

## Case Report

# Ventilatory Autonomy in a Complete C3 Lesion

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**Abstract**

Respiratory dysfunction is one of the serious repercussions of spinal cord injury. The degree of ventilatory compromise is related to the level and severity of the injury, being more severe in cervical or dorsal lesions as well as in complete lesions. This dysfunction is mainly due to two factors: respiratory muscle weakness and autonomic dysfunction.

The authors report a clinical case of a complete C3 lesion, hospitalized in a Spinal Cord Injury Unit (SCIU). Although unlikely, ventilatory weaning in a C3 complete lesion patient, with bilateral diaphragmatic dysfunction and ischemic heart disease can be achieved with appropriate treatment, minimizing complications and enhancing diaphragm recovery. The treatment of these patients in specialized spinal cord injury units is therefore fundamental.

**Keywords:** Spinal Cord Injury; Ventilatory Weaning; Tetraplegia; Respiratory Dysfunction

**Background**

Respiratory dysfunction is one of the serious repercussions of spinal cord injury. The degree of ventilatory compromise is related to the level and severity of the injury, being more severe in cervical or dorsal lesions as well as in complete lesions. This dysfunction is mainly due to two factors: respiratory muscle weakness and autonomic dysfunction. Weakness of inspiratory muscles involves reduction of tidal volume and inspiratory capacity; weakness of the expiratory muscles contributes to ineffective coughing, leading to respiratory complications such as pneumonia, atelectasis, and respiratory failure; the autonomic dysfunction associated with parasympathetic predominance promotes an increase in bronchial production, a decrease in ciliary activity and bronchospasm.

The diaphragm receives innervation mainly from C4 with contributions from C3 and C5. The higher the level of injury, the greater the respiratory compromise and the lesser the likelihood of spontaneous ventilation, with consequent need of permanent ventilatory support. However, few studies have reported predictive factors and the likelihood of being ventilator-independent in cervical lesions. In other studies, we do not know what type of injury they are referring to, because they do not classify the spinal cord injury according to the International Spinal Injury Association (ASIA) criteria. Chiodo AE et al. found that out of 15 patients with C3 lesion who were ventilated in a rehabilitation unit in the acute phase, only 3 (5.8%) were ventilator-independent, with no motor recruitment in a hemidiaphragm or a moderate decrease in both the diaphragms considered a predictor in the failure of weaning [1].

The authors report a clinical case of a complete C3 lesion, with bilateral diaphragmatic dysfunction hospitalized in a Spinal Cord Injury Unit (SCIU), where successful weaning was possible.

**Case Presentation**

A 63-year-old male with multiple cardiovascular risk factors, a history of ischemic heart disease, and a recent history of dental abscesses.

In June 2015, the patient had an episode of syncope with fall, immediate tetraplegia and desaturation with need for orotracheal intubation and ventilatory support. C3-C4 spondylodiscitis to MSSA was diagnosed, submitted to anterior cervical arthrodesis C3-C5 and medical treatment with targeted antibiotic therapy. The result of this episode was tetraplegia A Neurological Level (NL) C3, according to the classification of the American Spinal Injury Association (ASIA) Impairment Scale (AIS)-AIS A NL C3.

The patient was hospitalized for 1 month in the Intensive Care Unit and was later transferred to the SCIU, still under invasive ventilation through tracheostomy. Diaphragmatic function was studied to evaluate the potential of spontaneous ventilation. In August 2015, an ultrasound diagnostic was performed, which revealed a small amplitude diaphragmatic excursion in the right and absence in the left hemidiaphragm with respiratory effort; and a Motor Conduction Study (MCS) of the phrenic nerve showed a marked decrease in both right and left nerves potential amplitude, more noticeable on the left.

During hospitalization in the SCIU, the patient underwent bronchial toilette techniques with postural drainage and cough assist after nebulization with salbutamol and ipratropium bromide, strengthening of accessory inspiratory muscles (scalene and sternocleidomastoid) and diaphragm transcutaneous electrostimulation progressing to diaphragm strengthening exercises.

Various ventilatory weaning attempts were unsuccessful due to respiratory infections. Progressively longer periods without mechanic ventilation were possible from the 5<sup>th</sup> month of hospitalization. About six months after the injury, the patient managed to maintain spontaneous ventilation. Nevertheless, he still needed non-invasive ventilation for short periods, especially at night.

In a phrenic nerve MCS reevaluation in April 2016, there was potential improvement, normal in the right and only slightly decreased in the left hemidiaphragm. In the ultrasound, the diaphragm was intact bilaterally, albeit with slight movements.

On discharge in May 2016, after 9 months of hospitalization at our

Unit, the patient was in spontaneous ventilation, with tracheostomy closed, and no need of oxygen therapy.

## Discussion/Conclusion

Although the literature describes some cases of successful ventilatory weaning in complete level C3 or above lesions, these are rare. In the study, of 29 ventilated cervical lesion patients, 15 had a C3 level AIS A or B, from which only 3 (5.8%) achieved spontaneous ventilation [1]. Described diaphragmatic recovery in 12 of 33 patients (36%) with AIS a lesion between C1 to C4 [2]. In this study, however, the number of patients per level of injury is not identified.

It is still difficult to establish comparisons because many of the published studies in this area do not use the international criteria for classification of spinal cord injuries. Report a C2 case with ventilatory autonomy, but since the AIS is not used for classification of the lesion, we do not know if it was a complete or incomplete lesion [3]. In the study [4], in a total of 134 patients, 66 are described as having level C3 or higher, and in only 23 was it possible to wean off the ventilator. However, again, the international AIS classification was not used.

As previously reported, Chiodo AE et al. reported the absence of motor recruitment in a hemidiaphragm or moderate decrease in recruitment in both hemidiaphragms in needle Electromyography (EMG) with the impossibility of ventilatory weaning. In our case, although needle EMG was not performed, phrenic nerve MCS showed a marked decrease in the potential amplitude of both nerves, more noticeable on the left, which would make it unlikely for this patient to achieve respiratory autonomy.

It is also worth noting that our patient has ischemic cardiopathy that is, according to the study [5], strongly associated with Weaning-Induced Pulmonary Edema (WIPE), which is recognized as a limiting

factor for ventilatory weaning. In addition, in a 2016 review, reported that cardiac patients, particularly with coronary artery disease, are more likely to experience weaning difficulties due to weaning-induced heart failure [6].

Although unlikely, ventilatory weaning in a C3 complete lesion patient, with bilateral diaphragmatic dysfunction and ischemic heart disease can be achieved, as we have shown, with appropriate treatment, minimizing complications and enhancing diaphragm recovery. The treatment of these patients in specialized spinal cord injury units is therefore fundamental. The problem is the lack of family/caregivers able to maintain survival patients' care.

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