



Exercise and Myasthenia Gravis: A Review of the Literature to Promote Safety, Engagement, and Functioning

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Abstract

Currently no exercise protocol exists to inform healthcare practitioners how to advise individuals with myasthenia gravis how to begin exercise after stabilization of symptoms, which exercises are most beneficial for improving functioning, or detailing how to progress difficulty of the exercises as improvements in physiological functioning are made. However, with improved strength and endurance, individuals with myasthenia gravis will have a more meaningful life and the ability to engage in activities that are important to them. This literature review demonstrates that with skilled supervision by a rehabilitation professional, exercise is safe for those with mild myasthenia gravis and that strength gains and improvements in physiological functioning are possible. This research supports that exercise may decrease fatigue, increase strength, and improve functional mobility in individuals with myasthenia gravis. Additional rehabilitation research needs to be conducted on the physiological effects of exercise on individuals with myasthenia gravis and which exercises have the most significant impact on function and levels of fatigue.

Keywords: Exercise protocol; Myasthenia gravis; Occupational therapy; Strength training; Physiological functioning; Neuromuscular disease; Safety; Exacerbation; Myasthenic crisis

Exercise and Myasthenia Gravis: A Literature Review

Myasthenia gravis (MG) is characterized by symptoms of weakness, fatigue, and muscle failure with sustained and repetitive activities. Many healthcare practitioners believe that exercise may be contraindicated for the MG population, for fear of exacerbating the condition. Limited studies have been conducted on the safety and effectiveness of exercise programs for individuals with MG. However, without exercise, physiological capabilities diminish and fatigue increases, further limiting ability to engage in meaningful occupations. Additionally, exercise is beneficial for overall health and is a healthy coping strategy to deal with stress. This paper analyzes the available research on exercise rehabilitation for the MG population.

Literature Review

Background

Myasthenia gravis is a rare autoimmune disorder characterized by skeletal muscle weakness and fatigue which has significant impact on quality of life (QOL) [1-4]. In MG, antibodies attack the acetylcholine receptors of the neuromuscular junction, preventing contraction of the skeletal muscle. There are two primary types of MG, ocular and generalized. Ocular is characterized by diplopia and ptosis. Generalized MG presents with fatigue and weakness in axial, bulbar and limb muscles, which impairs balance and strength, and results in an overall decline in functional abilities [3,5]. In addition, varying severity levels of MG also impact an individual's QOL and social engagement.

Purpose

There is a lack of evidence-based research on exercise rehabilitation for the MG population; therefore, many healthcare practitioners feel uncomfortable prescribing exercise rehabilitation. However, many individuals with MG report using physical activity as a tool to self-manage fatigue, maintain their identity and cope with stress [6]. These individuals are left to manage these activities without professional guidance on which activities to engage in or how to progress the

exercises. The purpose of this literature review is to detail the available research on how the MG population can safely exercise, maintain muscle mass and physical abilities, and engage in meaningful occupations.

Treatments

Pharmaceutical strategies are not entirely specific to the structural/chemical autoimmune defect in MG [7]. Immunosuppressant medications to treat the neuromuscular junction dysfunction and destruction have serious side effects and widespread metabolic consequences, which contribute to medical co-morbidities and further decrease QOL [7]. These current generalized and focused immune-based therapies afford the best pharmaceutical treatment options for managing MG. Treatment options that focus on symptom management are either nonexistent or only address the immune system as a whole, this leaves many individuals with MG to self-manage their symptoms [6].

Exercise fatigue in MG

A significant concern in the MG population is the immediate and delayed fatigue as a result of excessive exercise. In a survey of MG fatigue, two thirds of respondents indicate that fatigue limits participation in activities, even with well-controlled disease severity [6]. Twenty percent of these respondents report engaging in low impact aerobic exercise, such as swimming and walking. These individuals self-reporting exercise participation have the highest levels of function and two-thirds use low intensity exercise to manage fatigue, suggesting activity may be a tool to manage fatigue and improve QOL. In addition, self-care actions emerge from the survey as supplemental strategies to diminish

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Received June 04, 2016; Accepted June 29, 2016; Published June 30, 2016

Citation: Naumes J, Hafer-Macko C, Foidel S (2016) Exercise and Myasthenia Gravis: A Review of the Literature to Promote Safety, Engagement, and Functioning. Int J Neurorehabilitation 3: 218. doi:[10.4172/2376-0281.1000218](https://doi.org/10.4172/2376-0281.1000218)

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fatigue and conserve energy. Mental interventions reduce perceptions of fatigue through cognitive control, distraction, diversion and stress reduction. Energy conservation, awareness of one's physical limits, engagement in relaxing occupations, and proper sleep and rest hygiene are beneficial. MG fatigue may worsen from lack of sleep, poor nutrition and stress. Measures to counter MG fatigue include rehabilitation to improve body mechanics to reduce potential for injury and for energy conservation and structured exercise prescriptions. These activity recommendations should be combined recommendations for health and well-being, and individualized for each person with MG to account for disease variability.

Exacerbation and Safety

Many individuals with MG and their clinicians are afraid of exacerbating symptoms by engaging in strenuous exercise. However, research demonstrates that exercise in individuals with mild MG improves strength and endurance [8-10]. Only seven percent of individuals with generalized MG are involved in regular physical activity [11]. Factors related to exercise that can worsen MG symptoms include inadequate activity pacing, extreme temperatures and humidity, and high intensity activities, such as running, inclines, stairs, or prolonged exercise [6,12]. The presentation and severity of MG can be variable day to day and across a day, depending on environmental and personal factors, such as timing of medication, stress, sleep, nutrition, and other obligations. These issues require a customized exercise program to meet individuals' fluctuating needs and safety requirements, otherwise exacerbations may occur.

Leddy and Chutkow [13] detail the challenges faced by people with MG who participate in organized athletics. Factors include limited exercise tolerance with potential inability to maintain an optimal level of performance, greater predisposition to soft tissue and orthopedic injuries, and medication side effects. The disease severity and physical demands of the sport must be taken into account on a case-by-case basis. Low aerobic and anaerobic intensity sports, such as golf, bowling, cricket, and curling, should be encouraged to enable individuals with MG resuming exercise to succeed. Additionally, the importance of weight-bearing exercise is stressed as a preventative measure to counter steroid-induced osteoporosis and myopathy. Currently, there is not sufficient evidence to determine the risk and reward that exercise poses for moderate and severe MG. Rehabilitation specialists with an understanding of MG, medication side effects, functional independence, kinesiology, and therapeutic exercises can help advise prior to engaging in sports, weighing the pros and cons of engagement and devising a successful exercise progression plan to meet the individual's needs and to prevent injury. The exercise prescription intensity and progression needs to account for the MG severity and the individual's overall health [14,15].

The Literature

A 16-session balance strategy exercise program improved

functional ability and balance in the MG population [5]. Subjects (n=6) trained once or twice a week on therapeutic workstation exercises, e.g. heel-toe walking, sit to stand, and ball catching and throwing. Training improved MG severity on the quantitative myasthenia gravis (QMG), Timed Up and Go (TUG) (cognitive), and standing balance on foam with eyes closed. Although this study had a small sample size and variable group characteristics (age, MG severity, functional ability), it demonstrated the benefit of this short balance strategy intervention on functional performance, attention, and postural stability.

Lohi et al. [9] demonstrated that physical training is safe and can improve maximal muscle force and endurance for individuals with mild MG. Individuals with mild to moderate MG (n=11) participated in a ten-week strength-training program, their contralateral extremities served as the within-subject control. The program was modified since many participants could not complete the prescribed number of repetitions or increased work load progression. Participants had no negative effects from the strength-training. Although most participants experienced slight to moderate muscular pain during initial testing, training eliminated this muscular pain during post-testing. Training increased knee extension maximal voluntary muscle force by 23% (p<0.05). Elbow extension strength gains were made, but were not significant (p=0.06). This is the first prospective study to show that supervised strength-training is safe and can improve leg strength in the MG population. In support of these benefits, a case report of a six-week strength-training and aerobic exercise in an individual with MG demonstrated decreased self-rated fatigue, improved hip extensor and flexor strength, and his ability to golf [8] (Table 1).

Resistance exercises (bench press, lat pulldown, shoulder press, leg extension, and leg curl) three times per week for fifteen weeks were combined with creatine supplementation (five grams daily) in an individual with MG. This combination was safe and improved peak leg strength, fat free mass, and load volume [16]. Similarly, a ten-day creatine monohydrate supplementation increased lean body mass, grip strength, dorsiflexion, and knee extensor strength in patients with neuromuscular disorders [17].

The final exercise study explored the use of cooling vests to improve exercise performance in individuals with MG (n=6) [18]. By reducing mean body temperature an average of 0.6°C, these vests improved mean maximal inspiratory pressure (pre 64.6 vs. post 79.5 cm/H₂O; p<0.03) and mean myasthenic muscle score (pre 91.9 vs. post 96.3; p<0.05). The use of cooling vests may enable more frequent and sustained engagement in exercise for the MG population.

Skilled Supervision of Exercise

Individuals with MG may benefit from a rehabilitation program in combination with medical therapies to improve function, modify daily living tasks using principles of energy conservation and compensatory

Citation	n	Type	Duration	Design	What was tested?	Positive Results	Negative Results
Lohi et al. [9]	11	Strength-training	10 weeks 27-30 sessions	Internal control; Ipsilateral trained; Contralateral untrained	Voluntary muscle force; Dynamic, repetitive max. isometric contraction fatigue	23% ↑ max. muscle force in knee extension	Slight to moderate pain initially; Fatigue with repetitions
Wong et al. [5]	5	Balance Strategy Training	8-16 weeks 16 sessions	Delayed entry control	MG severity, function, balance	↓ QMG; ↓ TUG; ↑ balance	None
Davidson et al. [8]	1	Strength-training and aerobic	6 weeks total (4 weeks at home)	Case study	Balance, gait, fatigue, and strength	↓ fatigue; ↑ hip extensor and flexor strength; able to golf	Fatigue with repetitions

Table 1: Research on exercise and MG.

techniques, facilitate return to work and social participation, cope with and adapt to physical limitations, and improve mental health [15,19]. Occupational therapists (OT) enable their clients to engage in occupations that are meaningful to them by adapting the environment, occupation, or person [20]. Based on review of the evidence and OTs scope of practice, interventions that could benefit the MG population include [21]:

- Environmental modifications
- Task analysis
- Ergonomics
- Energy conservation techniques
- Sleep hygiene
- Education
- Nerve glides
- Diaphragmatic and deep breathing
- Assistive devices
- Bed mobility
- Exercise prescriptions
- Balance training

Additionally, with OT's knowledge of activity analysis and physiology, practitioners can develop specific therapeutic exercise programs to enable individuals with MG to engage in occupations, activities, or exercise that is important to them.

Discussion

This review demonstrates that it is safe for people with mild to moderate MG to exercise and those improvements in physiological functioning are possible. Exercise can decrease fatigue, increase strength, and improve functional mobility [5,8,9,16-18]. Prior to initiating a new exercise program, the MG symptoms should be controlled and stable. Professional supervision is recommended for exercise in this population to individualize the program. Rehabilitation professionals, including OT, are highly trained to accommodate for fatigue and weakness. For individuals with more severe myasthenia symptoms, the program should focus on lower intensity activities and incorporate frequent rest breaks. Training prescriptions may need to be modified with reduced numbers of exercise sets, repetitions, and work load. Individuals should exercise during the periods of the day with peak energy, such as the morning or following a rest [14]. Due to the great variability in MG symptoms, it is vital to develop and modify the exercise program to accommodate for changes in function.

Conclusion

The purpose of this literature review is to highlight the need for an evidence-based exercise protocol to enable the MG population to maintain/improve physical functioning and in turn to enable more engagement in meaningful occupations and activities. Clearly there is a lack of rigorous evidence supporting specific therapeutic exercises and interventions for the MG population. However, the research available demonstrates that it is safe for people with mild MG to engage in supervised exercise programs. Strength gains and improved functional abilities are attainable with rehabilitation professional.

MG is often described as a snowflake disease because it presents differently for each person. Furthermore, each person with MG may experience variable ability to train from session to session, or even within a session. This must be taken into account when developing a therapeutic exercise program for an individual with MG so that the individual can successfully and safely engage in exercise without exacerbation of symptoms. Additionally, frequent rest breaks, low repetitions, low intensity exercises, and function-based exercises will enable successful and safe engagement in exercises for the MG population.

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