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Researchers use vagus nerve stimulation outside the forebrain

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A group of leading clinicians and experts dedicated to translational research in spinal cord injuries has recognized the work of a research fellow in the Texas Biomedical Device Center at UT Dallas.

Based on preclinical studies, vagus nerve stimulation (VNS) paired with rehabilitation shows promise in restoring function after spiinal cord injury and could expand the number of possible patients for the therapy.

Dr. Patrick Ganzer won a best paper award from the International Spinal Cord Repair (ISCORE) group for work that uses VNS paired with rehabilitation to enhance neuroplasticity—the changing of the nervous system in response to new experiences. The study found that VNS therapy with rehabilitation helped recover 75 percent more forelimb strength than rehabilitation alone after a cervical spinal cord injury.

"The honor highlights the potential significance of this approach to treating spinal cord injuries," said Dr. Robert Rennaker, executive director of the Texas Biomedical Device Center (TxBDC) and head of the Department of Bioengineering in the Erik Jonsson School of Engineering and Computer Science.

"This work provides an initial glimpse into the significance of neural plasticity in functional recovery following spinal cord injuries. Not only do the subjects regain useful motor function, but improved strength and sensory restoration."

VNS is an FDA-approved therapy for various neurological disorders, such as depression and epilepsy. It involves sending a mild electric pulse through the vagus nerve, which allows precise control of neurotransmitter release throughout the nervous system.

UT Dallas researchers in the labs of Rennaker, holder of the Texas Instruments Distinguished Chair in Bioengineering, and Dr. Michael Kilgard, associate director of the TxBDC and Margaret Fonde Jonsson Professor of neuroscience, are studying novel implementations of VNS to treat multiple neurological disorders and injuries.

Clinical trials at UT Southwestern Medical Center are underway for VNS as a potential treatment for stroke patients and individuals suffering from tinnitus, or constant ringing in the ears. University researchers are also exploring VNS as a potential treatment for post-traumatic stress disorder. Their work on cervical spinal cord injury is the first assessment of VNS therapy after an injury outside of the forebrain.

Spinal cord injuries disrupt communication between the brain and the damaged area. Each year, 250,000 to 500,000 spinal cord injuries occur around the world, with vehicle crashes and violence causing most of the injuries, according to the World Health Organization. Cervical spinal cord injuries occur in the neck and shoulder area of the spine, and can cause arm and hand dysfunction.

"Even though the brain and spinal cord are two distant but connected structures, our findings show that the brain is functionally engaged in recovery from cervical spinal cord injury driven by VNS therapy," Ganzer said.

For this study, researchers trained rats on a task that measures volitional forelimb strength. Researchers then compared the strength of subjects treated with VNS and rehabilitation to those who only received

rehabilitation after a cervical spinal cord injury. The subjects that received VNS recovered 75 percent more volitional forelimb strength than those given rehabilitation alone.

High-resolution brain maps revealed that VNS therapy led to an enhancement of connections to muscles controlling grasping, the magnitude of which was correlated to recovery of function.

"VNS therapy significantly enhanced forelimb recovery and enabled new motor connections from the brain to spinal cord," Ganzer said.

"To our knowledge, this is the first time VNS therapy has been shown effective at restoring lost motor function after an injury outside of the forebrain. This represents a significant opportunity to identify new patient populations who can benefit from targeted plasticity therapy using VNS."

The next step in the research is to assess the efficacy of VNS therapy after injuries damaging both sides of the spinal cord, and eventually move to clinical trials in humans.

Provided by University of Texas at Dallas