OHBM-DGKN Alliance: International Symposium on Stroke Recovery

Christian Grefkes Organizer
University of Cologne
Dept. of Neurology
Colgone, NRW
Germany

1147
Symposium

Stroke is a leading cause for permanent disability worldwide. Although the treatment of acute stroke has considerably improved, the majority of patients remain disabled with a considerable impact of functional independence and quality of life. The most important driver of functional recovery is neural reorganization. Hence, a better understanding of the mechanisms enabling neurological recovery is crucial to develop novel, neurobiologically informed strategies to promote recovery of function.

This symposium provides a comprehensive overview on recent developments in the field of stroke recovery using neuroimaging and non-invasive brain stimulation. Novel techniques like dynamic functional connectivity mappings, concurrent TMS-EEG assessments as well as fMRI-based network parameter estimates allow new insights into how a stroke lesion interferes with the functional integrity of different systems of the brain. Likewise, the combination of neuroimaging and neurostimulation techniques allows a better understanding of how brain plasticity can be modulated in order to promote the reorganization of neural networks. Finally, novel neurotechnology-based treatment strategies allowing patient-tailored interventions to achieve maximum treatment responses will be introduced and discussed. The symposium will also highlight important caveats and limitations of current models, and finally close with possible solutions and future directions.

Objective

1) To understand how the brain responds to a focal lesion in order to overcome a neurological deficit
2) To learn current brain stimulation strategies to support cortical reorganization of networks after stroke.
3) To learn novel neuroimaging/brain stimulation techniques allowing individualized predictions of recovery and treatment responses.

Target Audience

This symposium is of interest to all scientists and clinicians involved in brain plasticity, stroke reorganization and recovery of function.

Presentations

Cortical reorganization after stroke: New insights from Neuroimaging and Non-Invasive Brain Stimulation

Christian Grefkes will present data on the combined use of functional neuroimaging and non-invasive brain stimulation methods to assess activity and connectivity changes of motor brain regions in acute, subacute and chronic stroke patients. By using models of effective connectivity, he will show how abnormal connectivity develops and also changes during the course of the disease, revealing both supportive and disturbing influences on the kinematics of simple and complex hand movements. Machine learning algorithms can help to identify critical nodes for motor performance and recovery. Novel readouts like concurrent TMS-EEG measurements allow a unique window in recovering brain networks with high temporal resolution. These data are supplemented by TMS data obtained during performance of various motor tasks ("online TMS interferences ") or before a motor training is performed ("offline TMS"), showing that non-invasive brain stimulation can correct pathological network configurations underlying impaired motor performance. These experimental findings have already led to randomized clinical trials (RCT) aiming at implementing these techniques into clinical practice.

Presenter

Christian Grefkes, University of Cologne
Dept. of Neurology
Colgone, NRW
Germany

Network Neuroscience of Language Recovery after Stroke

Neurobiologically plausible models of human brain function are typically based on detailed animal models. For human speech and language, the cortical dorsal-ventral network architecture associated with the extended auditory system of nonhuman primates represents a strong model. A postero-dorsal network connects AC to the posterior and dorsal part of inferior frontal cortex (IFC) (Brodmann area [BA] 44) via posterior superior temporal (pST) cortex, inferior parietal lobule (IPL), and premotor cortex (PMC), whereas an antero-ventral network traverses anterior superior temporal cortex (aST) to terminate in more anterior and ventral parts of the inferior frontal gyrus (BA 45). In this talk, we suggest that language recovery from stroke depends on integration and segregation of these network communities that have been evolutionarily co-opted for language, and that focusing language therapy on these biological networks might have long term advantages. We illustrate such network-level translational neurology with a study of imitation-based treatment of aphasia targeting the dorsal language network.

Presenter

Steven Small, University of Dallas Dallas, TX
United States

Neuromodulation to improve motor recovery after stroke

Rehabilitation after stroke can be effective but is expensive and so there is motivation to identify adjunctive approaches that can be used to boost the effects of a dose of rehabilitation. Neuromodulation approaches can be used to drive activity to a more optimal pattern or to trigger brain plasticity which can facilitate recovery. For example, using transcranial direct current stimulation (tDCS) to the motor cortex we can speed people[1]s learning

of a new task, alter their brain chemistry, or improve function in stroke patients. Alternatively, we can use neurofeedback to tap into the brain's intrinsic capacity for activity modulation. Use of neurofeedback to shift laterality of motor cortical activity will be discussed. MRI identifies changes in cortical activity and alterations in brain structure, that may mediate these functional benefits. In future, imaging could be used to guide individually targeted brain stimulation to enhance adaptive brain plasticity and improve recovery.

Presenter

Heidi Johansen-Berg, University of Oxford Oxford, Oxfordshire
United Kingdom

Neuro-technologies to enhance functional recovery from brain lesions: towards personalized approaches

Innovative neuro-technology-based treatment strategies, such as non-invasive brain stimulation (NIBS), robot-, VR- or BCI-based treatments, have demonstrated promising results in proof-of-principle studies. However, treatment responses of the current 'one suits all' approaches are not satisfying yet, as their magnitude is heterogeneous, with responders and non-responders. Based on the fact that the population of stroke patients is quite heterogeneous in relation to e.g., lesion location, lesion size, course and degree of recovery, initial deficit, functional and structural pre-requisites beyond others, 'one suits all' seems not to be the most promising approach. Thus, to achieve treatment effects with much larger magnitudes, there might be a need for a paradigm shift from imprecision 'one suits all' treatment strategies towards patient-tailored precision medicine approaches. In the present talk, these issues will be addressed in more detail and potential approaches towards patient-tailored interventions to achieve homogenous treatment responses with maximized effects will be discussed.

Presenter

Friedhelm Hummel, Swiss Federal Institute of Technology Geneva, Switzerland
Switzerland