

## STUDY PROTOCOL

# A nurse-driven enhanced recovery after surgery (ERAS) nursing program for geriatric patients following lung surgery

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## Keywords

Enhanced recovery after surgery (ERAS); lung cancer; nursing program; the elderly.

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## Introduction

Lung cancer ranks first both in terms of morbidity and mortality among all malignancies in China.<sup>1</sup> Surgical resection remains the preferred treatment modality with curative intent for improved cure and survival rates of patients with non-small-cell lung cancer (NSCLC).<sup>2</sup> Recently, it has been reported that the number of geriatric patients with lung

## Abstract

Enhanced recovery after surgery (ERAS) is a multiprofessional, multidisciplinary and evidence-based program that aims to reduce complications, improve overall prognosis, shorten hospital stays, and promote fast recovery following major surgery. Nurses play a crucial role in the successful implementation of the ERAS program. Therefore, this research focuses on the trajectory optimized and acquired by nurses in the enhanced recovery of elderly patients undergoing radical surgery for lung cancer. This study concludes that the implementation of the proposed ERAS preoperative point-of-care trajectory is highly beneficial for improved outcomes and enhanced recovery of geriatric patients following lung surgery.

cancer has increased substantially and the proportion of patients ( $\geq 65$  years) undergoing surgery is as high as 68%,<sup>3</sup> and 30% for patients over 70 years of age.<sup>4</sup> It is projected that the average life expectancy will increase from 76.3 years to 79 years by 2030 in China. Considering the changing demographic structure of the population, it is expected that the age and demand for receiving lung cancer surgery will continue

to rise. Thoracoscopic surgery is associated with a reduced incidence in the perioperative complications of lung cancer, and it is now feasible for very elderly people previously considered unsuitable for surgery due to the high risks involved to now be treated surgically. However, there are greater possibilities of prolonged postoperative hospital stays for elderly patients, together with increased intensive care unit (ICU) admission rates, and increased 30 day readmission rates and mortality following lung cancer surgery.<sup>5,6</sup> Enhanced recovery after surgery (ERAS) is a multiprofessional, multidisciplinary and evidence-based approach that aims to lessen surgical stress response, reduce complications, lower medical costs, and promote patient recovery through optimizing a series of perioperative management measures. Accumulating studies have shown that the elderly can benefit from the ERAS program.<sup>6</sup> Geriatric patients with lung cancer often exhibit associated comorbidities than younger patients, thus necessitating more evaluation and care. This study conferred to the ERAS guidelines for lung cancer<sup>7</sup> and the optimal perioperative strategy for the elderly (2016)<sup>8</sup> proposed by the Enhanced Recovery after Surgery (ERAS) Society and the European Society of Thoracic Surgeons (ESTS). This study aimed to examine ERAS protocols for geriatric lung cancer patients and provide specific recommendations for these groups of patients in order to rationalize their surgical care and improve their outcomes. After a thorough review, an ERAS management program suitable for elderly lung cancer patients during perioperative care in the ward was developed, and implemented in the ERAS ward of Tianjin Medical University Cancer Hospital, China.

## Methods

### ERAS program

Table 1 includes the forms and checklists to be used by nursing staff in daily care, as well as indicators for implementing the ERAS program.

### Health education and counseling

#### Advantages of ERAS

Influenced by conventional perceptions, geriatric patients believe that after cancer surgery patients should stay in bed, and thus they express dissatisfaction towards adopting the ERAS ideas of early activities, more activities, and early food intake. This belief frequently leads to the occurrence of complications, and delayed discharge, or even readmission. Therefore, the ERAS program must be sufficiently publicized by medical staff through various means (verbal, printed, video, and demonstration), to facilitate an easy understanding of the ERAS ideas (based on the advancement of modern

surgical technology) to patients and their families. Thus, a better illustration of benefits is the paramount consideration before patients are asked to engage in these activities. Education in this field should stress not only the instructions about airway, diet, activities, and so forth, but also the clinical outcomes of failing to follow such instructions. It is desirable to encourage patients and their families to participate in all stages of ERAS management and take part in decision-making, with the intention to develop a sensitivity that the ERAS program is like a journey implemented from self-care to advanced professional nursing. Considering patients' individual needs, values, and preferences, full attention is provided to their subjective initiative, to realize the important role of their collaboration in enhanced recovery, and encourage their family members to participate in the program. Therefore, it is necessary to provide patients with the following:

- An enhanced recovery plan for pulmonary surgery: Introduction to thoracoscopic surgery, investigations to be performed, daily goals, and support methods before and after surgery and after discharge, expected hospital stay, and a diary in which patients record each stage of enhanced recovery must be provided to the patients.
- Pain assessment method (numerical rating scale [NRS]).
- Pulmonary rehabilitation and prehabilitation.
- Information concerning chest drains.
- Discharge advice with regards to diet, wound management, pain control, physiotherapy, travelling, and possible discomforts.
- Professional assessment and measures.

Nurses must enable patients to feel adequately prepared psychologically and physiologically for the surgery so that they are in their best condition before the surgery. Pre-recovery is defined as the enhancement of individual functional reserve before the surgery, which enables the patient to cope better with the consequent surgical stress. In order to provide the best care for elderly surgical patients, a comprehensive health assessment is required.

### Preoperative phase

#### Pulmonary rehabilitation

**High-risk airway assessment:** While respiratory failure and pulmonary complications are the most critical risk factors following pneumonectomy, preoperative risk assessment is based on pulmonary functions. Doctors must evaluate airway risks, including age, smoking history, the pathogenicity of tracheal colonized bacteria, critical or low lung function, peak expiratory flow, body mass index, basic lung diseases, and comorbidities. If the airway is considered as a high risk, it is recommended to provide inhalation treatment, including nebulization inhalation with budesonide and flumucil (b.i.d.),

**Table 1** Enhanced recovery pathways in lung surgery of Tianjin Medical University Cancer Institute and hospital

Name	Sex	Patient's phone number	Hospital number
Date of admission	Date of discharge		Postoperative stay days
Type of surgery	Surgeon name	Date of operation	Surgical approach <input type="checkbox"/> Open <input type="checkbox"/> VATS
Readmission	Yes/No	Readmission date	
Reasons for readmission:			
<b>Notes:</b>			
<b>Preoperative phase</b>			
<b>ERAS education and counseling</b>			
<b>Content</b>		<b>Complete status</b>	<b>Signature Notes</b>
ERAS advantage		Yes/No	
Assessment methods for pain control (NRS)		Yes/No	
The meaning of breathing exercise training		Yes/No	
Information about chest drains		Yes/No	
<b>Specialist assessment and measures</b>			
Airway evaluation		High risk/normal	<input type="checkbox"/> Respiratory exercises <input type="checkbox"/> Brisk walking training <input type="checkbox"/> Aerobic training (lower and/or upper limbs) <input type="checkbox"/> Walk/stair training
Atomization inhalation		Routine/high risk	
Smoke		Yes/No	
Smoking cessation		Yes/No	
Date of smoking cessation		____day	
Stair test (walk three flights of stairs)		Yes/No	Unable to walk three flights of stairs (the stair test) should be rigorously referred to physiotherapists for a more intensive rehabilitation program
Patient handing assessment		Barthel: score	
VTE assessment		Caprini score	≥5 score, refer to surgeon <input type="checkbox"/> Pharmacological prophylaxis <input type="checkbox"/> Mechanical prophylaxis
Nutritional risk screening		NRS2002 score	≥3 score, refer to surgeon <input type="checkbox"/> Oral nutritional supplements
PONV assessment		Yes/No	Refer to anesthetist
Assessment of anxiety state		Yes/No	Refer to the psychologist
Prostate symptom assessment		IPSS score	≥8 score, refer to surgeon
<b>Preoperative preparation</b>			
<b>Content</b>		<b>Complete status</b>	<b>Signature Notes</b>
Skin preparation		Yes/No	
Bowel preparation		Yes/No	Patients with absence of defecation for more than three days
Clear liquids 400 mL until two hours prior to anesthesia		Yes/No	
Oral care: Brush teeth every six hours with alcohol-free antiseptic mouth rinse, until two hours prior to anesthesia		Yes/No	
Decrease phenobarbitone before surgery.		Yes/No	
<b>Intraoperative phase</b>			
Anesthesia time (minutes)	Bleeding volume (mL)	Anesthesia method	<input type="checkbox"/> General anesthesia <input type="checkbox"/> Epidural anesthesia
<b>Content</b>		<b>Complete status</b>	<b>Signature Notes</b>
Antibiotic prophylaxis Preoperative 30 minutes		Yes/No	
Appropriate surgical methods and rational incision design		Yes/No	<input type="checkbox"/> Open <input type="checkbox"/> VATS <input type="checkbox"/> VATS to open
Multimodal analgesic regimen		Yes/No	

**Table 1** Continued

Intraoperative warming	Yes/No		
Goal-oriented liquid management	Yes/No		
VTE prevention	Yes/No		
Intraoperative low tidal volume ventilation	Yes/No		
<b>Postoperative phase</b>			
<b>Content</b>	<b>Complete status</b>	<b>Signature</b>	<b>Notes</b>
Day of surgery			
Liquid management (mL)	<input type="checkbox"/> 500 <input type="checkbox"/> 1000 <input type="checkbox"/> 1500 <input type="checkbox"/> 2000 mL		
Postoperative warming	Yes/No		
Early feeding	Yes/No		
Drink water after waking up, and administer semi-liquid if there is nothing abnormal. Resume normal diet on the first day after surgery			
Respiratory physiotherapy	Yes/No		
Early mobilization	Lower and upper limbs		
Multimodal analgesic regimen (NRS $\leq$ 4)	<input type="checkbox"/> PCA <input type="checkbox"/> Intercostal blocks <input type="checkbox"/> NSAIDs <input type="checkbox"/> Acetaminophen		
Prevention of sputum retention	Yes/No		
Drainage tube	<input type="checkbox"/> Chest drain tube <input type="checkbox"/> Urinary catheter		
Delirium prevention	CAM score		Refer to surgeon
<b>Postoperative day 1</b>			
Respiratory physiotherapy	Yes/No		
Normal diet	Yes/No		
Promote mobilization	<input type="checkbox"/> Lower and upper limbs <input type="checkbox"/> Sit on chair (up to two hours) <input type="checkbox"/> Walk _____m		
Multimodal analgesia regimen (NRS $\leq$ 4)	<input type="checkbox"/> PCA <input type="checkbox"/> Intercostal blocks <input type="checkbox"/> NSAIDs <input type="checkbox"/> Acetaminophen		
Prevention of sputum retention	Yes/No		
Drainage tube	<input type="checkbox"/> Chest drain tube <input type="checkbox"/> Urinary catheter		
Delirium prevention	CAM score		$\geq$ 2 score, refer to the surgeon
VTE prevention	<input type="checkbox"/> Pharmacological prophylaxis <input type="checkbox"/> Mechanical prophylaxis		
<b>Postoperative day 2</b>			
Respiratory physiotherapy	Yes/No		
Promote mobilization	<input type="checkbox"/> Sit on chair (up to two hours) <input type="checkbox"/> Walk _____m		
Multimodal analgesia regimen (NRS $\leq$ 4)	<input type="checkbox"/> PCA <input type="checkbox"/> Intercostal blocks <input type="checkbox"/> NSAIDs <input type="checkbox"/> Acetaminophen		
Prevention of sputum retention	Yes/No		
Drainage tube	<input type="checkbox"/> Chest drain tube <input type="checkbox"/> Urinary catheter		
Delirium prevention	CAM score		$\geq$ 2 score, refer to the surgeon
Prevention of constipation	Yes/No		
VTE prevention	<input type="checkbox"/> Pharmacological prophylaxis		

**Table 1** Continued

				<input type="checkbox"/> Mechanical prophylaxis
<b>Postoperative day 3</b>				
Respiratory physiotherapy				Yes/No
Promote mobilization				<input type="checkbox"/> Sit on chair (up to two hours)
				<input type="checkbox"/> Walk _____m
Multimodal analgesia regimen (NRS ≤ 4)				<input type="checkbox"/> PCA
				<input type="checkbox"/> Intercostal blocks
				<input type="checkbox"/> NSAIDs
				<input type="checkbox"/> Acetaminophen
Prevention of sputum retention				Yes/No
Drainage tube				<input type="checkbox"/> Chest drain tube
				<input type="checkbox"/> Urinary catheter
Delirium prevention				CAM score
Prevention of constipation				Yes/No
VTE prevention				<input type="checkbox"/> Pharmacological prophylaxis
				<input type="checkbox"/> Mechanical prophylaxis
Discharge advice				Yes/No
<b>Postoperative day 4</b>				
Respiratory physiotherapy				Yes/No
Promote mobilization				<input type="checkbox"/> Sit on chair (up to two hours)
				<input type="checkbox"/> Walk _____m
Multimodal analgesia regimen				<input type="checkbox"/> PCA
				<input type="checkbox"/> Intercostal blocks
				<input type="checkbox"/> NSAIDs
				<input type="checkbox"/> Acetaminophen
Prevention of sputum retention				Yes/No
Drainage tube				<input type="checkbox"/> Chest drain tube
				<input type="checkbox"/> Urinary catheter
Prevention of constipation				Yes/No
VTE prevention				<input type="checkbox"/> Pharmacological prophylaxis
				<input type="checkbox"/> Mechanical prophylaxis
Discharge readiness assessment				RHDS score
<b>Out of hospital after a week</b>				
Telephone follow-up				
Reasons for delayed discharge:				
Complication	Treatment condition	Complication	Treatment condition	
Hemorrhage		Chylothorax		
Incision infection		Bronchopleural fistula		
Intrathoracic infection		Arrhythmia		
Pulmonary infection		Heart failure		
Pulmonary atelectasis		VTE (DVT/PE)		
Pulmonary edema		Pleural leakage		
Death				

≥ 2 score, refer to the surgeon

and oral inhalation with salbutamol 100 ug (b.i.d.), for 7–10 days. Evaluation criteria and treatment protocols are in accordance with Che *et al.*<sup>9</sup>

Breathing and exercise training programs suitable for elderly patients should be developed to improve cardiopulmonary tolerance.

### Breathing training

A. Active circular breathing technique (ACBT)<sup>10,11</sup> training

This is conducted within 24 hours after admission, directed by a respiratory specialist nurse, with the patient in a seated position. It comprises three repetitive steps.

- (i) Breath control: With the upper chest and shoulders relaxed, a gentle tidal breath is taken in for 5–10 seconds/time;
- (ii) Thoracic expansion exercise: At this stage, inhalation is emphasized, with one hand placed on the thorax, and the other holding a colorful windmill made by the nurse. A deep breath is taken until the thorax cannot be lifted up anymore, then the breath is held for 3 seconds, followed by slow pursed-lips expiration; the windmill is blown to rotate, with an inspiration and expiration duration ratio of 1:2–3 seconds. This step is repeated for 3–4 times;
- (iii) Vigorous exhalation: Exhalation is performed like blowing mist on a window or cleaning the glasses with the exhalation; followed by a pause after 1–2 times of breathing, and breathing control. The above-mentioned three steps are repeated for 3–5 times, 15–20 minutes/day, lasting for 1 week.

#### B. Respiratory muscle strength and core muscle endurance exercises

(i) Inspiratory muscle (pectoralis major) exercises: In a standing position, the patient is asked to hold a 0.5 kg dumbbell with both hands, with shoulders and arms at the same level, elbows are bent at an angle of 100–120 degrees. Subsequently, the patient is slowly held forward and then returned to the former position, during which the patient can feel the stretch and contraction of the pectoral muscles.

(ii) Exhale muscle (diaphragm) exercises: With the patient lying flat on the bed, or on the ground and arms across the chest, and with knees bent at an angle of 90 degrees. Slowly shoulders are bent and torso upward, with the body curled. At the highest point, the patient is asked to deliberately squeeze the abdomen for maximum contraction. The patient then relaxes, shoulders are lowered and returned to the initial position.

#### C. Squat exercise (core muscles)

Knees and squat are bent down slowly with deep inhalation until the thighs are parallel to the ground and with upright back.

(i) Stand up: patients are asked to stand up slowly with a deep exhalation, and with upright back. The above-mentioned three steps are repeated for four sets, five times for each set, three seconds each time (with an interval of one minute between sets). This exercise can mobilize more than 70% of body muscles, and enhance cardiopulmonary endurance.

#### D. Stair-climbing exercise

Performed for 30 minutes/time, twice a day. A portable finger pulse oximeter is worn by the patient to record heart rate and blood oxygen variations. Those incapable of completing the stair climbing exercise were asked to take a brisk walk instead. The exercises A–D are repeated for 7–10 days.

For thoracic surgery, respiratory exercise training may be the most apparent difference from surgery in other parts. Increasing evidence<sup>12,13</sup> has shown that preoperative aerobic training and strength training help to improve prognosis, particularly in patients with critical lung functions.<sup>7</sup> To cope with surgery, there is no adequate evidence supporting the design of an exercise intervention program that is most suitable for lung cancer patients receiving surgery. It has been demonstrated in the literature<sup>12</sup> that at least 4–6 weeks is necessary to achieve an improvement in exercise capacity. The short-term high-intensity exercise of one week<sup>14</sup> before surgery has been proven to be an effective intervention, which can balance the compliance and economic pressure of patients. Our research and design are short-term and high-intensity training programs. In our design study, crunch is added to enhance diaphragm strength as two thirds of vital capacity are provided by diaphragmatic activities. The ribs are pulled towards the arms by dumbbell bird exercise to increase thorax diameter, thus exercising inspiratory muscles, including the pectoralis major and pectoralis minor. Squat training is used to enhance the endurance and strength of core muscles. The above training is not limited by equipment. After 7–10 days of training, the diary is placed at the end of the patient's bed for reference. After completion, the patient or family members are asked to check or fill in the completed number. Medical staff check the diary has been completed and provide encouragement to the patient during daily rounds.

If a patient is unable to walk three flights of stairs, they should be rigorously referred to physiotherapists for a more intensive rehabilitation program.

- Nutritional risk screening: Within 24 hours after admission, the primary nurse should check with the NRS2002 assessment tool.<sup>15</sup> If the result is  $\geq 3$ , it is advisable to communicate with the attending physician or prescribe oral nutritional supplements (ONS) for 5–7 days if needed.<sup>7</sup>
- VTE assessment: The improved Caprini assessment tool for thoracic surgery should be used. If the result is  $\geq 5$  points, the risk of bleeding is excluded, and low molecular weight heparin is administered until 12 hours before surgery.<sup>16</sup>
- Prostate symptoms assessment: The International Prostate Symptom Score<sup>17,18</sup> (IPSS) should be utilized for elderly male patients aged above 65-years-old, for the evaluation of lower urinary tract symptoms (LUTS). The surgeon is consulted if the result of IPSS is  $\geq 8$  points.

Benign prostatic hyperplasia, accompanied by lower urinary tract, is a common chronic disease in elderly men. Accumulating studies have indicated<sup>19</sup> that in men aged between 60 and 80 years, more than 50% have lower urinary tract symptoms (frequent urination, nocturia, urgent

urination, urinary incontinence, bladder pain, or acute urinary retention). An enlarged prostate may cause difficulties in catheterization, or cause local mucosal edema during placement of an indwelling catheter. Prompt evaluation and intervention are likely to reduce local symptoms and urinary retention after urinary catheter removal and lower the incidence of recatheterization.

- Postoperative nausea and vomiting (PONV) assessment: Inform doctors if there are high risk factors, the surgeon is consulted.
- Chronic disease management in the elderly: Hypertension and diabetes should be controlled at appropriate levels.

### Preoperative preparation

- Alcohol and smoking is prohibited before surgery. Mechanical bowel preparation is avoided (except for patients with absence of defecation for more than three days).
- The patient is advised to drink 400 mL of clear liquids up to two hours before anesthesia.
- Oral care: teeth should be brushed every six hours<sup>20</sup> until surgery, with an alcohol-free antiseptic mouthwash.

Evidence suggests a correlation between oral care and pulmonary infections.<sup>21</sup> *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Staphylococcus aureus*, and *Enterobacter* are potentially harmful bacteria that may colonize in the mouth. Gram-negative bacteria can multiply three-fold in 3–6 hours on the tooth surface. Oral microbiota may travel down to the lungs during intraoperative mechanical ventilation, leading to pulmonary complications. In China, most geriatric patients with lung cancer have a long history of smoking and dental caries, and therefore intensive oral care is absolutely necessary.

- 400 mL orally of clear liquid is advised until two hours prior to anesthesia.
- Phenobarbitone is reduced before surgery.

### Intraoperative phase

- Antibiotic prophylaxis is administered before surgery.
- Thoracic epidural analgesia/multimodal analgesic regimen is instigated.
- Proper surgical methods and rationally designed incisions are performed.
- Intraoperative warming: heating blanket and intravenous warming solution are used to prevent hypothermia (body temperature below 36°C) during the surgery.
- Goal-oriented liquid management is applied.

- Long-term analgesia for incisions: Ropivacaine intercostal block is administered before the end of the operation.
- Thrombosis prevention: intermittent air pressure in the lower limbs is maintained.
- Preventive measures are realized for patients at high risk of PONV in preoperative screening.

### Postoperative phase

- Fluid control: The total amount of intravenous fluid infusion is maintained within 24 hours after surgery to prevent heart failure.
- Postoperative warming: A heating blanket is used until the temperature of the patient exceeds 36°C.
- Promote early feeding: After the patient has woken up, water intake is recommended, and semiliquid is provided if no anomalies are recorded. The normal diet is resumed the first day following surgery.
- Multimodal analgesia: Before surgery has been completed, an intercostal nerve block with a long-acting local anesthesia is administered. The pain is subsequently assessed on a daily basis. Based on NSAID intravenous injection, q.12 hours, if the pain score is <4, oral acetaminophen and relaxation training is considered; if the range is between 4 and 7, an intercostal nerve block with long-acting local anesthesia and weak opioids are administered; if it is ≥8, a higher strength opioid is considered. However, the use of opioids is avoided or minimized.

The premise of encouraging patients to get out of bed as early as possible is effective in pain management with analgesia. NSAIDs are injected intravenously 30 minutes before the patient gets out of bed for the first time so they are not frightened of ground activity. Attention is paid to the consumption of analgesics. Health education is essential, particularly for most elderly people who believe that they should wait longer until there is no cough or pain. The correction of misconceptions is of vital significance.

- Respiratory physiotherapy: For cough, postural drainage, percussion, vibration, and shaking (if necessary), the inhalation treatment is planned which is the same as ACBT exercise performed before surgery. However, it remains uncertain which physical therapy intervention is most effective.
- Early mobilization: Before awakening from anesthesia, passive movements of the upper limbs and lower limbs should be performed with the help of a nurse, and physical activities should be considered after the patient has woken up. On the first day following surgery, the patient should get out of bed and stand for 1–2 hours, and walk at least 60 m, with the assistance of a caregiver (oxygen supplied when necessary). The activity level is raised gradually within the tolerance range, and upon

discharge, the patient should be able to engage in off-bed activities for 4–6 hours every day.

- The urinary catheter is removed within 48 hours.
- Delirium prevention: Delirium patients are monitored routinely<sup>22</sup> following the Confusion Assessment Method (CAM)<sup>23</sup> to confirm if there is delirium. Each day at 08:00 and 18:00 hours it is necessary to communicate with the doctor during a shift change, mainly about possible causes and symptomatic treatment for delirium, so that symptomatic treatment can be provided. To ensure a patient sleeps, medical procedures are intensively performed to reduce nighttime interferences and maintain the patient’s sleep cycle. It is also necessary to avoid or remove patient monitoring devices, and provide enough oxygen analgesia. Patients should try to get out of bed for exercise as soon as possible, wear hearing aids and reading glasses, and ensure smooth bowel movements. Family visits should be properly scheduled.
- Prevention of sputum retention: The patient should be asked whether they can smell airway secretions or hear thick wheezing while coughing or breathing (indicators of increased breathing). If percutaneous blood oxygen

saturation (SPO<sub>2</sub>) is <90%, the patient can be considered to have sputum retention, in which case timely treatment should be provided (Table 2).

Notably, elderly lung cancer patients are at high risk of sputum retention,<sup>24</sup> which is also one of the major causes of postoperative lung infection. During the process from sputum retention to lung infections, the nurse should be in close contact with the patient as they are most likely to detect complications at the earliest stage. The timing of early evaluation and treatment is highly significant.

- Discharge readiness assessment. One day before discharge, assessment should be conducted using the Readiness for Hospital Discharge Scale (RHDS)<sup>25</sup> from four dimensions (health condition, knowledge of the disease, coping ability after discharge, and expected social support after discharge). The aim is to perceive whether the patient is ready for being discharged, returning to society, and is prepared for further recovery and rehabilitation.

The application of enhanced recovery shortens hospital stays following surgery, resulting in shorter preparation for discharge. In particular, the lack of necessary resources and expertise on the part of elderly patients frequently leads to readmission, which increases medical and social burdens.<sup>26,27</sup>

Therefore, elderly patients are encouraged to express their needs and preferences after discharge and assisted in accessing available medical resources and social support resources. A few family members request the condition of the patient is concealed and volunteer to manage all precautions. Under such conditions, the skills and knowledge of the caregiver must be improved.

- Follow-up visit: One week after discharge, a follow-up call is made by the nurse to ascertain the current pain status, shortness of breath, body temperature, and activities. The nurse should consult the physician when necessary.

**Table 2** Assessment and measures of sputum retention

Reason	Measures
Inadequate intake	<ul style="list-style-type: none"> <li>• Fluid supplementation/oral intake</li> <li>• 0.9% NS aerosol inhalation</li> </ul>
Unable to cough	<ul style="list-style-type: none"> <li>• Fluid supplementation/encourage eating</li> <li>• Percussion on back. When you cough</li> <li>• Soft pillow assisted</li> <li>• Press the superior suprasternal fossa</li> <li>• Aerosol inhalation</li> <li>• Sputum suction technique</li> <li>• Cricothyroid membrane puncture</li> </ul>
Incompatibility	<ul style="list-style-type: none"> <li>• Clear explanation</li> <li>• Reduce anxiety</li> <li>• Avoid disturbance</li> <li>• Sputum suction</li> <li>• Visual reminder</li> </ul>
Pain	<ul style="list-style-type: none"> <li>• Analgesia</li> <li>• A comfortable position</li> <li>• Protect the wound when coughing</li> </ul>
Bronchospasm	<ul style="list-style-type: none"> <li>• Bronchodilators</li> <li>• Corticosteroids</li> <li>• Comfortable position</li> <li>• Avoid repeated coughing/wheeze</li> <li>• Observe for signs of fatigue, diminished respiration, and CO<sub>2</sub> retention</li> </ul>
Tachypnea	<ul style="list-style-type: none"> <li>• Respiratory control and regular rest</li> <li>• Position: Sit with body leaning forward</li> <li>• Oxygen high flow oxygen</li> <li>• Open mouth and mask oxygen inhalation</li> </ul>

Standard of sputum retention: Airway, when coughing or breathing, airway secretions or thick wheezes can be heard. Breath, lungs do more work. SpO<sub>2</sub>, Transcutaneous oxygen saturation <90%.

## Discussion

ERAS, a modern multidisciplinary perioperative management, functions through the entire perioperative care trajectory from admittance to discharge and is optimized based on multidisciplinary collaboration. Moreover, trained professional nurses remain indispensable evaluators, implementers, observers, and coordinators at all stages of the ERAS (presurgery, intrasurgery, and post-surgery) program. Thus, this study suggests that the implementation of the proposed ERAS preoperative point-of-care trajectory is highly beneficial for improved outcomes and enhanced recovery of geriatric patients following lung surgery.

## Disclosure

The authors confirm there are no conflicts of interest.



## References

- 1 Chen WQ, Sun KX, Zheng RS *et al.* Cancer incidence and mortality in China, 2014. *Chin J Cancer Res* 2018; **30**: 1–12.
- 2 Aytekin İ, Şanlı M, Işık AF *et al.* Outcomes after lobectomy and pneumonectomy in lung cancer patients aged 70 years or older. *Turk J Med Sci* 2017; **47**: 307–12.
- 3 Zhou M. Study on the clinical characteristics of lung cancer in the young and the old. *Chin J Clin Rational Drug Use* 2018; **11**: 122–3.
- 4 Shulte T, Schniewind B, Walter J, Dohrmann P, Kuchler T, Kurdow R. Age-related impairment of quality of life after lung resection for non-small cell lung cancer. *Lung Cancer* 2010; **68**: 115–20.
- 5 Yang J, Xia Y, Yang Y *et al.* Risk factors for major adverse events of video-assisted thoracic surgery lobectomy for lung cancer. *Int J Med Sci* 2014; **11**: 863–9.
- 6 Ljungqvist O, Hubner M. Enhanced recovery after surgery—ERAS—Principles, practice and feasibility in the elderly. *Aging Clin Exp Res* 2018; **30**: 249–52.
- 7 Batchelor TJP, Rasburn NJ, Abdelnour-Berchtold E *et al.* Guidelines for enhanced recovery after lung surgery recommendations of the Enhanced Recovery After Surgery (ERASVR) Society and the European Society of Thoracic Surgeons (ESTS). *Eur J Cardiothorac Surg* 2019; **55**: 91–115.
- 8 Mohanty S, Rosenthal RA, Russell MM, Neuman MD, Ko CY, Esnaola NF. Optimal perioperative management of the geriatric patient: A best practices guideline from the American College of Surgeons NSQIP and the American Geriatrics Society. *J Am Coll Surg* 2016; **222**: 930–47.
- 9 Che GW, Wu QF, Wu Y *et al.* Chinese expert consensus on multidisciplinary perioperative airway management (2018). *Chin J Clin Thorac Cardiovasc Surg* 2018; **25**: 401–5.
- 10 Yang M, Zhong JD, Zhang J *et al.* The effects of enhancing confidence of active cycle of breathing technique training on pulmonary rehabilitation in elder lung cancer patients with lung resection. *Chin J Nurs* 2018; **53**: 523–7.
- 11 Üzmezoğlu B, Altay G, Özdemir L, *et al.* The Efficacy of Flutter® and Active Cycle of Breathing Techniques in Patients with Bronchiectasis: A Prospective, Randomized, Comparative Study. *Turk Thorac J* 2018; **19**(3): 103–109.
- 12 Rosero ID, Ramirez-Vélez R, Lucia A *et al.* Systematic review and meta-analysis of randomized, controlled trials on preoperative physical exercise interventions in patients with non-small-cell lung cancer. *Cancer* 2019; **11**: 944.
- 13 Licker M, Schnyder JM, Frey JG *et al.* Impact of aerobic exercise capacity and procedure-related factors in lung cancer surgery. *Eur Respir J* 2011; **37**: 1189–98.
- 14 Meng S, Yang F, Dai F *et al.* Effect of a high intensive preoperative rehabilitation on the perioperative complications in patients with chronic obstructive pulmonary disease eligible for lung cancer surgery. *Chin J Lung Cancer* 2018; **21**: 841–8.
- 15 Weimann A, Braga M, Carli F *et al.* ESPEN guideline clinical nutrition in surgery. *Clin Nutr* 2017; **36**: 623–50.
- 16 Li H, Jiang GN. China National Research Collaborative Group on venous thromboembolism in thoracic surgery perioperative venous thromboembolism (VTE) prophylaxis in thoracic cancer patients Chinese experts consensus. *Chin J Lung Cancer* 2018; **21**: 739–51.
- 17 Wong CK, Choi EP, Chan SW *et al.* Use of the international prostate symptom score (IPSS) in Chinese male patients with benign prostatic hyperplasia. *Aging Male* 2017; **20**: 241–9.
- 18 Yeo JK, Choi H, Bae JH *et al.* Korean clinical practice guideline for benign prostatic hyperplasia. *Investig Clin Urol* 2016; **57**: 30–44.
- 19 Cornu JN, Oelke M, Parsons KF. Clinical practice. Benign prostatic hyperplasia and lower urinary tract symptoms. *N Engl J Med* 2012; **367** (17): 1668.
- 20 Warren C, Medei MK, Wood B, Schutte D. A nurse-driven oral care protocol to reduce hospital-acquired pneumonia. *Am J Nurs* 2019; **119**: 44–51.
- 21 de Carvalho Baptista IM, Martinho FC, Nascimento GG, da Rocha Santos CE, Prado RF, Valera MC. Colonization of oropharynx and lower respiratory tract in critical patients risk of ventilator-associated pneumonia. *Arch Oral Biol* 2018; **85**: 64–9.
- 22 Avidan MS, Maybrier HR, Abdallah AB *et al.* Intraoperative ketamine for prevention of postoperative delirium or pain after major surgery in older adults: An international, multicentre, doubleblind, randomised clinical trial. *Lancet* 2017; **390**: 267–75.
- 23 Inouye SK, Westendorp RG, Saczynski JS. Delirium in elderly people. *Lancet* 2014; **383**: 911–22.
- 24 Bonde P, McManus K, McAnespie M. Lung surgery identifying the subgroup at risk for sputum retention. *Eur J Cardiothorac Surg* 2002; **22**: 18–22.
- 25 Weiss ME, Piacentine LB, Lokken L *et al.* Perceived readiness for hospital discharge in adult medical-surgical patients. *Clin Nurse Spec* 2007; **21**: 31–42.
- 26 Oanh KN, Anil NM, Christopher C *et al.* Vital signs are still vital instability on discharge and the risk of post-discharge adverse outcomes. *J Gen Intern Med* 2016; **32**: 142–8.
- 27 Wallace AS, Perkhounkova Y, Bohr NL, Chung SJ. Readiness for hospital discharge, health literacy, and social living status. *Clin Nurs Res* 2016; **25**: 494–511.