Neural activity in the brain changes during stroke recovery

05.06.2018

15 million people suffer a stroke each year and it is one of the major causes of disability in adults. Approximately 75% of stroke patients have a motor deficit in the upper limb initially after the stroke. Impaired upper limb functioning hampers everyday life as well as ability to work and is therefore a major challenge in rehabilitation after stroke. Brain recovery is based on reorganization of neural pathways during a plastic period following the stroke. During the plastic period, the brain is able to transform by modifying its connections or re-wiring itself. However, the mechanisms of stroke recovery are not yet fully understood. To improve rehabilitation after stroke we should understand the brain plasticity and temporal development of the stroke recovery better.

Mirva Kallio has studied neural activation of stroke patients in her master’s thesis in the Department of Neuroscience and Biomedical Engineering (NBE) in Aalto University. She studied somatosensory cortex activation in stroke patients for one year after the stroke. The upper limb of the patients was partially paralyzed due to the stroke. Somatosensory cortex coordinates the sensory data coming up from all over the body and it has a tight connection with movement production. This makes the somatosensory activation important in motor recovery after stroke. The somatosensory activities were studied using two different stimulus types; a tactile stimulus to the tips of index fingers, and passive movement of index fingers. It was the first follow-up study to research somatosensory evoked responses to passive movement in several stroke patients.

The results of the thesis showed that neural activity in somatosensory cortex in both hemispheres was growing during the one year follow-up period. The activity was significantly stronger after one year compared to time after one week post-stroke. The results indicate that the activity changes during one-year follow-up, which refers that neural changes occur within first three months but can continue significantly up to 12 months. In addition, the results confirmed that a unilateral stroke affects both, damaged and healthy hemispheres. She also found that in healthy subjects, the magnitude of the neural activation is approximately equal in both hemispheres whereas, the stroke patients had a weaker activity in the damaged hemisphere compared to the healthy hemisphere. This is due to the changes in excitatory-inhibitory circuits. Normally, both hemispheres inhibit each other but when one hemisphere gets damaged, the other hemisphere is not inhibited in which case the healthy hemisphere strengthens. Furthermore, one interesting finding was that the activation in the damaged and healthy hemispheres was stronger in stroke patients than healthy control subjects after one year of the stroke. The enhanced activation may be associated with incomplete functional recovery as the impaired hand function of the patients in the present study did not reach the level of the healthy hand by 12 months.

The results strengthen earlier studies’ results of stroke recovery and opened some new, interesting questions for future research of the brain plasticity in stroke recovery.

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