

The application analysis of 8F ultrafine chest drainage tube in thoracoscopic lobectomy for lung cancer

Yongbin Song

Hebei Medical University

Chong Zheng

Hebei North University

Shaohui Zhou

Hebei General Hospital

Hongshang Cui

Hebei General Hospital

Jincong Wang

Ningbo University Medical School

Jianxun Wang

Hebei North University

Wenhao Wang

Hebei General Hospital

Lijun Liu

Hebei General Hospital

Junfeng Liu (✉ junfengliu4h@163.com)

Hebei Medical University Third Affiliated Hospital <https://orcid.org/0000-0002-0240-6608>

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Abstract

Background Currently, thoracoscopic lobectomy is widely used in clinical practice, and postoperative placing of ultrafine drainage tube has advantages in reducing postoperative pain and accelerating postoperative recovery of patients. This study aims to investigate the feasibility and safety of placing 8F ultrafine chest drainage tube after thoracoscopic lobectomy and its superiority over traditional 24F chest drainage tube.

Methods: A retrospective data analysis was undertaken on 134 patients who placed 8F ultrafine chest drainage tube or 24F chest drainage tube with thoracoscopic lobectomy for lung cancer from January 2018 to December 2019 by our surgical team. Patients divided into Group A (n=67) with 8F ultrafine chest drainage tube and Group B (n=67) with 24F chest drainage tube. The drainage time, the total drainage volume, postoperative hospital stay, postoperative pain score and postoperative complication of both groups were compared.

Results: Compared to B group, the A group had lower pain scores on postoperative days 1, 2 and 3 (3.72 ± 0.65 point vs 3.94 ± 0.67 point, $P=0.027$; 2.72 ± 0.93 point vs 3.13 ± 1.04 point, $P=0.016$; 1.87 ± 0.65 point vs 2.39 ± 1.22 point, $P=0.005$), shorter drainage time (4.25 ± 1.79 d vs 6.04 ± 1.96 d, $P=0.000$), fewer drainage volume (1100.42 ± 701.57 ml vs 1369.39 ± 624.25 ml, $P=0.021$); shorter postoperative hospital stay (8.46 ± 2.48 d vs 9.37 ± 1.70 d, $P=0.014$). Postoperative complication such as subcutaneous emphysema, pulmonary infection, atelectasis, chest tube reinsertion and intrathoracic hemorrhage displayed no difference between both groups as well ($P > 0.05$).

Conclusion: Compared with 24F chest drainage tube, the application of 8F ultrafine chest drainage tube after thoracoscopic lobectomy can significantly shorten the drainage time, reduce the total drainage volume, reduce the postoperative pain degree, shorten the hospital day, and effectively detect postoperative intrathoracic hemorrhage. It is an effective, safe and reliable drainage method.

Background

At present, the surgical method of lung cancer is gradually changing from thoracotomy to minimally invasive operation, and thoracoscopic lobectomy is widely used in clinical practice [1–4]. The purpose of placing a thoracic drainage tube after lobectomy is mainly to drain the blood and gas in the thoracic cavity, prevent reflux of exudate, reconstruct the normal negative pressure in the thoracic cavity, promote lung expansion and prevent intrathoracic infection [5, 6]. However, postoperative placing chest drainage tube will aggravate the wound pain, resulting in low efficiency of cough and inactivity of ambulating, which is not conducive to early postoperative recovery [7–9]. The concept of enhanced Recovery after surgery (ERAS) aims to optimize perioperative measures, alleviate surgical stress, reduce complications and achieve the goal of accelerated recovery by combining minimally invasive surgery [10]. In this study, the data of 67 such patients from were retrospectively analyzed and compared with 67 patients with

conventional 24F chest drainage tube. To investigate the feasibility and safety of placing 8F ultrafine chest drainage tube after thoracoscopic lobectomy, and its advantages over 24F chest drainage tube.

Methods

Patient selection

We retrospectively reviewed the medical data of patients with lung cancer who underwent video-assisted thoracoscopic surgery (VATS) lobectomy and systematic mediastinal lymph node dissection (MLND) in the Department of Thoracic Surgery I, Hebei General Hospital between January 2018 and December 2019. The patients met the following inclusion criteria: (1) Preoperative examination or intraoperative frozen section confirmed non-small cell lung cancer (NSCLC); (2) clinical stage I to IIIA disease as evaluated using the 8th edition of the TNM classification of lung cancer [11]. The patients with the following conditions were excluded from this analysis: (1) Preoperative complications of atelectasis, pulmonary infection or tuberculosis; (2) Hemothorax and empyema; (3) The second lobectomy; (4) Extensive dense pleural adhesion; (5) Tumor invasion of chest wall (T3); (6) Non-single lobectomy; (7) Lung lobe and other thoracic organs need to be excised simultaneously.

According to the above criteria, 67 cases of postoperative placing 8F ultrafine chest tube were selected by computer-generated random number and included in the experimental group (group A). Similarly, 67 cases of postoperative placing 24F chest drainage tube were selected and included in the control group (group B). General data of the two groups were compared as shown in Table 1.

Table 1
Preoperative Characteristics of Patient and Tumor

Characteristics	Group A(n = 67)	Group B(n = 67)	P-value
Gender(%)			0.596
Male	58.21%	62.69%	
Female	41.79%	37.31%	
Age(years)	59.60 ± 11.76	60.64 ± 9.35	0.570
Tumor location(%)			0.633
Upper right	37.31%	35.82%	
Middle right	5.97%	5.97%	
Lower right	23.88%	14.93%	
Upper left	22.39%	26.87%	
Lower left	10.45%	16.42%	
Postoperative pathological staging(%)			0.720
IA	74.63%	68.66%	
IB	4.48%	5.97%	
IIA	5.97%	2.99%	
IIB	5.97%	7.46%	
IIIA	8.96%	14.93%	
Pathological types(%)			0.360
Adenocarcinoma	70.15%	62.69%	
Squamous cell carcinoma	29.85%	37.31%	
Scale variables were expressed as median and range, ordinal and nominal parameters as absolute numbers, and percent.			

Surgical Approach

Patients in both groups underwent VATS lobectomy and systematic MLND, single-lung ventilation, and the lateral decubitus position. After disinfection, observation hole was made in the 7th intercostal space of the midaxillary line. A 1.5 cm incision was made and thoracoscope was placed. For the lesion of the upper lobe, an incision (3 ~ 4 cm) was made in the 4th intercostal space of the anterior axillary line. For the lesion of the middle or lower lobe, an incision (3 ~ 4 cm) was made in the 5th intercostal space of the

anterior axillary line. Without rib spreading, apply ultrasonic scalpel and linear cut-close device complete resection of blood vessels, bronchi, and lobes. For both group A and Group B, the upper lobectomy was used with double drainage tube. In case of middle or lower lobectomy, placing single drainage tube.

In group A, 8F ultrafine chest drainage tubes (ABLE®; Baihe, Guangdong, China) were placed postoperatively. The upper tube was placed in the 2rd intercostal space of the midaxillary line, and the lower tube was placed in the 7th ~ 9th intercostal the space of posterior axillary line. In group B, 24F chest drainage tubes (Cobonyy®; Kebang, Suzhou, China) were placed along the 7th intercostal observation hole after surgery. See Fig. 1.

After operation, electrocardiogram (ECG) and vital signs were monitored continuously and routine fluid was supplemented. Blood gas analysis, electrolyte analysis and bedside chest radiograph were reviewed on the first day after operation. Computer Tomography (CT) examination was performed on the third day after the operation. Nursing care of thoracic drainage was performed to ensure unobstructed drainage tube.

The criteria for chest tube removal were as follows: (1) drainage volume < 50 mL in 24 h; (2) absence of intrathoracic hemorrhage and air leakage, (3) absence of signs of pleural effusion and atelectasis.

Postoperative pain was evaluated by a visual analogue scale [12]: every patient subjectively scored postoperative pain on a scale of 0 (no pain) to 10 (severe pain). Pain scores were recorded on postoperative days (POD) 1, 2 and 3. Observation indicators were total postoperative drainage volume, drainage days, postoperative hospital stay, and postoperative complications (including subcutaneous emphysema, pulmonary infection, atelectasis, chest tube reinsertion, and intrathoracic hemorrhage).

Statistical analysis

SPSS 20.0 software was adopted for data analysis (IBM, Armonk, NY). Continuous variables were expressed as mean ± standard deviation (SD). Categorical variables were expressed as frequencies and percentages. Significant differences between the groups were assessed using Student's t - tests for continuous variables, and χ^2 -tests for categorical variables. Mann-Whitney test was used for ordinal categorical variable. A p-value of less than 0.05 was taken as a level of significance for all analyses.

Results

There was no significant difference in the general data between the two groups, indicating no statistical significance ($P > 0.05$), as shown in Table 1. Compared with Group B, Group A showed significant advantages in pain score (POD 1, 2 and 3), postoperative drainage volume, drainage days, and postoperative hospital stay ($P < 0.05$), as shown in Table 2.

Table 2

Visual analogue scale scores, Drainage time, Total drainage volume and Postoperative hospital stay

Postoperative observed indicators	Group A(n = 67)	Group B(n = 67)	P-value
Visual analogue scale score			
POD 1	3.72 ± 0.65	3.94 ± 0.67	0.027
POD 2	2.72 ± 0.93	3.13 ± 1.04	0.016
POD 3	1.87 ± 0.65	2.39 ± 1.22	0.005
Drainage time(d)	4.25 ± 1.79	6.04 ± 1.96	0.000
Total drainage volume(ml)	1100.42 ± 701.57	1369.39 ± 624.25	0.021
Postoperative hospital stay(d)	8.46 ± 2.48	9.37 ± 1.70	0.014
Scale variables were expressed as median and range, ordinal and nominal parameters as absolute numbers, and percent.			
POD postoperative days			

Postoperative complications of the two groups: subcutaneous emphysema, pulmonary infection, atelectasis, chest tube reinsertion, and intrathoracic hemorrhage were not significantly different ($P > 0.05$), as shown in Table 3. Thirty-seven cases of subcutaneous emphysema were found 1 ~ 3 days after operation, among which 33 cases were mild subcutaneous emphysema, which was cured by full exhaust drainage through thoracic drainage tube, and the remaining four cases were cured after chest tube reinsertion due to drainage tube dislocation or poor drainage. All the ten cases of pulmonary infection were found 3 ~ 4 days after operation, and were cured by ECG monitoring, anti-infection and nutritional support. Eleven patients with atelectasis were found 3 ~ 4 days after operation, and all of them showed poor performance of active cough and sputum excretion. Two cases of thoracic hemorrhage were found in the postoperative recovery room. After a thoracotomy in time and effective hemostasis, the patients were cured and discharged from the hospital.

Table 3
Postoperative complications

Variable	Group A(n = 67)	Group B(n = 67)	P-value
subcutaneous emphysema(%)	25.37%	29.85%	0.562
pulmonary infection(%)	5.97%	8.96%	0.511
atelectasis(%)	5.97%	10.45%	0.345
chest tube reinsertion(%)	4.48%	1.49%	0.310
intrathoracic hemorrhage(%)	2.99%	0%	0.154
Scale variables were expressed as median and range, ordinal and nominal parameters as absolute numbers, and percent.			

Discussion

The routine use of chest drainage tube after lobectomy is helpful for pleural effusion to be discharged from the body, eliminate the residual cavity of the chest and promote the reexpansion of the lung. It is very important to reduce pulmonary infection and timely detect intrathoracic bleeding and other postoperative complications[5]. Therefore, the selection of chest drainage tube should first consider the safety and effectiveness of patients[13]. With the promotion and use of the concept of ERAS and minimally invasive surgery deeply rooted in the hearts of the people in recent years[10], we realize that postoperative pain and diaphragm stimulation caused by thick chest tubes may not be conducive to the accelerated recovery of patients after operation. So, it is of great clinical significance to explore whether 8F ultrathin chest drainage tube is safe and reliable compared with traditional thick chest drainage tube, in order to accelerate the recovery of patients.

Due to the pressure of the drainage tube on the intercostal nerve and diaphragm, the placement of the closed thoracic drainage tube will cause postoperative chest This study showed that there were statistically significant differences in pain scores between the two groups on POD 1,2 and 3 after surgery(3.72 ± 0.65 point vs 3.94 ± 0.67 point, $P = 0.027$; 2.72 ± 0.93 point vs 3.13 ± 1.04 point, $P = 0.016$; 1.87 ± 0.65 point vs 2.39 ± 1.22 point, $P = 0.005$). Pain scores in group A were significantly better than those in group B. Postoperative pain increases, which affects the recovery of patients' respiratory function and increases the risk of postoperative respiratory complications. The postoperative pain was reduced, which enhanced the initiative of cough and sputum, promoted lung expansion, reduced lung infection, and was more conducive to ambulation.

The operation of 8F ultrafine chest drainage tube is simple, the extubation is convenient and quick. After extubation, the incision closes naturally and it is not easy to inject air. Just apply the normal dressing externally. However, after the extubation of 24F thick thoracic duct, in order to avoid the intake of air or leakage of drainage outlet, vaseline gauze or reserved suture ligation is needed, which is more complicated and risky, and long surgical scar will be left after healing, affecting the appearance and

leaving psychological trauma that is difficult to heal for the patient. After switching to ultrafine chest drainage tube, the incision was small, the perivascular tissue inflammatory response was mild, postoperative scar was small, and it was more beautiful.

In this study, the drainage days in group A were shorter than those in group B (4.25 ± 1.79 d vs 6.04 ± 1.96 d, $P = 0.000$), the postoperative hospital stay in group A were shorter than those in group B (8.46 ± 2.48 d vs 9.37 ± 1.70 d, $P = 0.014$), and the total postoperative drainage volume was also lower than that in group B (1100.42 ± 701.57 ml vs 1369.39 ± 624.25 ml, $P = 0.021$). The differences were statistically significant. The inner wall of the ultrafine chest drainage tube is smooth, with strong anti-coagulation ability and good flexibility. It can be coiled in the costophrenic angle or followed between the lung and chest wall, making drainage more smooth and sufficient. However, the texture of the thick chest tube is hard, and it is not easy to be completely placed in the costophrenic angle or followed between the chest wall and the lung lobe. Therefore, it may compress the lung lobe and diaphragm muscle, and stimulate the increase of pleural effusion.

Although the inner diameter of 8F ultrafine chest drainage tube is smaller than that of traditional 24F drainage tube, patients ambulate earlier, promote fluid accumulation and drainage faster due to its advantage in pain management, and the risk of atelectasis and pulmonary infection does not increase significantly compared with the thick drainage tube (5.97% vs 10.45% , 5.97% vs 8.96% , $P \geq 0.05$). If the lung recovers well and coughs without bubble overflow, patients using 8F ultrafine chest drainage tube can replace the water-sealed drainage bottle as the drainage bag, so that patients can ambulate more easily, which is also the convenience of the thin drainage tube.

For patients with postoperative air leakage, drugs such as high glucose can be injected into the chest to promote thoracic adhesion. The operation of 8F ultrafine chest drainage tube is simple and aseptic, while injecting drugs into thoracic cavity through traditional 24F chest drainage tube is tedious and easy to be contaminated.

Among the 67 patients in group A, 2 patients with intrathoracic hemorrhage were found in the postoperative resuscitation room and underwent secondary surgery for hemostasis, and all of them were cured and discharged. The results showed that although the 8F ultrafine chest drainage tube had a thicker and smaller inner diameter, it could still find the intrathoracic hemorrhage in time and effectively.

8F ultrafine chest drainage tube also has several problems: (1) Among the cases in group A, the reasons for the chest tube reinsertion in 3 patients were drainage tube dislocation. Therefore, the depth of the catheter should be flexibly grasped according to the thickness of the chest wall in clinical practice. It should not be too shallow or too deep. Too shallow may cause the drainage tube to come out, and too deep the drainage tube may bend into an angle in the chest cavity to affect the drainage. (2) The ultrafine chest drainage tube should be placed at another puncture point, not through the surgical incision. Because if the tissue around the tube is not dense enough, there may be fluid seepage around the mouth of the tube; drainage orifice exudation may also occur after extubation.

Conclusion

In conclusion, the application of 8F ultrafine chest drainage tube after thoracoscopic lobectomy can reduce postoperative pain, fully drain, facilitate ambulating, accelerate postoperative recovery, and do not increase the risk of postoperative complications such as subcutaneous emphysema, pulmonary infection, atelectasis. At the same time, it can detect postoperative thoracic hemorrhage timely and effectively, which is an effective, safe and reliable way of drainage.

Abbreviations

ERAS: enhanced Recovery after surgery;VATS:video-assisted thoracoscopic surgery;MLND:mediastinal lymph node dissection;CT:Computer Tomography; POD:postoperative days;SD:standard deviation

Declarations

Acknowledgments

Not applicable.

Availability of supporting data

The datasets used and analysed during the current study are available from the corresponding author on reasonable request

Authors' contributions

Junfeng Liu and Yongbin Song conceived the study.Shaohui Zhou,Hongshang Cui collected the data, Jincong Wang,Jianxun Wang analysed the data and performed statistical analyses.Wenhao Wang,Lijun Liu searched researches.Yongbin Song,Chong Zheng drafted the manuscript.Junfeng Liu gave important intellectual contribution and critically revised the manuscript. All authors read and approved the final manuscript.

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Ethics approval and consent to participate

Our research was approved by Ethical Committee of the Hebei General Hospital.All enrolled patients signed informed consent

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests

Author details

¹Graduate School, Hebei Medical University. ²Graduate School, Hebei North University. ³Department of Thoracic Surgery, Hebei General Hospital, Shijiazhuang, Hebei, P.R. China. ⁴Ningbo University Medical School. ⁵Department of Thoracic Surgery, Hebei Medical University Fourth Affiliated Hospital and Hebei Provincial Tumor Hospital, Shijiazhuang, Hebei, P.R. China.

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Figures



Group A



Group B

Figure 1

The appearance of placing chest drainage tube