involvement of the diaphragm (C3–5 segments), a larger portion of the accessory respiratory muscles, and autonomic dysfunctions that affect the respiratory system. Early recognition and timely management of autonomic dysfunctions in individuals with SCI are crucial for long-term health outcomes in this population. Numerous factors are responsible for respiratory dysfunction following SCI, including impairment of respiratory muscles, reduced vital capacity, ineffective cough, reduction in lung and chest wall compliance, and excess oxygen cost of breathing due to distortion of the respiratory system. Severely affected individuals may require assisted ventilation, which can cause problems with speech production. Appropriate candidates can sometimes be liberated from mechanical ventilation by phrenic-nerve pacing and pacing of the external intercostal muscles. Partial recovery of respiratory muscle performance could also occur spontaneously. This presentation will focus on available guidelines and the latest clinical evidence (Spinal Cord Injury Rehabilitation Evidence, SCIRE) on management of respiratory dysfunctions among individuals with SCI.


CO26-002-EN
Implanted phrenic nerve stimulation in quadriplegic patients with high cervical lesions
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Keywords: Quadriplegia; Central respiratory paralysis; Ventilatory dependency; Diaphragm; Stimulation

Implanted phrenic nerve stimulation restores ventilatory autonomy in patients with central respiratory paralysis, including those suffering from high cervical lesions and quadriplegia. Candidates must have preserved phrenic nerve conduction and a contractile diaphragm, which can be assessed through diagnostic phrenic nerve stimulation. There are currently two commercially available approaches for implanted phrenic stimulation, namely intrathoracic phrenic stimulation (quadripolar electrodes and radiofrequency transmission) and intradiaphragmatic phrenic stimulation (hookwire electrodes and percutaneous wire transmission). Both techniques allow the patients to be weaned from mechanical ventilation, decrease respiratory infections, and bring a clear benefit in terms of quality of life (easier discharge home, increased mobility in the house and outside, improved safety feeling, restoration of the sense of smell). One of the available devices (intradiaphragmatic stimulation) obtained a reimbursement authorization in France in 2010, and the other (intrathoracic stimulation) will be reimbursed in 2011. Implanted phrenic nerve stimulation is therefore a safe and effective technique for the management of quadriplegia-related ventilatory dependency. It is now fully and easily available in France, and should systematically be proposed to patients who are potential candidates.


CO26-003-EN
Managing high-level cervical spinal cord injuries: intensivist’s point of view
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Keywords: Spinal Cord Injuries; Ventilator Weaning; Trauma Centers/utilisations

Incidence of spinal cord injury in France is estimated at 1000 to 2000 patients per year. The diaphragm is innervated by the phrenic nerves that are formed from the cervical nerves C3, C4, C5. High tetraplegia is defined as a spinal cord injury for a level set from C1 to C4. More and more patients suffering such high level are now being admitted alive to trauma centres because of major progress made in pre-hospital management. Optimal pre-hospital management lies on direct admission to dedicated trauma centre, cautious cervical spine immobilization, and maintenance of adequate mean arterial blood pressure to improve spinal cord perfusion, mechanical ventilation in the case of respiratory insufficiency or coma. In hospital, time of surgery is decided as a collegiate decision between the neurological surgeons and the intensivist after managing first all life-threatening injuries. Weaning from mechanical ventilation must be envisaged as soon as possible after surgery, in the absence of any lung complication (infection, contusion). Ethical discussion are regularly held during ICU stay. Tracheotomy is frequently performed for comfort of weaning. Opportunity of implanting a phrenic-nerve pacemaker must be considered whenever possible. Weaning time goes from months to years. Early admission to spinal cord injury rehabilitation centres capable of managing ventilator weaning is therefore mandatory if aiming at early discharge from ICU.


CO26-004-EN
Unilateral diaphragmatic reinnervation in tetraplegic patients with chronic respiratory failure and phrenic nerve motoneurone destruction: Intermediate evaluation
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Tetraplegic patients with phrenic nerve motor neurone destruction could not be implanted with a phrenic nerve pace maker and are candidates for definitive ventilation. The aim of our study was to test the hypothesis that in these patients the diaphragm could be reinnervated on one side by the inferior laryngeal nerve to obtain at least a spontaneous ventilation.

Four patients were recruited (1 f, 21–56 years, C2–C3 ASIA A) with a lesion on MRI from C2 to C4. The delay between cervical injury and inclusion ranged from 12 to 36 months. Before surgery they all had a diaphragmatic exploration which consisted in cervical and cortical magnetic stimulations with the recording of diaphragmatic latencies and tracheal pressure and laryngeal and swallowing explorations, performed with a nasoendoscope. Surgery consisted after cervical dissection in an end-to-end anastomose between the right inferior laryngeal nerve and the right phrenic nerve. The right vocal cord paralysis created during the surgery was corrected by a medialisation and a non-selective reinnervation. Then the patients were hospitalised in intensive care before returning to their hospital.

Initial laryngeal and swallowing evaluation were normal. The surgery duration ranged from 2 to 5 hours. In one patient, direct phrenic stimulation performed before the anastomosis induced a diaphragmatic response. In this patient, a phrenic nerve stimulator was implanted with success one month later. In the 3 other patients, it confirmed the absence of phrenic nerve stimulation, and the anastomoses was performed without any complication. One week later, voice and swallowing were judged normal by the patients and the laryngoscopic evaluation showed that the right vocal cord was in medial position and that swallowing function was normal. One patient had a pulmonary embolism two weeks after the surgery. Three months later, none of the patients had recovered spontaneous ventilation, none of them suffered from dysphonia or oropharyngeal dysphagia. Six months after reinnervation, one patient died from unknown origin.

In conclusion, unilateral diaphragmatic reinnervation by the right inferior laryngeal nerve is feasible. Diaphragmatic evaluation needs to be performed again over two years to judge its efficacy.