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Original Article

Five-in-one nursing management promotes rapid recovery of patients after thoracic surgery

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Abstract: Objective: To explore the application effect of five-in-one nursing management in the rapid recovery of patients undergoing thoracic surgery. Methods: This prospective study included 45 patients admitted to thoracic surgery before the implementation of five-in-one nursing as the control group and 40 patients admitted during the implementation as the test group. The patients in the control group were nursed by conventional nursing plan, whole those in the test group received the five-in-one nursing management. The perioperative indicators, mental state, postoperative rehabilitation, surgical complications, and nursing satisfaction were compared between the two groups. Results: Compared with the control group, the time of extubation, the time of getting out of bed for the first time, the recovery time of bowel sounds, the time of the first defecation, and the length of hospital stay in the experimental group were significantly shortened ($P<0.05$). At 24 h after surgery, MTL and GAS levels of patients in the test group were significantly higher than those of the control group ($P<0.001$). Moreover, the test group had lower visual analogue score (VAS) at different times after the operation, as well as lower the Hamilton Anxiety Scale (HAMA) and Hamilton Depression Scale (HAMD) scores after nursing than the control group ($P<0.001$). The total incidence of postoperative complications in the experimental group was significantly reduced, while nursing satisfaction was significantly increased ($P<0.001$) when compared with the control group. Conclusion: The five-in-one nursing management effectively promoted the rapid recovery of patients after thoracic surgery, shortened the length of hospital stay, and improved nursing satisfaction.

Keywords: Five-in-one, nursing, thoracic surgery, rapid cover surgery, hospital stay

Introduction

Thoracic surgery is one of the common major surgeries and is mainly applied to treat organ diseases, e.g. lung cancer, mediastinum, and esophagus [1, 2]. Traditional thoracotomy often causes severe trauma, which results in a longer recovery time for patients with the operation. Surgical trauma tends to cause functional disorders of organs (e.g. heart and lung) and endocrine system, which further lead to surgical complications such as arrhythmia and atelectasis and seriously threaten the prognosis and life of patients [2]. Currently, as a tremendous change, thoracic surgery is transforming gradually to minimally invasive surgery instead of open surgery. The emergence of video-assisted technology is one of the milestones in the development of thoracic surgery. Video-assisted thoracic surgery (VATS) has rapidly become the major surgical option for almost all thoracic surgery [3, 4]. Especially for patients with lung cancer, the recovery time of patients who received VATS is significantly shortened [5]. Nevertheless, the rapid recovery effect of minimally invasive technology is still insufficient to satisfy the increasing requirements of patients for current medical services. Therefore, concern still remains about how to promote the rapid recovery of patients with thoracic surgery in clinical practice.

Enhanced recovery after surgery (ERAS) is a concept related to perioperative management, and aims to shorten hospital stay and further reduce the morbidity of patients and medical costs. Currently, ERAS has become one of the hot topics in the surgical field worldwide [6, 7]. With a combination of advanced minimally invasive surgery techniques, ERAS optimizes and

Table 1. General contents of nursing

Term	Nursing details
Perioperative nursing	1) General information collection
	2) General health education for hospitalization, knowledge related to the surgery, and information of precautions
	3) Communication with patients to reduce the stress and anxiety
	4) Fasting for 8 h before surgery, etc.
Intraoperative nursing	1) Vital sign monitoring
	2) Surgical position nursing
	3) Using intermittent compression devices to reduce pressure sores and VTE, etc.
Postoperative nursing	1) Thrombosis and anti-infection prevention according to doctors' orders
	2) Postoperative die guide
	3) Postoperative rehabilitation training guidance, and explanation of postoperative recovery precautions
	4) Daily respiratory tract and drainage tube care
	5) Analgesia with intravenous self-controlled analgesic pump
	6) Comfortable ward environment
	7) Illness monitoring and timely emergency feedback with doctors

applies evidence-based clinical measures before surgery to maximally to reduce complications and enhance postoperative recovery [8].

Increasing evidence shows that scientific perioperative nursing, especially preoperative evaluation and optimization, can reduce the physical and psychological pressure associated with surgery and promote functional recovery [2, 9]. However, similar reports are still lacking in thoracic surgery, especially lung cancer surgery. Therefore, based on the concept of ERAS, we designed a "five-in-one" nursing management program to explore the effect of ERAS on the rapid recovery of patients after lung cancer surgery, with the hope to provide theoretical support and data reference for clinical practice.

Materials and methods

Patients

This is a prospective non-randomized controlled study which included 85 patients with lung cancer admitted to the Department of Thoracic Surgery in our hospital. Among them, 45 patients who hadn't received the five-in-one care were included in the control group from June 2019 to December 2019, and 40 patients who had received the five-in-one care were included in the test group from January 2020 to September 2020.

Inclusion criteria: Patients with a diagnosis of lung cancer based on chest CT, pathologic biopsy, and other examinations [10]; Patients with an age ≥18 years old; Patients had no history of radiotherapy, chemotherapy, or surgery. Exclusion criteria: Patient with a diagnosis of advanced lung cancer; Patients with systemic diseases concurrent with inflammation, and intolerance of surgery; Patients with mental diseases such as severe cognitive impairment leading to unavailability for scale assessment; Patients with incomplete medical records. When analyzing the data, patients who withdraw, transfer to other hospital or die prior to the end of the study were also excluded.

Ethics statement

This study followed the principle of the Declaration of Helsinki and was approved by the Ethics Committee of our hospital. All patients and their families were informed of study contents and signed informed consent.

Nursing method

The patients in the control group received routine nursing care, including health education, condition assessment, perioperative vital sign monitoring, postoperative pain management, dietary guidance, daily life care, and rehabilitation training guidance. Specific nursing measures are shown in **Table 1**.

Table 2. Specific nursing procedures and measures

Term	Specific contents
Preoperative evaluation	1) Age evaluation: ≥60 years old or not
	2) Smoking index: ≥300 or not
	3) BMI: ≥25.0 kg/m^2 or not
	4) Pulmonary function: FEV1%, 6-min walking distance
	5) Nutrition relative risk assessment: NRS 2002 scale was used for screening and assessment [11]
	6) Anxiety/depression assessment: HAMA and HAMD were used for assessment
	7) Preoperative venous thromboembolism (VTE) risks assessment [12]
Preoperative preparation	1) Fasting 6 hrs before surgery, drinking clear liquid 2 hrs before surgery
	2) Preoperative breathing and exercise training
	3) Preoperative consultation and education
Intraoperative nursing	1) Intraoperative fluid supplementation <1000 mL, colloid and crystalloid liquid balance
	2) Intraoperative patient's core body temperature ≥36.5°C
	3) Using intermittent compression devices to reduce pressure sores and VTE
Postoperative nursing	1) Early feeding: 4 hours after operation, water and liquid diet are given according to the swallowing function, and appropriate food is selected for eating
	2) Postoperative Analgesia: multimodal analgesic, closely pain monitoring within 48 h after surgery, timely communication with the physician anesthetists to adjust analgesic plan, analgesia adverse reactions management
	3) The intervention of pulmonary rehabilitation training: rehabilitation physicians formulate, guide, and follow up individualized training programs for patients
	4) Aerosol inhalation to prevent and treat pulmonary infections
	5) Early exercise out of bed
	6) Assessment of gastrointestinal function recovery
	7) Chest tube nursing, closed system of digital chest drainage
	8) Postoperative VTE risk assessment

Note: BMI: body mass index; FEV: forced expiratory; NRS 2002: nutrition risk screening 2002; HAMA: Hamilton anxiety rating scale; HAMD: Hamilton depression rating scale; VTE: venous thromboembolism.

The patients in the test group were treated by a "five-in-one" nursing program

Specific details as follows: (1) Nursing working group establishment. Five-in-one nursing working group is composed of nurses (including one nurse head and 5 specialist nurses), attending physician, anesthesiologist rehabilitation physician, and patient's family. The head nurse takes the responsibility for the overall arrangement and performance of nursing work, while five specialist nurses are responsible for carrying out specific work. The doctor is on the duty for the surgical operation and post-operative treatment of patients. Additionally, professional explanations of disease and surgical operations should be provided to the patients and family members, who are also required to cooperate with nurses to manage emergencies. The anesthesiologist primarily manages the anesthesia during intraoperative and postoperative analgesia. Rehabilitation physicians guide and supervise the postoperative rehabilitation training programs of patients. Family members are requested to actively acquire disease-related knowledge and post-operative precautions, patients' diets, and training plans. Meanwhile, the family members should also actively communicate with patients and encourage to them to cooperate with medical work, so as to improve their compliance. (2) Nursing care plan: specific nursing measures are shown in **Table 2**.

Evaluation criteria

Anxiety and depression: HAMA and HAMD scales were used to evaluate the degree of anxiety and depression of patients [13, 14]. The HAMA scale includes 14 items with a maximum score of 56; the HAMD scale includes 17 items with a maximum score of 68. High score reflects a high degree of anxiety or depression.

Pain assessment: visual analogue scale (VAS) was applied to evaluate the knee pain degree of patients. VAS scale provides a range of scores from 0 to 10 according to patients' subjective perception of pain, and a higher score indicates a greater intensity of pain [15].

Satisfaction of nursing: a self-made nursing satisfaction questionnaire with a maximum score of 100 was used for assessment: very satisfied (score ≥90); satisfied (90> scores ≥75), average (75> total scores ≥60), and dissatisfied (score <60). The Cronbach's alpha coefficient values of the questionnaire are 0.855, and validation is 0.905 and indicates good reliability and validity. Total satisfaction rate (%) = (very satisfied case number + satisfied case number)/total case number*100.

Outcome measures

Primary outcome measures: (1) Surgeryrelated indicators: The extubation time (from operation end to chest tube removal), the required time for the first time of getting out of bed (from operation end to the first time of getting out of bed), the recovery time of bowel sounds (from operation end to the first return of bowel sound), defecation time (from the end of the operation to the first defecation), and hospitalization time (the time from the patient's admission to discharge) were all recorded and compared between the two groups. (2) Gastrointestinal hormone levels: About four mL of peripheral venous blood was drawn from the patient 24 h before and after surgery and the levels of serum motilin (MTL) and gastrin (GAS) were determined by radioimmunoassay. An automated immunoassay (cobas6000, Roche, Switzerland) was used for analysis, MTL and GAS kits were purchased from Shanghai Haring Biotechnology Co., Ltd., China. (3) VAS score, HAMA, and HAMD scale scores were calculated and compared between the two groups.

Secondary outcome measures: The incidence of complications during hospitalization and nursing satisfaction rate of patients.

Statistical methods

SPSS version 23.0 (SPSS, Inc., Chicago, IL, USA) software was used for statistical analysis of data. The counted data were shown by the number of cases (percentage) (n, %), and the chi-square test was used for the comparison between the two groups. The measured data conformed to the normal distribution were shown as mean ± standard deviation ($\bar{x}$ ± sd) and the independent sample t-test was used for comparison between two groups, while the paired t-test was employed for comparison of data before and after surgery of one group. Two-sided α=0.05 was selected as test standard. P<0.05 means that a difference is significant.

Results

Patients' baseline data of two groups

Table 3 shows the clinical characteristics and baseline data of the patients, including 40 cases of the test group and 45 cases of the control group. There were no significant differences between the two groups of patients in gender, age, educational level, TNM staging, and the pathological type (P>0.05; **Table 3**).

Comparison of preoperative indicators between two groups

The extubation time, the first time of getting out of bed, the time of bowel sounds return, the time of the first defecation, and the length of hospital stay in the test group were significantly shorter when compared with the control group (P<0.01) (**Table 4**).

Before surgery, no significant difference in gastrointestinal hormones level between the two groups was observed (P>0.05). At 24 h post operation, the level of the gastrointestinal hormones in the test group was barely different from that before surgery (P>0.05), while the control group had a significant reduction (P< 0.001). A much higher level of MTL and GAS were observed in the test group at 24 hours post-operation when compared to the control group (P<0.001; **Figure 1**).

Postoperative pain comparison of two groups

VAS scores of the two groups gradually declined with time after surgery (**Figure 2**). However, when comparing the VAS scores at 12 h, 24 h, and 48 h post operation and at discharge between the two groups, the test group had lower scores than the control group at each time point (P<0.001).

Table 3. Baseline data

Item	Test group (n=40)	Control group (n=45)	t/χ^2	P
Gender (n, %)			0.066	0.797
Male	22 (55.00)	26 (57.78)		
Female	18 (45.00)	19 (42.22)		
Age (years, $\bar{x} \pm sd$)	62.3±7.4	60.8±8.5	0.870	0.387
Education (n, %)			0.163	0.686
High school or above	35 (87.50)	38 (84.44)		
High school or below	5 (12.50)	7 (15.56)		
TNM stages (n, %)			0.305	0.859
I	10 (25.00)	9 (20.00)		
II	25 (62.50)	30 (66.67)		
III a	5 (12.50)	6 (13.33)		
Pathologic typing (n, %)			0.316	0.854
Adenocarcinoma	18 (45.00)	22 (48.89)		
Squamous cell cancer	16 (40.00)	18 (40.00)		
Adenosquamous carcinoma	6 (15.00)	5 (11.11)		

Table 4. Comparison of preoperative indicators between two groups ($\bar{x} \pm sd$)

Items	Test group (n=40)	Control group (n=45)	t	P
Time of bowel sounds return (h)	10.26±2.38	14.49±3.46	6.625	<0.001
First time of getting out of bed (h)	19.35±5.52	26.48±10.65	3.936	<0.001
First time of defecation (d)	2.20±0.85	3.15±1.03	4.656	<0.001
Extubation time (d)	4.27±1.15	5.72±2.35	3.674	<0.001
Hospital stay (d)	7.45±2.30	9.52±3.55	3.224	0.002

Anxiety and depression alteration of two groups

'Before nursing, HAMA and HAMD scores of patients were similar between the two groups, as all the patients were in moderate degree of anxiety and depression (P>0.05). After nursing, the anxiety and depression degree of patients in the two groups both was relieved markedly when compared with before nursing (P<0.001). Moreover, compared with the control group, the test group had much lower HAMA and HAMD scores after nursing (P<0.001; **Table 5**).

Comparison of complication incidence and nursing satisfaction between two groups

In the test group, one case of pulmonary infection was observed during the hospital stay, whereas six of atelectasis, five pulmonary infections, and two deep vein thromboses were observed in a control group. The total incidence of complications in the test group was significantly less when compared to that of the control group (2.5% vs 28.89%, P<0.001; **Table 6**).

Nursing satisfaction was evaluated at discharge, and the nursing satisfaction rate of patients in the test group was higher than that in the control group (95.00% vs 64.44%, P<0.001; **Table 6**).

Discussion

Nursing is an indispensable part of the patient's treatment process and runs through every part of hospitalization from admission to discharge. Therefore, scientific and complete nursing management is essential to guarantee the smooth treatment of patients. Increasing studies have also revealed that the scientific nursing model plays a crucial role in surgical ERSA. Besides, nursing also has an important role in the treatment experience of patients [16, 17].

Based on the concept of ERAS, our study developed a "five-in-one" nursing model involving doctors and patients. The five-in-one is multidisciplinary nursing management led by nurses and composed of attending physicians, rehabilitation physicians, anesthesiologists, and

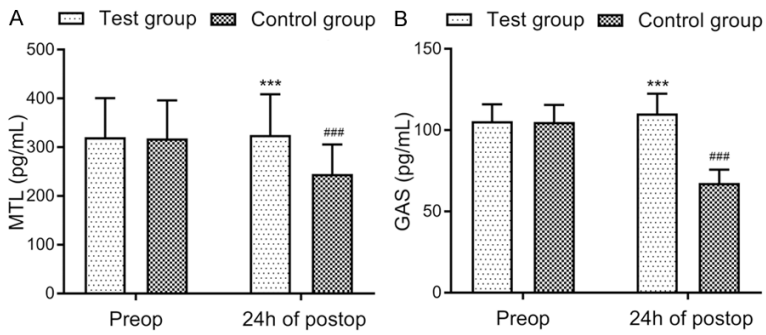

Figure 1. Comparison of the levels of MTL (A) and GAS (B) between two groups. Compared with control group at 24 h after surgery, ***P<0.001; compared with treatment group before surgery, ###P<0.001. MTL: motilin; GAS: gastrin.

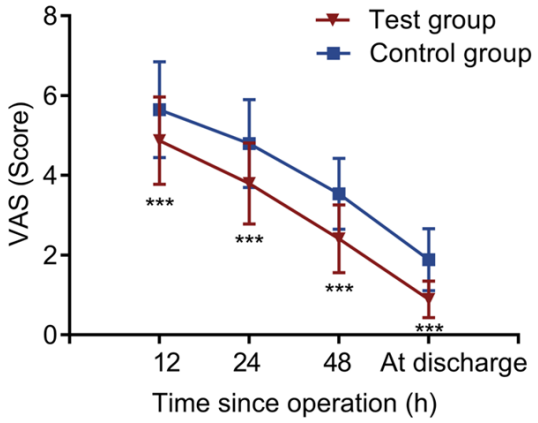

Figure 2. Comparison of postoperative VAS score between the two groups, compared with control group, ***P<0.001. VAS: visual analogue score.

patient family members. This study showed that at the postoperative recovery time, the extubation time, the time for first getting out of bed, the time of bowel sounds return, the time of the first defecation, and the length of hospital stay was reduced significantly in patients who received "five-in-one" nursing management when compared to those who received routine nursing care. In addition, postoperative VAS score was also much lower in the test group; anxiety, and depression of test patients were also improved significantly. Moreover, patients with five-in-one nursing management also had a marked reduction in the complication rate. The above data indicated that five-in-one management effectively promoted the rapid recovery of patients after surgery.

In order to determine available intervention plans and measures, a comprehensive preoperative evaluation is one of the requirements of ERAS for each patient accepting elective surgery and also essential for the rapid recovery of patients after surgery [18, 19]. A comprehensive evaluation is composed of patient age, smoking status, lung function, and VTE risk, which have been assessed among patients with five-in-one nursing management in this study. According to the results of the evaluation, targeted nursing strategies were formulated. Patients with poor performance required special attention and effective nursing management during the perioperative period, such as preoperative pulmonary function training, VTE prevention, and postoperative nebulization inhalation treatment. Previous research has reported that patients with severe comorbidities have a significantly increased risk of postoperative complications [20, 21]. In a large study involving 706 patients with thoracic surgery, 7% of patients without preoperative prevention had pulmonary embolism (PE) after surgery [22]. Conversely, preoperative optimization of comorbidities can reduce postoperative morbidity. Ven et al. have shown that preoperative pulmonary training effectively reduced respiratory complications in patients undergoing esophagectomy [23]. Our research also showed that the risk of complications such as VTE, pulmonary infection, and atelectasis in the test group were significantly reduced when compared with those risks in the control group. Therefore, fewer complications are one of the main key factors to shorten the length of hospital stay [22].

Postoperative analgesia management is also an important part of ERAS management. As known, pain is one of the major reasons that affect patients' postoperative rehabilitation training, and the refusal to exercise training due to pain results in a delay of rehabilitation [24]. In the system of five-in-one nursing management, the anesthesiologist managed the postoperative pain of patients with multiple analgesic plans. Close monitoring and evaluation for pain within 48 hours were performed after the operation to assist the anesthesiologist to adjust the analgesia plan in time. Pain manage-

Table 5. Comparison of HAMA and HAMD scores between two groups (points, $\bar{x} \pm sd$)

Time	Test group (n=40)	Control group (n=45)	t	P
Before intervention				
HAMA	30.25±4.45	29.94±4.29	0.326	0.745
HAMD	28.35±3.68	28.05±3.88	0.366	0.716
After intervention				
HAMA	18.23±3.05###	21.34±2.35###	5.217	<0.001
HAMD	15.48±2.28###	19.22±2.40###	7.364	<0.001

Note: Comparison between one group before and after surgery, ###P<0.001. HAMA: Hamilton Anxiety Scale; HAMD: Hamilton Depression Scale.

Table 6. Comparison of pulmonary function after surgery between the two groups ((n, %)/$\bar{x} \pm sd$)

Item	Test group (n=40)	Control group (n=45)	χ^2	P
Complication (n, %)				
Deep vein thrombosis	0 (0.00)	2 (4.44)	1.821	0.177
Pulmonary infection	1 (2.50)	5 (11.11)	4.722	0.030
Atelectasis	0 (0.00)	6 (13.33)	3.289	0.070
Summary	1 (2.50)	13 (28.89)	10.719	<0.001
Nursing satisfaction rate (n, %)			14.308	0.003
Very satisfied	28 (70.00)	16 (35.56)		
Satisfied	10 (25.00)	13 (28.89)		
Average	1 (2.50)	8 (17.78)		
Unsatisfied	1 (2.50)	8 (17.78)		
Total satisfaction rate (%)	38 (95.00)	29 (64.44)	11.845	<0.001

ment might be another crucial factor leading to an earlier movement and shorter hospital stay of patients in the test group [25]. Additionally, individualized postoperative rehabilitation training formulated by a specific physician also affects rapid recovery after surgery. Correct and effective breathing exercises after surgery have also been reported to effectively prevent complications, e.g. atelectasis and lung infections. It can also shorten the length of hospital stay through reducing the airflow accumulation induced by slow breathing, improving the coordinated movement of related respiratory muscles, and promoting alveolar expansion [26].

Consistent with previous studies, multidisciplinary collaboration plays a crucial role in five-in-one care constructed in the current research. The innovation of our research is to emphasize the importance of patients' family members. Family members, who are responsible for nursing after surgery, are the most important social relationship. The encouragement and support from family members have been reported to play an essential role in the treatment and recovery of disease [27]. Therefore, to assist a family member to understand the disease-related knowledge, postoperative precautions, diet, and training plans, nursing education was provided to a family member to provide better care to the patient after the operation. The guidance of active communication between family members and the patient is also beneficial for patients' self-confidence establishment, which further effectively alleviates negative emotions and improves treatment compliance of patients with surgery [28]. The present study revealed that the degree of anxiety and depression of patients after nursing decreased markedly when compared with the control group, which is consistent with above studies.

As an indispensable part of treatment, nursing is the crucial resource of patients' experience in the hospital. Our study has shown that patients in the test group had a higher degree of nursing satisfaction when compared with that of the control group. This result indicated that five-in-one nursing effectively promoted the nursing satisfaction of patients and improved the treatment experience.

However, there are some limitations in this study. First, due to a failure to perform a necessary randomized controlled trial, a bias of baseline data of patients in two groups might exist to affect the accuracy of the results. Secondly, since only lung cancer patients were included in the present study, the efficacy of the five-in-one nursing model used in this study may not represent its efficacy for all thoracic surgery. Additionally, during the period of the coronavirus pandemic, the implementation of some nursing measures may be slightly affected.

Therefore, prospective randomized controlled trials with a larger volume of cases are further required for future research.

In summary, our research revealed the five-in-one nursing management with the participation of doctors and patients can effectively promote the rapid recovery of lung cancer patients after thoracic surgery, shorten the hospital stay, and improve nursing satisfaction rate.

Disclosure of conflict of interest

None.

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