A potential clinical application for ventilator dependant spinal cord injured patients : a nerve by-pass induces respiratory diaphragm rehabilitation after chronic cervical high injury in the rat.

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Résumé

Cervical spinal cord injury still has a devastating impact on the respiratory system, leading to acute and chronic respiratory insufficiency which mainly results from diaphragm paralysis due to interruption of the descending respiratory pathways commanding the phrenic motoneurons or to direct injury of those motoneurons whose axons constitute the phrenic nerve (PN) commanding the diaphragm. Respiratory complications are frequent after cervical SCI and contribute significantly to associated morbidity, mortality and economic burden. Although electrical stimulation of the phrenic nerve or the diaphragm remains the current treatment for ventilator dependent patients, this method is still associated with side effects and high costs and does not allow optimum physiological control of respiration. In this context, repair strategies that may result in respiratory functional recovery or improvement after high spinal cord injury are therefore still required.

A potential tissular therapy for reinnervating the diaphragm consists in nerve bridging between laryngeal recurrent nerve (LRN) and phrenic nerve. The LRN expresses a spontaneous respiratory activity in phase with the phrenic nerve but doesn't emerge from the spinal cord, thus making it safe after spinal cord injury. The rationale is thus to reinnervate one hemidiaphragm by laryngeal respiratory fibers.

Recurrent-phrenic nerve anastomosis has already been proven to work in healthy animals or after acute SCI (Gauthier et al., 2006) but was never tested in a post-traumatic circumstance. Hence, the original feature of this report concerns the efficiency of the strategy after chronic high spinal cord injury in the rat.

We show that the nerve bridging strategy can induce a dramatic diaphram rehabilitation in the rat, even when the strategy is applied as long as one month after a chronic unilateral C2 spinal cord injury. In non treated animals, the injury induces a long-term persistent ipsilateral hemi-diaphragm paralysis whereas in transplanted animals, an ipsilateral diaphragm recovery starts at 2 months to be achieved at 5 months post-bridging. The present study confims that diaphragm rehabilitation originates from laryngeal re-innervation and illustrates the time course and amount of diaphragm recovery.

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