

ESF Exploratory Workshop
The use of functional recovery in neurorehabilitation of MS people
NEUROSCIENCE
SCIENTIFIC REPORT

Prague, April 20th, 2003

Executive summary, scientific content of the event, assessment of the results and contribution to the future direction of the field

Multiple sclerosis (MS) is a neurological disease that results in the inflammation of random plaques in the central nervous system (CNS), with loss of the myelin sheath that covers the fibres in the brain and spinal cord. The plaques cause nerve impulse conduction to be disrupted, and even when the inflammation subsides, nerve impulses are carried at a reduced speed. These disruptions lead to the widely diverse and unpredictable symptoms of MS. The most common primary symptoms are weakness and spasticity, numbness and tingling in different parts of the body, reduced vision, slurred speech, bladder dysfunction, ataxia, tremor, depression, cognitive dysfunction and fatigue. Consequently, MS can lead to secondary complications (for example to dyspnea, osteoporosis, urinary infectious), and tertiary complications (disrupted planning for a family or a career) and decreases the quality of life.

First part of ESF workshop concerned neurorehabilitation in MS and use of plasticity CNS in neurorehabilitation

The complexity of MS requires comprehensive care including rehabilitation. Although rehabilitation is very vast and often integrant of comprehensive care, it is often inadequate, inconsistent and is not used as effectively as it could be.

The neurorehabilitation uses a number of therapeutic methods such as Vojta's reflexive locomotion, Bobath concept, sensori-motor stimulation, proprioceptive neuromuscular facilitation or Brüger concept. Various oriental techniques are also utilized, such as acupressure, yoga or tai-chi. The purpose of neuro-rehabilitation is to combine particular techniques in such a way that stimulates the activities of the central nervous system. It was proven that targeted and regular neuro-rehabilitation care influences the symptoms of the disease, the course of the disease, and the quality of life.

Moreover it seems that the therapy has an impact on the brain activity changes as discovered by the fMRI and other methods, which could give an evidence of creation of new neuronal interconnections or modification of the existing ones.

In this workshop specialists (Andereck, Nuyens, Smedal, Gjelsvik) in neurorehabilitation exchanged knowledge and experiences in the field of neurorehabilitation, which could primarily improve physical and psychical health dimension of MS people and secondarily improve social, cultural and institutional environment.

The aim of this session was to present therapeutic approaches in different countries in each phase of the disease, make consensus how to develop and provide neurorehabilitation as a part of comprehensive care for patients with MS, and to prepare the guidelines of neurorehabilitation based on the latest scientific knowledge.

Neuro-rehabilitation uses the fact that even if a part of a brain is damaged not all information stored in this area must be lost. This is very important as the information in the brain is truly stored and you can obtain information due for one hemisphere by attacking the other one. The information is not perfect but for a normal life it is completely sufficient.

Furthermore, in neuro-rehabilitation we can use the plasticity of the central neural system, due to which the brain tissue is able to accommodate to changing both internal and external environment. During neurorehabilitation we stimulate higher inflow of correct information to the brain which stimulates reorganisation of the brain tissue in the way, which uses the undamaged parts of the brain for partial repair of the disrupted function.

In the workshop there were presented results of several studies, where were shown unspecific changes in the brain activity after neurorehabilitation (movement therapy and cognitive rehabilitation) in stroke and multiple sclerosis.

Johansen-Berg presented results of longitudinal study "Are changes in function associated with changes in motor networks?" where scanned twice before and twice after 2 weeks of home-based progressive exercise therapy in 7 patients with mild to moderate hemiparesis at least 6 months post-stroke. She found that changes in motor representation of the affected hand are specific to patients who improve.

Rasova presented results of the study "The use of functional recovery in neurorehabilitation" where showed that after therapy based on the theory of plasticity and adaptability of the CNS and sensorimotor learning improves impairment, disability, handicap and quality of life in MS people. This improvement was accompanied by changes in brain activity, mainly in cerebellum. It seems that neurorehabilitation influences the function of the whole body (trunk stability, limb function and cognition) and the whole brain. When amplitude of signal during performance of the paradigm of left hand increased, it increased during performance of right hand.

Penner presented results of the study "Therapy induced plasticity of cognitive functions in MS patients studied by fMRI" where confirmed an effect of training on behavioural and imaging readouts. Activation of the precuneus, the posterior cingulate cortex and the dorsal frontal cortex was only observed after training, but for both patient groups and both attention tasks. She considered that performance gain may depend on the brain's capacity to use new interconnections.

Although there has already been presented the results confirming that processes related to learning, adaptation and training occur all along the neuroaxis and can create new synaptic pathways or modify existing neuronal circuits, there is still very little

scientific basis for the training and therapy that are designed to help damaged brain circuits recover.

Second part of ESF workshop concerned plasticity CNS and its examination

Prof. Nevšimalová spoke about neuroplasticity as a possibility of functional recovery from clinical, neurophysiological and neuroimaging point of view. She presented extended research proceeded in Department of Neurology, Charles University in Prague concerning physiology (sleep, memory and learning) and pathology (neuroplasticity in narcolepsy, hypersomnia, restless leg syndrome, nocturnal epilepsy, parasomnias and autonomic dysfunction, sleep apnea syndrome). She emphasised that motor skill acquisition increases the CBF in contralateral primary sensorimotor cortex, supplementary motor area, thalamus and that transcranial direct current stimulation modulates motor learning, alters neuronal excitability (induces prolonged excitability changes).

Prof. Comi presented lecture concerning neurophysiological principles which are needed to use in neurorehabilitative treatment.

Prof. Matthew in his contribution tried to define questions which are necessary to answer for use of plasticity CNS in neurorehabilitation:

- Does the altered activation pattern in patients represent changes in neuronal interactions?
- Can we differentiate effects of brain injury from those of altered patterns of use?
- What is the potential time frame for functional reorganisation?
- Can we define shifts in activation consistent with local axonal changes?
- How can grey matter cytoarchitectonic structures be identified in vivo?

Filippi presented the data which indicate that cortical reorganization does occur in patients with early MS and might contribute to limit the consequences of irreversible tissue damage in lesions and normal-appearing brain tissue. They also suggest that local synaptic reorganization, recruitment of parallel existing pathways and reorganization of distant sites are all likely to contribute to the genesis of cortical adaptive changes since the earliest phase of the disease.

Rocca demonstrated that cortical functional changes do occur in patients with the progressive forms of MS and involve a widespread network usually considered to function in motor, sensory and multimodal integration processing. Although the role of cortical reorganization in limiting the functional impact of MS structural damage is still not definitively proven, results support the concept that cortical adaptive responses may have an important role in compensating for tissue damage in MS. They also suggest that the rate of accumulation of disability in MS might not only be a function of tissue loss, but also of progressive failure of the adaptive capacity of the cortex.

Ward in his presentation discussed what can functional imaging tell us about recovery of motor function after stroke? Jech spoke about other possibilities how to evaluate plasticity of CNS in MS people.

All contributions will be presented in a booklet and sent to all participants and European MS Centres. The booklet will be a contribution for an open discussion of an attempt to find a common way of effective use of plasticity CNS in neurorehabilitation of MS people.

The ESF workshop brought together various specialists (medical doctors, physiotherapists, psychologists and physics) including young researchers and PhD students from the top institutions in different European countries for an open academic discussion on wide aspects of the issue of use of plasticity and adaptability of CNS in neurorehabilitation of MS people. The ESF workshop in Prague have started cooperation in this field. All participants agreed to establish the work group for future network of cooperation. Next workshop was arranged on, September 17 – 20, 2003 during the Congress of the European Committee for Treatment and Research in Multiple Sclerosis in Milano.

The main aims of next cooperation defined by Havrdova are:

To find the best way how to improve functioning of MS patients, to prove it objectively and to find tools which can help us in doing it.

Based on current knowledge on the level of neurorehabilitation of MS patients in European countries to gather our efforts to manage to push the guidelines on sustained neurorehabilitation care in MS through into the guidelines of the treatment of MS from its beginning.

Final Programme of the ESF Exploratory Workshop
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Monday 14th April 2003

9 – 9:30:

Welcome and introduction:

E. P. Beem, ESF Representative

H. Illnerová, president of The Academy of Science of the Czech Republic

M. Šolc, president of Impuls, charitable fund

9:45 – 10:10 Nevšimalová, S., Jakoubková, M., Jech, R.: Neuroplasticity - a possibility of functional recovery. Clinical, neurophysiological and neuroimaging point of view.

10:15 – 10:35 Havrdová, E.: Possibility of functional recovery in multiple sclerosis.

10:55 – 11:10 Anderseck, B.: Practical aspects in the rehabilitation of multiple sclerosis.

11:15 – 10:30 G. Nuyens, W. De Weerd, P. Ketelaer: Assessment of hypertonia in stroke, multiple sclerosis and Parkinson's disease.

11:30 – 11:45 Tori, S.: Single subject experimental design - physiotherapy intervention in neurorehabilitation (ongoing project).

11:45 – 12 Bente, G.: Neurorehabilitation techniques based on plasticity of the CNS and musculoskeletal systems related to the two patients (case history, ongoing project).

12 – 13:13 lunch

13:30 – 14 Obenbenger, J, Krasensky J, Dolezal. O: Use fMRI for imaging plasticity CNS.

14:15 – 14:45: Rasova, K.: The use of functional recovery in neurorehabilitation of MS people.

15 – 15:30 Johansen-Berg: Motor improvement and altered fMRI activity after rehabilitative therapy.

15:45 – 16:15 Penner, I.K.: Therapy induced plasticity of cognitive functions in MS patients studied by fMRI".

Tuesday 15th April 2003

9 – 9:45: Comi, G: The main approaches to the examination of functional recovery, valuation techniques (benefits, costs, efficiency, sensitivity and specificity).

10 – 10:45: Matthew, PM : Towards understanding brain plasticity using fMRI.

11 – 11:45: Filippi, M.: fMRI in the early phase of MS.

12 – 13:30 lunch

13: 30 – 14 Rocca, Ma, Filippi, M: fMRI in the progressive form of MS was supposed to be replaced it.

14: 15 – 14: 45 Jech, R.: Visual perception and morphometric changes of the visual pathway in MS.

15 – 15:30 Ward, N: Functional imaging in stroke recovery.

Final list of participants

Convenors:

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STATISTICAL INFORMATION ON PARTICIPANTS

NUMBER OF PARTICIPANTS: 19

GENDER STRUCTURE: 10 WOMEN, 9 MEN

**COUNTRIES OF ORIGIN: CZECH REPUBLIC 8
UNITED KINGDOM 3
ITALY 3
NORWAY 2
SWITZERLAND 2
BELGIUM 1**

**PROFESION: NEUROLOGISTS 10
PHYSIOTHERAPISTS 5
PSYCHOLOGISTS 2
PHYSICIST 1
PRE-GRADUATE STUDENT 1**