April 2018 Abstract 4

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Hello members.

We are continuing our focus of Neuroplasticity this week. The future of neuroplasticity. Neuroimaging, what can we learn?

A review of transcranial magnetic stimulation and multimodal neuroimaging to characterize post-stroke neuroplasticity (link for PDF)

Auriat A, Neva J, Peters S, Ferris J, Boyd L. A review of transcranial magnetic stimulation and multimodal neuroimaging to characterize post-stroke neuroplasticity. *Frontiers in Neurology*.2015; 6:1-20.

Abstract:
Following stroke, the brain undergoes various stages of recovery where the central nervous system can reorganize neural circuitry (neuroplasticity) both spontaneously and with the aid of behavioral rehabilitation and non-invasive brain stimulation. Multiple neuroimaging techniques can characterize common structural and functional stroke-re-lated deficits, and importantly, help predict recovery of function. Diffusion tensor imaging (DTI) typically reveals increased overall diffusivity throughout the brain following stroke, and is capable of indexing the extent of white matter damage. Magnetic resonance spectroscopy (MRS) provides an index of metabolic changes in surviving neural tissue after stroke, serving as a marker of brain function. The neural correlates of altered brain activity after stroke have been demonstrated by abnormal activation of sensorimotor cortices during task performance, and at rest, using functional magnetic resonance imaging (fMRI). Electroencephalography (EEG) has been used to characterize motor dysfunction in terms of increased cortical amplitude in the sensorimotor regions when performing upper limb movement, indicating abnormally increased cognitive effort and planning in individuals with stroke. Transcranial magnetic stimulation (TMS) work reveals changes in ipsilesional and contralesional cortical excitability in the sensorimotor corti-ces. The severity of motor deficits indexed using TMS has been linked to the magnitude of activity imbalance between the sensorimotor cortices. In this paper, we will provide a narrative review of data from studies utilizing DTI, MRS, fMRI, EEG, and brain stimulation techniques focusing on TMS and its combination with uni- and multimodal neuroimaging methods to assess recovery after stroke. Approaches that delineate the best measures with which to predict or positively alter outcomes will be highlighted.

CLINICAL POINT OF VIEW:

1. Early intervention is important but what interventions are important for brain recovery, and with more people living after a stroke we need to understand neural mechanisms for recovery. How does the brain best learn and how does behavior affect neural recovery?

2. Location of stroke explains impairments seen more than size of stroke, but more research emerging on volumetric analysis of brain volumes. This may shed some light on brain damage that is seen remotely from location of stroke. Authors do recommend caution when using this information-more clinically as more research is done-volumetric analysis may predict response to post-stroke interventions.

3. Diffusion-weighted magnetic resonance imaging (DW-MRI) can provide info on white matter pathways. Clinically the corpus callosum and corticospinal tract have been studied to assess functional potential and motor function. DW-MRI may be able to predict neural changes after motor learning and prognosis after stroke. Prelim studies showing that DW-MRI can also provide info when selecting rTMS protocols.

4. Functional MRI (fMRI) "measures changes in blood movement in the brain over time." Task-based fMRI "can inform the capacity of individuals to recover after stroke, specifically with regard to motor function and learning."

5. Electroencephalography (EEG) can predict behavioral performance by coupling of 2 resting EEGs.

6. Transcranial Magnetic Stimulation (TMS) measures cortical excitability, but reported effects are moderate, but inconsistent. More research needed, but TMS has "great potential to enhance post-stroke recovery…"

7. Multimodal Assessments-combining neuroimaging TMS, MRI and EEG and looking at various combinations and clinically is there a way to use these methods in an individualized manner? The "predicting recovery potential algorithm has been introduced and suggested that patients who present with an ipsilesional MEP have the best prognosis for recovery, and intensive unilateral therapy of the paretic limb is recommended." Potential for multimodal imaging in future neuroplasticity and rehab studies after stroke!

We are seeking volunteers interested in assisting with the Stroke SIG while we are growing and developing. If you are interested, please contact heather.hayes@hsc.utah.edu Heather Hayes
Thank you.

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