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Rehabilitation Challenges in Limb-Girdle Muscular Dystrophies

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Abstract
Limb-girdle muscular dystrophy (LGMD) is a burdensome progressive neuromuscular disease, with a great impact upon quality of life. Unlike other types of neuromuscular dystrophies, which have onset in early childhood and severely limit the life expectancy, LGMD is usually diagnosed at young adulthood age. Since no etiological treatment is currently available, physiotherapy and generally, rehabilitation therapy, are mandatory for preserving the functional capabilities of the muscles for as long as possible. Exercise therapy, electrical stimulation or novel therapies such as exoskeleton devices aim towards alleviating the impact of disability. It is ideal that muscular dystrophy should be assessed in interdisciplinary clinics (physical therapy, neurology, cardiology, pneumology, surgery and orthopedics) for proper long-term care.
Keywords: *LGMD, muscle strength, rehabilitation, quality of life,*

Introduction

Limb-girdle muscular dystrophy (LGMT) is a group of genetic conditions that includes various phenotypes, with predilection to impairment of shoulder and pelvic girdles, as well as proximal muscle weakness. Different myopathic subtypes of the disease have a wide range of manifestations, which in some cases manifest in early childhood, and in other case, during adulthood [1, 2]. Degeneration of muscle fibers and the resulting loss of strength are determined by genetic mutations that determine different pathogenic mechanisms [3].

The underlying genetic conditions of LGMDs are either autosomal dominant (LGMD1) or autosomal recessive (LGMD2) [2]. These determine progressive degeneration of muscle fibers, loss in strength and difficulties of muscle fibers in maintaining physical structure during contraction [3].

More than 60% of the patients with muscle dystrophy experience important fatigue, a common sign of early disease, as physical activity and normal endurance produce discomfort [3]. The disease typically manifests during the second or third decade of life, with variable progression towards disability within the next 20-30 years. Tibial and peroneal innervated muscles are involved in the pathological process, usually with respect to facial muscles [4].

Although life expectancy is slightly reduced, the progressive motor disability and the respiratory or cardiac complications, have a huge impact upon quality of life, thus the need of proper rehabilitation programs and interdisciplinary approach.

Clinical case

A 42 years old male patient is evaluated both clinically and by electromyography for follow up of a muscular dystrophy, limb-girdle type. An initial diagnosis suggestive for myopathy has been first established around the age of 17. According to the patient's medical history, the first manifestations occurred around the age of 14, with fatigue and discrete loss of muscle strength in proximal muscles, especially in the lower limbs. Until that moment, the patient had been an active child and teenager, and had been practicing different sports, including professional dancing. In spite of this diagnosis, especially due to the slow evolution of signs and symptoms, he continued to perform in a dance crew until nearly the age of 30. That was the moment when the patient looked for medical advice again, after almost 15 years, and the final diagnosis of LGMD has been established by clinically and electrophysiological methods. As the motor deficit in the lower limbs progressed by the age of 35, with difficulties in lifting the

legs, he started physical therapy. A muscle biopsy has never been performed, nor genetic tests, which were at the time, unavailable.

At the current visit, from clinical point of view, the patient had poor balance (he used a cane while walking), arms and shoulders held backwards with the abdomen prominently visible while walking and knees bent backwards. Getting up from sited position evoked the classic Gower's sign, usually seen in children and teenagers with Duchene or Becker dystrophies: the need of a dystrophic patient to use the hands and arms to "climb" up his own body from squatting position.

Some uncertain, undocumented, history of episodes with loss of conscience in early childhood might have made a difficult differential diagnosis at a certain time, as a mitochondrial myopathy should be taken into consideration knowing such facts. However, the clinical evolution, the clinical signs and electromyography (EMG) tests have been suggestive for LGMD during the years.

At the EMG study, both sensory and motor conduction studies for the median nerve, peroneal and tibial nerve were normal. Needle EMG was performed in the following muscles: right tibialis anterior, left vastus lateralis, left deltoid, left extensor digitorum communis and mentalis. Insertion of the needle electrode was difficult through the dense thickened muscle tissue, with no spontaneous activity, and with short duration and reduced amplitudes of the motor unit action potential (MUAP), with myopathic fast and reduced amplitude recruitment. This EMG aspect is suggestive for the discussed diagnosis.

As the disease progresses and the motor deficit worsen, the question that arises is: what is the best therapeutic approach to a patient with this diagnosis, for postponing a greater disability and maintaining a decent quality of life for as long as possible?

Aspects of rehabilitation in LGMD

According to the model of inheritance, LGMDs can be either autosomal dominant (LGMD1) or autosomal recessive (LGMD 2). Different variants of cardiac and respiratory muscles affectation, joints and muscles impairment, are considered patterns of the underlying genetic type [5].

Muscle strength and respiratory function are worthy parameters to monitor for assessing QoL, especially as loss of muscle strength limits the ability of walking and performing activities of daily living [6]. Results of respiratory muscle training in patients with LGMD in randomized control trials yet seems to be uncertain [7].

Either because of muscle fiber loss or because of the motor deficit related to a sedentary lifestyle, effort tolerance is affected in LGMD patients. There is debate weather physical exercise fights the loss of muscle fibers and muscle strength or, on the other hand, it might induce damage within muscles due to the unstable sarcolema, especially because of intense contractions during movement [3].

LGMD is related to the inability of muscle fibers of maintaining their physical structure during contraction, with damage of the sarcolema, progressive degeneration of muscle fibers and loss of strength. Alteration of energy metabolism in the muscle fibers is also considered to be involved in the pathological background of the disease. These changes add to the loss of skeletal muscle mass, and manifest as muscle fatigue [3].

Muscle fatigue can be defined as the inability of continuing an intended physical activity, or as the excessive discomfort felt by the patient when trying to continue a physical effort. The underlying mechanisms also include the failure in calcium release from the sarcoplasmic reticulum, as well as the oxidative stress [3].

A normal physical training activity is composed of strength training (repeated muscle contraction against resistance) and aerobic exercise (the use of large muscle groups, continuously and rhythmical) [3]. Strength training and aerobic exercises in patients with LGMD, both at moderate intensity for long period of times are considered to be beneficial, not only for improving muscle, cardiac and respiratory function and preventing muscle atrophy, but also in prevention type 2 diabetes and other sedentary lifestyle related pathologies. This contrasts the fear of muscle overuse, although ischemia or hypoxia in the muscles can occur during prolonged exercises [3]. Muscle damage can result from altered mechanisms of the creatin kinase (CK), lactate dehydrogenase (LDH), myoglobin and troponin in case of intensive exercises. However, supervised aerobic exercise appears to be safe, if performed under supervision. It is also considered that physical exercise can be both safe and useful, no matter the type of training, as long as the intensity is low or moderate [3].

Strength training dedicated to specific muscles should be performed under professional supervision, especially as the optimal resistance needed is usually difficult to estimate, and because myalgia and CK increase should be avoided. Aerobic training can also improve muscle function, especially treadmill walking [5].

LGMD various disease subtypes have a profound impact upon the quality of life (QoL), especially as cardiopulmonary affectation manifests as the illness progresses [1]. QoL tends to be seriously impaired by issues also concerning physical health (muscle weakness, limitation of motility and walking), mental health (emotional distress and impaired body image) and social limitations. Physical therapy in these patients can provide motivation and purpose [1].

Patients with LGMD should have the possibility to benefit from multiple specialties such as: physical therapy, occupational therapy, respiratory therapy, orthopedics and genetics [2]. As the disease progresses, some cases might even require surgery, especially scoliosis corrective surgery techniques such as spinal fusion, or tendon surgery [8].

High voltage pulsed galvanic stimulation (HVPGS), rather than other electrical stimulation methods, seems to positively influence muscle contraction, also providing benefits upon muscle strength and reducing pain [9]. HVPGS even turns out to be more effective than moderate physical therapy according in small studies, with need of further trials for confirmation [9].

The diagnosis is difficult to be perceived by the patients, as one is usually overwhelmed by concerns about the disease progression and how it will eventually imply coping with new ways of living. The transition from receiving the diagnosis towards the necessity of using a wheelchair should be supported by regular controls and psychological support. Part of this, the patient should be engaged in meaningful activities in society [10]. Using clinical scales initially designed for other types of muscular dystrophies might also be of help in LGMD, especially assessing performance of the upper limb [11].

Exoskeletons are already been used in rehabilitation in various neurologic disorders. Sczesny-Kaiser et al propose the hybrid assistive limb voluntary-driven exoskeleton for improvement of endurance of walking function, as part of a treadmill therapy program, with promising results [5].

Anti-gravity training combined strength (squats, calf rises and lunges) and aerobic exercises (walking or jogging in place), 3 times a week, according to Jensen et al, improves the closed-kinetic-chain leg muscle strength, but not the isometric knee extension strength or capacity of absolute explosion force production [12].

Even though involvement of the cardiovascular system can limit physical activity in patients with LGMD, and exercising in excess is to be avoided, it is important to encourage a healthy lifestyle and physical active life [13].

Conclusions

Exercise is useful in LGMD for improving muscle strength, joint mobility and delaying progression towards disability, as much as possible. In absence of available disease modifying treatments, a rehabilitation strategy adapted to individual needs emerges as essential. Maintaining walking and overall active mobilization of the patient also has favorable effect on the quality of life.

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