ORIGINAL RESEARCH

Effectiveness of Enhanced Recovery After Surgery-Based Respiratory Function Exercise in Elderly Patients with Lung Cancer and its Effect on Postoperative Functional Recovery

Jinxia Du, MMed; Chuntao Wu, MMed; Aijuan Li, MMed; Jiajia Chen, MMed; Qiongying Li, MMed; Xuyi Wu, MD

ABSTRACT

Objective • To investigate the effect of enhanced recovery after surgery-based respiratory function exercise in elderly lung cancer patients and its impact on postoperative functional recovery.

Methods • A total of 109 elderly lung cancer patients admitted to our hospital between January 2020 and January 2021 were included in the study. The patients were randomly assigned to either the control group (n = 52), receiving conventional care, or the research group (n = 57), receiving enhanced recovery after surgery-based respiratory function exercise in addition to conventional care. Respiratory function, functional capacity, quality of life, and incidence of pulmonary complications were compared between the two groups before and after the intervention.

Results • Following the intervention, the research group showed significant improvements in Forced Expiratory Volume in the first second, Forced Vital Capacity, and Forced Expiratory Volume in the first second/Forced Vital Capacity compared to the control group ($P < .05$). The research group also exhibited higher Barthel indices (indicating better functional capacity) and lower St George's Respiratory Questionnaire scores (indicating better quality of life) compared to the control group ($P < .05$). The incidence of pulmonary complications was significantly lower in the research group (5.26%) compared to the control group (21.15%) ($P < .05$).

Conclusions • Enhanced recovery after surgery-based respiratory function exercise can improve respiratory function, promote postoperative functional recovery, enhance the quality of life, and reduce pulmonary complications in elderly lung cancer patients. These findings support its clinical application and wider adoption. (*Altern Ther Health Med.* 2023;29(6):56-61).

Jinxia Du, MMed; Aijuan Li, MMed; Jiajia Chen, MMed; Qiongying Li, MMed; Xuyi Wu, MD; Department of Rehabilitation Medicine Center, West China Hospital, Sichuan University/West China School of Nursing Sichuan University, Wuhou District, Chengdu, Sichuan, China. **Chuntao Wu, MMed;** Department of Surgery and Oncology Surgery, Chengdu Public Health Clinical Center, Chengdu, Sichuan, China.

Corresponding author: Xuyi Wu, MD
E-mail: m17780607096@163.com

INTRODUCTION

Lung cancer is one of the most prevalent malignancies worldwide, with a significant burden of morbidity and mortality, particularly in China.[1] Surgery remains the primary treatment modality for lung cancer, effectively eliminating cancerous lesions. However, it often leads to compromised lung function, resulting in postoperative symptoms such as dyspnea, coughing, and chest tightness. Impaired respiratory function negatively impacts patients' quality of life.[2,3] Existing literature suggests that consistent engagement in respiratory function exercises can enhance lung function, exercise endurance, reduce complications, and improve the quality of life in postsurgical lung cancer patients.[4]

In recent years, the concept of Enhanced Recovery After Surgery (ERAS) has emerged as a comprehensive approach that encompasses evidence-based interventions during the perioperative period. The primary goals of ERAS are to reduce surgical stress, shorten hospital stays, minimize complications, and facilitate patient recovery.[5] The effectiveness and safety of ERAS-based care have been extensively studied and proven in various surgical fields, including gastrointestinal surgery and breast cancer surgery.[6-8] However, there is a lack of randomized controlled trials specifically investigating the effectiveness of respiratory function exercises as part of ERAS in the perioperative period for elderly lung cancer patients. This gap in the literature highlights the need for further research on this topic, particularly considering the unique challenges faced by elderly lung cancer patients during the perioperative period.

Therefore, we investigated the impact of incorporating ERAS-based respiratory function exercises in enhancing the outcomes of elderly lung cancer patients.

MATERIALS AND METHODS

Study Design

A total of 109 elderly lung cancer patients who were admitted to our hospital between January 2020 and January 2021 were selected to participate in this study. The patients were divided into two groups using the random number table method: the control group (n = 52), which received conventional care, and the research group (n = 57), which received enhanced recovery after surgery (ERAS)-based respiratory function exercise in addition to conventional care. All patients or their families provided informed consent before participating in the study. The research protocol was approved by the Institutional Review Board of West China Hospital, Sichuan University (IRB number: 2022-705).

Inclusion and Exclusion Criteria

Inclusion criteria: (1) Pathologically confirmed primary lung cancer; (2) Age ≥ 60 years; (3) Carlsbad score ≥ 60; (4) TNM stage: Stage I-II; (5) Indications for surgery,[9] specifically thoracoscopic lobectomy; (6) No prior receipt of preoperative radiation therapy or chemotherapy.

Exclusion criteria: (1) Patients with coexisting hepatic or renal dysfunction; (2) Patients who underwent intraoperative procedure changes or required secondary surgery; (3) Patients with a propensity for active postoperative bleeding; (4) Patients with cranial metastases, extensive bone metastases, weight-bearing bone metastases with restricted motion, or severe liver or renal metastases; (5) Patients with severe cognitive dysfunction impeding cooperation with nursing interventions and assessments; (6) Patients with concomitant immune suppression; (7) Patients with preoperative complications such as pulmonary infection and respiratory failure; (8) Patients who experience respiratory depression due to other diseases; (9) Patients with severe cardiovascular complications, including those resulting from factors such as hemorrhagic shock after surgery; (10) Patients with other malignancies.

Treatment Protocol

Control group: The patients in the control group received routine care, primarily including perioperative observation, psychological support, pain management, dietary adjustments, and standard postoperative respiratory function exercises.

Research Group: Besides the routine care provided to the control group, the research group received enhanced recovery after surgery (ERAS)-based respiratory function exercises. Patients in both groups were treated with thoracoscopic lobectomy.

The implementation of the ERAS respiratory function exercise group was as follows:

Formation of the ERAS Respiratory Function

Exercise Group. A nurse leader was appointed as the group leader, while seven nurses served as group members, collectively forming the ERAS respiratory function exercise group. The group leader organized the group members to study the development history, current status, and theoretical foundation of ERAS. They reviewed relevant literature to gain insights into the current application of ERAS in various departments. Based on this knowledge, a targeted ERAS-based respiratory function exercise strategy was formulated, aligning with the nursing practices specific to lung cancer patients in the department. Furthermore, a reward and punishment system was established to ensure the effective implementation of nursing responsibilities.

Pre-operative Health Education. To ensure effective pre-operative health education, the following measures were implemented: (1) Development of peri-operative education manual: A comprehensive peri-operative education manual was developed, which included information on the causes of lung cancer, surgical methods, expected surgical outcomes, and post-operative precautions. The manual was designed using clear and easily understandable language to facilitate patient comprehension; (2) production of educational videos: short videos were created to provide scientific explanations and visual demonstrations. These videos utilized various forms of health education to enhance patient understanding. The focus was on highlighting the advantages of the ERAS model of care. Patients were informed about the significance of peri-operative respiratory function exercises and the purpose, measures, and expected outcomes of ERAS-based respiratory function exercises; (3) emphasis on eras model: patients were educated about the superiority of the ERAS model of care, emphasizing the importance of peri-operative respiratory function exercises. Detailed explanations were provided to reduce patients' sense of unfamiliarity and improve their cooperation and compliance with the prescribed care.

Pre-operative Respiratory Function Exercise

Pre-operative respiratory function exercise was conducted using the following techniques:

Lung Function Expander Trainer. The patient was provided with a lung function expander trainer (manufactured by Guangzhou Red Elephant Medical Technology Co.). This device enabled the patient to assess their own lung function using the lung function index scale on the trainer. The purpose of the training was explained to the patient to enhance their training comprehension and strengthen their motivation. During the training, the patient was instructed to sit or lie in a semi-recumbent position, hold the lung function expander tube with their lips, and inhale maximally. Additionally, the patient was guided to assume a semi-recumbent or recumbent position, lean forward, relax their shoulders, and perform forceful coughing with maximum chest and abdominal effort to clear secretions. The intensity of the training was adjusted according to the patient's tolerance, and it was recommended to perform the exercises three times a day (morning, afternoon, and evening).

Abdominal Breathing Training. The patient was instructed to maintain a natural posture, relax their body muscles, and engage in abdominal breathing training. It involved slow and deep inhalation through the nasal cavity to reach maximum lung capacity, followed by a breath-hold of 2-5 seconds. Exhalation was performed through the mouth while the abdomen rose. The training sessions lasted 15-20 minutes, and the frequency was determined based on the patient's physical condition and post-operative recovery.

Lip Contraction Breathing Training. The patient was instructed to relax their body muscles and perform lip contraction breathing exercises. It involved inhaling forcefully through the nasal cavity and exhaling slowly through the mouth while puckering the lips, actively contracting the abdomen during exhalation. The inhalation-to-exhalation time ratio was set at 1:2 or 1:3, with a breathing rate of 7-8 breaths per minute. The number of training sessions was adjusted based on the patient's tolerance. The patient was advised to minimize thorax and shoulder movements throughout the exercises. If necessary, they could place their hands on top of the abdomen at the end of exhalation to apply gentle pressure and aid in emptying the residual air volume. The training commenced one week before surgery, was halted on the day of surgery, and resumed one day after surgery.

Postoperative Respiratory Exercise

The post-operative respiratory exercise protocol included the following components: (1) mechanical sputum expeller: starting from the first day after surgery, a mechanical sputum expeller was utilized to assist in sputum removal. The patient underwent a 10-minute session twice a day. This intervention aimed to facilitate effective sputum clearance and respiratory hygiene; (2) continuation of pre-operative respiratory exercise: the pre-operative respiratory exercise regimen was continued post-operatively. The patient was instructed to maintain the same techniques and exercises described previously; (3) simultaneous respiratory gymnastics: the patient was guided to perform simultaneous respiratory gymnastics. This involved raising both upper limbs to a 150° angle, clasping the hands behind the head, followed by inhalation and slow, forceful opening of the elbows behind the body. The position was held for 3 seconds, and then the hands lowered while exhaling. This exercise aimed to promote thoracic mobility and enhance respiratory muscle strength; (4) aerobic exercise training: aerobic exercise training was incorporated into the postoperative regimen. Activities such as walking, stair climbing, tai chi, and jogging within the ward were selected based on the patient's physical condition and preference. The intensity of exercise was gradually increased according to the patient's tolerance, with sessions lasting 10 minutes and performed three times per day. This aerobic exercise aimed to improve cardiovascular endurance and overall physical fitness.

These post-operative respiratory exercises were implemented to promote lung expansion, enhance sputum clearance, improve respiratory muscle strength, and facilitate early mobilization and recovery.

Observation Indicators

The following observation indicators were employed in the study.

Respiratory Function Indicators. Forced expiratory volume in the first second (FEV1), forced vital capacity (FVC), and the FEV1/FVC ratio was measured before and after the intervention using a MasterScreen-Body/Diff spirometer from Gummi-Jaeger Group, Germany. These indicators provided objective measures of lung function and were utilized to assess the impact of the intervention on respiratory function.

Activities of Daily Living Score. The Barthel Index of Independence[10] was employed to evaluate patients' activities of daily living before and after the intervention. This assessment includes various tasks such as eating (0, 5, 10), bathing (0, 5), grooming (0, 5), dressing (0, 5, 10), bowel control (0, 5, 10), urine control (0, 5, 10), toileting (0, 5, 10), bed and chair transfer (0, 5, 10, 15), level walking (0, 5, 10, 15) and walking up and down stairs (0, 5, 10). Each task is assigned a specific score, with higher scores indicating a higher level of independence in performing daily activities.

Quality of Life Score. The St George's Respiratory Questionnaire (SGRQ)[11] was used to measure the patient's quality of life before and after the intervention. The questionnaire assesses three dimensions: symptoms, limitation of activities, and the impact of illness on quality of life. It consists of a total of 50 items, with scores ranging from 0 to 100. Lower scores on the SGRQ indicate better quality of life.

Incidence of Pulmonary Complications. The study observed the incidence of three pulmonary complications: intrapulmonary infection, dyspnea, and atelectasis. The occurrence of these complications was recorded, and the overall incidence was calculated. This assessment aimed to determine the impact of the intervention on reducing the occurrence of postoperative pulmonary complications.

Statistical Analysis

Statistical analysis was performed using SPSS 21.0 software (IBM, Armonk, NY, USA), and data visualization was conducted using GraphPad Prism 9.0 software. Complication rates were presented as [n(%)] and compared using the chi-square test. Respiratory function indicators were expressed as mean ± standard deviation ($\bar{x} \pm s$) and compared using the *t* test, ANOVA, and LSD test. Statistical significance was set at $P < .05$ to determine the presence of significant differences between groups.

RESULTS

Comparison of Patient Characteristics

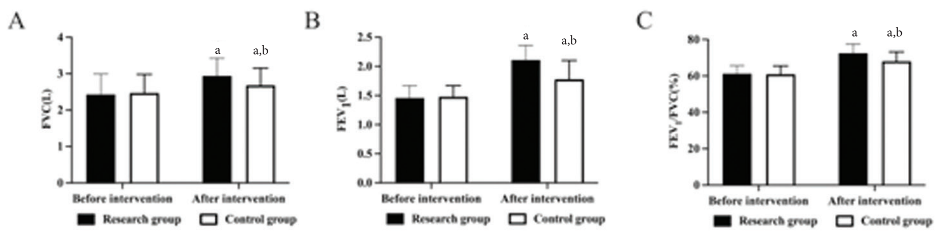
There were no statistically significant differences in age and gender between the two groups of patients ($P > .05$, Table 1), indicating comparability.

Table 1. Clinical Information of The Two Groups of Patients

Group	M/F*	Age	Surgical Approach			Type Of Pathology			
			Lung Lobectomy	Pulmonary Segment Resection	Wedge Resection	Squamous Carcinoma	Adenocarcinoma	Adenosquamous Carcinoma	Others
Research Group (n = 57)	37 (64.91)/20 (35.09)	68.74 ± 3.11	24	18	15	13 (22.81)	29 (50.88)	10 (17.54)	5 (8.77)
Control Group (n = 52)	34 (65.38)/18 (34.62)	68.81 ± 3.14	21	12	9	12 (23.08)	25 (40.08)	11 (21.15)	4 (7.69)
χ^2 (or *t*)	0.003	0.117	0.033	0.985	1.285	0.001	0.085	0.228	0.042
P value	.959	.907	.855	.321	.257	.973	.770	.633	.838

Abbreviations: M, Male; F, Female; M/F, Male to Female ratio.

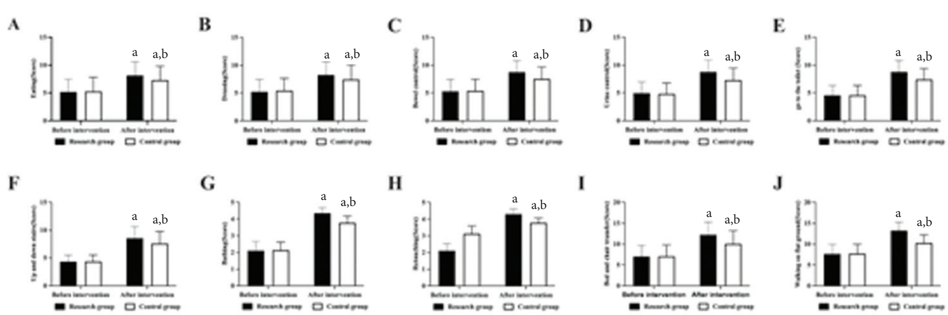
Figure 1. Changes in respiratory function indicators in both groups; **A.** Change in FVC; **B.** Change in FEV_1; **C.** Change in FEV_1 /FVC



[a]*P* < .05 compared to the same group before intervention
[b]*P* < .05 compared to the control group.

Abbreviations: FVC, Forced Vital Capacity; FEV_1, forced expiratory volume in the first second.

Figure 2. Change in ability to live scores in both groups **A.** change in eating; **B.** change in dressing; **C.** change in control of bowel movements; **D.** change in control of urination; **E.** change in toileting; **F.** change in going up and down stairs; **G.** change in bathing; **H.** change in grooming; **I**. change in bed and chair transfer; **J.** change in walking on level ground.



[a]*P* < .05 compared to the same group before intervention
[b]*P* < .05 compared to the control group.

Respiratory Function Analysis

Before the intervention, there were no significant differences in FEV1, FVC, and FEV1/FVC between the two groups (*P* > .05). However, following the intervention, both groups showed improvements in respiratory function indicators. Specifically, the observation group demonstrated significantly higher FEV1, FVC, and FEV1/FVC values than the control group (*P* < .05, Figure 1. A-C).

Quality of Life Score

Before the intervention, there was no significant difference in various St George's Respiratory Questionnaire (SGRQ) scores between the two groups (*P* > .05). However, following the intervention, the quality-of-life scores decreased in both groups. Notably, the observation group had lower scores compared to the control group (*P* < .05, Figure 3A-C).

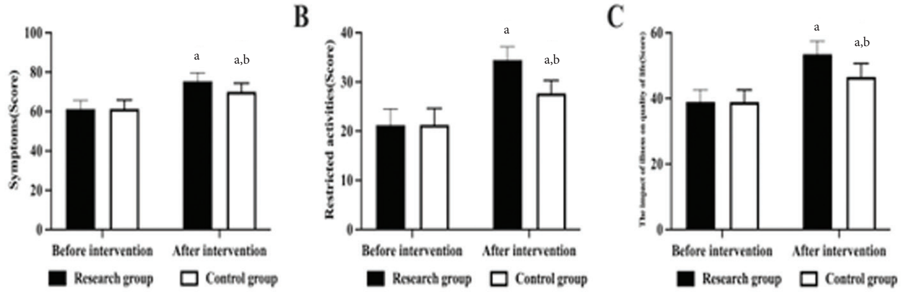
Incidence of Complications

The research group exhibited a lower incidence of complications compared to the control group (*P* < .05, Table 2).

DISCUSSION

With the progressive acceleration of population aging, the rise in work-life stress, lifestyle changes, and the gradual deterioration of the natural air environment, a confluence of factors has resulted in cancer, particularly lung cancer,

Figure 3. Changes in quality of life in the two groups. **A.** Changes in symptoms; **B.** Changes in activity limitations; **C.** Changes in the impact of the disease on quality of life.



[a]$P < .05$ compared to the same group before intervention
[b]$P < .05$ compared to the control group.

Table 2. Incidence of Complications in Both Groups

Group	Breathing Difficulties	Intrapulmonary Infections	Pulmonary Atelectasis	Total
Research Group (n = 57)	3 (5.26)	0 (0.00)	0 (0.00)	3 (5.26)
Control Group (n = 52)	5 (9.62)	3 (5.77)	3 (5.77)	11 (21.15)
χ^2 (or *t*)	-	-	-	6.134
P value	-	-	-	.013

emerging as a significant public health issue that poses a substantial threat to public well-being.[12,13] Although surgery is the primary approach for treating lung cancer, lung resection can significantly diminish lung capacity and maximum ventilation, leading to reduced oxygen utilization and impaired clearance of pulmonary secretions. Consequently, this can result in respiratory dysfunction, affecting the individual's ability to carry out daily activities and overall quality of life.[14,15]

Older patients diagnosed with lung cancer often experience diminished physical function, slower post-operative recovery, and a higher prevalence of respiratory dysfunction compared to younger patients.[15-16] Danish academic Kehlet initially introduced ERAS, and it has been gradually implemented in China through the efforts of academician Li Jieshou and Professor Jiang Zhiwei. At its core, ERAS involves implementing a set of evidence-based care interventions during the perioperative period to promote faster recovery, reduce hospitalization duration, and minimize complications.[16]

The findings of our study demonstrate that implementing ERAS-based respiratory exercises contributes to the recovery of respiratory function in elderly patients undergoing lung cancer surgery. It is evident from the improved FEV1, FVC, and FEV1/FVC ratios, as well as the lower incidence of complications observed in the research group. Following the principles of ERAS, pre-operative health education was provided to enhance patients' understanding of respiratory exercises and improve their adherence to the program. By incorporating abdominal breathing and lip contraction breathing training, patients were able to modify their breathing patterns and effectively address postoperative respiratory deficiencies. Additionally, instructions on proper coughing and sputum clearance techniques were provided, aiding in the prompt removal of sputum following surgery and reducing the risk of postoperative pulmonary infections and atelectasis.[17]

After the surgical procedure, the preoperative respiratory exercises were supplemented with respiratory gymnastics and aerobic exercise training to enhance respiratory function further. The comprehensive approach to respiratory function exercises demonstrates foresight, and the diverse range of exercise methods yields excellent results while improving patient compliance. These findings underscore the significant contribution of ERAS in promoting respiratory function exercises.

Meanwhile, our study's results further demonstrate that the research group exhibited higher scores in all Barthel Index categories compared to the control group after the intervention. These findings confirm the significant role of ERAS-based respiratory function exercises in promoting the post-operative functional recovery of elderly lung cancer patients. The ability to perform activities of daily living encompasses a range of fundamental tasks necessary for individuals to manage their clothing, nutrition, accommodation, transportation, personal hygiene, and independent community engagement in their daily lives.

On the other hand, under the guidance of ERAS, consistent and high-quality respiratory exercises throughout the perioperative period enhance lung ventilation and air exchange, thereby reducing symptoms such as dyspnea. On the other hand, effective respiratory exercises decrease the occurrence of complications like lung infection and atelectasis, eliminating disease-related factors that hinder postoperative functional capacity. This dual approach promotes the improvement and restoration of the patient's functional abilities.

Lung cancer, being an incurable disease, presents significant limitations when evaluating the effectiveness of care solely based on objective indicators such as FVC. Consequently, assessing cancer patients' quality of life has emerged as an important research area within the medical field. Enhancing the quality of life is ultimately a key objective in the treatment of lung cancer patients, particularly the elderly.[18,19]

Our study revealed that, following the intervention, the research group exhibited lower SGRQ scores compared to the control group. It suggests that ERAS-based respiratory function exercises can contribute to improving the quality of life in elderly lung cancer patients after surgery. Under the guidance of ERAS, respiratory function exercises during the perioperative period facilitate enhanced diaphragmatic movements, improved thoracic compliance, increased ventilatory efficiency, and alleviation of clinical symptoms. Moreover, these exercises allow patients to experience physical and mental relaxation, temporarily diverting their attention from the pain associated with the disease and optimizing their psychological well-being.[20]

Study Limitations

Although this study yielded various positive results confirming the significant impact of ERAS-based respiratory function exercises in elderly lung cancer patients undergoing surgery, several limitations should be addressed to enhance the study's robustness. Firstly, the inclusion of a small number of cases may have led to insufficient statistical power, limiting the generalizability of the findings. Additionally, a notable limitation is the lack of patient follow-up to assess long-term survival.

Future Perspectives

To overcome these limitations, future research endeavors will focus on increasing the sample size and implementing rigorous follow-up protocols to investigate patient survival outcomes. By doing so, we aim to validate further the effectiveness of ERAS-based respiratory exercises in elderly lung cancer patients undergoing surgery, thereby offering more reliable insights into clinical care for lung cancer.

Furthermore, as ERAS-related care in China is still in its early stages, efforts will be directed towards advancing research based on ERAS principles and working towards establishing a standardized ERAS procedure in the country. It will facilitate the systematic and consistent application of ERAS practices, ultimately improving the quality of care for lung cancer patients.

CONCLUSION

In conclusion, the implementation of ERAS-based respiratory function exercises demonstrates significant benefits in improving respiratory function, postoperative living ability, quality of life, and reducing pulmonary complications in elderly lung cancer patients. These findings highlight the clinical applicability and promotion of ERAS-based respiratory function exercises. Furthermore, considering the early stage of ERAS-related care in China, the results of this study will contribute to the establishment and standardization of ERAS-related care practices in the country. These results strongly advocate for the prioritized and widespread adoption of ERAS measures in clinical practice throughout China.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

AUTHORS' CONTRIBUTIONS

All authors contributed equally; they read and approved the final manuscript.

FUNDING

This study did not receive any funding in any form.

REFERENCES

1. Chen WQ, Zhang SW, Zou XN. Estimation and epidemiological trends of lung cancer mortality in China. *Zhongguo Fei Ai Za Zhi*. 2010;13(05):488-493.
2. Aubin M, Vézina L, Verreault R, et al. Effectiveness of an intervention to improve supportive care for family caregivers of patients with lung cancer: study protocol for a randomized controlled trial. *Trials*. 2017;18(1):304. doi:10.1186/s13063-017-2044-y
3. Naito T, Mitsunaga S, Miura S, et al. Feasibility of early multimodal interventions for elderly patients with advanced pancreatic and non-small-cell lung cancer. *J Cachexia Sarcopenia Muscle*. 2019;10(1):73-83. doi:10.1002/jcsm.12351
4. Messaggi-Sartor M, Marco E, Martínez-Téllez E, et al. Combined aerobic exercise and high-intensity respiratory muscle training in patients surgically treated for non-small cell lung cancer: a pilot randomized clinical trial. *Eur J Phys Rehabil Med*. 2019;55(1):113-122. doi:10.23736/S1973-9087.18.05156-0
5. Sánchez-Iglesias JL, Gómez-Hidalgo NR, Pérez-Benavente A, et al. Importance of Enhanced Recovery After Surgery (ERAS) Protocol Compliance for Length of Stay in Ovarian Cancer Surgery. *Ann Surg Oncol*. 2021;28(13):8979-8986. doi:10.1245/s10434-021-10228-2
6. Swaminathan N, Kundra P, Ravi R, Kate V. ERAS protocol with respiratory prehabilitation versus conventional perioperative protocol in elective gastrectomy- a randomized controlled trial. *Int J Surg*. 2020;81:149-157. doi:10.1016/j.ijsu.2020.07.027
7. Saurabh K, Sureshkumar S, Mohsina S, Mahalakshmy T, Kundra P, Kate V. Adapted ERAS Pathway Versus Standard Care in Patients Undergoing Emergency Small Bowel Surgery: a Randomized Controlled Trial. *J Gastrointest Surg*. 2020;24(9):2077-2087. doi:10.1007/s11605-020-04684-6
8. Tong QY, Liu R, Gao Y, Zhang K, Ma W, Shen WD. Effect of Electroacupuncture Based on ERAS for Preoperative Anxiety in Breast Cancer Surgery: A Single-Center, Randomized, Controlled Trial. *Clin Breast Cancer*. 2022;22(7):724-736. doi:10.1016/j.clbc.2022.04.010
9. Zhou Q, Fan Y, Wang Y, et al. [China National Guideline of Classification, Diagnosis and Treatment for Lung Nodules (2016 Version)]. *Zhongguo Fei Ai Za Zhi*. 2016;19(12):793-798.
10. Martínez-Velilla N, Casas-Herrero A, Zambom-Ferraresi F, et al. Effect of Exercise Intervention on Functional Decline in Very Elderly Patients During Acute Hospitalization: A Randomized Clinical Trial. *JAMA Intern Med*. 2019;179(1):28-36. doi:10.1001/jamainternmed.2018.4869
11. El Rhazi K, Nejjari C, Benjelloun MC, et al. Validation of the St. George's Respiratory Questionnaire in patients with COPD or asthma in Morocco. *Int J Tuberc Lung Dis*. 2006;10(11):1273-1278.
12. Schabath MB, Cote ML. Cancer Progress and Priorities: lung Cancer. *Cancer Epidemiol Biomarkers Prev*. 2019;28(10):1563-1579. doi:10.1158/1055-9965.EPI-19-0221
13. Bade BC, Dela Cruz CS. Lung Cancer 2020: Epidemiology, Etiology, and Prevention. *Clin Chest Med*. 2020;41(1):1-24. doi:10.1016/j.ccm.2019.10.001
14. Jones GS, Baldwin DR. Recent advances in the management of lung cancer. *Clin Med (Lond)*. 2018;18(2)(suppl 2):s41-s46. doi:10.7861/clinmedicine.18-2-s41
15. Wu F, Wang L, Zhou C. Lung cancer in China: current and prospect. *Curr Opin Oncol*. 2021;33(1):40-46. doi:10.1097/CCO.0000000000000703
16. Decoster L, Schallier D. Treatment of older patients with advanced non-small cell lung cancer: A challenge. *J Geriatr Oncol*. 2019;10(4):528-533. doi:10.1016/j.jgo.2018.09.008
17. Morrison EJ, Novotny PJ, Sloan JA, et al. Emotional Problems, Quality of Life, and Symptom Burden in Patients With Lung Cancer. *Clin Lung Cancer*. 2017;18(5):497-503. doi:10.1016/j.cllc.2017.02.008
18. Steffens D, Beckenkamp PR, Hancock M, Solomon M, Young J. Preoperative exercise halves the postoperative complication rate in patients with lung cancer: a systematic review of the effect of exercise on complications, length of stay and quality of life in patients with cancer. *Br J Sports Med*. 2018;52(5):344. doi:10.1136/bjsports-2017-098032
19. Cochrane A, Woods S, Dunne S, Gallagher P. Unmet supportive care needs associated with quality of life for people with lung cancer: A systematic review of the evidence 2007-2020. *Eur J Cancer Care (Engl)*. 2022;31(1):e13525. doi:10.1111/ecc.13525
20. Boswell-Ruys CL, Lewis CRH, Wijeysuriya NS, et al. Impact of respiratory muscle training on respiratory muscle strength, respiratory function and quality of life in individuals with tetraplegia: a randomised clinical trial. *Thorax*. 2020;75(3):279-288. doi:10.1136/thoraxjnl-2019-213917