Case Report

Improving Physical Endurance in Palliative Stage IV Lung Cancer: A Case Report

Evi Rachmawati Nur Hidayati[1,2]*,Choirunnisa Yaumal Akhir[1], Irvi Addini Zatirah[1]

[1]Department of Physical Medicine and Rehabilitation, Universitas Indonesia Hospital, Depok
[2]Occupational Therapy Study Program, Vocational Education Program, Universitas Indonesia, Depok

Corresponding Author:
Evi Rachmawati Nur Hidayati | Department of Physical Medicine and Rehabilitation, Universitas Indonesia Hospital - Occupational Therapy Study Program, Vocational Education Program, Universitas Indonesia, Depok | evir96@gmail.com

Submitted: February 23rd, 2025
Accepted: April 23rd, 2025
Published: June 13th, 2025

Respir Sci. 2025; 5(3): 225-34
https://doi.org/10.36497/respirsci.v5i3.174

Abstract

Background: Lung cancer remains the leading cause of cancer-related mortality worldwide, with advanced stages often causing fatigue, reduced endurance, and impaired lung function. Pulmonary rehabilitation, including incentive spirometry exercise (ISE) and aerobic exercise, has been proven effective in improving functional capacity in patients with lung cancer, even in palliative care settings. This case report examines the effects of ISE and aerobic exercise on a stage IV lung cancer patient.

Case: A 58-year-old male with stage IV lung cancer and spinal metastases experienced increased fatigue, especially after walking 500 meters. He underwent a four-weeks palliative rehabilitation program that included individualized supportive exercises (ISE) and moderate aerobic activity.

Discussion: Following the completion of the program, the patient showed improvements in respiratory function, thoracic expansion, walking ability and overall performance status. His walking distance increased from 450 meters to 522 meters, and his MET score improved, indicating an enhancement in cardiovascular fitness. Despite a decline in forced vital capacity (FVC), other indicators show significant improvements in his physical function and quality of life.

Conclusion: The combination of ISE and aerobic exercise proves to be an effective rehabilitation approach in improving respiratory function, physical endurance, and quality of life with stage IV lung cancer, even within the palliative care phase.

Keywords: aerobic exercise, incentive spirometry, lung cancer, METs

INTRODUCTION

Lung cancer remains the leading cause of cancer-related mortality worldwide.[1] In Indonesia, lung cancer ranks third overall, while it remains the most common cancer among males.[2] Despite advancements in treatment, patients diagnosed with lung cancer patients with survive over five years often experience a significant decline in their quality of life, with a 35% reduction in functional well-being. While managing chronic symptoms can be challenging,

approximately 15% of patients demonstrate an impressive ability to adapt, underscoring the importance of addressing their physical and emotional needs during palliative care to provide high-quality end-of-life care.[3,4]

In the advanced stages of lung cancer, patients frequently face treatment-related issues, including fatigue, reduced physical endurance, and impaired pulmonary function.[5] These factors severely impact quality of life, with over 75% of patients with metastatic disease reporting experiencing cancer-related fatigue (CRF).[6]

In addition, lung cancer patients often experience obstructive lung function, as evidenced by decreased forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC) ratio.[7] These impairments can significantly limit exercise capacity, further hindering physical activity, especially in those with moderate airflow restrictions.[8]

Given these challenges, pulmonary rehabilitation has emerged as a vital aspect of supportive care for lung cancer patients.[9] The American Thoracic Society (ATS) and the European Respiratory Society (ERS) highlight pulmonary rehabilitation as an effective method for enhancing exercise capacity and overall functional.[10] Combining pulmonary rehabilitation with aerobic exercise has been shown to yield even better outcomes, improving both physical endurance and respiratory function.[11]

Additionally, the use of incentive spirometry (IS) has demonstrated positive effects, with studies reporting a 16% increase in maximal inspiratory volume after consistent use over 30 days.[12] Other studies have shown that inspiratory muscle exercise using IS my improve lung function, especially by enhancing FVC.[13]

Physical activity provides additional benefits for cancer survivors, including reduced fatigue through enhanced cardiorespiratory fitness, improved physical performance, and elevated energy levels.[14] Furthermore, the Tokuhashi and Tomita scores are commonly used to predict a patient's survival prognosis and inform treatment decisions. These scores help determine whether a patient may benefit from more intensive treatments or if palliative care is the more appropriate approach. These scoring systems play a critical role in tailoring interventions based on individual patient needs.[15]

A crucial component in managing stage IV lung cancer patients is assessing their functional status. The Karnofsky Performance Scale (KPS) is commonly used to evaluate a patient's ability to perform daily activities and their level of dependence. This scale, ranging from 0 (dead) to 100 (normal), provides clinicians with an essential tool for tracking changes in physical status and guiding treatment decisions. As physical performance directly correlates with quality of life, performance assessment becomes a key indicator for prognosis and treatment planning.[16,17]

In this report, we present a case study of a stage IV lung cancer patient,

focusing on the combined impact of incentive spirometry exercise (ISE) and aerobic exercise on physical endurance, as demonstrated by improvements in functional respiratory capacity. This case highlights the potential benefits of rehabilitative interventions in palliative care settings, offering a tailored approach to enhancing the quality of life for patients facing advanced lung cancer.

CASE

A 58-year-old male with a history of stage IV lung cancer presented to the hospital with a primary complaint of fatigue, particularly when walking long distances. Over the past month, the fatigue had worsened significantly, and he now experiences substantial fatigue after walking just 500 meters. Despite these symptoms, the patient denies shortness of breath, cough, or chest pain.

The patient was diagnosed with stage IV lung cancer two years ago. According to the TNM classification system, imaging revealed the following findings: A heterogeneous, solid mass with partially defined (articulated) margins is located in segment 3 of the right lung. Post-contrast imaging shows the lesion measures 2.4 × 2.5 × 1.3 cm, reduced from a previous measurement of 3.2 × 2.0 × 4.4 cm, suggesting a partial response or regression. The mass obliterates the B3B branch of the right bronchus, forming an open bronchus sign, and is in close contact with the right-sided pericardium, indicating local invasion.

These features particularly pericardial involvement and bronchial obstruction are consistent with T4 classification, which denotes a tumor of any size that invades the mediastinum, heart, great vessels, trachea, or pericardium, or involves separate tumor nodules in the same lobe, there is no enlargement or abnormal contrast enhancement is observed in the hilar or mediastinal lymph nodes. Thus, the nodal status is classified as N0.

Suspected metastatic involvement of the L2 vertebral body, as well as the body and bilateral pedicles of the L3 vertebra; these findings are interpreted as M1b, which denotes a single extrathoracic metastasis (or involvement of a single organ), in this case, the spine. Based on the above findings, the patient's lung cancer is staged as: T4-Invasion of pericardium and bronchus, N0 -No regional lymph node involvement, M1b - Suspected vertebral metastasis (L2 and L3) resulting in IVB Stage IV Lung Cancer.[18]

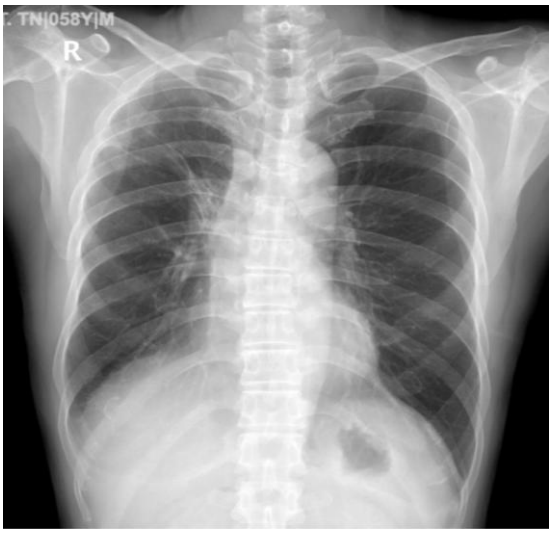

Figure 1. Chest x-ray showed heterogeneous opacities and fibrosis in the upper-middle right lung

Initial diagnostic workup included chest X-ray, which showed heterogeneous opacities and fibrosis in the upper-middle right lung fields (Figure 1).

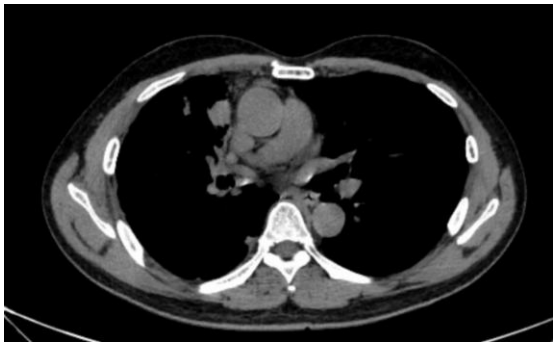

Figure 2. CT scan revealed a malignant-appearing mass in the right lung

A CT scan revealed a malignant-appearing mass in the right lung's segment 3 measuring (Figure 2). Thoracolumbar MRI further confirmed these findings, revealing sclerotic lesions in the L2-L3 vertebral bodies as well as in the right and left pedicles of L3 (Figure 3). His treatment history includes completed chemotherapy and a bone marrow replacement surgery performed on the L4 vertebra, performed one month before this visit.

Figure 3. Thoracolumbar MRI showed sclerotic lesions in L2-L3

Physical examination findings, thoracic expansion measurements revealed decreased values at three key levels: the axillary level (1.5 cm), areola level (4 cm), and xiphoid level (2.5 cm). A spirometry test was conducted to evaluate lung function, and the results showed a forced vital capacity (FVC) of 2170 mL.

Table 1. Tokuhashi scoring system[15]

Characteristic	Score
General Condition (performance status)	
Poor (PS 10%-40%)	0
Moderate (PS 50%-70%)	1
Good (PS 80%-100%)	**2**
Number of extraspinal bone metastases foci	
>3	0
1-2	**1**
0	2
Number of metastases of the major organs	
>3	0
2	**1**
1	2
Metastases to the major internal organs	
Unremovable	0
Removable	1
No metastases	**2**
Primary site of the cancer	
Lung, osteosarcoma, stomach, bladder, esophagus, pancreas	**0**
Liver, gallbladder, unidentified	1
Others	2
Kidney, uterus	3
Rectum	4
Thyroid, breast, prostate, and carcinoid tumor	5
Palsy	
Complete (frankel A,B)	0
Incomplete (frankel C,D)	1
None (frankel E)	**2**
Total Score	**8**

These findings suggested significant lung volume impairment, which caused a decrease in oxygen capacity, thereby

contributing to his fatigue during physical activities. The patient's performance status was assessed using the KPS, which indicated a score of 60%, meaning he requires occasional assistance but can care for most of his personal needs.

A prognostic evaluation was conducted using two established scoring systems, the Tokuhashi scoring system and the Tomita scoring system, to assess the patient's life expectancy and guide subsequent treatment decisions. The Tokuhashi scoring system, which evaluates factors such as general condition, the number of bone and organ metastases, neurological status, and the type of primary tumor, resulted in a total score of 8 points (Table 1).

This score suggests a life expectancy of less than 6 months, where palliative care is recommended as the primary approach. The Tomita scoring system, which assesses prognosis based on tumor growth rate, visceral organ involvement, and bone metastases, resulted in a score of 6 points (Figure 5).

Scoring System				Prognostic Score	Treatment Goal	Surgical Strategy
Point	Prognostic factors: Primary tumor	Visceral mets.*	Bone mets.**			
1	slow growth (breast, thyroid, etc.)		solitary or isolated	2, 3	Long-term local control	Wide or Marginal excision
2	moderate growth (kidney, uterus, etc.)	treatable	multiple	4, 5	Middle-term local control	Marginal or Intralesional excision
4	rapid growth (lung, stomach, etc.)	un-treatable		6, 7	Short-term palliation	Palliative surgery
				8, 9, 10	Terminal care	Supportive care

★ No visceral mets. = 0 point. ★★ Bone mets. including spinal mets.

Figure 5. Tomita scoring system[15]

The patient's total score is 8, calculated as follows: good condition (2 points), 1-2 extraspinal bone metastases (1 point), 2 of metastases in the vertebral body (1 point), no metastases to the major internal organs (2 points), primary cancer site at the lung (0 point), and no Palsy (2 points).

The patient's prognostic score was calculated as follows: rapid growth of the primary tumor in the lung (4 points), no visceral metastases (0 points), and multiple bone metastases (2 points). The total prognostic score is 6, with the treatment goal being short-term palliation through palliative surgery.

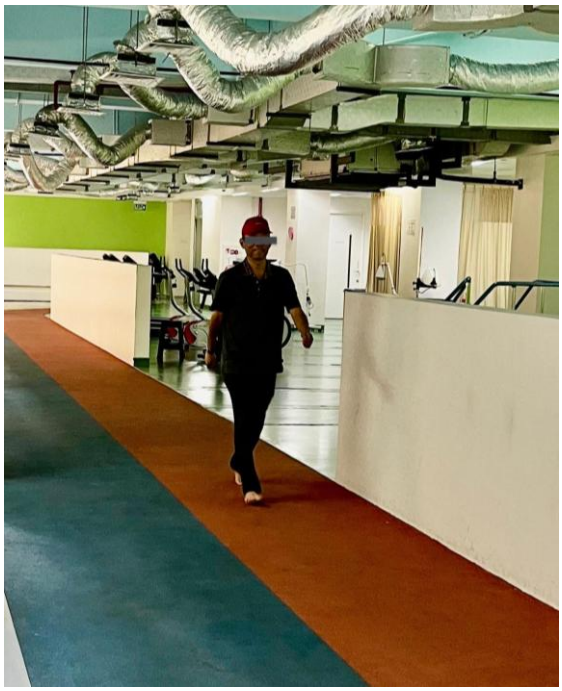

Figure 6. The 6-minute walking test (6MWT) was performed before and after the rehabilitation program

Based on these findings, the patient was enrolled in a palliative rehabilitation program, including an incentive spirometer (ISE), with instructions for the patient to perform 10 breaths three times

daily over 4 weeks. This was combined with moderate exercise, was developed using the results of a 6MWT. The 6MWT was performed before and after the rehabilitation program. There was an improvement in the walking distance from 450 to 522 meters, indicating enhanced endurance and cardiovascular fitness (Figure 6)**.**

During the test, the patient could initially walk a distance of 450 meters and had a metabolic equivalent of task (MET) score of 5.2. Based on these results, the program prescribed walking 2000 meters three times a week. This combination was tailored to improve the patient's functional capacity while taking into account his overall prognosis and physical limitations.

DISCUSSION

Lung function improvement is crucial for enhancing comfort and quality of life in patients with end-stage lung cancer, as respiratory difficulties are common in this patient population. ISE has proven to be an effective, low-cost, and user-friendly tool that aligns with the patient's natural breathing pattern.[4,12]

Incentive spirometry encourages slow, deep breaths, which help open collapsed airways, thereby improving lung ventilation. This technique has minimal side effects, requires little supervision after training, and has been shown to significantly enhance exercise capacity and improve the quality of life in lung cancer patients, particularly those with advanced disease. In this case, the use of ISE contributed to significant functional improvements in the patient's respiratory capacity.[4,12]

The patient's prognosis was assessed using two established scoring systems: the Tokuhashi and Tomita scoring systems. The Tokuhashi score of 8 points indicated a life expectancy of less than six months, suggesting that palliative care should be prioritized. This was in alignment with the decision to enroll the patient in a palliative rehabilitation program.

The Tomita score, which emphasized the rapid growth of the primary tumor and the presence of multiple bone metastases, further reinforced the need for a palliative approach. Both scoring systems were instrumental in guiding the rehabilitation strategy, which focused on improving functional capacity and managing symptoms despite the patient's limited prognosis.

Four weeks after starting the combination program, significant improvements were observed in the patient's respiratory function and physical endurance. First, the patient's airflow during ISE increased from 600 mL/s to 900 mL/s, reflecting enhanced lung ventilation and improved breathing mechanism, helping the patient manage the respiratory demands of daily activities. This improvement in airflow demonstrates that ISE effectively targeted airway patency and lung function, which is critical for patients with advanced lung cancer and compromised pulmonary

function.

Second, thoracic expansion measurements showed significant improvement at all three levels: from 1.5-4-2.5 cm to 3-5-3.5 cm. This improvement suggests an increase in chest wall mobility, leading to enhanced lung expansion during inspiration. These improvements are important for lung cancer patients who often experience reduced chest wall mobility and ventilation, further exacerbating fatigue and shortness of breath.

Third, the patient demonstrated an improvement in walking capacity, as evidenced by the 6MWT. The 6MWT is a simple and widely used tool for assessing an individual's submaximal functional capacity, which is particularly valuable for patients with advanced diseases and multiple comorbidities who might struggle with complex exercise tests due to low endurance. It measures the distance walked in 6 minutes on a flat surface.[19]

As mentioned, the 6MWT has been shown to correlate with improvements in activities of daily living (ADLs).[20] Regular walking exercises, as part of a structured program, might enhance endurance, muscle strength and overall mobility. In this case, the walking distance improved from 450 meters to 522 meters, indicating a gain in endurance and cardiovascular fitness.

The patient's MET score, which estimates physical activity intensity, increased from 5.2 to 5.6, suggesting a higher capacity for physical activity at a higher intensity. This increase in MET score reflects improved aerobic capacity, overall endurance, and cardiovascular fitness, all of which for enhancing mobility and quality of life. The patient's performance status also improved from 60% to 70%, indicating better self-care ability but still difficulty carrying out normal activities or work tasks.

Despite the observed improvements in airflow, thoracic expansion, walking capacity, and performance status, there was a decline in the FVC, which measures the total volume of air a person can forcefully exhale after taking a deep breath. This was evaluated using the Single Breath Count Test (SBCT), which could serve as a reliable, quick, simple, and easily interpretable alternative to spirometry, has shown a significant correlation with FVC, with reported correlation coefficient of 0.71.[21] The results showed a significant decrease in FVC, decreasing from 2170 mL to 1150 mL.

This decline in FVC may reflect the progressive nature of lung cancer, which leads to damage to the lung parenchyma and a reduction in lung volume. However, it is important to recognize that FVC alone may not fully capture the improvements in respiratory mechanics or functional capacity that can result from rehabilitation efforts.

Other indicators of lung function and physical endurance, such as airflow, thoracic expansion, and walking distance, all demonstrated significant improvement. These findings suggest that the rehabilitation program had a positive

effect on respiratory and functional capacity, even if FVC did not improve.

The decrease in FVC is concerning, as it highlights the progressive nature of lung cancer. However, it remains unclear whether the reduction in FVC is due to disease progression or an isolated effect of the rehabilitation program, as the patient did not undergo further diagnostic testing due to financial constraints. The patient had recently retired, lost his health insurance, thus was unable to access additional medical evaluation. This financial limitation impacts their ability to undergo essential medical evaluations and adjustments to treatment plans.

Overall, this case demonstrates the potential benefit of combining ISE and aerobic exercise to improve functional outcomes in patients with advanced lung cancer. The observed improvements in airflow, thoracic expansion, walking capacity, and performance status indicate that this combined rehabilitation approach can enhance quality of life, even in patients with limited prognosis. However, the observed reduction in FVC warrants further investigation for potential adjustment to the rehabilitation strategy, aiming to clarify the long-term effects of these interventions on lung function in cancer patients and to determine optimal rehabilitation protocols.

CONCLUSION

The combination of Incentive Spirometry Exercise (ISE) and moderate aerobic exercise proved to be an effective rehabilitation strategy for improving lung function, physical endurance and overall performance.

These findings highlight the potential benefits in the management of lung cancer patients, even during the palliative care phase, by enhancing quality of life, reducing fatigue, and improving physical function. Further studies are needed to better understand the long-term impact of these interventions on lung function and overall survival, as well as to optimize rehabilitation protocols for different stages of the disease.

REFERENCES

1. Leiter A, Veluswamy RR, Wisnivesky JP. The global burden of lung cancer: current status and future trends. Nat Rev Clin Oncol. 2023;20:624–39.
2. Putri A, Pratiwi SE, Musawaris RF. Characteristics of Lung Cancer Patients at Dr. Soedarso Hospital Pontianak from 2017 to 2019. Indonesian Journal of Cancer. 2023;17(2):101–4.
3. Lim RBL. End-of-life care in patients with advanced lung cancer. Ther Adv Respir Dis. 2016;10(5):455–67.
4. Apriliana D, Suradi S, Setijadi AR. Role of Incentive Spirometry On Exercise Capacity, Breathing Symptoms, Depression Rate, and Quality of Life in NSCLC Patients with Chemotherapy. Respiratory Science. 2021;2(1):8–17.
5. Avancini A, Sartori G, Gkountakos A, Casali M, Trestini I, Tregnago D, et

al. Physical Activity and Exercise in Lung Cancer Care: Will Promises Be Fulfilled? Oncologist. 2020;25(3):e555–69.

6. Bade BC, Faiz SA, Ha DM, Tan M, Barton-Burke M, Cheville AL, et al. Cancer-related Fatigue in Lung Cancer: A Research Agenda: An Official American Thoracic Society Research Statement. Am J Respir Crit Care Med. 2023;207(5):e6–28.
7. Kang HS, Park YM, Ko SH, Kim SH, Kim SY, Kim CH, et al. Impaired Lung Function and Lung Cancer Incidence: A Nationwide Population-Based Cohort Study. J Clin Med. 2022;11(4):1077.
8. Moon SM, Lim JH, Hong YS, Shin KC, Lee CY, Kim DJ, et al. Clinical impact of forced vital capacity on exercise performance in patients with chronic obstructive pulmonary disease. J Thorac Dis. 2021;13(2):837–46.
9. Tiep B, Sun V, Koczywas M, Kim J, Raz D, Hurria A, et al. Pulmonary Rehabilitation and Palliative Care for the Lung Cancer Patient. Journal of Hospice & Palliative Nursing. 2015;17(5):462–8.
10. Spruit MA, Singh SJ, Garvey C, ZuWallack R, Nici L, Rochester C, et al. An Official American Thoracic Society/European Respiratory Society Statement: Key Concepts and Advances in Pulmonary Rehabilitation. Am J Respir Crit Care Med. 2013;188(8):e13–64.
11. Rehman M, Ahmad U, Waseem M, Ali B, Tariq MI. Effects of Exercise Training in Patients with Lung Cancer During Chemotherapy Treatment. Malaysian Journal of Medical Sciences. 2023;30(2):141–52.
12. Toor H, Kashyap S, Yau A, Simoni M, Farr S, Savla P, et al. Efficacy of Incentive Spirometer in Increasing Maximum Inspiratory Volume in an Out-Patient Setting. Cureus. 2021;13(10):e18483.
13. Irmaini I, Priyanto H, Yanifitri DB. The Effect of Inspiratory Breathing Muscle Exercise Using Respirometer on Changes in Lung Function and Dyspnea Severity in Tuberculosis Pleurisy Patients. Jurnal Respirologi Indonesia. 2022;42(1):43–51.
14. Coups EJ, Park BJ, Feinstein MB, Steingart RM, Egleston BL, Wilson DJ, et al. Physical Activity among Lung Cancer Survivors: Changes across the Cancer Trajectory and Associations with Quality of Life. Cancer Epidemiology, Biomarkers & Prevention. 2009;18(2):664–72.
15. Candido PBM, Perria FM, da Costa HR, Defino HLA. A Comparison Of The Tomita And Tokuhashi Scores In Spinal Metastasis. Coluna/Columna. 2020;19(4):297–301.
16. Karaman E, Kasar KS, Deniz K, Yıldırım Y. Symptoms, performance status and quality of life in cancer patients receiving palliative care. Ege Tıp Dergisi. 2022;61(1):64–72.
17. Péus D, Newcomb N, Hofer S. Appraisal of the Karnofsky Performance Status and proposal of a simple algorithmic system for its

evaluation. BMC Med Inform Decis Mak. 2013;13:72.

18. Lababede O, Meziane MA. The Eighth Edition of TNM Staging of Lung Cancer: Reference Chart and Diagrams. Oncologist. 2018;23(7):844–8.
19. Giannitsi S, Bougiakli M, Bechlioulis A, Kotsia A, Michalis LK, Naka KK. 6-minute walking test: a useful tool in the management of heart failure patients. Ther Adv Cardiovasc Dis. 2019;13.
20. Venturelli M, Scarsini R, Schena F. Six-Month Walking Program Changes Cognitive and ADL Performance in Patients With Alzheimer. Am J Alzheimers Dis Other Demen. 2011;26(5):381–8.
21. Bhandari SK, Bist A, Ghimire A. Single breath count test and its applications in clinical practice: A systematic review. Annals of Medicine & Surgery. 2024;86(4):2130–6.