The Role of MR in Promoting Long Term Recovery From Stroke

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Ischemic stroke is the most frequent neurological disease characterized by an age-related incidence and chronic disability in the majority of patients. A great challenge in acute stroke is to predict to what degree a patient will recover eventually. The cornerstone of acute stroke treatment, and thus recovery, is the rapid arterial recanalization. Magnetic resonance imaging has revealed that treatment induced re-perfusion limits the extent of ischemic brain damage thereby allowing for rapid and profound recovery. Nevertheless, patients may retain deficits in motor, sensory or cognitive functions due to the infarct lesion. Apart from the cortical stroke lesion, the extent of damage of hemispheric white matter tracts differentiates patients with good from those with poor recovery. Functional magnetic resonance imaging has shown that recovery is associated with abnormal activation patterns in the perilesional vicinity and in the non-affected, contralesional hemisphere. These abnormalities are related to structural changes such as lesion topography and lesion extent and to an altered functional balance between both cerebral hemispheres as probed with transcranial magnetic stimulation. Recent neurorehabilitative strategies including constraint-induced forced use follow the principle of repetitive training of the residual neuron pool. More recently, mental imagery known to recruit higher order association areas of the sensorimotor network such as the mirror-neuron system has been shown to be effective in stroke recovery. Furthermore, physiological studies have shown that peripheral nerve or cortex stimulation are suited to modulate these functional cortico-subcortical networks. Successful recovery results in a normalization of the task-related cerebral activation patterns resembling normal learning. Accordingly, clinical research based on proof-of-principle MR studies has provided new vistas on the neurobiological mechanisms of post-lesional plasticity and opened future avenues for science-based pharmacological and neurophysiological training strategies to enhance recovery after stroke.