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Original Article

Effects of comprehensive nursing care on recovery of respiratory function after thoracic surgery

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Abstract: Objective: To explore the effects of comprehensive nursing care on recovery of respiratory function after thoracic surgery. Methods: A total of 86 patients with esophageal cancer (EC) who underwent thoracic surgery were recruited and randomly allocated into a control group (n=43) and an observation group (n=43). Patients in the control group received conventional care, and those in the observation group received comprehensive nursing care additionally, including preoperative psychological nursing, respiratory function training, pain expression guidance, sputum elimination guidance, postoperative nursing, as well as dietary guidance. Related indices between the two groups were compared after nursing. Results: In the observation group, postoperative pulmonary function and arterial blood gas (ABG) were improved than those in the control group ($P<0.05$). Besides, lower St George's Respiratory Questionnaire (SGRQ) score, shorter duration of chest tube indwelling, higher nursing satisfaction, and decreased complication rate were also demonstrated in the observation group ($P<0.05$). Conclusion: Comprehensive nursing care has a favorable clinical impact on the recovery of respiratory function after thoracic surgery. It speeds up the rehabilitation and improves the prognosis of patients, thus achieving positive nursing feedback.

Keywords: Comprehensive nursing care, thoracic surgery, postoperative recovery, respiratory function indices

Introduction

Thoracic surgery is one of the most difficult and risky surgical operations. During the surgery, one-lung ventilation is often required, and the traction and compression of the tissues in the process of expanding the field of vision inevitably cause injury and stimulation to bronchus, hilum, and lungs. Furthermore, respiratory function of patients with esophageal cancer (EC) is greatly affected by adverse symptoms of upper abdominal pain, vomiting, weakness, and chest tightness. Weakened respiratory function, cough, limited lung recruitment is more likely to be induced by anesthesia and primary diseases [1, 2]. Besides, due to postoperative pain or other surgical stimuli, patients usually suffer from declined pulmonary function and are vulnerable to lung exudation, inflammation, infection, respiratory distress and other complications, which in turn prolong the recovery time and affect the quality of life (QOL) [3, 4].

Therefore, how to prevent postoperative pulmonary complications of thoracic surgery is one of the key concerns of perioperative nursing [5]. There are reports that effective individual nursing is available for improving postoperative recovery, stabilizing respiratory state, as well as reducing complications [6, 7].

Taking the nursing procedure as the core and the systematic nursing management and responsibility nursing as the means, this study explored the effects of comprehensive nursing care, a new nursing mode, on pulmonary and respiratory functions of patients with EC after thoracic surgery, and defined the perioperative nursing standard of thoracic surgery, so as to provide reference for effective nursing intervention.

Materials and methods

General data

In this prospective study, 86 patients with EC who underwent thoracic surgery in the First Affiliated Hospital of Xi'an Jiaotong University from January 2017 to December 2019 were

enrolled and allocated into a control group (n=43) and an observation group (n=43) by parity. The control group received conventional care, and the observation group adopted comprehensive nursing care additionally. All the admitted patients signed informed consent form, and this study was approved by the Ethics Committee of the First Affiliated Hospital of Xi'an Jiaotong University.

Inclusion criteria

a. aged 18-60 years; b. diagnosed with EC; c. receiving thoracic surgery and nursing, and signing informed consent form; d. no wound infection before surgery; e, no other respiratory diseases or severe heart, liver, kidney and other organ diseases; e. surgical duration less than 3 h.

Exclusion criteria

Patients refused to receive surgical treatment, or referred to another hospital before surgery; patients with preoperative pulmonary infection; patients with difficulty in normal communication or suffering from mental illness; patients requiring thoracoabdominal surgery.

Nursing methods

Patients in the control group were given conventional care, including ward environment management, surgical incision, oral care, anti-infection care, monitoring of oxygen inhalation and drainage devices, postoperative postural adjustment, and defecation and urination guidance.

On the basis of conventional care, the observation group adopted a comprehensive nursing mode additionally, covering the whole process from the admission to discharge. After admission, nurse-in-charge formulated nursing plan, nurse practitioner acted as person in charge, and nurses actively participated the whole procedure, including nursing plan, education plan, discharge plan, filling of nursing forms, as well as nursing quality control. Targeted management was carried out. (1) Preoperative psychological nursing. Nurses carefully introduced surgical plan and replied all questions on rounds to relieve patients' tension and anxiety and improve their compliance and confidence. (2) Respiratory function training. Patients were instructed to take deep breathing exercises slowly with balloons before surgery, 10-20 times per group, 2 groups/day [8], and patients received abdominal and pursed-lips breathing training, 10-15 min/times, 3 times a day. (3) Pain expression guidance. One day before the surgery, nurses communicated with the patients who had difficulty in expressing the pain accurately to confirm their way of pain expression, for example, by gestures/eye contact or using a numerical rating scale (NRS), so as to grasp the condition of patients and take corresponding measures. (4) Sputum elimination nursing. Patients with severe cough were guided to keep comfortable posture: lean forward, take slow deep breaths, contract abdominal muscles as much as possible and cough continuously for 2-3 times while breath-holding, cough effectively to ensure expectoration. Atomization inhalation was carried out if necessary, 3-4 times a day, 15-20 min each time, so as to facilitate sputum elimination [9]. (5) Postoperative nursing. Patients were placed in wards with soothing environment to distract their attention and relieve their anxiety and pain. Nurses made regular rounds every day to guide patients to change positions and prevent pressure sores. (6) Dietary guidance. Patients received nasogastric feeding in the first 3 days after surgery. Those with no adverse reactions and good recovery were gradually given high protein, high vitamin, high calorie, and digestible food to ensure nutrition intake, and simultaneously took moderate exercise to facilitate rapid recovery. The two groups of patients continued their weekly telephone follow-up after discharge to monitor the diet, exercise, respiratory quality. And they were arranged for further consultation and assessment one month after discharge.

Outcome measures

Main outcome measures: Pulmonary function indices of patients 1 week after surgery, including forced expiratory rate in the 1st second (FEV1%), forced vital capacity (FVC), FEV1/FVC, and peak expiratory flow (PEF); Arterial blood gas (ABG) indices of radial artery at the wrist before surgery and 3 days after surgery, including partial pressure of oxygen (PaO_2), partial pressure of carbon dioxide ($PaCO_2$), and oxygen saturation (SaO_2).

Secondary outcome measures: complications (thoracic infection, wound infection, lung infection); St George's Respiratory Questionnaire (SGRQ) (lower score indicated higher QOL) and

Table 1. Comparison of general clinical data

Group	Control group (n=43)	Observation group (n=43)	t/χ^2	P
Gender			0.195	0.659
Male	27	25		
Female	16	18		
Body weight (kg)	64.8±7.9	66.9±11.2	1.005	0.317
BMI (kg/m^2)	20.5±3.3	22.1±4.2	1.964	0.0528
Intraoperative blood loss (mL)	273.53±59.32	260.25±65.81	0.983	0.329
Surgical duration (min)	147.54±20.35	139.44±28.93	1.502	0.137
Intraoperative blood transfusion volume (mL)	142.5±29.4	138.8±33.4	0.545	0.587
Average age (years)	46.7±5.8	48.1±8.4	0.899	0.371

Note: BMI: body mass index.

duration of chest tube indwelling before surgery and 1 month after surgery; satisfaction with nursing care. Incidence of complications = cases of complications/total cases × 100%.

Pulmonary function and ABG indices were detected with a pulmonary function tester (Master Screen IOS, Germany) and a hemodynamic analyzer (ABL90-FLEX, Denmark), respectively, and the nursing satisfaction was measured by a self-made questionnaire grading general satisfaction, satisfaction, and dissatisfaction. Nursing satisfaction = (general satisfaction + satisfaction)/total × 100%.

Data processing

All the data in this study were systematically analyzed by SPSS17.0, in which the counting data (n, %) were processed by chi-square (χ^2) test, the measurement data were expressed by mean ± standard deviation ($\bar{x}$ ± sd). The between-group comparison was completed by independent *t* test, and the within-group comparison was conducted by paired *t* test. A value of $P<0.05$ was considered statistically significant.

Results

Patients with uncontrollable postoperative condition or serious complications, as well as those who required open thoracic surgery or lung resection, were treated as lost-follow-up patients. No intraoperative exclusion or lost-follow-up occurred in this study.

Comparison of clinical data

Both groups of patients had different degrees of hypotension before surgery. Thoracoscopic surgery was adopted, and one-lung ventilation was used for general anesthesia, intercostal nerve block plus intravenous patient-controlled analgesia was used for postoperative analgesia. There was no significant statistical difference in sex, average age, body weight, body mass index (BMI), intraoperative blood loss, surgical duration and intraoperative blood transfusion volume (P>0.05), indicating a comparability, as shown in **Table 1**.

Comparison of pulmonary function indices

There was no significant difference in pulmonary function indices (FEV1%, FVC, FEV1/FVC, and PEF) between the two groups before treatment (P>0.05), which were remarkably reduced in the control group after treatment (P<0.05), FVC and FEV1/FVC in the observation group were significantly decreased (P<0.05). The indices of FVC, FEV1/FVC, and PEF in the observation group improved significantly compared with the control group after treatment (P<0.05). There was a slight difference in FEV1%, but with no statistical significance (P>0.05), as shown in **Table 2**.

Comparison of ABG indices

There was no significant difference in ABG indices (PaO_2, $PaCO_2$, and SpO_2) between the two groups before treatment (P>0.05), which were relatively stable in the observation group after treatment, and became worse in the control group (P<0.05). After treatment, the PaO_2, $PaCO_2$, and SpO_2 in the control group were 75.66±5.95 mmHg, 40.85±4.92 mmHg, and 90.14±3.34%, respectively, and those in the observation group were 78.41±6.12 mmHg, 38.23±3.79 mmHg, and 92.35±3.52%, indicat-

Table 2. Comparison of pulmonary function indices

Group	Control group (n=43)	Observation group (n=43)	t	P
FEV1%				
Before treatment	51.81±7.23	50.73±6.44	0.731	0.5467
After treatment	47.81±5.24*	49.86±5.85	1.712	0.091
FVC (L)				
Before treatment	1.64±0.41	1.65±0.49	0.103	0.919
After treatment	1.50±0.26*	1.61±0.24*	2.039	0.045
FEV1/FVC (%)				
Before treatment	57.73±3.42	58.83±3.51	1.472	0.145
After treatment	52.23±3.16**	56.01±4.32**	4.631	<0.001
PEF (L/s)				
Before treatment	5.49±0.99	5.51±1.02	0.092	0.927
After treatment	5.06±1.01*	5.41±0.44	2.083	0.040

Note: * compared with before treatment, P<0.05; ** compared with before treatment, P<0.01; FEV1%: forced expiratory rate in the 1st second; FVC: forced vital capacity; PEF: peak expiratory flow.

Table 3. Comparison of ABG indexes

Group	PaO_2 (mmHg)		$PaCO_2$ (mmHg)		SpO_2 (%)	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Control group (n=43)	80.84±4.72	75.66±5.95*	37.52±5.49	40.85±4.92**	92.73±3.84	90.14±3.34**
Observation group (n=43)	79.82±3.78	78.41±6.12	37.63±4.56	38.23±3.79	92.01±4.04	92.35±3.52
t	1.106	2.113	0.101	2.766	0.847	2.987
P	0.272	0.038	0.919	0.007	0.399	0.004

Note: * compared with before treatment, P<0.05; ** compared with before treatment, P<0.01; PaO_2: partial pressure of oxygen; $PaCO_2$: partial pressure of carbon dioxide; SaO_2: oxygen saturation.

ing a statistically significant difference in each index between the two groups (P<0.05), as shown in **Table 3**. Therefore, comprehensive nursing care was effective in improving the ABG indices of patients.

Comparison of postoperative QOL

There was no significant difference in preoperative SGRQ score between the two groups (P>0.05). After postoperative care, the SGRQ score was significantly decreased in both groups (control group: t=5.760, P<0.001; observation group: t=8.279, P<0.001), and the observation group was lower than the control group (P<0.05). The duration of chest tube indwelling in the observation group was significantly shorter than that in the control group after nursing (P<0.05), as shown in **Table 4**.

Comparison of complications

There were different proportions of postoperative complications in both groups (as shown in **Table 5**). The total incidence in the observation group was significantly lower than that in the control group, 9.3% (4/43) *vs* 25.6% (11/43) (P=0.047), as shown in **Figure 1**.

Comparison of nursing satisfaction

Nursing satisfaction in the observation group was 93.0%, significantly higher than that in the control group (76.7%) (P<0.05), which indicated that patients were satisfied with the quality of comprehensive nursing care, as shown in **Table 6**.

Discussion

EC surgery is complicated and traumatic, and has long anesthesia time. In addition, dysphagia and massive secretions stimulated by gastric tube intubation are likely to occur. Moreover, pulmonary tissue movement during surgical view expansion brings damages to hilum, bronchus, and respiratory tract, which is easy to cause postoperative complications such as tis-

Table 4. Comparison of chest tube indwelling time and quality of life of the patients

Group	SGRQ score		Chest tube indwelling time (d)
	Before treatment	After treatment	
Control group (n=43)	149.64±17.83	128.75±15.74***	4.52±1.10
Observation group (n=43)	147.89±19.75	115.51±16.36***	4.06±1.03
t	0.431	3.247	2.002
P	0.667	0.002	0.049

Note: *** compared with before treatment, P<0.001; SGRQ: St George's Respiratory Questionnaire.

Table 5. Comparison of complications after treatment

Group	Lung infection	Incision infection	Pleural effusion
Control group (n=43)	3	4	4
Observation group (n=43)	1	2	1
χ^2	1.049	0.717	1.911
P	0.306	0.397	0.167

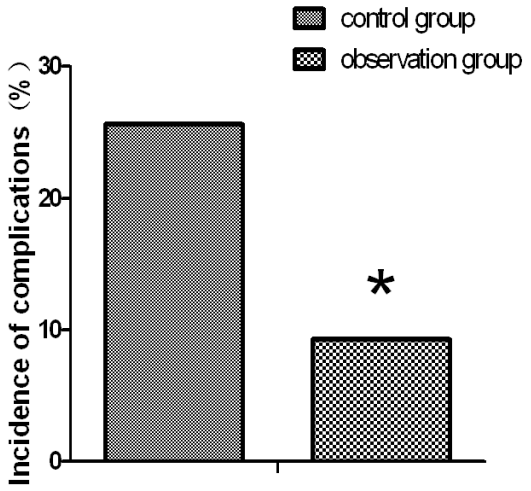

Figure 1. Comparison of postoperative complications. * compared with control group, P<0.05.

sue infection, inflammation, and atelectasis, affecting the rehabilitation of patients, and even endangering life safety in severe cases [10, 11]. Therefore, how to prevent respiratory complications after thoracic surgery, especially after lung surgery, is one of the key issues concerned by thoracic surgeons.

Effective nursing measures have posed very positive clinical effects on the reduction of complications and recovery of patients undergoing thoracic surgery, especially the recovery of postoperative respiratory and pulmonary functions [12-15]. Owing to the poor overall procedure, pertinence and standardization, conventional nursing cannot meet the patient's expectations and clinical requirements [16]. In this study, new comprehensive nursing care measures, including psychological care, respiratory tract care, respiratory function training, diet care, as well as postoperative guidance, were applied to treat EC patients undergoing thoracic surgery, in order to improve postoperative respiratory function. Patients in the observation group who received targeted sputum elimination nursing and preoperative respiratory training showed significantly improved postoperative pulmonary function indices than those in the control group, suggesting the high clinical value of preoperative respiratory training and effective sputum elimination for the recovery of pulmonary function. Pehlivan pointed out that preoperative pulmonary rehabilitation training is helpful to improve the postoperative pulmonary function and recovery rate of lung transplant candidates undergoing open surgery, especially for elderly patients [17, 18]. Besides, we found that the preoperative inspiratory muscle training had a significant impact on the ABG indices of patients, that is, PaO_2 and SpO_2 in the observation group were higher than those in the control group, which may be due to the fact that the inspiratory muscle training contributed to the blood-oxygen exchange, and the improvement of lung function further promoted the difference of ABG indices. Karanfil also believed that effective preoperative training could improve the homeostasis and metabolic respiratory stability of patients undergoing lung surgery [19].

Wang et al. retrospectively analyzed the impact of comprehensive nursing care on surgical patients, and shortened hospital stay, reduced complications, and accelerated recovery were revealed, showing a significant clinical value [20, 21]. We also compared the postoperative QOL and complications of patients. The SGRQ

Table 6. Comparison of nursing satisfaction

Group	Satisfaction	Basic satisfaction	Dissatisfied	Satisfaction rate (%)
Control group (n=43)	12	21	10	76.7
Observation group (n=43)	15	25	3	93.0
χ^2	4.45			4.440
P	0.108			0.035

score and complication rate in the observation group were significantly better than those in the control group, suggesting that comprehensive nursing care, a systematic and scientific nursing mode, is available in thoracic surgery. Meanwhile, active psychological nursing and postoperative rehabilitation guidance were effective in improving treatment confidence and nursing recognition. However, there were still several limitations, such as small sample size, errors in the blood sample process, and inability to reflect the overall changes. Therefore, sample size will be expanded and multicenter and synchronous comparison will be conducted to improve the reliability of this study.

To sum up, comprehensive nursing care has a favorable clinical impact on the recovery of respiratory function after thoracic surgery, with few complications, fast postoperative recovery, high recognition, as well as positive clinical nursing feedback.

Disclosure of conflict of interest

None.

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References

[1] Shanthanna H, Moisuik P, O'Hare T, Srinathan S, Finley C, Paul J and Slinger P. Survey of postoperative regional analgesia for thoracoscopic surgeries in Canada. J Cardiothorac Vasc Anesth 2018; 32: 1750-1755.

[2] Grondell J, Holleran C, Mintz E and Wiesel O. Postoperative bedside critical care of thoracic surgery patients. Am J Crit Care 2018; 27: 328-333.

[3] Porrello C, Scerrino G, Vaglica A, Palazzolo M, Gagliardo CM, Giangregorio F, Iadicola D, Tomasello G, Lo Faso F, Kawamukai K, Lacava N, Carini F, Cocorullo G and Gullo R. Postoperative complications, pain and quality of life after thoracoscopic or thoracotomic lobectomy for lung cancer. G Chir 2019; 40: 115-119.

[4] Bhagat R, Bronsert MR, Juarez-Colunga E, Weyant MJ, Mitchell JD, Glebova NO, Henderson WG, Fullerton D and Meguid RA. Postoperative complications drive unplanned readmissions after esophagectomy for cancer. Ann Thorac Surg 2018; 105: 1476-1482.

[5] Marret E, Cinotti R, Berard L, Piriou V, Jobard J, Barrucand B, Radu D, Jaber S and Bonnet F. Protective ventilation during anaesthesia reduces major postoperative complications after lung cancer surgery: a double-blind randomised controlled trial. Eur J Anaesthesiol 2018; 35: 727-735.

[6] Kwak C and Ko Y. Clinical nurse specialist-led implementation of an early discharge protocol after cardiac surgery. Clin Nurse Spec 2019; 33: 184-190.

[7] Van Haren RM, Mehran RJ, Mena GE, Correa AM, Antonoff MB, Baker CM, Woodard TC, Hofstetter WL, Roth JA, Sepesi B, Swisher SG, Vaporciyan AA, Walsh GL and Rice DC. Enhanced recovery decreases pulmonary and cardiac complications after thoracotomy for lung cancer. Ann Thorac Surg 2018; 106: 272-279.

[8] Kim BS, Kim JH, Park SH, Seo HS, Lee HS and Lee MM. Effect of a respiratory training program using wind instruments on cardiopulmonary function, endurance, and quality of life of elderly women. Med Sci Monit 2018; 24: 5271-5278.

[9] Liu W, Mu X, Wang X, Zhang P, Zhao L and Li Q. Effects of comprehensive pulmonary rehabilitation therapy on pulmonary functions and blood gas indexes of patients with severe pneumonia. Exp Ther Med 2018; 16: 1953-1957.

[10] Markar SR, Wiggins T, MacKenzie H, Faiz O, Zaninotto G and Hanna GB. Incidence and risk factors for esophageal cancer following achalasia treatment: national population-based case-control study. Dis Esophagus 2019; 32.

[11] Zevallos-Villegas A, Alonso-Moralejo R, Cambra F, Hermida-Anchuelo A, Perez-Gonzalez V, Gamez-Garcia P, Sayas-Catalan J and De Pablo-Gafas A. Morbidity and mortality of serious

gastrointestinal complications after lung transplantation. J Cardiothorac Surg 2019; 14: 181.
[12] Mitchell J. Relevance of a specialised nurse in thoracic surgery. J Thorac Dis 2018; 10: S2583-S2587.
[13] Refai M, Andolfi M, Gentili P, Pelusi G, Manzotti F and Sabbatini A. Enhanced recovery after thoracic surgery: patient information and careplans. J Thorac Dis 2018; 10: S512-S516.
[14] Templeton R and Greenhalgh D. Preoperative rehabilitation for thoracic surgery. Curr Opin Anaesthesiol 2019; 32: 23-28.
[15] Jiang X and Tang J. Analysis of the effect of comprehensive nursing intervention on pulmonary infection in patients with severe neurosurgery. Biomed Res 2018; 29: 1149-1153.
[16] Ardo NP, Loizzi D, Panariti S, Piccinin I and Sollitto F. Enhanced recovery pathways in thoracic surgery from Italian VATS group: nursing care program. J Thorac Dis 2018; 10: S529-S534.
[17] Pehlivan E, Mutluay F, Balci A and Kilic L. The effects of inspiratory muscle training on exercise capacity, dyspnea and respiratory functions in lung transplantation candidates: a randomized controlled trial. Clin Rehabil 2018; 32: 1328-1339.
[18] Sakhaei S, Sadagheyani HE, Zinalpoor S, Markani AK and Motaarefi H. The impact of pursed-lips breathing maneuver on cardiac, respiratory, and oxygenation parameters in COPD patients. Open Access Maced J Med Sci 2018; 6: 1851-1856.
[19] Thybo Karanfil EO and Moller AM. Preoperative inspiratory muscle training prevents pulmonary complications after cardiac surgery-a systematic review. Dan Med J 2018; 65: A5450.
[20] Wang LL, Zhang L, and Chen D. Application value and effect of comprehensive nursing intervention on tumor metastasis and postoperative and nosocomial infections in patients with colorectal cancer. Int J Clin Exp Med 2018; 11: 13620-13626.
[21] Brown D and Xhaja A. Nursing perspectives on enhanced recovery after surgery. Surg Clin North Am 2018; 98: 1211-1221.