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Guest Editorial

Neurorehabilitation of Parkinson's Disease and ALS

Parkinson's disease (PD) is the second most common neurodegenerative disease, exceeded only by Alzheimer's disease (AD). About 1 million people in the United States, 1 million in Western Europe, and 5 million worldwide suffer from PD. Clinically, PD is characterized by motor symptoms including rest tremor, rigidity, bradykinesia, and posture instability. In addition, patients with PD also suffer from non-motor symptoms including cognitive impairment and dementia, fatigue, autonomic disturbances, and sleep disorders. While the degeneration of dopaminergic neurons in the substantia nigra is responsible for the motor symptoms, the degeneration of non-dopaminergic neurons including cholinergic neurons of the nucleus basalis of Meynert (NBM), norepinephrine neurons of the locus coeruleus (LC), serotonin neurons in the raphe nuclei of the brainstem, and peripheral autonomic nervous system are responsible for the non-motor symptoms (Orlanow el al., 2015).

Because PD is a slowly progressive disorder that compromises patients' quality of life (QOL) progressively, neurorehabilitation plays a critical role in improving QOL in PD. Difficulty turning, freezing, and postural instability result in high risk for falls and fractures. Cognitive impairment and dementia are also major risk factors for shortened life. Poor motor control and cognitive impairment lead to driving impairment. Poor nocturnal sleep and daytime sleepiness associated with dopaminergic medicine further affect driving safety. Neurorehabilitation is increasingly playing a major role as part of a multidisciplinary approach in managing PD. Neurorehabilitation interventions have been used in the treatment of motor, gait, speech, and cognitive problems (Uc et al., 2014). A systematic review showed that neurorehabilitation has beneficial effect on motor functions, quality of life, and activities of daily living (Foster et al., 2014).

The advance of technology enables researchers to use wireless wearable sensors to measure motor impairments in PD quantitatively. In this issue, Mancini el al. used wireless sensors to compare turning mobility in PD versus normal control over seven days. They showed that although the total numbers of steps and turns were not different between the two groups, the PD group had slower and more variable turning velocity and higher number of steps per turn. These wearable sensors therefore can quantitatively detect abnormality in turning that cannot be detected by clinical examination. These sensors will be useful for monitoring progress in rehabilitation practice and clinical trials.

Parkinson's disease, due to its slowly progressive nature, may offer a unique model to investigate whether non-invasive brain stimulation (NIBS) such as transcranial magnetic stimulation (TMS) or direct current stimulation (tDCS) can improve symptoms and reverse functional changes in the motor cortex and motor circuit secondary to dopaminergic deficiency. The motor system is an ideal target for cause-effect exploration, because its output can easily be measured using neurophysiological techniques such as surface EMG or motor function assessment. The rationale for non-invasive brain stimulation is that if the abnormalities in brain activity and physiology that cause clinical deficits are reversed, normal function should be restored. The dramatic effects of deep brain stimulation (DBS) provide the best evidence for this rationale and suggest that DBS may have widespread effects across the motor circuit that connects motor cortex, basal ganglia, and thalamus. This raises hope that stimulating elsewhere within this circuit, such as stimulating motor cortex by NIBS, could achieve comparable effects. The second paper, by Benninger and Hallett, reviewed the available clinical studies in TMS and tDCS. Although rTMS and tDCS have therapeutic potential, their clinical effects so

far have been very small regarding QOL. Future studies need to focus on harnessing the potential of NIBS and use it to potentiate the efficacy of rehabilitative interventions.

Fatigue is a major complaint in many patients with PD and it affects patients' QOL. The numbers of studies of fatigue in PD have increased significantly since an item of fatigue is included in the most commonly used clinical rating scale in PD – Movement Disorders Society-Unified Parkinson Disease Rating Scale (MDS-UPDRS) scale in 2007 (Goetz et al, 2007). In this issue, Lou reviewed our current understanding of fatigue and fatigability, including their measurement, pathophysiology and potential treatments. There are no evidence-based treatments for fatigue and fatigability available currently. Several pilot studies on the effects of pharmacological agents and exercise on fatigue and fatigability provide some insights on the design of future larger clinical trials.

Compared to normal controls, patients with PD are more likely to cease driving and have higher incidence of depression, social isolation and comorbidity that lead to increased mortality (Edwards et al., 2009). In the next paper, Devos et al. conducted a systemic review of 27 studies about driving capabilities of patients with PD. They showed that the impaired on-road driving performance in drivers with PD is due to a combination of visual, cognitive, and motor deficits. They recommend that driving rehabilitation strategies for individuals with PD include a comprehensive training program honing visual, cognitive, and motor skills.

Amyotrophic lateral sclerosis (ALS) is the third most common neurodegenerative disease, which affects about 30,000 Americans. In contrast to Parkinson's disease, ALS is a rapidly progressive disease with an average life expectancy of only 3 years after symptom onset. Multidisciplinary care, which is rehabilitative in nature, is the standard of care (Miller et al., 2014). Although ALS is incurable, many treatments are available to help patients coping with disability caused by ALS and improve patients' QOL. Here, Paganoni et al. reviewed rehabilitative care across the ALS disease spectrum. They discussed what rehabilitation teams could offer to assist patients as the disease progresses.

Some patients who are inflicted with a neurodegenerative disease such as PD, ALS, Alzheimer's disease, or Huntington's disease will develop communication impairments due to speech intelligibility caused by motor and/or cognitive impairments. In the final paper, Fried-Oken et al. discuss augmentative and alternative communication (AAC) services available to these patients depending on whether their condition primarily affects motor or cognition skills. They suggest that AAC should be standard practice for adults with neurodegenerative disease such as PD and ALS to ensure patients remain active participants in daily activity.

I hope you find this issue informative and helpful for your patient care.

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