Manipulation of afferent inputs in motor rehabilitation

FW 15-1

Subliminal electrical and vibrotactile stimulation in stroke rehabilitation

Stefan M. Golaszewski[1,2], M. Kronbichler[1,3], J. Bergmann[1], A. Kunz[1], E. Gallasch[4], K.M. Stephan[5], V. Hoemberg[5], F. Gerstenbrand[6], G. Ladurner[1]
[1]Department of Neurology, Paracelsus Medical University Salzburg, [2]FMRI Lab., Department of Psychiatry, Medical University Innsbruck, [3]Institute of Psychology, University of Salzburg, [4]Institute of Physiology, Medical University Graz, Austria [5]Department of Neurorehabilitation, St. Mauritius Clinic, Meerbusch, Germany, [6]Department of Neurology, Medical University Innsbruck, Austria

Objective: To investigate the effect of subliminal electrical and vibrotactile stimulation of the hand on sensorimotor cortical activity for application in stroke rehabilitation.
Methods: 10 healthy volunteers were studied using BOLD-fMRI with 1) a test motor-task with finger-to-thumb tapping of the left hand, 2) a subliminal electrical and vibrotactile stimulation of the left hand, 3) a second fMRI run with the same paradigm as in the test motor-task immediately after the electrical and vibrotactile stimulation, and 4) a final identical fMRI run 2 hours post-stimulation to test the cortical changes induced by electrical and vibrotactile stimulation. Experiments were carried out on a 1.5/3T MR scanner with echo planar sequences. Data analysis was performed with SPM99/SPM05. In a transcranial magnetic stimulation (TMS) study motoneuron excitability of the primary sensorimotor cortex of the left hand was tested before and after electrical stimulation of the hand.
Results: An increase of movement-related responses was seen within the primary motor and primary somatosensory areas of both hemispheres when comparing the test motor-task with the motor-task after electrical and vibrotactile stimulation relative to the baseline stimulation. After 2 hours of stimulation the modulatory effects of the peripheral stimulation diminished to baseline level except within the contralateral primary motor region. With TMS an increase of motoneuron excitability within the primary motor cortex of the left hand could be demonstrated after electrical stimulation of the left hand.
Conclusions: The increased BOLD response spatially localized within the sensorimotor cortex reflects an increase in motoneuron excitability, which was verified with TMS.

FW 15-2

Upper plexus anaesthesia in stroke rehabilitation

Klaus M. Stephan[1,2], M. Stollorz[1], J. Bohland[1], J. Specht[1], H. Krause[1], T. Steinforth[3], V. Hoemberg[1,2]
[1]St. Mauritius Therapieklinik, Meerbusch, [2]Neurologisches Therapiezentrum, Heinrich-Heine Universität, [3]Anaesthesie, Augusta Krankenhaus, Düsseldorf, Germany

Enhancement of sensory experience and repetitive motor training are two complementary modes to improve hand motor function during sensorimotor rehabilitation. Furthermore, in chronic stroke patients Muellbacher et al. (2002) demonstrated improved hand motor function after transient blockage of sensory inputs to upper arm and shoulder representations using upper plexus aneasthesia. Thus in chronic stroke, both specific sensory enhancement and temporary blockage of rival sensory information may stimulate sensorimotor recovery. We were interested to see whether this procedure would also help patients with subacute stroke. In a preliminary study 12 patients with a moderate paresis 4 to 8 weeks after their first clinical stroke received upper plexus anaesthesia on the affected side. A second group of patients with similar demographic and clinical data served as a control. Both groups received the same special training lasting for two weeks. Both, the patients of the experimental group and of the control group showed a clear improvement of arm function during their training. Patients without plexus anaesthesia showed most recovery during the first week, in patients with plexus anaesthesia the speed of recovery was greater in the second week. Furthermore, proximal and distal arm functions showed different time courses of recovery. Our period of observation was not long enough to show, whether temporary blockage of sensory information from adjacent body parts led to a lasting clinical improvement of hand function in subacute stroke. We conclude, that upper plexus anaesthesia influences the sequence and possibly also the mode of recovery in subacute stroke.

FW 15-3

Repetitive sensory stimulation training in stroke

Herbert R. Dinse[1], J. Boland[2], T. Kalisch[1], M. Kraemer[2], E. Freund[2], E. Beeser[2], V. Hoemberg[2], K.M. Stephan[2]
[1]Institut NeuroInformatik, Neural Plasticity Lab, Ruhr-University, Bochum, [2]St. Mauritius Therapy Clinic, Meerbusch, Germany

Background and aims: Somatosensory input is crucial for tactile perception and sensorimotor performance, and for improving performance through neuroplasticity mechanisms. Effective rehabilitation following stroke consists of training and practicing, but stimulation of cortical substrates via activation of sensory pathways has been shown to be effective as well (Wu et al. 2006, Arch Phys Med Rehabil 87). As an alternative to training, we have introduced a passive stimulation protocol called tactile co-activation (CA), which enforces cortical reorganization in parallel to improvement of tactile and sensorimotor performance (Pleger, Dinse et al. 2001 Proc Natl Acad Sci USA 98; Dinse et al. 2003 Science 301; Dinse et al. 2005 Transaction Appl Perc 2; Dinse et al. 2006 Ann Neurol 60). The unique advantage of co-activation is its passive nature, i.e. it does not require the active cooperation of the subject.
Methods: We therefore used CA in subacute stroke therapy over 2 weeks in patients suffering from middle cerebral artery infarction. For co-activation, the fingers of the affected arm were electrically stimulated (20 Hz bursts with 5 sec interburst intervals) resulting in a total of 6 h of co-activation.
Results: Assessment of tactile, haptic and sensorimotor performance after the end of treatment and 3 months of follow-up revealed significant improvements in all tasks tested including touch threshold, tactile acuity, Moberg, and peg-board tests. Remarkably is that even after the end of treatment improvement progressed.
Conclusions: The effectiveness of co-activation in combination with its passive nature makes co-activation a prime candidate for therapeutic intervention programs.

EUROPEAN JOURNAL OF NEUROLOGY

Volume 15, Supplement 3, August 2008

Abstracts of the 12th Congress of the European Federation of Neurological Societies

Aug. 24-26, 2008

Madrid, Spain

Information on this journal can be accessed at www.blackwellpublishing.com/ene or www.efns.org.

Printed in Austria.

EFNS HEADOFFICE
Breite Gasse 4-8
A-1070 Vienna
Austria
Tel.: +43 1 889 05 03
Fax: +43 1 889 05 03 13
e - mail: headoffice@efns.org
www.efns.org

1351-5101(200808)15:08+3