МЫШЕЧНАЯ АСИММЕТРИЯ КОНЕЧНОСТЕЙ И НЕРВНО-МЫШЕЧНЫЕ ВЗАИМООТНОШЕНИЯ

MUSCULAR ASYMMETRY OF THE LIMB AND NEURO-MUSCULAR RELATIONSHIPS

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Резюме
В статье рассмотрены объективные методы исследований в неврологии с точки зрения их диагностической ценности для пациентов с асимметрией мышц конечностей. Учитывались также конституция тела и центры массы тела, коррелирующие с уменьшением силы, координации движений и поражением нейронов. Описаны взаимоотношения опорно-двигательного аппарата и механизмов нервной регуляции, как способствующие применению физикальных и лабораторных тестов, так и ограничивающие их точность.
Ключевые слова: мышечная асимметрия; автономная нервная система; Опорно-двигательный аппарат
Summary
The article discusses objective research methods in neurology from the point of view of their diagnostic value for patients with limb muscle asymmetry. The constitution of the body and the centers of mass of the body were also taken into account, correlating with a decrease in strength, coordination of movements, and damage to neurons. The relationship between the musculoskeletal system and the mechanisms of nervous regulation is described, both facilitating the use of physical and laboratory tests, and limiting their accuracy.
Key words: Muscular asymmetry; autonomic nervous system; locomotor system

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Relevancy. To review reliable methods of objective and laboratory examination aimed at evaluating the nervous system through the functions of the locomotive apparatus, implying the relationship of mutual influence between them. Understand which physical exams can be performed without the need for large infrastructure and equipment, but which contribute with significant information to establish the clinical diagnosis of patients who have, among other health problems, asymmetry in the limb's muscles.

Method and materials. Study design: Through a literature review on the topics of musculoskeletal asymmetry, neuromuscular atrophy, neuropathology of the locomotor system, neuromuscular assessment methods, influence of the autonomic system on the locomotor system and vice versa; carried out through scientific dissemination platforms, newspapers and libraries and electronic collections, such as Scielo, Pubmed, Google Scholar, and clinical cases of high-performance athlete patients complaining of musculoskeletal pain and muscle asymmetry in the thigh muscles and/or with hip rotation accompanied with low back pain and case reviews of patients with neurological degenerative diseases such as Amyotrophic Lateral Sclerosis and Spinal Muscular Atrophy (SMA). Analysis of the comparative study: The data collected in the publications of the research institutes and the investigation between data presented in the literature with the clinical cases collected, aiming to understand the correct and practical use of neuromuscular assessment tests in patients with muscle asymmetry in the thigh muscles, given the multiplicity of variables that influence such objective examination.

Discussion and results. The musculoskeletal system includes bones, muscles, tendons, ligaments and soft tissues, such structures are responsible for absorbing shocks, producing

heat, protecting internal organs, stabilizing and moving joints, among other functions, most of which arise in response to neuroendocrinological stimuli. The nervous system controls voluntary and involuntary muscle movements. Focusing on neurological activity on skeletal muscle, and the body's ability to develop movement, that is called motor coordination, it occurs through nerve impulses that trigger contraction or relaxation of a given musculature that moves the bones through the tendons in the direction of the vector resulting from the applied application.

The performance of fine and complex coordinated movements is only possible due to intra and intermuscular properties mediated by the nervous system to the locomotor system and the ability of muscle balance which refers to the length and strength relationship between the agonist and antagonist muscles as well as the relationship between the contralateral muscles, or dominant versus non dominant limb. The muscle stabilizing competence also plays a protective role as it prevents harmful forces imposed in the joints. Due to the variety of locomotor abilities, we can divide the skeletal muscles into two groups, the mobilizing muscles that are responsible for functional movements, located more superficially and tend to fatigue more easily, and the stabilizing muscles, which are located more deeply and protect the joints. Muscle imbalances tend to be the result of what is called functional pathology that are faulty movement patterns, which do not cause pain to patients, however such alteration can result in an atypical mechanical functioning of the joints, or involve the stabilizing muscles that since they the mobilizers muscles have a tendency adapt, becoming short and tight to support the extra workload, potentially resulting in faulty mechanics which can make the joint more susceptible to the development of lesions and these injuries may cause pain. This whole process demonstrates how relevant and dignified the price of asymmetries in preventing injuries to the musculoskeletal system.

In order to maintain the balance of the human body, the gravity line must always be above the feet, since the body moves and the center of gravity changes in relation to the support (feet), the patient loses balance. The anatomical localization of the center of gravity changes according to the age, gender and anthropometric size, but in adults it is approximately anterior to the second sacral vertebra and its magnitude is equal to their weight. it means that any given extra mass added to the body displace the center of gravity towards and proportional to the additional weight.

Few studies have assessed the gait asymmetry based on the activator muscles, mostly of the diagnostic methods done using parameters from surface electromyography (sEMG), however research published in ieee transactions on neural systems has shown that asymmetry index in muscle activations can be successfully used in clinics for an objective assessment of the muscle activation asymmetry during locomotion [1].

Numerous studies on discrepancies in gait form made with high performance athletes of different specifications found relevant differences in the comparison of dominant and non-dominant strength members for all strength measures, this may be due to numerous causes, but one of them to movements agile and unilateral explosives [2]. In other studies, we see that patients with leg length discrepancy develop compensatory mechanisms, which result in kinematic alterations in the lower limbs and pelvis [3] which can be converted into changes in the rectus femoris and hamstring, where those adaptations may lead to lower back pain in a long run. Other range of causes that affect the locomotor apparatus that the differential diagnosis can be extremely difficult is the pseudoradicular pain, like facet syndrome or the myofascial pain syndrome, that possess a nociceptive character in the skeleto-mechanical system, but also as neurogenic, the pain emanating from lesions in the peripheral nerves or nerve roots or as referred pain resulting from disorders of visceral organs [4]. Despite this direct relationship between the locomotor system and the nervous system via nociceptors and motor neurons, the interconnectivity and influence between them goes far beyond, in studies conducted at the University of São Paulo (USP), in Brazil, contrary to what was previously thought, the sympathetic nervous system in muscle tissue, in addition to controlling blood flow through the contraction or relaxation of vessels, presenting indicators based on biochemical analysis of muscle sympathetic activity and fluorescent biosensors, observed in the motor plate, which is the neuromuscular union, the presence of β2-adrenergic type receptors, so when a noradrenaline released by the sympathetic system attach to the receptor and cyclic adenosine monophosphate (cAMP) is released in the neuromuscular union plate, which would denote a sympathetic innervation in the region that to increase the stability of the receptors cholinergic and thus, the sympathetic innervation would be indirectly helping the motor innervation there was no control of muscle contraction. These results have a return in the treatment of neuromuscular diseases, such as myasthenic syndromes [5]. Such findings are of great importance, as they broaden the horizons of understanding neuromuscular activities, opening precedents for the emergence of new physiotherapeutic approaches. It gives ground to neurophysiological techniques, especially in peripheral innervation [6], since, for example, the anatomical characteristics of the pelvic floor and perineal muscles, and their innervation, which, at some level, are correlated with the pelvic organs. Even with the need for more research to be carried out in this area, up to the level of application of this

knowledge as a diagnostic tool, the concept of interrelationship and functioning of the autonomic system in front of the locomotor system has been gaining more and more space in the literature.

Conclusion: It was revised that the neuropathological effects on the locomotor system depend on its etiology and pathophysiology, which allows us to trace diagnostic criteria to identify a given neuropathology and assess its grade or degree in order to prescribe the best treatment. For this purpose, physical assessment methods are of paramount importance for the diagnostic differentiation and classification of the stage of neurological damage, as some diseases present typical musculoskeletal manifestations, such as symmetrical or asymmetrical atrophy, loss of symmetrical or asymmetrical strength, location more frequent (upper or lower limbs), affection on motor or sensory neurons or both and so on. According to clinical data methods of objective examination, due to the multiplicity of variables that can influence the result, it does not present itself as a precise diagnostic tool when used isolated, therefore new methods of laboratory studies that are currently emerging and are still in the development stage, are more promising for establishing a clinical diagnosis, based on findings that assess intramuscular immunohistochemical interactions.

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