

Functional Recovery after Motor Cortical Stroke Related to Cerebellum Activity

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Commentary

Although anatomical, experimental, functional and clinical studies suggest an important role of cerebellar pathways in motor cortical plasticity, little is known about the mechanisms through which the cerebellum exerts its influence on cerebral cortex. There are several reasons to investigate it [1].

Cerebellar circuitry is involved in the processing of sensory information by receiving ipsilaterally somatotopically organized somatosensory inputs [2]. Moreover, lesions of the cerebellum and its associated circuitry abolish or impair several types of motor learning [3].

Beside this in motor cortex stroke recovery, peripheral somatosensory stimulation was shown to provide improvements in impaired motor function. It has been suggested that the organization of the motor cortex is greatly dependent on the balance between excitatory and inhibitory influences from sensory peripheral systems. Motor cortex excitability is affected by a number of pharmacological, electrophysiological and behavioral interventions. Longitudinal studies have shown that after a cortical injury, the improvement in motor activity is accompanied by an altered cortical activation pattern on transcranial magnetic stimulation (TMS) evaluation in motor-related regions such as the bilateral sensorimotor cortex, premotor cortex, cingulate motor areas and overall in cerebellum [4,5].

In this way, experimental and human studies have evaluated the role of the cerebellum in motor skill learning after motor cortex stroke. Using TMS they have found that stimulation of the cerebellum could produce a clear change of the excitability of the contralateral sensory and motor cortex in healthy patients and also in neurological impaired ones. Recent studies also highlight that the cerebellum plays a key function in the adaptation of the motor cortex to repeated trains of peripheral sensory and motor training.

The hypothesis proposed is that the cerebellum could control cortical plastic changes by modulating cortical excitability in a discrete topographic manner and that this mechanism could induce the coupling between sensory inputs and motor outputs considered as the neurobiological substrate for recovery after motor cortex injury [6-10].

Several alternative possibilities are considered and ruled out. If the cerebellar-motorcortical connections could influence the motor recovery and learning after a motor cortical stroke, cerebellar stimulation therapies could interfere on the recovery of a task in motor cortex stroke patients and in the final results of neurorehabilitation therapies. Moreover if the cerebellum could modulate the motor

cortex response to a motor training, than the cerebellum stimulation could be added to conventional motor rehabilitation therapies for patients with motor cortex stroke.

In this way, the cerebellar stimulation like cerebellar transcranial direct current stimulation (tDCS) or specific pharmacotherapy that directly influences the pattern of cerebellum activation could be used like new rehabilitation strategies to promote functional recovery after motor cortex stroke [11,12].

Future studies have to explore the neurophysiology of cerebellar afferent input to motor cortex to confirm such promising observations and optimize future rehabilitation therapies.

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