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Observation on the Effect of Spontaneous Ventilation Single-Port Thoracoscopy and Conventional Thoracoscopy on T Lymphocyte Subsets and Inflammatory Factors in Patients with Non-Small Cell Lung Cancer

Hefei Li[1†], Cuifang Liu[1†], Yanan Wang[2], Shaoyong Dong[1], Haijiang Liao[1], Ce Li[1], Xuguang Zhang[1*], Mo Deng[3*]

[1]Department of Thoracic Surgery, Affiliated Hospital of Hebei University, Baoding 071000, Hebei Province, China

[2]Pathology Department, Affiliated Hospital of Hebei University, Baoding 071000, Hebei Province, China

[3]Anesthesiology Department, Affiliated Hospital of Hebei University, Baoding 071000, Hebei Province, China

[†]These authors contributed equally to this work

***Corresponding authors:** Xuguang Zhang, 570079522@qq.com; Mo Deng, momo_129@126.com

Abstract: *Objective:* To explore the effects of two types of surgical approaches, spontaneous ventilation single-port thoracoscopy and conventional thoracoscopy, on T lymphocyte subsets and inflammatory factors in patients with non-small cell lung cancer. *Methods:* Fifty-eight patients with non-small cell lung cancer who underwent surgery in the Affiliated Hospital of Hebei University from January 2020 to December 2021 were selected as the study subjects. All of them underwent standard lobectomy and lymph node dissection. Among them, 32 patients who underwent spontaneous ventilation single-port thoracoscopy were included in the study group, while 26 patients who underwent conventional thoracoscopy were included in the control group. The perioperative related indices, lung function, immune factor levels, and inflammatory factor levels were compared between the two groups. *Results:* In the study group, the perioperative incision length, intraoperative blood loss, operation time, and number of lymph node dissections were 4.28 ± 2.01, 77.89 ± 12.02, 87.21 ± 16.11, and 20.69 ± 4.45, respectively. In the control group, the perioperative incision length, intraoperative blood loss, operation time, and number of lymph node dissections were 6.32 ± 2.45, 84.98 ± 16.98, 95.88 ± 14.89, and 21.45 ± 4.36, respectively. There was no statistical difference between the study group and the control group in the number of lymph node dissections and intraoperative blood loss; the lung function in the study group was significantly better than that in the control group; the levels of T cell subsets $CD4^+$, $CD8^+$, $CD4^+/CD8^+$, $CD16^+CD56^+$ of the study group were 46.36 ± 5.87, 30.98 ± 4.12, 1.19 ± 0.23, and 17.41 ± 6.25, respectively, while those in the control group were 35.78 ± 4.12, 34.14 ± 3.87, 1.04 ± 0.24, and 12.45 ± 5.56, respectively; the levels of immunoglobulin IgG, IgM, and IgA of the study group were 10.45 ± 2.14, 1.21 ± 0.24, and 1.26 ± 0.25, respectively, while those of the control group were 8.78 ± 1.78, 1.06 ± 0.12, and 1.06 ± 0.26, respectively, with statistical differences; the levels of CRP, IL-6, IL-8, and TNF-α of the control group were 21.87 ± 4.26, 98.01 ± 9.58, 111.03 ± 9.96, and 123.05 ± 9.77, respectively, while those of the study group were 19.47 ± 3.89, 89.12 ± 8.96, 104.32 ± 9.12, and 112.98 ± 9.16, respectively, in which the comparison was statistically significant. *Conclusion:* In the surgical treatment of non-small cell lung cancer, spontaneous ventilation single-port thoracoscopic surgery has several advantages, which include less trauma and bleeding. It reduces the impact of surgical trauma on the immune function of the body, improves the postoperative lung

function and inflammatory stress of the body, as well as accelerates the recovery of patients. It is an alternative to open lung lobectomy for the treatment of lung cancer.

Keywords: Spontaneous ventilation; Single-port thoracoscopy; Non-small cell lung cancer; T lymphocytes; Inflammatory factor

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1. Introduction

Non-small cell lung cancer (NSCLC) is a malignant lung tumor originating from the bronchial mucosa, bronchial glands, and alveolar epithelium, accounting for 85% of all lung cancers. Lobectomy combined with systematic lymph node dissection is a common surgical approach for the treatment of NSCLC. Compared with traditional thoracotomy, thoracoscopy has significant advantages, including less trauma and rapid recovery, and it is widely used in clinical practice. Single-port thoracoscopic surgery benefits from the advancements of surgical instruments and laparoscopic technology. While achieving the same curative effect as three-port thoracoscopic surgery, the surgical incision is reduced to one, thereby being minimally invasive. Traditional thoracotomy, on the other hand, enables the focus to be cleared completely and ensures a stabilized condition. It is a commonly used surgical approach in the clinical treatment of non-small cell lung cancer. However, due to large surgical trauma, patients are prone to experiencing strong pain and stress reactions after surgery, thus increasing the incidence of complications and prolonging the length of hospital stay among patients [1-5]. There has been an emerging trend in the application of thoracoscopic surgery in the treatment of non-small cell lung cancer by virtue of its advantages, including small incision, small impact on respiratory muscles and thoracic structures, and small stress response to the body, and the fact that it reduces bleeding and hospitalization time while accelerating recovery as well as obviates the need to cut ribs [2-7]. This study mainly investigated the effect of spontaneous ventilation single-port thoracoscopy and conventional thoracoscopy on T lymphocyte subsets and inflammatory factors in patients with non-small cell lung cancer.

2. Data and methods

2.1. Study population

Fifty-eight patients with non-small cell lung cancer who were treated in the Affiliated Hospital of Hebei University from January 2020 to December 2021 were selected as the subjects of the study. Among them, 32 patients who underwent spontaneous ventilation single-port thoracoscopy were included in the study group, while 26 patients who underwent conventional thoracoscopy were included in the control group. There was no statistically significant difference in the general data of the patients.

2.2. Methods

The preoperative preparation of spontaneous ventilation single-port thoracoscopy was the same as that of conventional thoracoscopy. The patient was placed in a lateral decubitus position, with arm abducted and fixed at 90°. An incision was made between the anterior axillary line and the midaxillary at the fourth or fifth intercostal space, about 3 cm long, with an incision protector placed in. A 10 mm 30° thoracoscopy was used, and the thoracoscopy was close to the side of the incision. The surgeon stood at the ventral side of the patient, and the hand holding the mirror is on the same side as the surgeon. Oval forceps were used to clamp the lung tissue and explore the location of the lesion. After the surgery, a plasma tube was placed in front of the incision as a closed thoracic drainage tube. A deep venous puncture catheter was placed in the 6th intercostal space at the posterior axillary line.

2.3. Observation indicators

The perioperative related indices, lung function, immune factor levels, which include the levels of T lymphocyte subsets and immunoglobulin, as well as inflammatory factor levels were observed and analyzed. Among them, the patients' pulmonary function was measured one month after surgery, whereas the levels of immune factors and inflammatory factors were determined via blood sampling on the first day after surgery.

2.4. Statistical analysis

SPSS 25.0 was used for t-test and chi-square test (χ^2).

3. Results

3.1. Comparison of perioperative related indices between the two groups

In the study group, the perioperative incision length, intraoperative blood loss, operation time, and number of lymph node dissections were 4.28 ± 2.01, 77.89 ± 12.02, 87.21 ± 16.11, and 20.69 ± 4.45, respectively. In the control group, the perioperative incision length, intraoperative blood loss, operation time, and number of lymph node dissections were 6.32 ± 2.45, 84.98 ± 16.98, 95.88 ± 14.89, and 21.45 ± 4.36, respectively. There was no statistical difference between the study group and the control group in the number of lymph node dissections and intraoperative blood loss, as shown in **Table 1**.

Table 1. Comparison of perioperative related indices between the two groups

Group	Control group (n =26)	Study group (n = 32)	t	P
Incision length (cm)	6.32 ± 2.45	4.28 ± 2.01	3.4847	0.0010
Intraoperative blood loss (mL)	84.98 ± 16.98	77.89 ± 12.02	1.8588	0.0683
Operation time (min)	95.88 ± 14.89	87.21 ± 16.11	2.1080	0.0395
Number of lymph node dissections	21.45 ± 4.36	20.69 ± 4.45	0.6257	0.5166

3.2. Comparison of pulmonary function between the two groups

The lung function of the study group was significantly better than that of the control group, as shown in **Table 2**.

Table 2. Comparison of pulmonary function between the two groups

Group	Control group (n =26)	Study group (n = 32)	t	P
FVC (L)	2.32 ± 0.41	2.89 ± 0.36	5.6348	0.0000
FEV_1 (L)	2.13 ± 0.41	2.52 ± 0.36	3.8554	0.0003
MVV (L)	103.98 ± 20.11	119.01 ± 20.69	2.7859	0.0073
FEV_1/FVC (%)	58.14 ± 7.45	63.45 ± 8.45	2.5080	0.0151

3.3. Comparison of immune factor levels between the two groups

The levels of T cell subsets $CD4^+$, $CD8^+$, $CD4^+/CD8^+$, $CD16^+CD56^+$ of the study group were 46.36 ± 5.87, 30.98 ± 4.12, 1.19 ± 0.23, and 17.41 ± 6.25, respectively, while those of the control group were 35.78 ± 4.12, 34.14 ± 3.87, 1.04 ± 0.24, and 12.45 ± 5.56, respectively; the levels of immunoglobulin IgG, IgM, and IgA of the study group were 10.45 ± 2.14, 1.21 ± 0.24, and 1.26 ± 0.25, respectively, while those of the control group were 8.78 ± 1.78, 1.06 ± 0.12, and 1.06 ± 0.26, respectively, with statistical differences, as shown in **Table 3** and **Table 4**.

Table 3. Comparison of T cell subsets between the two groups

Group	Control group (n =26)	Study group (n = 32)	t	P
$CD4^+$ (%)	35.78 ± 4.12	46.36 ± 5.87	3.3601	0.0014
$CD8^+$ (%)	34.14 ± 3.87	30.98 ± 4.12	2.9844	0.0042
$CD4^+/CD8^+$	1.04 ± 0.24	1.19 ± 0.23	2.4225	0.0187
$CD16^+CD56^+$ (%)	12.45 ± 5.56	17.41 ± 6.25	3.1563	0.0026

Table 4. Comparison of immunoglobulin levels between the two groups

Group	Control group (n =26)	Study group (n = 32)	t	P
IgG (g/L)	8.78 ± 1.78	10.45 ± 2.14	3.1826	0.0024
IgM (g/L)	1.06 ± 0.12	1.21 ± 0.24	2.9024	0.0053
IgA (g/L)	1.06 ± 0.26	1.26 ± 0.25	2.9762	0.0043

3.4. Comparison of inflammatory factor levels between the two groups

The levels of CRP, IL-6, IL-8, and TNF-α of the control group were 21.87 ± 4.26, 98.01 ± 9.58, 111.03 ± 9.96, and 123.05 ± 9.77, respectively, while those of the study group were 19.47 ± 3.89, 89.12 ± 8.96, 104.32 ± 9.12, and 112.98 ± 9.16, respectively, with statistically significant difference, as shown in **Table 5**.

Table 5. Comparison of inflammatory factor levels between the two groups

Group	Control group (n =26)	Study group (n = 32)	t	P
CRP (mg/L)	21.87 ± 4.26	19.47 ± 3.89	2.2393	0.0291
IL-6 (ng/L)	98.01 ± 9.58	89.12 ± 8.96	3.6432	0.0006
IL-8 (ng/L)	111.03 ± 9.96	104.32 ± 9.12	2.6740	0.0098
TNF-α (ng/L)	123.05 ± 9.77	112.98 ± 9.16	2.0348	0.0466

4. Discussion

In recent years, the development of single-port thoracoscopy has made thoracic surgery more minimally invasive and further reduced the surgical trauma and the pain experienced by patients. At the same time, the concept of enhanced recovery after surgery (ERAS) has garnered increasing attention from surgeons. The concept involves the use of better anesthesia and surgical techniques to reduce the trauma and pain experienced by patients, shorten the hospitalization time, and accelerate the recovery of patients [2]. Under ERAS and the concepts of "comfortable anesthesia" and "overall minimally invasive," non-intubation anesthesia with spontaneous ventilation has rapidly developed. General anesthesia with double lumen endotracheal intubation and one lung ventilation is the main mode of anesthesia in VATS. However, endotracheal intubation and general anesthesia may cause complications, such as airway injury, acute lung injury, tracheal spasm, arrhythmia, postoperative sore throat, etc., thus delaying postoperative recovery, prolonging postoperative hospitalization time, and increasing hospitalization expenses [3]. Non-intubated video-assisted thoracic surgery (VATS) refers to the use of regional anesthesia to complement analgesic and sedative drugs in VATS while maintaining spontaneous ventilation [8]. The non-endotracheal intubation anesthetic technique prevents complications of traditional general anesthesia via endotracheal intubation and has obvious advantages in surgeries, especially for myasthenia gravis patients and elderly patients. However, it puts forward higher requirements for surgeons and anesthesiologists. Thoracic surgeons must

have a good grasp of the skills needed for thoracoscopic surgery, while anesthesiologists need to be able to regulate relevant pathophysiology and equipped with skilled anesthesia techniques, such as endotracheal intubation in lateral position. We introduced the single-port thoracoscopic surgery in 2015 [9-12], and in terms of anesthetic techniques, we accumulated experience from simple pneumothorax procedures. Practice has proven that this approach is safe and feasible.

In addition to the tumor itself, which may have a certain impact on the patient's immune function, traditional thoracotomy has a significant impact on the immune system and also increases the risk of postoperative infection [13]. Immune cells and humoral immunity are the main components of the immune function. Changes in the levels of T lymphocyte subsets may affect the immune system. $CD4^+$ cells are helper T cells, which participate in immune response and promote the secretion of a variety of inflammatory factors; $CD8^+$ is a cytotoxic T cell, which kills pathological cells and viruses through the activation of helper T cells. The immune function of T cells can be directly reflected by the levels of $CD4^+/CD8^+$. $CD16^+$ and $CD56^+$ directly act on the body's defense against tumor cells through cytotoxic factors; the development of tumor has a significant correlation with their low levels [13]. The humoral immunity mainly achieves immune purpose through the barrier effect. IgG, IgM, and IgA are able to recognize B cell antigen molecules and effectively inhibit the occurrence of infection [14-16].

Peripheral blood T cell subsets are divided into $CD4^+$ helper/inducible T cells and $CD8^+$ inhibitory/cytotoxic T cells. Among them, $CD4^+$ cells help activate B cells to secrete antibodies and regulate the immune response of other T cells, while $CD8^+$ cells, which are the main cytotoxic effector cells, often exhibit cytotoxic activity [13]. Studies have shown that the large trauma from traditional thoracotomy weakens the immunity, while thoracoscopic surgery, which causes less trauma, has little impact on the immune function [14]. These findings are similar to the results of this study, suggesting that thoracoscopy can reduce the damage to the immune function and promote the recovery of T lymphocyte immune function [16].

In conclusion, in the surgical treatment of non-small cell lung cancer, spontaneous ventilation single-port thoracoscopic surgery has several advantages, including less trauma and bleeding. It reduces the impact of surgical trauma on the immune function, improve the postoperative lung function and inflammatory stress of the body, as well as accelerate the recovery of patients. It is an alternative to open lung lobectomy for the treatment of lung cancer.

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Disclosure statement

The authors declare no conflict of interest.

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