Abstract Information

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Title :	Neurostimulation and respiratory recovery after cervical spinal cord injury
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Abstract :

A majority of spinal cord injury (SCI) happen at a cervical level, resulting in a marked respiratory dysfunction. When injury is high (4th cervical or above), disruption of the spinal cord integrity not only paralyzes the limb but it alters phrenic nerves which innervate the diaphragm, the main inspiratory muscle. Survivors can be rendered ventilator dependent, a sequela that dramatically compromises quality-of-life and increases mortality rate. Today, mechanical ventilation (MV) is the only treatment available for these patients to ensure breathing. Alternative solutions such as diaphragm pacing or nerve transfer approaches are strongly limited by MV-induced atrophy of the respiratory muscles over time. Only one patient out of ten has sufficient phrenic conduction and diaphragmatic function to benefit from it.

In our lab, one current project is to develop and optimize neuromodulation techniques to improve respiratory recovery after cervical SCI. Based on clinical observation, we have developed a sensori-motor stimulation allowing to indirectly preserve diaphragm activity and restore ventilatory capacity in a mouse model of tetraplegia1. This approach aims at reactivating the lost connections with a breathing-synchronized neuromuscular electrical stimulation algorithm for intercostal and abdominal muscles (rSynES), built on mathematical modeling of ventilatory flow, adjusted to mirror real ventilation patterns2.

This symposium will present current approaches for treating respiratory impact of cervical SCI and how this innovative concept could be promising for future treatment of respiratory deficits in patients with tetraplegia and respiratory deficiency. In particular, we will discuss how it could promote respiratory recovery when combined to other neuromodulation approaches such as repetitive trans-spinal magnetic stimulation, known to increase the corticospinal network3, or

tissue engineering, known to improve spinal tissue restoration and neuro-inflammation4. The ultimate goal is to treat respiratory deficits in patients with SCI to deliver patients from whole life respirator dependency.

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2. Coustillet T. et al. European Respiratory Journal, Abstarct of the ERS conference, (2021)
3. Michel-Flutot P. et al., Respiratory Physiology & Neurobiology 292 (2021) 103704
4. Chedly J. et al. Biomaterials 138, 91-107 (2017)