Miami Project Study Shows Acute Intermittent Hypoxia Enhances Corticospinal Synaptic Plasticity

Monica A. Perez, P.T., Ph.D., associate professor in the Department of Neurological Surgery and The Miami Project to Cure Paralysis at the University of Miami Miller School of Medicine, has published “very exciting results” from a recent study, Acute Intermittent Hypoxia Enhances Corticospinal Synaptic Plasticity in Humans, in the April issue of eLife.

Brief exposures to hypoxic air interspersed with periods of breathing ambient room air, a phenomenon known as acute intermittent hypoxia (AIH), improve motor function in humans with spinal cord injury. Here, for the first time, Perez and her team provide evidence for a physiological mechanism that can contribute to those beneficial effects. The team examined transmission in the corticospinal pathway and found that a single 30-minute exposure to AIH increased excitability in corticospinal projections to hand muscles for up to 75 to 120 minutes in intact humans, likely related to changes in corticospinal-motoneuronal synaptic activity.

“These are very exciting results,” Perez said. “The ability of AIH to induce temporary changes in excitability in the human corticospinal pathway opens an avenue for targeting recovery after injury. Our group is collaborating with Dr. Gordon Mitchell from the University of Florida, a pioneer in the use of AIH in animal models, to continue our efforts to understand the mechanisms by which AIH works in the human motor system.”

Mitchell said of the study, “After several decades of work developing new concepts and gaining understanding of the ways that intermittent hypoxia enhances movement in animal models, it is quite gratifying to see those concepts applied to humans. I look forward to the results of Dr. Perez’s forthcoming studies devoted to understanding mechanisms of intermittent hypoxia enhanced movement in people with chronic spinal cord injuries.”

Perez and Rachel E. Cowan, Ph.D., research assistant professor in the Department of Neurological Surgery and The Miami Project to Cure Paralysis; William Zev Rymer, M.D., Ph.D., from the Shirley Ryan Ability Lab; and Steven Kirshblum, M.D., from Kessler Institute, are collaborating in a multi-center trial sponsored by the National Institute on Disability, Independent Living, and Rehabilitation Research
to evaluate the effectiveness of daily AIH therapy combined with massed practice training to improve upper-extremity function in individuals with chronic incomplete cervical spinal cord injury. The goal is to use AIH to facilitate hand function in people with deficits due to spinal cord injury.

Rehabilitation strategies aim to strengthen transmission in neural networks spared after damage to the central nervous system. AIH is emerging as a noninvasive innovative approach that offers the possibility of enhancing voluntary motor output in humans with central nervous system injury.

Plasticity in the corticospinal pathway contributes to improvements in motor performance in humans with and without spinal cord injury. The new results provide evidence for an intervention that successfully engages corticospinal synaptic plasticity following central nervous system damage.

An electronic version of the paper can be viewed here.