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The role of aerobic exercise in improving functioning and treating the symptoms of individuals with multiple sclerosis

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Abstract

Multiple sclerosis (MS) is a progressive long-term neurological disorder of the central nervous system (CNS) that directly affects the lives of individuals and their environment. Early intervention through the systematic application of aerobic exercise can help to better treat the symptoms in people with MS by improving their balance, quality of movement and reducing their functional limitations. The aim of this review is to describe recent research data on the efficacy of this method in improving the functioning and treatment of symptoms in people with MS. The Google Scholar and PubMed database were searched in English and Greek with the following keywords: multiple sclerosis, aerobic exercise, functional ability, rehabilitation. The review included 10 articles from clinical trials, systematic reviews and books. Discussion - Conclusions: The application of aerobic exercise seems to have a positive effect on the treatment of motor disorders in people with MS when compared to conventional physiotherapy. The results of this review show that aerobic exercise two to three times a week for more than six weeks is able to improve the functional level of people with MS.

Keywords: multiple sclerosis, aerobic exercise, functional ability, rehabilitation

Introduction

Multiple sclerosis (MS) is a demyelinating disease of the central nervous system (CNS). The pathological damage that characterizes MS is the presence of areas with specific demyelination that are scattered in the parenchyma and the space of the white matter of the CNS ^[1]. Loss of myelin, the fat that insulates nerves, dramatically affects the rapid and smooth travel along nerve pathways in the CNS. This myelin loss reduces the rate at which stimuli propagate, affecting smooth, rapid, and coordinated movement. As a result, the problems associated with MS range from mild to severe disability ^[2]. The physical, cognitive and psychological consequences of MS often have a wide range, are varied and complex. Because the disease progresses at a different rate over several decades, the needs of each individual change over time, sometimes quite suddenly and unexpectedly. Effective disease management therefore requires a long-term and preventive rehabilitation approach, with an interdisciplinary team working with the patient and their family. Ideally this collaboration starts at the time of diagnosis and progresses along with the disease ^[3]. Before the advent of MRI, it was more difficult to diagnose MS, as the clinical picture may include a single symptom or the symptoms may be mild and subside over a period of time ^[4].

MS is one of the most common neurological disorders, affecting approximately 300000 patients in the United States, with a higher incidence in young adults. Clinically, it is determined by the involvement of different parts of the CNS at different times - provided that other disorders causing multifocal central dysfunction have been ruled out. Initial symptoms generally appear before the age of 55, with a maximum incidence between the ages of 20 and 40. Women are affected almost twice as often as men. Epidemiological studies show that the prevalence of the disease increases with the distance from the equator and that there is no population at high risk for the disease between latitudes 40 and 40N. Vitamin D levels may play a role, as well as exposure to Epstein-Barr virus. Genetic predisposition results from twin studies, few family cases, and a strong association between the disease and specific HLA antigens ^[5].

Physiotherapy has been proven to help better treat motor dysfunction in people with MS. The application of aerobic exercises plays a very important role in improving the ability to move and maintaining balance.

The aim of this review is to describe recent research data on the efficacy of aerobic exercise in improving functional ability in these patients.

Literature review

The Google Scholar and PubMed database were searched in English and Greek with the following keywords: multiple sclerosis, aerobic exercise, functional ability, rehabilitation. The review included 10 articles from clinical trials, systematic reviews and books. Below are their main findings.

In their pilot study, Motl *et al.* [6] examined changes in gait function associated with combined exercise training consisting of aerobic, endurance, and balance activities in people with MS who had recently had a gait impairment. The study involved 13 participants with significant disability due to MS (Expanded Disability Status Scale (EDSS) = 4.0-6.0) completed the Multiple Sclerosis Walking Scale-12, 2 trials of the Timed 25-Foot Walk, the Timed Up & Go (TUG) test and the functional stimulation profile score from 4 hiking tests on a treadmill (GaitRite), before and after an 8-week training session. The training program was designed by a physiotherapist and took place three days a week under the supervision of an exercise specialist. In terms of results, there were significant improvements in the MS gait, the Timed 25-Foot Walk, the TUG test and the functional stimulation profile scores. These results suggest that a moderately intense, comprehensive, combined exercise program represents a rehabilitation strategy associated with improved gait mobility in a small sample of people with MS who have recently had a gait impairment.

Furthermore, Edwards and Pilutti [7] in their systematic review showed that there is evidence for the benefits of exercise in people with MS. However, these benefits have been identified primarily in people with mild to moderate disability. They conducted a systematic review of the current literature on exercise in people with MS with severe mobility disabilities. They searched four electronic databases (PubMed, EMBASE, OvidMEDLINE and PsychINFO) for related articles published by October 2016. Data were analyzed using a descriptive approach and summarized by how the exercise was performed (conventional or adapted exercise training) and by outcome (disability, fitness, physical function, symptoms and involvement). Initially, 19 articles were included in the final review. Five studies examined conventional exercise training (aerobics and resistance) and 13 studies looked at tailored exercises, including body-weight-supported treadmill training (BWSTT), total-body recumbent stepper training (TBRST) and electrical stimulation cycling (ESAC). Regarding their findings, there is limited but promising evidence of the benefits of exercise for people with MS with severe mobility disabilities. Given the lack of effective treatment strategies for managing long-term disability accumulation, exercise can be considered as an alternative approach.

Moreover, Halabchi *et al.* [8] through a systematic review noted that proper exercise can cause remarkable and significant improvements in various areas of cardiac

respiration (aerobic capacity), muscle strength, flexibility, balance, fatigue, knowledge, quality of life and respiratory function in patients with MS. Low to moderate intensity aerobic exercise may improve aerobic capacity and reduce fatigue in these patients with mild to moderate disability. Flexibility exercises such as stretching muscles can reduce spasticity and prevent future painful contractions. Balancing exercises have beneficial effects on fall rates and better balance. There are some general guidelines for recommending exercise to the MS population. In general, exercise should be considered a safe and effective means of rehabilitation in patients with MS. Existing evidence suggests that a supervised and personalized exercise program can improve fitness, function and quality of life, as well as modifiable disorders in MS patients.

Motl and Sandroff [9] emphasize that exercise is a behavioral approach to the safe management of many of the functional, symptomatic and qualitative consequences of MS. Summarizing data from literature reviews and meta-analyses, supplemented by recent individual studies, they suggest that exercise training can yield small but significant improvements in gait, balance, cognition, fatigue, depression and quality of life in people with MS. Their paper highlights the limitations of research on exercise training and its implications and future research directions while providing an overview of the promotion of exercise in MS based on recent guidelines. Collectively, evidence for the benefits of exercise suggests that time is ripe for its promotion by healthcare providers, particularly neurologists, as a central part of clinical care and management of MS patients.

Pilutti *et al.* [10] provide a quantitative synthesis of randomized controlled trials examining the effect of exercise on symptomatic fatigue in people with MS. They searched online databases (Web of Science, PubMed, PsycInfo and Google Scholar) for articles published between 1960 and October 2012 using the keywords "fatigue" or "energy" or "mood" or "relaxation" and "exercise" or "Physical activity" or "rehabilitation" or "fitness" with "multiple sclerosis". They came up with 17 articles that included randomized controlled trials with 568 participants and that met the inclusion criteria and provided enough data to calculate effect sizes (ESs, Cohen's d). The meta-analysis was performed using a meta-analysis software program and a random effects model was used to calculate the total ES, expressed as Hedge's g. The main conclusion they drew from the cumulative data was that exercise training is associated with a significant small reduction in fatigue among people with MS.

Platta *et al.* [11] provided a quantitative synthesis of randomized controlled trials, which examined the effect of exercise on muscle and cardiorespiratory capacity in people with MS. Using the online databases PubMed, Google Scholar and Web of Science, they searched for all the relevant articles published up to October 2014. "Exercise" or "aerobics" or "strength training" or "resistance" or "cardiorespiratory" and "multiple sclerosis" were used as keywords. The trials that were included examined the effect of exercise on muscle and/or cardiorespiratory fitness parameters. In total 20 articles were included. The meta-analyses were performed using a random effects model to calculate the total or average ES per fitness parameter. Cumulative evidence suggests that exercise training is associated with changes in muscle (small in size) and

cardiorespiratory (moderate in size) fitness in people with MS. Such an indication of size is important for clinical research and practice by providing a substantiated estimate of the true benefit of exercise to normal fitness.

Regarding guidelines, Dustine and Moore^[2] suggest the application of physical exercise as it does not seem to have any effect on the prognosis or the development of MS. However, exercise can temporarily improve fitness and functional performance (e.g., strength, endurance, aerobic capacity). It must be adapted to the symptoms of the disease as these greatly affect its application. Therapeutic exercise in people with MS should aim to maintain and where possible improve the given level of joint mobility, muscle strength and endurance and cardiorespiratory endurance. Due to the fact that exhaustion is a common symptom, any process that can increase energy through improved efficiency should be integrated into a well-balanced exercise program. Specific aerobic exercises include cycling, walking and swimming, which help maintain and/or increase aerobic cardiovascular capacity and are applied for 30 minutes a day for three days a week and the expected time for success is four to six months.

Caution is suggested by Aminoff *et al.*^[5], who argue that although exercise and physiotherapy are indeed important, excessive exercise should be avoided, especially during periods of acute relapse. Fatigue is a serious problem for many patients and sometimes responds to antiaminergic and one of the antidepressants in the group of selective serotonin reuptake inhibitors. Treatment of spasticity is often required, as well as aggressive treatment of bladder and bowel problems. Treatment for other aspects of advanced MS, such as cognitive deficits, pain, tremor and disorder, is generally less successful.

In their study, Kubsik-Gidlewska *et al.*^[12] present a rehabilitation strategy for MS based on the latest developments in the field of physiotherapy. Publications on the problem discuss a wide range of physiotherapy methods that can be used to reduce the degree of disability and alleviate the symptoms associated with the disease. The complexity of the disease, the difficulty in determining the appropriate treatment and a wide range of symptoms require a comprehensive approach to the patient, which will include both pharmacology and neuroprocessing. Rehabilitation, which includes psychotherapy and symptomatic treatment, is now considered the best form of treatment for MS. An in-depth diagnostic assessment of functional status and prognosis should be performed prior to initiating the recovery process. The prognosis must take into account the mental state, neurological state and awareness of the patient. The MS physiotherapy program is based on a physiotherapy gradation that requires a gradual transition from basic movements to more complex ones until universal functions are achieved. The most appropriate form of treatment is functional rehabilitation in combination with natural procedures. Recent reports indicate that aerobic training should be included in the rehabilitation program. Introduction of physical activity, regardless of the severity of the disease, will reduce the negative effects of immobility and, consequently, will increase the functional capabilities of all body systems.

Lastly, Grazioli *et al.*^[13] in their study note that loss of balance and ability to walk are two of the main disorders of MS, which leads to loss of autonomy, increased perception of fatigue and severity of the disease in patients. Physical

activity has been shown to improve functional MS disorders, but there is limited evidence of synergistic efficacy of exercise training interventions that have both resistance and aerobic focus in these patients. They assessed the effect of a combined 12-week training intervention (resistance and aerobic exercise) on balance, walking ability, fatigue perception, quality of life and disease severity in MS patients. Combined training was well tolerated by patients and improved their quality of life, as well as was reflected in improved walking and balance and reduced depression, fatigue and disease severity. The results of this study confirm the beneficial effects of physical activity in these patients and support the use of a combination of resistance training and aerobic exercise to achieve functional and psychological therapeutic results.

Discussion and Conclusions

The results of this review show that the application of aerobic exercise can significantly contribute to improving the functional ability of people with MS. There is evidence that applying aerobic exercise at least three times a week for 30 minutes for 4-6 months in combination with medication improves the functioning of these patients^[2,5]. Exercise should be considered a safe and effective means of rehabilitation in patients with MS. Evidence has shown that a supervised and personalized exercise program can improve fitness, function, quality of life and modifiable disorders in MS patients^[8]. There are general guidelines that can be followed for prescribing exercise in this population. These guidelines should be tailored to the needs, abilities and preferences of the patient.

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