involvement of the diaphragm (C3–5 segments), a larger portion of the access-
sory 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 popu-
lation. Numerous factors are responsible for respiratory dysfunction following
SCI, including impairment of respiratory muscles, reduced vital capacity, inef-
ficacious 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 inter-
costal 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 cervi-
cal lesions and quadriplegia. Candidates must have preserved phrenic nerve
conduction and a contractile diaphragm, which can be assessed through diag-
nostic phrenic nerve stimulation. There are currently two commercially available
approaches for implanted phrenic stimulation, namely intrathoracic phrenic
stimulation (quadripolar electrodes and radiofrequency transmission) and intra-
diaphragmatic phrenic stimulation (hookwire electrodes and percutaneous wire
transmission). Both techniques allow the patients to be weaned from mecha-
nical 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 (intradiaaphragmatic stimulation) obtained a reimburse-
ment authorization in France in 2010, and the other (intrathoracic stimulation)
will be inscribed in 2011. Implanted phrenic nerve stimulation is therefore a
safe and effective technique for the management of quadriplegia-related vent-
ilatory 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 immobili-
sation, and maintenance of adequate mean arterial blood pressure to improve
spinal cord perfusion, mechanical ventilation in the case of respiratory insuffi-
ciency 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 nasendoscope. Surgery consisted after cervical
dissection in an end-to-end anastomose between the right inferior laryngeal
erve 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
anastomosis 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 laryn-
geal nerve is feasible. Diaphragmatic evaluation needs to be performed again
over two years to judge its efficacy.


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