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Analysis of the Application Effect of Preoperative Prehabilitation Based on the ERAS Concept in the Rapid Postoperative Recovery of Elderly Patients with Lung Cancer

Xiaoping Huang, Qiaoming Gao
Taizhou Hospital of Traditional Chinese Medicine, Taizhou 225300, Jiangsu, China

Abstract: *Objective:* To explore the application effect of preoperative prehabilitation based on the ERAS concept in the rapid postoperative recovery of elderly patients with lung cancer. *Methods:* The elderly lung cancer patients who received surgical treatment in our hospital from 2023.7 to 2024.7 were included. The total sample size included was 64 cases. They were divided into groups using the ball-touching method and carried out different clinical nursing methods. There were 32 cases in both the control group and the observation group. The corresponding nursing plan was routine care and preoperative prehabilitation based on the ERAS concept. *Results:* There was no significant difference in pulmonary function indicators between the groups at admission. The preoperative pulmonary function indicators of the observation group were higher than those of the control group, $P < 0.05$. The pulmonary function indicators of the patients decreased 7 days after surgery, but the FEV1, FVC, and PEF levels of the observation group were higher than those of the control group, $P < 0.05$. The incidence rate of pulmonary-related complications in the observation group (6.25%) was lower than that in the control group (25.00%), $P < 0.05$. The first time to get out of bed after surgery, recovery of bowel sounds, spontaneous urination time and total hospitalization time in the observation group were shorter than those in the control group, $P < 0.05$. *Conclusion:* Carrying out preoperative pre-rehabilitation based on the ERAS concept in the perioperative care of elderly lung cancer patients is of significant value in improving patients' preoperative pulmonary function and reducing the impact of surgery on postoperative pulmonary function. It can also effectively prevent the occurrence of postoperative pulmonary-related complications and promote the postoperative rehabilitation process.

Keywords: Elderly lung cancer; Perioperative period; ERAS concept; Preoperative prehabilitation; Pulmonary function; Complications

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1. Introduction

Lung cancer is one of the most common malignant tumors in the world. Its morbidity and mortality are particularly prominent among the elderly. With the advancement of medical technology, surgery has become the main method of treating early-stage lung cancer. However, elderly patients often face higher perioperative risks due to declining physiological functions and multiple comorbidities [1]. Postoperative pulmonary complications and delayed functional

recovery not only affect the treatment effect, but may also prolong hospitalization and increase medical burden [2]. The concept of accelerated recovery surgery provides a new idea to improve this situation. Preoperative pre-rehabilitation strengthens patients' physiological reserves through systematic intervention and becomes a key link in optimizing perioperative management [3]. This study focuses on elderly patients with lung cancer and explores the role of preoperative pre-rehabilitation based on the ERAS concept in promoting rapid postoperative recovery. It aims to provide feasible intervention programs for clinical use and fill the gap in research on the correlation between preoperative functional optimization and postoperative recovery in elderly patients.

2. Materials and methods

2.1. General information

The 64 elderly patients with lung cancer were all included between 2023.7 and 2024.7. The samples were divided into two groups (32 cases/group) using the ball-touching method. The group name was the control group [20 males and 12 females; Age threshold: 60–76 years old, mean (67.70±3.57) years old], observation group [19 males and 13 females; age threshold: 60–78 years old, mean (68.25±4.33) years old]. The baseline data of the two groups were balanced, $P > 0.05$.

Inclusion criteria: patients are ≥ 60 years old, diagnosed with primary lung cancer by pathology or imaging [4]; meet the surgical indications; tumor stage is stage I to IIIA; do not have severe cardiopulmonary failure; can cooperate to complete pre-rehabilitation training and postoperative follow-up; patients and their families sign informed consent, voluntarily participate in the study and complete the pre-rehabilitation plan.

Exclusion criteria: presence of distant metastasis; severe cardiovascular and cerebrovascular diseases; hepatic and renal insufficiency; active infection or immune system disease; presence of bone and joint disease or neurological disease that prevents the completion of pre-rehabilitation training; previous history of chest surgery, long-term dependence on hormone therapy, and participation in other clinical trials within 3 months.

2.2. Method

The control group received routine perioperative care, including preoperative health education, guidance on fasting and drinking, postoperative vital sign monitoring, incision care, pain management and basic respiratory function training. Patients were encouraged to move early according to traditional procedures after surgery.

The observation group implemented preoperative pre-rehabilitation based on the ERAS concept.

(1) Preoperative respiratory function training: (a) Respiratory muscle endurance training: Patients were instructed to perform abdominal breathing combined with pursed lip breathing training every day. When inhaling, the abdomen bulged, and when exhaling, the lips were pursed and slowly exhaled. Repeat 10 times as one group, 3 groups per day. (b) Resistance breathing training: Use a breathing trainer and set the appropriate resistance level. The patient remains seated and performs deep and slow inhalation training for 5 seconds each time, twice a day, 10 minutes each time. (c) Aerobic exercise intervention: Based on the cardiopulmonary function assessment results, develop an individualized brisk walking or cycling training program, with the target heart rate maintained at 60–70% of the reserve heart rate, for 20 minutes a day.

(2) Nutrition and metabolic regulation: Supplement whey protein powder daily from 3 days before surgery, with a target protein intake of 1.5 g/kg/d, taken three times with meals, combined with vitamin D and branched-chain amino acids; 400 mL of a 12.5% carbohydrate drink was taken orally 10 hours before surgery, and 200 mL was replenished 2 hours before surgery to maintain intraoperative glycogen reserves; probiotic preparations containing bifidobacteria were taken daily starting 1 week before surgery to regulate the balance of intestinal flora.

(3) Psychological and pain intervention: A psychiatrist will conduct anxiety counseling 1 week before surgery, through mindfulness meditation and progressive muscle relaxation training, once a day for 30 minutes each time; use a visual analog scale to explain postoperative pain expectations in advance, and train patients to use non-drug

analgesic techniques such as acupressure and cold compresses. Gabapentin combined with acetaminophen will be administered orally 24 hours before surgery to reduce the risk of central sensitization.

(4) Early postoperative activities: Start ankle pump exercise on the bed 6 hours after the operation, once every 2 hours; assist with bedside sitting training 12 hours after the operation; complete 5 minutes of standing and walking under supervision 24 hours after the operation. After surgery, the preoperative breathing training program was continued every day, combined with a vibrating expectoration device to assist in airway clearance, twice a day. Start drinking a small amount of water 4 hours after surgery, transition to enteral nutrition preparations 6 hours after surgery, and resume a high-protein diet within 24 hours.

2.3. Observation indicators

(1) The patients' pulmonary function indicators, including forced expiratory volume in 1 s (FEV1), forced vital capacity (FVC) and maximum expiratory flow (PEF), were measured on admission, 1 day before surgery, and 7 days after surgery.

(2) The incidence rates of pulmonary-related complications such as pulmonary infection, respiratory failure, atelectasis, and pulmonary embolism were calculated in the two groups.

(3) The first time out of bed, recovery of bowel sounds, spontaneous urination time and total hospital stay were recorded in both groups.

2.4. Statistical methods

The calculation software used for the relevant data is SPSS 25.0, the pulmonary function indicators and postoperative recovery are measurement data, and the complication rate is count data; the former is described by mean ± standard deviation (SD) and t-value test; the latter is described by frequency and constituent ratio, χ^2 test. $P < 0.05$ is statistically significant.

3. Results

3.1. Compare the pulmonary function indicators of the two groups of patients on admission and 7 days after surgery

There was no significant difference in pulmonary function indicators between the groups at admission. The preoperative pulmonary function indicators of the observation group were higher than those of the control group, $P < 0.05$. The pulmonary function indicators of the patients decreased 7 days after surgery, but the FEV1, FVC, and PEF levels of the observation group were higher than those of the control group, $P < 0.05$. See **Table 1** for details

Table 1. Comparison of lung function indicators between the two groups (mean ± SD)

Group	n	FEV1(L)			FVC(L)			PEF(L/s)		
		On admission	1 day before surgery	7 days after surgery	On admission	1 day before surgery	7 days after surgery	On admission	1 day before surgery	7 days after surgery
Control group	32	2.03 ± 0.45	2.05 ± 0.52	1.55 ± 0.48	2.75 ± 0.60	2.78 ± 0.57	1.78 ± 0.42	4.65 ± 0.80	4.67 ± 0.82	3.85 ± 0.64
Observation group	32	2.05 ± 0.52	2.45 ± 0.50	1.86 ± 0.64	2.78 ± 0.57	3.21 ± 0.69	2.30 ± 0.58	4.67 ± 0.82	5.40 ± 0.94	4.50 ± 0.67
t	--	0.165	3.134	2.121	0.205	2.719	4.108	0.099	3.310	3.968
P	--	0.870	0.003	0.038	0.838	0.009	0.000	0.922	0.002	0.000

3.2. Compare the occurrence of pulmonary-related complications between the two groups

The incidence rate of pulmonary-related complications in the observation group (6.25%) was lower than that in the control group (25.00%), $P < 0.05$. See **Table 2** for details.

Table 2. Comparison of complications between the two groups (*n*, %)

Group	n	Lung infection	Respiratory failure	Atelectasis	Pulmonary embolism	Overall incidence
Control group	32	2 (6.25%)	1 (3.13%)	3 (9.38%)	2 (6.25%)	8 (25.00%)
Observation group	32	1 (3.13%)	0 (0.00%)	1 (3.13%)	0 (0.00%)	2 (6.25%)
t	--	--	--	--	--	4.267
P	--	--	--	--	--	0.039

3.3. Compare the postoperative recovery of the two groups

The first time to get out of bed after surgery, recovery of bowel sounds, spontaneous urination time and total hospitalization time in the observation group were shorter than those in the control group, $P < 0.05$. See **Table 3** for details.

Table 3. Comparison of postoperative recovery conditions (mean ± SD)

Group	n	Getting out of bed for the first time (h)	Return of bowel sounds (h)	Spontaneous urination (h)	Length of stay (d)
Control group	32	38.72 ± 10.35	30.85 ± 8.92	16.63 ± 4.47	10.45 ± 2.95
Observation group	32	28.45 ± 7.67	24.13 ± 6.54	12.25 ± 3.12	7.67 ± 2.53
t	--	4.510	3.437	4.545	4.047
P	--	0.000	0.001	0.000	0.000

4. Discussion

Elderly patients with lung cancer commonly have problems such as reduced lung function reserves and weakened immune defenses due to age-related decline in physiological functions. Surgical trauma will not only trigger an inflammatory response but also lead to respiratory muscle dysfunction and reduced ventilation efficiency [5]. Factors such as postoperative pain inhibiting deep breathing, anesthetic drug residue affecting ciliary movement, and long-term bed rest leading to pulmonary secretion accumulation significantly increase the risk of complications such as pulmonary infection and atelectasis. Patients have special needs for perioperative care, which requires targeted intervention in maintaining respiratory mechanics stability, optimizing gas exchange efficiency, and promoting airway cleaning to minimize the negative impact of surgery on respiratory function and ensure a smooth perioperative period [6]. The traditional perioperative nursing model has obvious limitations. It mainly focuses on the passive treatment of postoperative symptoms, lacks systematic preoperative functional reserve construction, respiratory training is single and insufficient in intensity, nutritional support lacks individualized plans, pain management and psychological intervention are relatively weak, resulting in patients' inadequate preoperative preparation and a slow and difficult postoperative recovery process [7].

The implementation of preoperative prehabilitation can make full use of the critical window of the surgical waiting period, improve the patient's physiological functional reserve through multi-dimensional intervention, enhance the tolerance to surgical trauma, and create favorable conditions for rapid postoperative recovery. This is an important breakthrough that cannot be achieved by the traditional nursing model [8]. Preoperative prehabilitation based on the ERAS concept is a multidisciplinary collaborative intervention system based on evidence-based medicine. The core is to

reduce surgical stress reactions through systematic preoperative functional optimization [9]. Preoperative prehabilitation based on the ERAS concept integrates multiple key dimensions such as respiratory function training, precise nutritional support, psychological stress adjustment, and pain pre-adaptation. It improves lung compliance through respiratory muscle endurance training, maintains positive nitrogen balance through protein supplementation, and reduces stress reactions through psychological intervention, forming a comprehensive physiological protection mechanism [10]. Compared with traditional nursing, its outstanding advantage lies in the forward-looking, systematic, and individualized intervention, which can provide precise support for the special needs of elderly patients.

The results showed that there was no significant difference in pulmonary function indicators between the groups at admission. The preoperative pulmonary function indicators of the observation group were higher than those of the control group, $P < 0.05$. The pulmonary function indicators of the patients decreased 7 days after surgery, but the FEV1, FVC, and PEF levels of the observation group were higher than those of the control group, $P < 0.05$. The incidence rate of pulmonary-related complications in the observation group (6.25%) was lower than that in the control group (25.00%), $P < 0.05$. The first time to get out of bed after surgery, recovery of bowel sounds, spontaneous urination time and total hospitalization time in the observation group were shorter than those in the control group, $P < 0.05$. Reasons for analysis: Resistance breathing training effectively enhances the contraction endurance of the diaphragm and intercostal muscles, allowing patients to better overcome respiratory depression caused by postoperative pain; abdominal breathing training improves chest-abdominal coordination and maintains adequate ventilation; aerobic exercise improves cardiopulmonary endurance reserves. In terms of nutritional intervention, protein supplementation promotes the synthesis of alveolar surfactants, and carbohydrate loading reduces intraoperative catabolism, which all contribute to lung tissue repair; psychological intervention reduces the negative impact of catecholamines on respiratory function by reducing stress response; early activity combined with vibration expectoration effectively prevents the accumulation of secretions and reduces the risk of infection.

5. Conclusion

In summary, preoperative prehabilitation based on the ERAS concept in the perioperative care of elderly lung cancer patients is of significant value in improving patients' preoperative pulmonary function and reducing the impact of surgery on postoperative pulmonary function. It can also effectively prevent the occurrence of postoperative pulmonary-related complications and promote their postoperative rehabilitation process.

About the author

Huang Xiaoping (1972.04-), female, Han nationality, Jiangsu, undergraduate, deputy chief nurse, Taizhou Hospital of Traditional Chinese Medicine, research direction: common thoracic surgery operations for esophageal cancer, lung cancer.

Disclosure statement

The authors declare no conflict of interest.

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