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Short Communication

The Fatigue of Central Origin as Performance Restrictor in Rehabilitation Programs

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In clinical practice, fatigue has been cited as a frequent component especially in neurological conditions, such as Amyotrophic Lateral Sclerosis, Multiple Sclerosis, Cerebral Palsy, Spinal Cord Injuries, Muscular Dystrophies, among others, being listed as a limiting factor in the rehabilitation process besides affecting in the daily life activities that require a satisfactory physical performance, both in young people and in adult.

Fatigue is a combination of physiological and psychological aspects. When of peripheral origin, it is related to impairments in muscle level, whether it be by limitation of the contraction of the fibers or by a lack of nutrients. The central origin fatigue can be understood as the state in which the muscle activation resulting from the central nervous system is compromised, causing a reduction in the number of active motor units and changes in the excitatory command to the motor centers, being a limiting factor for physical performance. It relates to the changes: [1] excitatory command to the higher motor centers; [2] lower motor neuron; [3] its degree of excitability, and [4] neuromuscular transmission [1, 6].

Studies have shown that the fatigue of central origin is related to synthesis and metabolism of monoamines such as dopamine, serotonin and noradrenaline. These neurotransmitters play critical roles in various brain functions such as motivation, responses to stress, excitement, motor control and attention [2]. The increase in serotonin \ dopamine and norepinephrine are associated with decreased physical performance, being the effect of serotonin dosage-dependent, in other words, moderate levels exercise excitatory effect, while higher levels cause central fatigue.

The need to discuss the various ways to evaluate fatigue, whether it is central or peripheral, is justified by the influence it has on the training protocols. This influence is evident when one increases the intensity of exercise, where a decrease of speed and motor control is observed. Studies suggest that this assessment can be made after the induction of a supra-maximal electrical stimulation to the motor nerve during a maximal isometric contraction (MIC) to estimate the magnitude of voluntary activation that during an exercise or prolonged contraction tend to decrease. In addition, studies apply transcranial magnetic stimulation on motor areas during a MIC suggesting that when a force is increased, part of the central fatigue may be due to insufficient cortical output. The measurement of that response is performed using electromyography [5].

The use of Proton Emission Computerized Tomography, Functional Magnetic Resonance Imaging, *near-infrared* Spectrography, have also been mentioned but it is necessary for the individual to be inactive during the evaluation, thus making it difficult for the study of neural changes within the human cortex. The electroencephalography (EEG) with active electrodes allows the recording of cerebral cortical activity during complex movements and incremental exercise, demonstrating to be a relevant tool for measurement of the central origin fatigue process, which is already being used in some researches [3].

Another way of evaluating central fatigue is using the central effort perception scales as, for example, the 20 point Borg scales. The effort perception refers to all subjective sensations presented during the performance of the exercise and it is associated with prefrontal cortical areas where current activities are compared with previous ones as part of the decision-making process of the necessary intensity of contraction.

Although the evaluation of central fatigue has been addressed in a significant way in some studies, partly due to the growth of individuals with this clinical condition, there has not yet been a construction of an objective instrument to serve as a reference, to provide accurate data for decision making and development of rehabilitation programs, since the most frequently used methods are merely subjective.

It is considered relevant the development of evaluation techniques with higher precision objective to be used as a reference in various conditions, not only neurological, since fatigue can influence even in the rehabilitation programs of small orthopedic injuries. Future studies could also make use of the accelerometer, an inexpensive and easily reproducible device that permits evaluation of the duration of the exercise, speed, strength and motor performance in the three motion scenes.

Programs for neurologic patients with central fatigue should be developed based on the clinical findings and in accordance with the natural history of the disease addressed. The exchange of knowledge

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among professionals, the use of supportive and protective equipment, as well as psychological support, should be part of the proposed rehabilitation. Submaximal exercise therapy may contribute to a better control of muscle weakness and fatigue, improvement cardiorespiratory aptitude and walking pattern. The patients should avoid activities which cause muscle fatigue or joint pain. It is important to emphasize that it is difficult to differentiate central and peripheral fatigue, which often correlate.

The literature suggests an individualized, submaximal approach, adapted to the peculiarities of the patients and natural history of the diseases.

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