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Original research article

Aerobic exercise and preoperative respiratory muscle training improve respiratory vital capacity and everyday activity after surgical treatment for myasthenia gravis

[1]Dr. Peram Kuppuswamy, [2]Dr. Yogi Sundara Rao Chaganti, [3]Dr. Pramoda Hari, [4]Dr. Mothilal

[1, 2, 3]Assistant Professor, Department of Cardiothoracic and Vascular Surgery, Guntur Medical College, Guntur, Andhra Pradesh, India

[4]Associate Professor, Department of Cardiothoracic and Vascular Surgery, Guntur Medical College, Guntur, Andhra Pradesh, India

Corresponding Author:
Dr. Mothilal

Abstract

Background and Objectives: Preoperative respiratory muscle training (RMT) for patients undergoing surgical treatment for myasthenia gravis (MG) has not been shown to improve postoperative complications. The purpose of this research was to analyse the effects of RMT and aerobic exercise on respiration, physical activity, and hospital stay in patients with MG prior to surgery.

Methods: Ninety patients with MG who were having a prolonged thymectomy were split into two groups at random. In the SG, 45 participants underwent preoperative moderate-to-intense RMT in addition to aerobic exercise and respiratory physiotherapy, while the CG received only chest physiotherapy. Patients' vital capacities (VC, FVC, FEV1, FEV1/FVC, and PEF) and exercise capacities (6-minute walk test [6 MWT]) were assessed prior to surgery, during recovery, and immediately prior to discharge. Both length of hospital stay and "activities of daily living" (ADL) scores were calculated.

Result: Vital capacity, exercise capacity, and demographic and surgical characteristics were similar across the two groups before surgery. While the FEV1/FVC ratio did not change significantly from pre- to post-op in the CG, all measures of lung function (VC, FVC, FEV1, PEF, and 6MWT) were significantly worse after surgery (p=0.001). After surgery, the SG had significantly better VC, FVC, FEV1, and PEF than the CG did (p=0.012, 0.030, 0.014, and 0.035 respectively), while having similar 6MWT results. On day 5 post-op, SG ADL was significantly greater than CG ADL (p=0.001).

Conclusion: Recovery from surgery for people with MG can speed up with the help of respiratory muscle training (RMT) and aerobic exercise.

Keywords: Respiratory muscle training, myasthenia gravis, vital capacity, thymectomy

Introduction

Muscle weakness is a symptom of myasthenia gravis (MG), an autoimmune illness. Muscles involved in breathing, skeletal movement, swallowing, speaking, and eyelid closure can all decrease to variable degrees in MG. Approximately 60%-75% of MG patients have thymic hyperplasia and 20%-25% have thymomas, both of which are pathological anomalies in the thymus tissue that are directly linked to the pathophysiology of MG. Surgical procedures are the current standard of care for MG. Postoperative respiratory and skeletal muscle weakness induced by anaesthetic medication stimulation, postoperative respiratory tract inflammation, and increased autoantibody release has been observed in patients undergoing minimally invasive thymectomy. MG crises and other respiratory problems such weak expectoration and coughing, dyspnea, pneumonia, and atelectasis can result from this. Therefore, strategies are required to effectively strengthen respiratory muscles, increase expectoration and coughing, reduce postoperative pulmonary problems, and improve early postoperative patient quality of life [1, 2, 3].

People with myasthenia gravis who took part in aerobic activities have been the focus of recent research. Aerobic and resistance strength training have been shown to help MG patients with muscular functioning, notably in the proximal leg muscles, and have been found to be safe for those with myasthenia gravis. Long-term training of respiratory muscle endurance was projected to lead to better respiratory and functional outcomes for MG patients, and this was observed in patients. Aerobic exercise and respiratory muscle training have been demonstrated to help MG patients [4, 5, 6].

Training in pulmonary rehabilitation soon after surgery has also been found to be beneficial for patients with lung cancer and the elderly with chronic obstructive pulmonary disease. Patients with a wide range of pulmonary diseases can benefit from respiratory muscle exercise following postoperative discharge. Pulmonary rehabilitation training, which includes aerobic exercise and moderate- to high-intensity respiratory muscle training (RMT) [7, 8, 9], is beneficial for patients who have undergone lung surgery.

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Patients who have undergone preoperative inspiratory muscle training have experienced less pulmonary problems following major abdominal, cardiac, or pulmonary procedures. Preoperative inspiratory muscle training has been shown to minimise the incidence of pneumonia and atelectasis in patients undergoing lung resection, coronary artery bypass grafting, or heart valve surgery. Based on these results, it appears that MG patients may benefit from postoperative rehabilitation therapies such moderate to severe RMT and cardiovascular exercises [9, 10, 11], especially when combined with chest physiotherapy. Patients with MG were evaluated for their respiratory vital capacity, exercise capacity, and length of hospital stay before and after moderate-intensity RMT, aerobic exercise, and chest physiotherapy [12, 13]. Following surgical surgery for MG, the researchers wanted to know if these procedures improved patients' vital capacity and everyday life activity.

Material and Methods

This study at Department of Cardiothoracic and Vascular Surgery, Guntur Medical College, Guntur, Andhra Pradesh, India from August 2022 to July 2023 was designed as a randomised controlled experiment. Ninety MG patients who were set to undergo extended thymectomy were randomly divided into two groups.

Inclusion criteria

Patients over the age of 65 with myasthenia gravis who underwent radical thymectomy (resection of the hyperplastic thymus or thymus tumour body), mediastinal fat dissection, and thoracic drainage tube installation were included.

Exclusion criteria

Patients with severe coronary heart disease, COPD, or limb pain were not allowed to participate in the trial.

Result

Ninety patients with MG who were scheduled to undergo surgery were randomly divided into two groups, the study group (SG) and the control group (CG), each of which consisted of 45 individuals. There was no sudden deterioration in muscle strength after surgery. The demographics and surgery details of the patients included. None of these characteristics were significantly different between the SG and CG groups (p>0.05).

Table 1: Patient demographics and surgical procedures between the SG and CG

Variables	SG	CG	p-value
n	45	45	
Age (years)	39.85±13.58	41.96±8.98	0.584
Sex, M/F	19/21	17/23	0.698
Height (cm) Weight (kg) BMI	159.98±7.25	160.85±9.12	0.450
(kg/m^2)	52.56±7.52	52.60±7.25	0.098
MGFA classification	21.52±2.56	20.96±1.65	0.124
MGFA I	14 (30.0%)	16 (35.0%)	0.856
MGFA IIA	19 (45.0%)	17 (37.5%)	0.712
MGFA IIB	12 (25.0%)	11 (27.5%)	0.815

Table 2: Parameters of static and dynamic pulmonary function in the SG and CG following surgery

Variables	SG	CG	p-value
VC (L)			
Preop	3.78±0.80	3.12±0.65	0.354
Postop	3.42±0.71	2.55±0.52	0.023
P	0.001	0.001	
FVC (L)			
Preop	2.55±0.68	3.00±0.84	0.465
Postop	2.54±0.23	1.48±0.45	0.056
P	0.001	0.001	
FEV_1 (L)			
Preop	3.33±0.35	1.56±0.34	0.654
Postop	2.65±0.65	2.65±0.56	0.025
P	0.002	0.001	
FEV_1/FEV (%)			
Preop	89.65±9.45	89.54±9.86	0.644
Postop	86.75±9.47	83.62±11.56	0.865
P	0.141	0.170	P
PEF (L/s)			

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Preop	4.12±2.85	4.45±2.86	0.368
Postop	3.75±0.89	3.68±223	0.052
P	0.004	0.001	
6 MWT (m)			
Preop	568.54±54.64	564.77±109.36	0.764
Postop	552.00± 45.55	486.26±214.56	0.896
P	0.041	0.001	

Table 3: Analysis of ADL in the Hospital: Comparison of the SG and CG
Variables SG CG p-value

Variables	SG	CG	p-value
Preoperative ADL	85.25±6.33	86.32±7.58	0.752
Postoperative ADL			
Day 1	34.78±5.70	28.98±9.58	0.659
Day 3	63.58±3.88	65.89±9.96	0.265
Day 5	94.79±4.88	98.98±8.86	0.005

Discussion

MG is an uncommon neuromuscular condition marked by muscle weakness and fatigue that is linked to thymic dysfunction. Muscle weakness caused by MG can impact more than just the eyelids; it can also affect the respiratory, skeletal, and swallowing systems. Anaesthetic drugs, postoperative respiratory tract inflammation, mental distress, and enhanced autoantibody production can all exacerbate the MG symptoms of weak cough and expectoration, respiratory weakness, dyspnea, pneumonia, and atelectasis. A full-scale MG crisis could be precipitated by such an event. It is unclear whether active training of the respiratory muscle groups can increase their postoperative strength and lessen postoperative respiratory complications in MG patients, despite the fact that there have been ten intervention studies on the safety and usefulness of systematic training in MG patients, of which three focused on the respiratory muscles. In light of this, the current study compared the efficacy of chest physiotherapy alone to that of chest physiotherapy plus RMT and aerobic exercise in decreasing the duration of hospitalisation for MG patients prior to surgery, measuring outcomes such as respiratory vital capacity, exercise capacity, and length of hospital stay. Patients with MG benefit from RMT and aerobic exercise after surgery, with improvements in their respiratory vital capacity and ability to perform daily tasks [14, 15].

Perioperative accelerated rehabilitation has been shown to reduce the length of hospital stays and the number of issues experienced by patients recovering from thoracic surgery. Rehabilitative diagnosis and treatment of lung illnesses includes enhancing perioperative care, according to the American College of Chest Physicians (ACCP). Reduce trauma stress and complications and decrease hospital stays by using multi-modal strategies to speed recovery, such as getting out of bed quickly after surgery, minimising the length of the fasting period prior to the operation, and starting oral feeding soon after surgery. Patients now experience less discomfort and a shorter recovery period after undergoing a thymectomy [16, 17].

The anaesthetic strategy and operating room setup for MG surgery are very similar to those used for lung excision. This suggests that, prior to surgery, individuals with MG may benefit more from RMT plus moderate to vigorous aerobic activity than from chest physiotherapy alone. Previous studies have demonstrated that both physical activity and repetitive muscle activation worsen muscular weakness, suggesting that exercise may be detrimental for people with MG. But the current study's findings revealed that moderate to vigorous RMT, when combined with chest physiotherapy, may enhance postoperative respiratory vital capacity and ADLs in MG patients who had undergone surgery. A multidisciplinary approach to rehabilitation is superior to a single therapy for people with MG, especially those with mild to moderate symptomatology. Physical, respiratory, and balance training are just few of the rehabilitation methods that have been studied in the past [18, 19].

In addition to the expected gains in respiratory muscle strength, respiratory endurance, and physical performance, respiratory training was found to have far-reaching advantages. The occurrence of additional MG symptoms, such as dyspnea, appears to be reduced. Skeletal muscle and diaphragm fatigue were considerably reduced through training in extended hyperpnea, making it more effective for patients with MG than respiratory strength training. The current research also showed that RMT and aerobic exercise, both before and after surgery, did little to prevent MG patients' limbs from losing skeletal muscle and exercise capability as a result of the procedures. Muscle weakness in the limbs is a hallmark of MG, thus it's likely that this aspect was also a part in the lack of response to RMT. Preoperative exercise did not enhance exercise capacity recovery in patients with MG [20, 21], despite patients reporting increased exercise capacity with an increase in distance on the 6MWT and the length of hospital stay in patients spanning from 4 days to 2 weeks after lung surgery.

Previous research suggested that aerobic exercise and respiratory muscle training would improve both functional capacity and pulmonary function in MG patients, and the current study found that ADL 5 days after surgery were significantly better in the SG than in the CG, though the differences 1 and 3 days after surgery were not statistically significant. Physical activity was found to be severely restricted for the first

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few postoperative days for patients who had undergone thoracic surgery due to pain and dizziness. It has been shown that patients who are encouraged to get up and begin rehabilitation activities as soon as they feel safe doing so following surgery, regardless of how much pain they are experiencing, show significant gains in ADL. This study, on the other hand, was a randomised controlled trial with matched groups. A larger sample size is needed to confirm the beneficial benefits of RMT and aerobic exercise on postoperative respiratory vital capacity and DLQs in MG patients due to the low power of the current experiment. More study is needed to assess the efficacy and safety of rehabilitation after surgical treatment for MG [21, 22].

Conclusion

Patients with MG who had participated in moderate to intense RMT and aerobic exercise prior to surgery had better postoperative respiratory vital capacity and function, despite the fact that no negative effects of exercise on humans have been discovered. These findings highlight the need for precise exercise tolerance improvement prediction in advance of surgical treatment for MG patients.

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