Clinical Effect of Lobectomy Under Single-Hole Thoracoscope in Minimally Invasive Surgical Treatment of Non-Small Cell Lung Cancer

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Abstract: **Aims:** To explore the effect of single-hole thoracoscopic lobectomy in the treatment of non-small cell lung cancer (NSCLC). **Methods:** A total of 56 patients with NSCLC from the Third People's Hospital of Jinan during May 2020 to May 2022 were selected as the study subjects, which were divided into control group and observation group according to the difference of treatment methods. Three holes thoracoscopic lobectomy was performed in the control group, and single-hole thoracoscopic lobectomy was conducted in the observation group. The operation time, intraoperative bleeding, total number of lymph node dissection, total drainage volume of thoracic duct 3 days after operation, extubation time of thoracic duct, postoperative hospital stays, postoperative pain score (day 1, 3, 7), and postoperative complication rate were compared between the two groups. **Results:** Compared with the control group, the operation time, postoperative decannulation time and postoperative hospital stay of patients in the observation group were significantly shortened ($P<0.05$), the amount of intraoperative bleeding and the total drainage volume of thoracic duct 3 days after operation were significantly reduced ($P<0.05$), and the postoperative pain score and the incidence of postoperative complications were significantly improved ($P<0.05$). **Conclusion:** Single-hole thoracoscopic lobectomy is effective and safe in the treatment of non-small cell lung cancer, which is worthy of clinical promotion.

Keywords: Single-Hole Thoracoscopic Lobectomy; Three Holes Thoracoscopic Lobectomy; Non-Small Cell Lung Cancer (NSCLC); Lobectomy; Curative Effect

Intoduction

Lung cancer is the main cause of cancer related deaths, with an annual death toll of 1.6 million [1]. Non-small cell lung cancer (NSCLC) is the main subtype of lung cancer, accounting for about 85% of lung cancer cases [2]. At present, surgery is still one of the main methods for clinical treatment of NSCLC. With the promotion and application of thoracoscopic technology, thoracoscopic lobectomy has become a common operation for NSCLC patients at this stage due to its minimally invasive and high safety [3]. This study intends to compare the clinical efficacy of single hole thoracoscopic lobectomy with that of three holes thoracoscopic lobectomy in the treatment of NSCLC. The report is as follows.

1. Materials and methods

1.1 General data

56 patients with non-small cell lung cancer admitted to the Third People's Hospital of Jinan from May 2020 to May 2022 were selected as the study subjects. Inclusion criteria：①Patients diagnosed as lung cancer and confirmed as early

NSCLC by biopsy；②Tumor diameter ≤ 4 cm；③Tumor did not accumulate chest wall and large vessels；④No distant metastasis；⑤patients have signed informed consent form in advance. Exclusion criteria：① Patients have a history of chest trauma；②Intolerable lobectomy. According to the difference of treatment methods, the patients were divided into two groups: control group and observation group. The control group consisted of 26 patients who underwent lobectomy under three hole thoracoscope, including 15 males and 11 females, aged 49 to 73 years, with an average age of 60.23±7.51. Location of lesion：9 cases in the upper lobe of the left lung, 7 cases in the lower lobe of the left lung, 7 cases in the upper lobe of the right lung, and 3 cases in the lower lobe of the right lung. In the observation group, 30 patients underwent lobectomy under single hole thoracoscope, including 19 males and 11 females, aged from 51 to 75 years, with an average age of 61.73 ± 7.00. Focus location: left upper lobe 11 cases, left lower lobe 9 cases, right upper lobe 8 cases, right lower lobe 2 cases. There was no significant difference in general information between the two groups, which was comparable。

1.2 Surgical methods

All patients were examined before operation after admission. After admission, they were given general anesthesia with double lumen endotracheal intubation, recumbent position, one lung ventilation, and routine disinfection. In the control group, pulmonary lobectomy under three holes thoracoscope was performed. A 1.5cm incision was made between the 7th intercostal space of the midaxillary line as the observation hole, and a thoracoscope was placed. A 3cm incision was made between the 4th intercostal space of the front axillary line and the 7th intercostal space of the scapular line as the operation hole. For patients with ground glass nodule, the micro spring coil combined with methylene blue localization under CT guidance before operation, while for those who have been diagnosed pathologically before operation, lobectomy was performed directly. If there was no pathological result, the lesion was first removed by wedge and sent for rapid pathology. Lobectomy was performed after lung cancer was identified。All patients underwent systematic lymph node dissection. The left side included groups 4, 5, 6, 7, 9, 10 and intrapulmonary lymph nodes, and the right side included groups 2, 3, 4, 7, 9, 10 and intrapulmonary lymph nodes. The observation group received lobectomy under single hole thoracoscope. The patient was intubated under general anesthesia and placed in a transverse position. After one lung ventilation, an elastic rubber protective sleeve was placed in the fourth to fifth intercostal (about 3 cm long) hole at the front of the axilla as the operation hole, and a trocar was placed at the other end of the seventh intercostal (about 1.5 cm long) of the posterior axillary line as the observation hole. Hilar and mediastinal lymph nodes were completely removed by thoracotomy or thoracoscopic resection. The specimen was then placed in a clean bag, from which it was removed through an operating hole, and a closed thoracic drainage tube was placed.

1.3 Observed indicator

The observation indexes included the operation time (excluding the rapid pathological time during the operation), the amount of bleeding during the operation, the number of lymph node dissection groups, the total number of lymph node dissection, the total drainage volume of the thoracic duct 3 days after the operation, the time of decannulation of the thoracic duct after the operation, the length of hospital stay after the operation, the postoperative pain score (the first, third, seventh days), and the incidence of postoperative complications. Postoperative pain was scored using VAS scale: 0: painless; 1-4 points: mild pain; 5-6 points: moderate pain; 7~9 points: severe pain, which was still tolerable; 10 points: unbearable pain [4]. Postoperative complications include incision infection, pneumothorax, pulmonary infection and atelectasis.

1.4 Statistical analysis

SPSS 26.0 statistical software was used to process the data. The quantitative data （ $\bar{x}\pm s$）conforming to the normal distribution were tested by t test, and the qualitative data (%) were analyzed by $\chi 2$ test or Fisher exact test, $P<0.05$ indicates

that the difference is statistically significant.

2. Results

2.1 The surgical conditions were compared between the two groups

The operation time of the observation group was significantly shorter than that of the control group. In addition, the amount of intraoperative bleeding, the volume of drainage 3 days after operation, the time of chest tube extubation and the length of hospital stay after operation in the observation group were significantly higher than those in the control group（P＜0.05）. However, there was no significant difference in the number of lymph node dissection between the two groups (P＞0.05).

Table 1. The operation conditions of the two groups were compared

	operation time（min）	Intraoperative bleeding（ml）	Total lymph node dissection	the volume of drainage 3 days after operation（ml）	the time of chest tube extubation（min）	the length of hospital stay after operation（days）
Control group（n=26）	153.80±24.86	60.73±5.54	11.27±2.77	621.70±38.42	5.92±1.13	7.46±1.33
Observation group（n=30）	192.90±9.94	47.53±4.90	12.07±2.61	453.70±27.44	3.10±0.71	5.73±0.87
t	7.938	9.458	1.109	19.010	11.350	5.820
P	<0.001	<0.001	0.272	<0.001	<0.001	<0.001

2.2 Comparison of VAS pain scores between two groups

The VAS pain scores of patients in the two groups 1, 3 and 7 days after surgery are shown in Table 2. The pain scores in the observation group are significantly lower than those in the control group, with statistically significant differences (P＜0.05).

Table 2. VAS pain score of patients between two groups（ $\bar{x}$±s）

	1 day after operation	3 days after operation	7 days after operation
Control group（n=26）	7.12±1.45	5.27±0.92	3.08±0.80
Observation group（n=30）	6.20±0.71	3.77±1.01	1.60±0.72
t	3.057	5.800	7.269
P	0.0035	<0.001	<0.001

2.3 Comparison of complication rate between two groups

There were 2 patients had incision infection, 1 pneumothorax, 3 pulmonary infections and 2 atelectasis in the control group with the total incidence of complications was 30.77%. Moreover, 1 case of incision infection, 2 cases of lung infection and 1 case of atelectasis occurred were found in observation group with the total incidence of complications was 13.33%. The incidence of complications in the observation group was significantly lower than that in the control group, with statistical significance (P<0.05).

Table 3. Comparison of complication rate between two groups

	Incision infection	Pneumothorax	Pulmonary infection	Atelectasis	Total incidence
Control group（n=26）	2（7.69%）	1（3.85%）	3（11.54%）	2（7.69%）	8（30.77%）
Observation group（n=30）	1（3.33%）	0（0.00%）	0（0.00%）	1（3.33%）	2（6.67%）
χ^2					5.516
P					0.019

3. Discussion

At present, lobectomy is commonly used in clinical treatment of NSCLC. However, the traditional open surgery has great trauma, which is not conducive to the recovery of patients as soon as possible [5]. SALATI M et al. first reported the efficacy of lung wedge resection under single hole thoracoscope in the treatment of spontaneous pneumothorax and interstitial lung disease, and clearly put forward the concept of single-hole thoracoscope [6]. In recent years, with the continuous development of minimally invasive technology, single hole endoscopic surgery is gradually applied to different pneumonectomy [7-9]. However, the safety, difficulty and lymph node dissection of single-hole thoracoscopic surgery are still questioned.

The results of the study showed that the operation time of lobectomy under single-hole thoracoscope was significantly shorter than that of the control group (P<0.05), and the volume of intraoperative bleeding, the total drainage volume of thoracic tube 3 days after operation, the time of removal of thoracic tube after operation, and the length of hospital stay after operation were significantly better than those of the control group (P<0.05). It was suggested that lobectomy under single hole thoracoscope was more effective than lobectomy under three hole thoracoscope, which was consistent with the research results of a large number of scholars [10-12]。 This may be because compared with the three hole operation, the single hole operation has less bleeding, which can save the time for hemostasis and chest closing, so the operation time will not be prolonged; It has less trauma to patients and less bleeding, which can reduce the trauma to patients' bodies caused by surgery, enable patients to recover their incisions and bodies as soon as possible, shorten the time of decannulation and hospitalization after surgery, and thus shorten the recovery time of patients after surgery [13]. In addition, the total number of lymph node dissection in the observation group was more than that in the control group, but the difference was not significant (P<0.05), indicating that single hole thoracoscopic surgery could achieve the same lymph node dissection effect as three holes endoscopic surgery.

The results of this study also showed that the pain scores of the observation group were lower than those of the control group at 1, 3 and 7 days after operation, with a statistically significant difference (P<0.05). Three holes thoracoscopic surgery has many incisions and great damage to the human body, so the postoperative pain is obvious. Single hole surgery has only one operation hole, which has little damage to muscles, blood vessels and nerves, and the patients have little postoperative pain [14]. Therefore, single hole thoracoscopic lobectomy can minimize trauma, improve patient satisfaction, and thus improve their comprehensive quality of life, which is more in line with the minimally invasive concept of modern surgery [11].

Thoracoscopic lobectomy needs to remove 1~2 diseased lung lobes, which can significantly reduce lung volume and pulmonary ventilation. At the same time, postoperative pulmonary infection, atelectasis and other complications can affect pulmonary ventilation function, and reduce the pulmonary function of patients in a short period of time [15]. This study found that the probability of incision infection, pneumothorax, pulmonary infection and atelectasis in the observation group

(6.67%) was significantly lower than that in the control group (30.77%), which further proved the safety of single hole thoracoscopic lobectomy.

To sum up, single-hole thoracoscopic lobectomy has obvious advantages, which could shorten the operation time, the time for decannulation of the thoracic tube after the operation and the hospital stay after the operation, reduce the amount of intraoperative bleeding and the total drainage volume of the thoracic tube 3 days after the operation, improved the quality of life of patients, and could greatly reduce the occurrence of complications. Single-hole thoracoscopic lobectomy was a safe and effective operation method. However, due to the limited sample size, it is still necessary to further explore the exact efficacy of single hole thoracoscopic lobectomy in the future.

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