NeuroRehabilitation 23 (2008) 1–2
IOS Press

Guest-Editorial

Emerging Approaches in Rehabilitation after Brain Injury

Lumy Sawaki
Wake Forest University, Department of Neurology, Program in Rehabilitation, Winston Salem, NC, USA
E-mail: lsawaki@wfubmc.edu; lumy@dr.com

This special issue of *NeuroRehabilitation* reviews the scientific bases of the emerging strategies for motor retraining associated with brain injury. The issue focuses, in particular, on the cutting edge of basic and multidisciplinary translational research from diverse perspectives including contributions from clinicians, physical and occupational therapists as well as engineers.

During the last two decades, we have learned that the brain is able to reorganize more after brain injury than thought possible, property known as neuroplasticity. Now, it is believed that these plastic changes play a crucial role in learning and memory processes as well as recovery of function after brain injury. Substantial literature, on the other hand, supports the view that the ability of the mature brain to reorganize decreases with age. As demonstrated by the greater rate of functional motor recovery in younger adults as compared to the elderly. Therefore, a major goal of the research in rehabilitation after brain injury is to harness the capacity of the brain to reorganize after neurologic damage has occurred and thus ultimately leading to successful restoration of function.

Remarkable changes in cortical motor system have been demonstrated during the performance of motor activities, in response to pharmacological agents and peripheral or central nervous stimulation. Modification of synaptic strength, axonal sprouting and changes in synaptic firing occur continuously in the adult nervous system and in response to environmental demands. As a result of these recently emerging evidences, rehabilitation after brain injury is experiencing a dramatic paradigm shift and beginning to replace compensatory approaches by strategies to maximize neuroplastic changes.

The contributors of this issue critically review and correlate concepts of basic science with interventions to improve motor function in subjects with brain injury. Blanton, Wilsey and Wolf discuss one of the techniques that have been evaluated in large-scale clinical trials known as constraint-induced movement therapy in stroke. This technique involves restraining the unaffected arm with a mitt combined with massive motor training of the affected side. The study is a cornerstone for the development of evidence-based multicenter trials in neurorehabilitation. McCombe Waller and Whitall, on the other hand, focuses on bimanual arm training after stroke, bringing intriguing arguments in favor of bimanual over unimanual training such as constraint-induced movement therapy. Following the same concept of massive training as described above, how about employing state of art equipments such as robotic system to accomplish appropriate degree of motor training? Krebs and colleagues present data regarding robot-assisted therapy to improve arm function in severe and moderate stroke. Hesse assesses the crucial role of gait trainers such as partial body weight supported treadmill training for restoration of gait after brain injury. These two articles are examples of the fascinating and ever growing symbiosis of clinical knowledge and technology. There is no doubt that extraordinary technological advances will be made during the upcoming millennium and words such as robotic exoskeleton

ISSN 1053-8135/08/$17.00

and neuroprosthesis will become routinely used in neurorehabilitation. Mazzocchio and colleagues' review discusses the potential to use locomotor-like cycling for retraining subjects with impaired locomotor activity. While this intervention has been evaluated in a small scale study, it is one of the few studies that holds potential to better understand the locomotor-related spinal pathways and therefore develop new strategies to improve gait after brain injury.

Kaelin-Lang summarizes the concept of applying peripheral nerve stimulation to optimize hand motor function after stroke. He describes compelling evidence that sensory training and experience can drive plastic changes that play a crucial role in recovery of function after brain injury. The review by Rösser and Flöel focuses on pharmacological interventions to optimize motor recovery. The authors summarize medications that can up-regulate plastic changes by influencing specific neurotransmitters in the brain and therefore recovery after stroke. This is a growing topic that will likely bring new avenues to optimize function after brain injury especially when paired with structured training. Edwards and Fregni focus on the impact of modulating cortical excitability to improve motor function after stroke. The concept that we are able to non-invasively excite or inhibit specific cortical areas through repetitive transcranial magnetic stimulation is intriguing and an increasing number of clinical researchers are applying this technique to improve function in a wide-range of neurological disorders.

Finally, two review articles discuss emerging strategies of motor retraining in movement disorders. It is conceivable that neuroplasticity may be maladaptive in neurological dysfunction such as Parkinson's Disease and Dystonia. Zeuner and Molloy describe a sensory retraining technique to optimally tune the impaired sensorimotor integration in focal dystonia. Siddiqui and colleagues present a comprehensive review of deep brain stimulation for movement disorders. This relatively new intervention may hold huge promises to a wide number of neurological disorders in the future.

In spite of the evidence accomplished to date, much work is still needed. However, the results already gathered provide great potential for functional recovery after brain injury and committed evidenced-based research in neurorehabilitation will advance the field in a extraordinary rate during the next decade.