CASE REPORT / PRIKAZ SLUČAJA

PULMONARY REHABILITATION AFTER IVOR LEWIS ESOPHAGECTOMY FOR END-STAGE ACHALASIA

Plućna rehabilitacija nakon Ivor Lewis ezofagektomije u bolesnice s krajnjim stadijem ahalazije

SNJEŽANA BENKO MEŠTROVIĆ [1,2,3], MARTIN IVANOVIĆ [1], MARIJA GOMERČIĆ PALČIĆ [4,5], ALDA RANOGAJEC [6], ANTEA MARKOVIĆ [7]

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ABSTRACT

Background: Achalasia is a rare primary esophageal motility disorder characterized by impaired lower esophageal sphincter relaxation and absent or impaired esophageal peristalsis. Progressive esophageal dilatation may result in severe dysphagia, recurrent aspiration, respiratory complications, and, in selected patients with end-stage disease, the need for esophagectomy.

Case Presentation: A 46-year-old woman with end-stage achalasia underwent subtotal Ivor Lewis esophagectomy with intrathoracic esophagogastric anastomosis after progressive dysphagia and recurrent aspiration pneumonia. Three months after surgery, she presented with persistent dry cough, hoarseness, impaired breathing pattern, postoperative pain, and markedly reduced exercise tolerance. Baseline physiotherapeutic assessment demonstrated inspiratory muscle weakness, reduced peripheral muscle strength, and decreased functional exercise capacity, whereas ultrasonographic examination confirmed preserved diaphragmatic function. The patient subsequently completed a seven-week individualized outpatient pulmonary rehabilitation program comprising breathing retraining, inspiratory muscle training, aerobic exercise, and progressive resistance training.

Results: Following rehabilitation, maximal inspiratory pressure increased from 46 to 75 cmH_2O (51% to 83% of the predicted value), the 6-minute walk distance improved from 403 to 555 m, and bilateral handgrip strength increased from 18 to 26 kg. The patient also reported marked reductions in cough, postoperative pain, and dyspnea during physical activity. Persistent hoarseness was subsequently attributed to unilateral vocal cord paresis, and speech therapy was initiated.

Conclusion: This case demonstrates that a comprehensive pulmonary rehabilitation program may substantially improve respiratory muscle performance, functional exercise capacity, peripheral muscle strength, and postoperative symptoms following esophagectomy for end-stage achalasia.

Keywords: achalasia; pulmonary rehabilitation; esophagectomy

[1] University Hospital "Sveti Duh", Sveti Duh 64, Zagreb

[2] University Sjever, Department of Physiotherapy, Varaždin

[3] Faculty of Health Studies, University of Rijeka

[4] Division of Pulmonology, Department of Internal Medicine, Sestre Milosrdnice University Hospital Center, Zagreb, Croatia

[5] School of Medicine, University of Zagreb, Zagreb, Croatia.

[6] Special Hospital for Pulmonary Disease, Rockfellerova 3 , Zagreb

[7] School of Dental Medicine, University of Zagreb

ORCID ID:

Snježana Benko Meštrović
ID: 0000-0002-4092-9434

Martin Ivanović
ID: 0009-0004-6618-0961

Marija Gomerčić Palčić
ID: 0000-0002-6836-4447

Alda Ranogajec
ID: 0009-0000-3300-9317

Antea Marković
ID: 0009-0008-4664-3913

SAŽETAK

Uvod: Ahalazija je rijedak primarni poremećaj motiliteta jednjaka obilježen oslabljenom relaksacijom donjeg ezofagealnog sfinktera i odsutnom ili oštećenom peristaltikom jednjaka. Progresivna dilatacija jednjaka može dovesti do teške disfagije, čestih aspiracija, respiratornih komplikacija te, kod odabranih pacijenata u završnoj fazi bolesti, potrebe za ezofagektomijom.

Prikaz slučaja: Pacijentica u dobi od 46 godina sa završnom fazom ahalazije operirana je metodom subtotalne Ivor Lewisove ezofagektomije s intratorakalnom ezofagogastričnom anastomozom nakon progresivne disfagije i recidivirajuće aspiracijske pneumonije. Tri mjeseca nakon operacije, dolazi na pregled zbog perzistentnog suhog kašlja, promuklosti, nepravilnog obrasca disanja, postoperativne boli te izrazito smanjene tolerancije na fizičke napore. Početnom fizioterapijskom procjenom utvrđena je slabost inspiratornih mišića, smanjena snaga perifernih mišića i smanjeni funkcionalni kapacitet vježbanja, dok je ultrazvučni pregled potvrdio očuvanu funkciju ošita. Pacijentica je nakon toga provela sedmotjedni individualizirani izvanbolnički program plućne rehabilitacije koji je obuhvaćao respiratornu reedukaciju, trening inspiratornih mišića, aerobne vježbe i progresivni trening snage.

Rezultati: Nakon rehabilitacije, maksimalni inspiratorni tlak porastao je s 46 na 75 cmH_2O (s 51% na 83% predviđene vrijednosti), udaljenost u šestominutnom testu hoda poboljšala se s 403 na 555 m, a obostrana snaga stiska šake porasla je s 18 na 26 kg. Pacijentica je također prijavila izrazito smanjenje kašlja, postoperativne boli i dispneje tijekom fizičke aktivnosti. Perzistentna promuklost naknadno je pripisana jednostranoj parezi glasnica te je započeta logopedska terapija.

Zaključak: Ovaj slučaj pokazuje da sveobuhvatni program plućne rehabilitacije može značajno poboljšati funkciju respiratornih mišića, funkcionalni kapacitet vježbanja, snagu perifernih mišića i smanjiti postoperativne simptome nakon ezofagektomije zbog završne faze ahalazije.

Ključne riječi: ahalazija; plućna rehabilitacija; ezofagektomija

Corresponding Author:
Snježana Benko Meštrović, PhD, MSC PT, University Hospital "Sveti Duh", Sveti Duh 64, Zagreb;
University Sjever, Department of Physiotherapy, Varaždin;
Faculty of Health Studies, University of Rijeka

e-mail:
snjezanabenkom@gmail.com

INTRODUCTION

Achalasia is a rare primary esophageal motility disorder characterized by impaired relaxation of the lower esophageal sphincter and absent or severely impaired esophageal peristalsis, resulting in progressive esophageal dilatation and dysphagia. In advanced stages, chronic retention of food and secretions within the esophagus predisposes patients to recurrent aspiration and respiratory complications, which may substantially contribute to morbidity and impaired quality of life (1).

The annual incidence of achalasia is approximately 1.6 cases per 100,000 individuals, with an estimated prevalence of 10 cases per 100,000. The disease affects men and women equally and may occur at any age, although the highest incidence is observed between the third and sixth decades of life (1,2,3).

Patients typically present with progressive dysphagia, regurgitation, and chest discomfort, whereas advanced disease may be complicated by recurrent aspiration pneumonia and significant esophageal dilatation. The diagnosis is established using upper gastrointestinal endoscopy, high-resolution esophageal manometry, endoscopic ultrasonography when indicated, and computed tomography to exclude secondary causes of esophageal obstruction (4,5).

Treatment depends on disease severity and aims to improve esophageal emptying by reducing lower esophageal sphincter pressure. Early-stage disease is generally managed with less invasive approaches, including pneumatic dilation and peroral endoscopic myotomy (POEM). In patients with end-stage achalasia, characterized by irreversible esophageal dilatation and failure of previous therapeutic interventions, esophagectomy may represent the most appropriate treatment option. Among the available surgical techniques, Ivor Lewis esophagectomy remains one of the standard procedures for carefully selected patients (5).

The aim of this case report was to describe the effects of a comprehensive pulmonary rehabilitation program in

a patient who underwent Ivor Lewis esophagectomy for end-stage achalasia and subsequently developed persistent respiratory symptoms, dysphonia, and reduced exercise tolerance.

CASE PRESENTATION

A 46-year-old woman was diagnosed with achalasia in 2023 after presenting with progressive dysphagia, exertional dyspnea, and recurrent febrile episodes associated with aspiration pneumonia. Chest computed tomography (CT) demonstrated marked esophageal dilatation with retained intraluminal contents and bilateral ground-glass opacities consistent with recurrent aspiration. Flexible bronchoscopy revealed multinucleated giant cells, raising initial suspicion of sarcoidosis, for which corticosteroid therapy was initiated. However, sarcoidosis was subsequently excluded following further diagnostic evaluation. As the disease progressed, dysphagia became the predominant symptom, leading to the diagnosis of end-stage achalasia.

Because of advanced disease and severe impairment of esophageal function, the patient underwent subtotal Ivor Lewis esophagectomy with intrathoracic gastric transposition and esophagogastric anastomosis in October 2025. The postoperative course was uneventful with respect to surgical complications; however, persistent respiratory and functional symptoms became evident during recovery. Three months after surgery, the patient continued to experience dry cough, hoarseness, postoperative thoracoabdominal pain, dyspnea during low-intensity physical activity, and markedly reduced exercise tolerance. Owing to these persistent symptoms, she was referred by her pulmonologist to an outpatient pulmonary rehabilitation program in January 2026.

A comprehensive physiotherapeutic assessment was performed before initiating rehabilitation. Clinical examination revealed a predominantly apical breathing pattern with excessive activation of accessory inspiratory muscles. Attempts to activate diaphragmatic breathing provoked pain originating in the xiphoid region and radiating bilaterally along the costal margins. Inspection demonstrated a healed midline abdominal scar extending from the xiphoid process to the umbilicus and a right posterolateral thoracotomy scar extending from the lateral border of the scapula toward the right breast. The patient reported an inability to achieve deep inspiration and developed tachypnea and dizziness even during low-intensity exercise.

Inspiratory muscle strength was assessed using a POWERbreathe device by measuring maximal inspiratory pressure (MIP), defined as the highest value obtained from three maximal inspiratory efforts. Peripheral muscle strength was evaluated using a Saehan SH5001 hydraulic hand dynamometer, with the best of three measurements recorded for each hand. Functional exercise capacity was assessed using the 6-minute walk test (6MWT) according to European Respiratory Society recommendations (6,7).

Baseline assessment demonstrated reduced inspiratory muscle strength (MIP 46 cmH_2O; 51% predicted), impaired functional exercise capacity (6MWT 403 m; 69% predicted), and decreased bilateral handgrip strength (18 kg in both hands). During the initial 6MWT, the patient was unable to complete the test without interruption and required a pause between 2:57 and 4:08 minutes because of severe dyspnea (modified Borg score 8).

Given the extent of the thoracoabdominal procedure, diaphragmatic function was additionally assessed by ultrasonography using a Mindray e5Ms ultrasound system. Diaphragm thickness at end-expiration (TD_{min}) and at end-inspiration (TD_{max}) was measured in B-mode through a right intercostal approach with the patient in the supine position. These measurements were then used to calculate the diaphragm thickening fraction (DTF). Diaphragmatic excursion during deep breathing was subsequently assessed through a right subcostal approach with the patient in the supine position using M-mode ultrasonography (6,8). Baseline measurements demonstrated a diaphragm thickness of 1.6 mm at end-expiration (TD_{min}) and 2.6 mm at end-inspiration (TD_{max}), corresponding to a diaphragm thickening fraction of 62%. Diaphragmatic excursion during deep breathing measured 7.0 cm, indicating preserved diaphragmatic contractility and mobility. Clinically, these results are relevant given that phrenic nerve injury and diaphragmatic dysfunction frequently follow major thoracoabdominal surgery and complicate respiratory recovery (9).

An individualized outpatient pulmonary rehabilitation program was subsequently initiated and continued for seven weeks, comprising three supervised sessions per week. The rehabilitation protocol included breathing retraining focused on restoring diaphragmatic breathing and reducing respiratory rate, progressive resistance training for upper and lower extremity muscles using free weights and elastic resistance bands, and aerobic exercise on a cycle ergometer performed for 20 minutes at an individualized workload ranging from 75 to 125 W. Daily inspiratory muscle training was performed using a POWERbreathe Medic Plus® device. The patient completed 30 inspiratory efforts once daily against a resistance of 20 cmH_2O during the first two weeks, which was progressively increased to 40 cmH_2O during the remaining five weeks according to individual tolerance and clinical progression. During the early phase of rehabilitation, breathing retraining represented the greatest challenge because of pronounced accessory inspiratory muscle recruitment and difficulty in maintaining diaphragmatic breathing during exercise.

Following completion of the rehabilitation program, clinically meaningful improvements were observed across all functional outcomes. Maximal inspiratory pressure increased from 46 to 75 cmH_2O, corresponding to an improvement from 51% to 83% of the predicted value. Functional exercise capacity improved substantially, with the 6-minute walk distance increasing from 403 to 555 m (69% to 95% predicted). Bilateral handgrip strength increased from 18 to 26 kg. In parallel with these objective findings, the patient reported a marked reduction in dry cough, improved breathing efficiency, decreased postoperative pain, and greater tolerance of daily physical activities.

Despite these favorable outcomes, persistent hoarseness and a breathy voice remained. Subsequent otolaryngological evaluation confirmed unilateral vocal cord paresis, and the patient was referred for speech and language therapy.

Ethical considerations

According to institutional and national regulations, formal ethical approval was not required because this report represents a non-interventional retrospective case report based solely on fully anonymised data obtained from routine physiotherapy documentation and medical records, without any additional interventions or prospective data collection performed for research purposes.

DISCUSSION

In this case report, we describe the successful rehabilitation of a patient who developed persistent respiratory symptoms, impaired exercise tolerance, and dysphonia following Ivor Lewis esophagectomy performed for end-stageachalasia. After completing a seven-week individualized pulmonary rehabilitation program, the patient demonstrated clinically meaningful improvements in inspiratory muscle strength, peripheral muscle strength, functional exercise capacity, postoperative pain, and respiratory symptoms. These findings suggest that pulmonary rehabilitation may represent an important component of postoperative management in carefully selected patients following esophagectomy.

A review of the available literature revealed a remarkable lack of studies specifically addressing postoperative pulmonary rehabilitation following esophagectomy for achalasia. This is not unexpected, as esophagectomy is reserved for a relatively small proportion of patients with end-stage disease. Although the procedure is considered safe and effective in appropriately selected patients, it is generally indicated only when severe esophageal dilatation and functional deterioration persist despite previous therapeutic interventions (10). In current clinical practice, less invasive treatment modalities are preferred whenever feasible, whereas esophagectomy is reserved for patients in whom these interventions have failed or are no longer appropriate. Howard et al. described two patients with end-stage achalasia in whom less invasive treatment approaches, including pneumatic dilation and surgical myotomy, failed to achieve satisfactory symptom control. Consequently, open esophagectomy was performed, resulting in complete symptom resolution and a substantial improvement in quality of life (11).

Although evidence regarding esophagectomy for achalasia is limited, pulmonary complications following esophagectomy have been extensively investigated in patients with esophageal cancer. Regardless of the underlying indication for surgery, the mechanisms responsible for postoperative respiratory impairment are largely comparable. Respiratory complications may include atelectasis, pneumonia, acute respiratory distress syndrome, pleural effusion, pneumothorax, mucus retention, aspiration, tracheobronchial injury, and respiratory failure (12).

Another important postoperative complication is recurrent laryngeal nerve injury, which may result in vocal cord paralysis, dysphonia, impaired airway protection, and an increased risk of aspiration. Seesing et al. reported that approximately 25% of patients with recurrent laryngeal nerve paralysis require vocal cord surgery within the first postoperative year (13). In our patient, persistent hoarseness remained despite significant improvement in respiratory function and was ultimately attributed to unilateral vocal cord paresis confirmed by otolaryngological evaluation. Although pulmonary rehabilitation could not reverse the neurological deficit, improved respiratory muscle performance and breathing efficiency likely contributed to better overall functional recovery before speech therapy was initiated.

Several strategies have been proposed to reduce postoperative pulmonary morbidity after esophagectomy. Edmondson et al. emphasized the importance of preoperative pulmonary optimization, including breathing exercises, coughing techniques, inspiratory muscle training, incentive spirometry, and pharmacological measures aimed at improving secretion clearance (12). Likewise, Yoshida et al. highlighted the benefits of smoking cessation, nutritional optimization, meticulous oral hygiene, minimally invasive surgical techniques whenever feasible, perioperative corticosteroid administration, and multidisciplinary perioperative care (14). While these strategies primarily focus on reducing the incidence of postoperative pulmonary complications, our findings suggest that patients with persistent respiratory impairment after surgery may also benefit substantially from a structured postoperative pulmonary rehabilitation program.

Appropriate identification of patients at increased risk of postoperative pulmonary complications remains an important aspect of perioperative management. Ferguson et al. identified advanced age, reduced forced expiratory volume in one second (FEV_1), impaired diffusing capacity for carbon monoxide (DLCO), poor performance status, elevated serum creatinine levels, active smoking, and transthoracic surgical approach as independent predictors of major pulmonary complications (15).

The clinical importance of preventing pulmonary complications extends beyond the immediate postoperative period. Manara et al. demonstrated that patients undergoing esophagectomy for esophageal cancer who remained free of postoperative pulmonary complications had significantly better overall survival, cancer-specific survival, and disease-free survival than those who developed pulmonary complications (16). Although these findings originate from an oncological population, they further emphasize the importance of preserving postoperative respiratory function and minimizing pulmonary morbidity whenever possible.

Our case suggests that pulmonary rehabilitation may support recovery through several complementary mechanisms, including optimization of breathing patterns, improvement of inspiratory muscle performance, restoration of peripheral muscle strength, and enhancement of functional exercise capacity. Improvements in objective functional outcomes, together with reductions in patient-reported symptoms, suggest a potential clinical role for comprehensive pulmonary rehabilitation following esophagectomy for end-stage achalasia. However, given the single-case design and the absence of a control condition, the observed improvements cannot be attributed exclusively to the rehabilitation intervention. Spontaneous postoperative recovery and other factors related to the natural course of recovery may also have contributed to the favorable outcomes. Therefore, these findings should be interpreted cautiously and considered primarily as supportive evidence for the feasibility and potential benefit of pulmonary rehabilitation in this specific clinical context.

CONCLUSION

This case report demonstrates that a comprehensive, individualized pulmonary rehabilitation program may substantially improve postoperative recovery following Ivor Lewis esophagectomy for end-stage achalasia. After seven weeks of rehabilitation, the patient showed clinically meaningful improvements in inspiratory muscle strength, peripheral muscle strength, functional exercise capacity, breathing pattern, and postoperative symptoms, accompanied by normalization of pulmonary function parameters. Although vocal cord paresis persisted and required subsequent speech therapy, pulmonary rehabilitation contributed to significant functional recovery and improved overall respiratory performance.

Given the limited evidence regarding postoperative rehabilitation in patients undergoing esophagectomy for achalasia, this case highlights the potential value of incorporating pulmonary rehabilitation into routine multidisciplinary postoperative care. Early assessment of respiratory function and timely initiation of individualized rehabilitation may facilitate recovery, reduce postoperative disability, and improve patients' functional status and quality of life. Further prospective studies are needed to establish standardized rehabilitation protocols and to determine their long-term effects on respiratory outcomes, exercise capacity, and health-related quality of life.

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