Medical Xpress

Noninvasive brain stimulation shown to impact walking patterns

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In a step towards improving rehabilitation for patients with walking impairments, researchers from the Kennedy Krieger Institute found that non-invasive stimulation of the cerebellum, an area of the brain known to be essential in adaptive learning, helped healthy individuals learn a new walking pattern more rapidly. The findings suggest that cerebellar transcranial direct current stimulation (tDCS) may be a valuable therapy tool to aid people relearning how to walk following a stroke or other brain injury.

Previous studies in the lab of Amy Bastian, PhD, PT, director of the Motion Analysis Laboratory at Kennedy Krieger Institute, have shown that the cerebellum, a part of the brain involved in movement coordination, is essential for walking adaptation. In this new study, Dr. Bastian and her colleagues explored the impact of stimulation over the cerebellum on adaptive learning of a new walking pattern. Specifically, her team tested how anode (positive), cathode (negative) or sham (none) stimulation affected this learning process.

"We've known that the cerebellum is essential to adaptive learning mechanisms like reaching, walking, balance and eye movements," says Dr. Bastian. "In this study, we wanted to examine the effects of direct stimulation of the cerebellum on locomotor learning utilizing a split-belt treadmill that separately controls the legs."

The study, published today in the Journal of Neurophysiology, found that by placing electrodes on the scalp over the cerebellum and applying very low levels of current, the rate of walking adaptation could be increased or decreased. Dr. Bastian's team studied 53 healthy adults in a series of split-belt treadmill walking tests. Rather than a single belt, a split-belt treadmill consists of two belts that can move at different speeds. During split-belt walking, one leg is set to move faster than the other. This initially disrupts coordination between the legs so the user is not walking symmetrically, however over time the user learns to adapt to the disturbance.

The main experiment consisted of a two-minute baseline period of walking with both belts at the same slow speed, followed by a 15-minute period with the belts at two separate speeds. While people were on the treadmill, researchers stimulated one side of the cerebellum to assess the impact on the rate of re-adjustment to a symmetric walking pattern.

Dr. Bastian's team found not only that cerebellar tDCS can change the rate of cerebellum-dependent locomotor learning, but specifically that the anode speeds up learning and the cathode slows it down. It was also surprising that the side of the cerebellum that was stimulated mattered; only stimulation of the side that controls the leg walking on the faster treadmill belt changed adaptation rate.

"It is important to demonstrate that we can make learning faster or slower, as it suggests that we are not merely interfering with brain function," says Dr. Bastian. "Our findings also suggest that tDCS can be selectively used to assess and understand motor learning."

The results from this study present an exciting opportunity to test cerebellar tDCS as a rehabilitation tool. Dr. Bastian says, "If anodal tDCS prompts faster learning, this may help reduce the amount of time needed for stroke patients to relearn to walk evenly. It may also be possible to use tDCS to help sustain gains made in therapy, so patients can retain and practice improved walking patterns for a longer period of time. We are currently testing these ideas in individuals who have had a stroke."

Provided by Kennedy Krieger Institute