Review

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The Role of Physiotherapy in Enhanced Recovery After Surgery for Lung Cancer: A Narrative Review

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ABSTRACT

Introduction: Enhanced Recovery After Surgery (ERAS) is a multimodal approach to the perioperative care of patients undergoing surgery for lung cancer. Physiotherapy can support both preoperative preparation and postoperative functional recovery. However, its contribution must be distinguished from the impact of the overall ERAS program. **Aim:** The aim of this narrative review is to present the contribution of prehabilitation, respiratory physiotherapy, early mobilisation, and subsequent functional rehabilitation to the perioperative care of lung cancer patients, distinguishing the individual interventions from the comprehensive ERAS program. **Methods:** A narrative review was conducted involving searches of the PubMed and PEDro databases and the ScienceDirect platform between April 12 and September 8, 2025. Publications regarding perioperative recovery and ERAS were reviewed, including the 2019 ERAS Society/ESTS guidelines. The literature was examined regarding preoperative preparation, postoperative rehabilitation, and the relationship between physiotherapy interventions and the overall ERAS program. **Results:** A literature search indicated that therapeutic exercise can improve the functional capacity of lung cancer patients. ERAS programs have been associated with fewer postoperative complications and shorter hospital stays, although these benefits cannot be attributed solely to physiotherapy. The heterogeneity of patient populations and interventions limits the ability to formulate standardised recommendations. **Conclusions:** Physiotherapy can contribute to the perioperative functional rehabilitation of lung cancer patients when integrated into personalised, multidisciplinary care. Further studies are needed to clarify the contribution of specific physiotherapy interventions and their appropriate dosage within the ERAS framework.

Key words: *Lung cancer; physiotherapy; enhanced recovery after surgery; ERAS*

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INTRODUCTION

Enhanced Recovery After Surgery (ERAS) protocols constitute a multimodal approach to perioperative care, combining interventions before, during, and after the procedure. In lung surgery, the guidelines from the ERAS Society and the European Society of Thoracic Surgeons (ESTS) encompass preoperative education and prepara-

tion, optimisation of analgesia, management of drains and catheters, and early mobilisation. Physiotherapy contributes to this coordinated care, although it is not synonymous with the overall ERAS program [1].

Implementing ERAS requires collaboration among surgeons, anaesthesiologists, nurses, physiotherapists, and other healthcare professionals, depending on the patient's needs. Preoperative physiotherapy aims to improve functional reserve before surgery, while postoperative physiotherapy supports respiratory care, mobilization, and functional recovery. These interventions are an integral part of ERAS protocols and do not constitute a comprehensive program on their own [2,3].

The surgical management of lung cancer involves varying extents of pulmonary resection, such as segmentectomy, lobectomy, or pneumonectomy. Resection may be performed via open thoracotomy or through a minimally invasive approach, such as video-assisted thoracoscopic surgery or robotic surgery. These surgical approaches are related to the risk of mortality and morbidity due to potential postoperative complications.

Preoperative physiotherapy can improve the patient's functional capacity and support their preparation for the procedure [4]. However, there is no evidence that it alone ensures the safety of the procedure or reduces postoperative mortality. The primary goal is to improve clinical parameters such as dyspnoea, cardiorespiratory endurance, and functional recovery, with the principal objective being the patient's smooth reintegration into daily life.

Critical components of postoperative rehabilitation within ERAS protocols include early mobilisation and early oral feeding within the first 24 hours, as well as the effective management of tubes and catheters, with an emphasis on their prompt removal. From a physiotherapy perspective, early mobilisation, muscle strengthening, and functional reintegration into daily activities constitute the core elements of rehabilitation [1]. Prolonged immobilisation results in muscle weakness, decreased muscle mass, respiratory difficulties, complications such as atelectasis, and pneumonia, as well as an increased risk of venous thromboembolic events [1].

Early mobilisation is an integral part of postoperative care within ERAS; however, the benefits of comprehensive ERAS programs cannot be attributed solely to mobilisation, nor does evidence support an independent reduction in mortality resulting from this intervention [1,2].

METHODOLOGY

This paper presents a narrative review of the literature regarding the contribution of physiotherapy to the perioperative care of patients undergoing lung cancer surgery, focusing on the relationship between specific interventions and the overall ERAS program. The literature search was conducted between April 12 and September 8, 2025, using the PubMed and PEDro databases and the ScienceDirect platform. The combination of terms "lung cancer AND physiotherapy AND enhanced recovery after surgery" was used. The publication timeframe was limited to the period 2020–2025. An exception was made for the lung cancer management guideline developed by the ERAS Society, published in 2019, which was included for analysis due to its clinical relevance. This guideline was collected from the ERAS Society website: https://erassociety.org/ "Guidelines for enhanced recovery after lung surgery: recommendations of the Enhanced Recovery After Surgery (ERAS) Society and the European Society of Thoracic Surgeons (ESTS)"

The selection focused on English-language publications concerning perioperative physiotherapy, preoperative physiotherapy, and ERAS in the surgical management of lung cancer. Sources concerning broader oncological rehabilitation and general background were also utilised; these sources provided supplementary context and were not considered direct evidence of the effectiveness of physiotherapy interventions within ERAS. Selection was limited to publications with freely available full text, and articles were excluded due to a lack of access. This limitation may introduce availability bias and does not constitute a scientific criterion of relevance or quality. Initially, 26 publications were reviewed, including the 2019 ERAS Society/ESTS guidelines and general background sources. This narrative synthesis focuses on the publications cited and discussed in the final text. Duplicates were identified and removed using Mendeley. A complete record of the initial results and exclusions was not retained; therefore, numerical data regarding the successive selection stages are not presented.

The selection of publications was carried out by a single researcher, without an independent second check. No standardised assessment of methodological quality or risk of bias was performed. These limitations are taken into account when interpreting the findings of the narrative review. Eventually, for the collection of general anatomical information and background data regarding lung cancer, additional information was collected from the book ABC of Lung Cancer [5].

RESULTS

The role of physiotherapy in the eras protocol in lung cancer

Preoperative Management

Physiotherapy is an essential part of the ERAS proto-

TABLE 1. Key publications on perioperative rehabilitation and ERAS in lung cancer surgery.

Publication	Design and population	Intervention and comparator	Main findings or recommendations	Relationship to ERAS and interpretation
Batchelor et al., 2019	ERAS Society/ESTS clinical practice guidelines for lung surgery; not an individual clinical trial.	Multimodal perioperative care, including prehabilitation for high-risk patients, analgesia, chest-drain management and early mobilization.	Recommendations support coordinated interventions to facilitate recovery; they do not represent outcomes from a single physiotherapy programme.	Directly addresses ERAS. Physiotherapy is one component of the overall pathway.
Ferreira et al., 2021	Randomised controlled trial: 124 patients randomised; final cohort of 95 patients undergoing lung cancer surgery.	Multimodal prehabilitation initiated four weeks before surgery versus multimodal postoperative rehabilitation.	Prehabilitation was as effective as postoperative rehabilitation in restoring functional capacity.	Both groups received care within an enhanced recovery pathway. The trial did not compare ERAS with conventional care or physiotherapy with no physiotherapy.
Goldsmith et al., 2021	Prospective observational study involving 216 patients with lung cancer.	Pulmonary prehabilitation, with assessments before and after the intervention and postoperative comparisons between risk subgroups.	Improvements were observed in dyspnoea, performance status and frailty. In the high-risk subgroup defined by dyspnoea and performance status, 52.6% became eligible for surgery and 42.8% subsequently underwent surgery.	Addresses preoperative optimization. The observational design does not establish an independent causal effect on mortality.
Li et al., 2021	Systematic review and meta-analysis of 21 studies involving 6,480 patients.	Multimodal ERAS programmes versus conventional perioperative care in lung cancer surgery.	Lower postoperative complication risk and shorter hospital stay; no significant reduction in in-hospital mortality or readmission rates.	Findings concern the complete ERAS pathway and do not isolate the contribution of physiotherapy.

The table presents selected publications directly relevant to perioperative rehabilitation and ERAS. Guidelines, randomised trials, observational studies and meta-analyses provide different types of evidence and should not be regarded as equivalent. Publications used for general background or broader cancer rehabilitation are not included.

Abbreviations: ERAS, Enhanced Recovery After Surgery; ESTS, European Society of Thoracic Surgeons.

col, as it aims to enhance patient recovery. Preoperative physiotherapy aims to improve functional capacity and prepare the patient for surgery. Findings regarding multimodal prehabilitation do not allow for the isolation of physiotherapy's contribution, nor do they substantiate an independent reduction in postoperative mortality [4].

The prospective observational study by Goldsmith and colleagues examined 216 patients with lung cancer participating in a pulmonary prehabilitation program. Following the intervention, improvements were observed in dyspnoea, functional status, frailty, and activity levels [6]. In the high-risk patient subgroup—defined based on dyspnoea and functional status—52.6% were deemed suitable for surgery following prehabilitation, and 42.8% ultimately underwent surgery. These figures pertain to the specific subgroup rather than the total cohort of 216 participants. The study design does not allow the change in surgical suitability to be causally attributed solely to the intervention [6].

Prehabilitation may be of particular importance for patients with limited cardiopulmonary reserve, chronic obstructive pulmonary disease, frailty, or low exercise tolerance. The need for and content of the intervention should be determined by the preoperative assessment rather than being considered identical for all patients. ERAS/ESTS guidelines recommend considering prehabilitation for patients with borderline pulmonary function or exercise capacity [1].

The randomised study by Ferreira et al. compared multimodal prehabilitation—initiated four weeks prior to surgery—with multimodal postoperative rehabilitation within an enhanced recovery pathway. Prehabilitation was equally effective regarding the recovery of functional capacity. The study did not compare physiotherapy against the absence of physiotherapy, nor did it isolate its effect from the other components of the multimodal intervention [4].

Preoperative physiotherapy aims to prepare the patient for the demands of the surgery, although its independent effect on postoperative mortality has not been established.

Surgical procedures, whether major or minimally invasive, may lead to postoperative complications. Lobectomy refers to the removal of a lung lobe and can be performed via open thoracotomy or a minimally invasive approach, such as video-assisted thoracoscopic surgery or robotic surgery. Therefore, the term "minimally invasive" refers to the surgical approach rather than the lobectomy "itself" [1].

Postoperative Management

Postoperative complications are common following thoracic surgery, and the implementation of preoperative physiotherapy has demonstrated promising outcomes in reducing their incidence. Structured postoperative physiotherapy can support functional recovery and the return to daily activities through personalised intervention programs tailored to patients' clinical conditions and needs. Patients' abilities and endurance need to be assessed to include them in a program that will benefit them and that they will want to participate in.

In postoperative physiotherapy, mobilisation in the first 24 hours after surgery is essential, as is strengthening and reintegration into everyday life. Prolonged immobilisation results in muscle weakness, reduced muscle mass, respiratory difficulties and complications, such as atelectasis and pneumonia, as well as an increased risk of venous thromboembolic events [1]. Early mobilisation is a key principle of postoperative care within ERAS protocols. However, the reduction in complications and length of hospital stay associated with ERAS programs cannot be attributed solely to early mobilisation, nor has an independent reduction in mortality resulting from this intervention been demonstrated [1,2].

Early mobilisation requires adequate pain control and coordinated management of drains and catheters. The ERAS/ESTS guidelines recommend multimodal analgesia with opioid-sparing strategies and the use of regional analgesia, timely removal of chest drains based on clinical criteria, and the avoidance of unnecessary urinary catheters. These interventions facilitate patient participation in physiotherapy and highlight the need for collaboration among physiotherapists, surgeons, anaesthesiologists, and nurses [1].

Postoperative Respiratory Physiotherapy

In postoperative respiratory rehabilitation, breathing exercises such as diaphragmatic breathing and pursed-lip breathing are generally recommended, as well as the use of inspiratory muscle training (IMT) aimed at improving their strength [7]. The narrative review by Toohey et al. reports that shorter programs with higher session frequency showed higher attendance compared to longer programs with lower frequency. This observation does not establish general superiority regarding effectiveness and requires further investigation [7].

Subsequent Functional Rehabilitation

The exercise program includes aerobics, resistance and breathing exercises and the dosage depends on the stage and endurance of each patient. The review by Toohey et al. [7] describes various exercise intensities and frequencies for patients with lung cancer. These dosages do not constitute a uniform recommendation for the immediate postoperative period. Early mobilisation must be distinguished from subsequent aerobic and strengthening exercise programs, depending on the patient's clinical status and tolerance [7].

DISCUSSION

Physiotherapy is a component of ERAS protocols and can support functional recovery, although its contribution cannot always be isolated from the other interventions. Respiratory interventions should not be treated as a single category with equivalent efficacy. Specifically, regarding incentive spirometry, ERAS/ESTS guidelines state that no additional benefit has been demonstrated in terms of pulmonary function recovery or the reduction of postoperative pulmonary complications. Consequently, the use of respiratory devices requires evidence supporting the specific intervention and the target population [1].

Moreover, physiotherapy improves physical condition through aerobic exercise training, resulting in enhanced cardiorespiratory endurance and an increase in maximal oxygen uptake (VO_2max), as well as through resistance training, which promotes gains in muscle strength. The meta-analysis by Li et al. included 21 studies involving 6,480 patients and compared comprehensive ERAS programs with conventional perioperative care. A lower risk of postoperative complications and a shorter length of hospital stay were observed, without a significant reduction in in-hospital mortality or readmissions. The relative risk of postoperative complications was 0.64, with a 95% confidence interval of 0.52–0.78. These findings do not isolate the effect of physiotherapy from the other components of ERAS [2].

Limitations

This narrative review does not constitute an exhaustive mapping of the literature. The limited coverage of databases and platforms, the restricted combination of

search terms, and the selection of English-language publications may have led to the omission of relevant sources. Furthermore, the exclusion of articles lacking free access to the full text introduces potential availability bias.

Selection was performed by a single researcher without independent verification, and a complete record of exclusions was not maintained. No standardised assessment of methodological quality or risk of bias was conducted. The heterogeneity of populations, interventions, and study designs, along with potential data overlap between primary studies and reviews, limits the interpretation of the findings. Finally, the contribution of physiotherapy cannot always be disentangled from the other components of ERAS.

CONCLUSIONS

Available literature suggests that perioperative physiotherapy can support the functional recovery of patients undergoing lung cancer surgery. Preoperative preparation, respiratory care, and early mobilisation require individualisation and coordination with the multidisciplinary team. However, the benefits of comprehensive ERAS programs cannot be attributed solely to physiotherapy, nor has its independent effect on postoperative mortality been established.

It should also be noted that the implementation of the protocol must be based on the needs of each patient, and the human-centered approach must be appreciated. It is important to provide support, boost self-confidence, maintain honesty and deliver timely information. Furthermore, health professionals need to listen to their patients and recognise their needs including communication needs [8].

Further studies are needed to clarify the independent contribution of physiotherapy interventions within ERAS, their optimal dosage, and the patient characteristics associated with the greatest benefit. Evaluating their implementation across different healthcare systems—including the Greek system—can facilitate the tailoring of perioperative care to local needs and available resources.

Data Availability Statement: *No new data were created or analysed in this study. Data sharing does not apply to this article, as this study is based on previously published literature.*

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