Case Report

Cardiorespiratory Rehabilitation in Generalized Myasthenia Gravis After Thymectomy and Radiotherapy with Class II Obesity : A Case Report

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Abstract

Background: Generalized myasthenia gravis (MG) is an autoimmune neuromuscular disorder that can reduce respiratory reserve, impair cough effectiveness, and limit daily activities. These limitations may be exacerbated by thymoma, obesity, previous myasthenic crisis, and post-thymectomy or post-radiotherapy status. Cardiorespiratory rehabilitation may address both physiologic and functional impairments through symptom-limited exercise, breathing retraining, airway-clearance techniques, and energy conservation strategies.

Case: A 39-year-old woman with AChR-positive generalized MG, status post extended thymectomy for thymoma and radiotherapy, was referred to Physical Medicine and Rehabilitation because of easy fatigability, exertional dyspnea, and reduced tolerance for daily activities. Baseline evaluation revealed class II obesity, reduced chest expansion, restrictive spirometry, weak cough, low exercise tolerance, impaired functional endurance, and moderate limitations in daily function and quality of life.

Discussion: The patient's limitations reflected a multifactorial cardiorespiratory condition involving neuromuscular weakness, reduced thoracic mobility, and obesity. The rehabilitation program included graded aerobic exercise, breathing retraining, incentive spirometry, airway-clearance education, and energy conservation strategies. After six weeks, the patient demonstrated reduced fatigue and dyspnea, improved cough effectiveness, increased chest expansion, and greater walking capacity.

Conclusion: Cardiorespiratory rehabilitation produced clinically meaningful functional improvement in a patient with generalized MG after thymectomy and radiotherapy despite coexisting class II obesity. These findings suggest that functional limitations in MG are modifiable and can respond to a structured rehabilitation program, although long-term follow-up and weight management remain essential.

Keywords: generalized myasthenia gravis; cardiorespiratory rehabilitation; obesity; respiratory muscle weakness; exercise intolerance

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INTRODUCTION

Myasthenia gravis (MG) is an autoimmune disorder characterized by fluctuating fatigable weakness due to impaired neuromuscular transmission. In generalized MG, respiratory muscle involvement may reduce ventilatory reserve, cough effectiveness, and exercise tolerance even when resting vital signs remain normal. Thymoma is a well-recognized association with MG.[1-3,5,8-13] The need for surveillance remains important after thymectomy because recurrence can still occur, particularly in B2 disease and stage II tumors.[23,24,29]

In the present case, the respiratory limitation was not explained by MG alone. The combination of obesity, prior myasthenic crisis, post-thoracic surgery scar, low physical activity, and probable deconditioning likely reduced chest wall mobility and amplified exertional dyspnea.[4,14,15,17-20] Obesity can further increase the work of breathing and worsen functional limitation, especially when central adiposity is present.[25-28]

Cardiorespiratory rehabilitation therefore has a clear role. Symptom-limited aerobic training, breathing retraining, airway-clearance instruction, and activity pacing are commonly used to improve functional capacity while avoiding overexertion in MG.[6,14-18,21] Recent literature also suggests that carefully supervised exercise is safe in selected MG patients and may improve walking performance, respiratory function, fatigue, and quality of life.[26-29] This case extends the current rehabilitation literature by describing a pragmatic multimodal cardiorespiratory rehabilitation program in a patient with clinically stable generalized myasthenia gravis following thymectomy and adjuvant radiotherapy, complicated by prior myasthenic crisis and class II obesity. Unlike previous studies that primarily evaluated isolated exercise interventions, this report integrates respiratory training, graded aerobic conditioning, airway-clearance techniques, energy conservation, and progressive functional strengthening within routine clinical practice, demonstrating the feasibility of an individualized multidisciplinary rehabilitation approach in a complex clinical setting.

CASE ILLUSTRATION

A 39-year-old married woman was referred from the Pulmonology Department because of easy fatigability during daily activities, intermittent cough, and shortness of breath that improved with rest. Her disease was first diagnosed in May 2023 after initial ocular symptoms (ptosis) with acetylcholine receptor (AchR) antibody testing confirmed positivity.

She experienced a myasthenic crisis in June 2023, requiring intubation and a 5-day course of intravenous immunoglobulin (IVIG). Chest computed tomography demonstrated an anterior mediastinal mass consistent with thymoma, and the patient subsequently underwent extended thymectomy on 6 September 2023. Histopathological examination revealed WHO type B2 thymoma. Postoperatively, she had recurrent respiratory decompensation (October 2023) requiring hospitalization and another 5 sessions of IVIG.

Subsequent treatment included 28 fractions of intensity-modulated radiotherapy to the thymoma bed (January–February 2024) and two cycles of therapeutic plasma exchange (November 2024). Throughout this period, she was managed by neurology, pulmonology, and oncology teams. Long-term medical therapy consisted of

pyridostigmine 60 mg six times per day, a history of prednisone use for 9 months, and other concomitant medications.

There is no episode of worsening MG symptoms for one year in 2025. According to the Myasthenia Gravis Foundation of America (MGFA) classification, the patient reached MGFA Class V during both crises. After stabilization, she improved to MGFA Class IIa at the time of rehabilitation referral, with residual ocular manifestations and mild generalized weakness without respiratory failure. She remained clinically stable for 8 weeks before baseline rehabilitation assessment, without evidence of acute exacerbation, myasthenic crisis, or medication adjustment.

Bulbar symptoms including dysphagia, dysarthria, or chewing difficulty were absent during rehabilitation evaluation, whereas exertional fatigability remained the predominant complaint. At the most recent oncology follow-up, surveillance chest CT demonstrated no evidence of local recurrence or distant metastasis

On first presentation to rehabilitation (March 13th 2026), she was haemodynamically stable and fully alert. She had class II obesity (BMI 36.5 kg/m²) with central adiposity (waist 101 cm, hip 118 cm). Neurological exam showed bilateral ptosis (left > right) without focal limb weakness (muscle power 5/5 in all limbs). Cardiorespiratory examination revealed a well-healed 19-cm midline sternal scar and reduced chest wall expansion (3–4–4 cm at axilla, xiphoid, and subxiphoid levels).

Resting spirometry demonstrated a restrictive pattern (FEV_1 59% predicted, FVC 63% predicted, FEV_1/FVC 80%). Peak cough flow was low (180 L/min) and single-breath count test (SBCT) was 25. Functional assessment showed moderate dependency: 6-minute walk distance 285 meters (approximately 3.6 METs, Borg 12 post-exercise), a high Fatigue Severity Scale score (FSS 38), and limitations in daily activities (MG-ADL 7/24). Her Barthel score was 18/20 and Lawton IADL 5/8, indicating assistance required for complex tasks, and her MG-QoL15 score was 24 (moderate impact).

Figure 1. Postural assessment of the patient

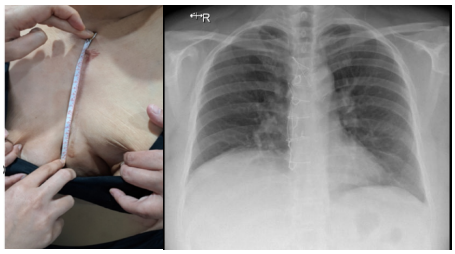

Figure 2. Healed midline sternotomy scar and chest x-ray showing no focal cardiopulmonary abnormality and postoperative sternal wires

At the most recent referral, she was stable but had progressive activity limitation, type II obesity, reduced chest expansion, restrictive ventilatory impairment, weak cough flow, and decreased aerobic capacity. A structured cardiorespiratory rehabilitation program was prescribed. Graded aerobic exercise consisted of walking on a level surface 2–3 times weekly, progressing toward 5 sessions weekly, with an initial intensity corresponding to Borg RPE 9–11 and gradual progression toward RPE 11–13.

Exercise was performed in interval format, beginning with 5-minute walking bouts separated by 1–2-minute recovery periods for a total duration of 15–20 minutes and progressing toward 30 minutes per session. Breathing retraining included diaphragmatic breathing and pursed-lip breathing twice daily (3 sets of 10 repetitions). Incentive spirometry was prescribed twice daily at a target inspiratory volume of approximately 900 mL (80% of maximal achieved volume), with inspiratory holds of 3–5 seconds and 3 sets of 10 repetitions.

Additional interventions included chest expansion exercises, airway-clearance education using huff coughing techniques, energy conservation strategies, medication adherence counseling, and home exercise instruction. Following improvement in fatigue symptoms (FSS <36), low-intensity upper- and lower-extremity strengthening exercises were introduced using symptom-limited loads (RPE 9–11), 1–2 sets of 5–10 repetitions.

The rehabilitation program combined supervised outpatient sessions with a structured home-based exercise program over six weeks. Progression was individualized according to symptom tolerance, Borg RPE, fatigue severity, and the absence of symptom exacerbation.

Exercise sessions were scheduled approximately 1–2 hours after pyridostigmine administration to optimize neuromuscular performance. Heart rate, blood pressure, oxygen saturation, perceived exertion, and dyspnea were monitored before and after supervised sessions.

Patients were instructed to discontinue exercise in the presence of marked muscle weakness, excessive fatigue, worsening dyspnea, chest pain, dizziness, oxygen desaturation, or other concerning symptoms. Home exercise adherence was assessed during weekly follow-up visits, and no myasthenic exacerbation, fall, desaturation, arrhythmia, or other adverse events were observed throughout the intervention period

Figure 3. Patient performing incentive spirometry and regular walking as aerobic exercise

The follow-up response showed improvement across multiple domains, which is more convincing than a single isolated test change. After six weeks rehabilitation, the patient reported less dyspnea and fatigue. Her mMRC score decreased from 3 to 1, FSS from 38 to 28, MG-QoL from 24 to 21, SBCT from 25 to 49, peak cough flow from 180 to 220 L/min, peak flow rate from 200 to 230 L/min, chest expansion from 3-4-4 cm to 4-4-6 cm, and 6MWT from 285 m to 370 m. These coordinated gains suggest better ventilatory efficiency, improved airway clearance, and

enhanced functional endurance rather than day-to-day variation. The quality-of-life outcome was assessed using the validated MG-QOL15 questionnaire, in which higher scores indicate poorer disease-specific quality of life. Functional disability was evaluated using the MG-ADL scale, with higher scores reflecting greater functional impairment. Peak cough flow increased from 180 to 220 L/min after rehabilitation but remained below the commonly accepted threshold associated with effective airway clearance. Therefore, the observed changes should be interpreted as functional improvement rather than normalization of respiratory function

Table 1. Functional and Respiratory Outcomes Before and After Six Weeks of Cardiorespiratory Rehabilitation

Measure	Baseline (13/03/2026)	Follow-up (27/04/2026)
Chest expansion (axilla–xiphoid–subxiphoid, cm)	3–4–4	4–4–6
Single-breath count test (SBCT)	25	49
Fatigue Severity Scale (FSS)	38	28
Six-minute walk distance (m)	285	370
mMRC dyspnoea scale	3	1
MG-ADL score	7/24	6/24
MG-QoL	24	21

DISCUSSION

This case is best interpreted as a multifactorial cardiorespiratory limitation rather than generalized MG alone. Generalized MG is characterized by fluctuating fatigable weakness due to impaired neuromuscular transmission, and respiratory muscle involvement may reduce ventilatory reserve, cough effectiveness, and exercise tolerance even when resting vital signs remain normal.[1,7-10,23,24] In this patient, restrictive spirometry, low SBCT, reduced peak cough flow, short 6-minute walk distance, and high fatigue severity were consistent with reduced cardiorespiratory reserve. Class II obesity and a history of thoracic surgery likely increased the work of breathing and amplified activity intolerance.[14,25,27,29]

The coexistence of thymoma further supports a paraneoplastic MG phenotype. Thymoma is a well-recognized association with MG, and thymoma-associated disease is linked to AChR antibodies and cross-reactive autoimmunity at the neuromuscular junction.[11,12] Surgical resection remains the mainstay of thymoma management, but postoperative recurrence is still possible; adjuvant radiotherapy is commonly used in stage II-III disease to reduce recurrence risk.[2,13] Her history of myasthenic crisis and the need for thymectomy and radiotherapy therefore justify prolonged surveillance and careful multidisciplinary follow-up.[23,24,29]

Her respiratory limitation was also shaped by reduced chest wall mobility. MG can weaken the diaphragm and intercostal muscles, producing shallow breathing, reduced tidal volume, impaired cough, and a greater risk of infection and atelectasis.[10,14-16]

Thoracic surgery may additionally reduce chest expansion and respiratory mechanics for a prolonged period.[19,20] Because the patient had reduced chest expansion and a restrictive pattern, the main rehabilitation target was respiratory muscle endurance rather than symptom suppression alone. Diaphragmatic breathing, thoracic expansion exercises, respiratory muscle training, and huff coughing are appropriate strategies, with incentive spirometry as an adjunct to promote lung recruitment.[16-18].

Breathing retraining is particularly relevant in fatigable neuromuscular disease because controlled diaphragmatic and pursed-lip breathing can reduce respiratory rate, lower the work of breathing, and improve perceived exertional tolerance.[16]

For stable post-acute MG patients, incentive should be interpreted primarily as a **lung-expansion strategy** rather than a true inspiratory muscle training intervention because it does not provide a quantifiable threshold inspiratory load. Its intended purpose was to encourage sustained maximal inspiration, improve lung expansion, promote alveolar recruitment, and facilitate chest wall mobility after thoracic surgery.[17,18] In the discussion of this case, the proposed home dose is 10 slow sustained inspirations per session, held for 2-3 seconds, repeated with rest between breaths and performed several times per day as tolerated.[17,18,29].

Obesity and inactivity likely compounded the disease burden. Long-term glucocorticoid exposure and reduced physical activity are recognized contributors to weight gain in MG, and central adiposity can further impair diaphragmatic mechanics and respiratory compliance.[21-25]

The World Health Organization recommends at least 150 minutes of moderate-intensity aerobic exercise or 75 minutes of vigorous exercise per week, together with two resistance sessions weekly, and available MG studies suggest that patients with mild stable disease can tolerate aerobic or resistance training without objective deterioration.[26]

Exercise interventions have also been associated with improved handgrip strength, longer 6-minute walk distance, and better sit-to-stand performance.[26] In this patient, the low 6MWT, reduced METs, and FSS of 38 reflected the combined effects of MG-related respiratory muscle dysfunction, obesity, and post-crisis deconditioning.[7,24,27,28].

The fatigue and activity limitation were clinically meaningful because they affected both body function and participation. Fatigue in MG is multifactorial, with peripheral fatigability at the neuromuscular junction and a possible central fatigue component that can reinforce inactivity and deconditioning over time.[7,27] For this reason, exercise should be low-to-moderate intensity, interval-based, and scheduled when medication effect is maximal, with planned rest periods and energy conservation to prevent overexertion.[28,29]

The patient's difficulties with bathing, toileting, sweeping, brisk walking, and independent community mobility, together with an MG-QoL score of 24, indicate moderate quality-of-life impairment and participation restriction. Rehabilitation should therefore emphasize graded interval aerobic conditioning, functional strengthening, respiratory training, airway clearance, and structured energy conservation to improve endurance and daily independence.[29].

Serial follow-up showed a coherent functional response to rehabilitation. After six weeks, the patient reported less dyspnea and fatigue, with improvement in mMRC score from 3 to 1, FSS from 38 to 28, MG-QoL from 24 to 21, SBCT from 25 to 49, peak cough flow from 180 to 220 L/min, peak flow rate from 200 to 230 L/min, chest expansion from 3-4-4 cm to 4-4-6 cm, and 6MWT from 285 m to 370 m. These coordinated gains suggest better ventilatory efficiency, improved airway clearance, and enhanced functional endurance rather than day-to-day variation.[6,14-18,21,26-28].

The response is consistent with prior reports showing that supervised exercise and respiratory training can be safe in selected stable patients with MG and can improve fatigue, walking capacity, respiratory function, and quality of life.[6,14-18,21,26-28] At the same time, persistent exertional dyspnea and unresolved obesity indicate that rehabilitation improved function without eliminating the underlying disease burden, so the intervention should be viewed as functional disease-modifying care rather than curative immunologic therapy.[6,22,25,29]

Although coordinated improvements were observed across dyspnea, fatigue, respiratory performance, cough effectiveness, and walking capacity, these findings cannot establish causality and may also have been influenced by natural disease fluctuation, learning effects, medication timing, or measurement variability. Nevertheless, the consistent multidomain functional improvement without adverse events supports the feasibility and potential clinical value of individualized cardiorespiratory rehabilitation in carefully selected patients with clinically stable generalized myasthenia gravis.[24,25,28,29]

CONCLUSION

The rehabilitation program was followed by meaningful functional improvement that aligns with the pathophysiology discussed above. The patient's reduction in fatigue, improvement in mMRC score, better cough effectiveness, larger chest expansion, increased walking distance, and lower MG-QoL score indicate that the main limitation was not irreversible organ failure, but a combination of impaired respiratory mechanics, deconditioning, and reduced activity tolerance that could be modified through rehabilitation.

The gains are clinically relevant because they occurred in daily life: the patient was able to walk longer, perform activities with less dyspnea, and re-engage in social participation. However, the improvement was partial rather than complete, which is expected in generalized myasthenia gravis with obesity and a history of exacerbation. This means that the case supports a progressive, symptom-limited, and long-term rehabilitation approach, combined with continued medical follow-up, nutritional management, and patient education to maintain the functional gains that were achieved.

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CONFLICT OF INTEREST

I confirm that there are no conflict or competing interests related to this work.

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