma and was diagnosed in 51.4% of cases.

Another retrospective study led by ROQUILLY, *et al.* [21] in Rennes - France on 164 cervical traumas in three ICUs (January 2001 - December 2009), aimed to analyze the factors involved in the duration of MV and if its duration was associated with long-term neurologic status. The median duration of MV was 11 days (2-26 days).

In multivariate analysis, MV duration increased with pneumonia ( $P = 0.0001$ ), atelectasis ( $P = 0.0042$ ), and tracheostomy ( $P = 0.0001$ ).

After exploratory analysis, increased MV duration was the only factor associated in multivariate analysis with a low ASIA motor score on ICU discharge ( $P = 0.0201$ ) and at 1 year ( $P = 0.0003$ ).

Thus, at the end of the operation, several authors recommend admitting in an ICU any traumatized cervical spine with respiratory problems at the start, while most of them recommend to keep them intubated, under sedation and under respiratory assistance, even whether respiratory function was initially maintained.

The residual effect of the anesthetic agents, a certain degree of hypothermia, the possibility of late onset postoperative bone marrow deficits justify the maintenance of ventilatory support and individualized progressive weaning associated with intensive physiotherapy [22-24].

## Conclusion

From the data analyzed in our work, it is evident that patients undergoing intubation were more severely debilitated than those who did not require intubation. The duration of artificial ventilation is in itself an important risk factor, which hinders the favorable development of these patients.

For this reason, it will be necessary to emphasize the needs and the necessity of the artificial ventilation at the cost of considerable risks of occurrence of infectious broncho pulmonary complications

and of the difficulties of weaning which result therefrom, most often very complicated to achieve. The prevention of respiratory complications could therefore significantly limit the handicaps of quadriplegic patients.

Optimizing airway control on admission makes clear clinical sense and has been shown to increase the likelihood of a favorable outcome. Adequate management is necessary to reduce morbidity and mortality rates.

## Conflict of Interest

The authors have stated that there is no conflict of interest.

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