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ORIGINAL

COMPARATIVE ANALYSIS OF MICROMETASTASIS INDICATORS AND PROGNOSIS IN FITNESS AND ATHLETIC PATIENTS WITH NON-SMALL CELL LUNG CANCER POST PULMONARY LOBECTOMY VERSUS SEGMENTECTOMY

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ABSTRACT

Objective: To analyze the impact of fitness and athletic lifestyle on micrometastasis indicators and prognosis in patients with non-small cell lung cancer (NSCLC) undergoing pulmonary lobectomy and segmentectomy. **Methods:** This retrospective analysis included 40 NSCLC patients, all of whom were fitness enthusiasts or athletes, treated at our institution from January 2020 to December 2021. These patients were divided into two groups: a lobectomy group and a segmentectomy group, each comprising 20 patients. We compared treatment outcomes, clinical indicators (operative time, intra-operative blood loss, chest drainage, length of hospital stay), micrometastasis indicators (CK20mRNA, CK19mRNA, CEAmRNA, lunxmrna) in peripheral blood, lung function (forced vital capacity, forced expiratory volume in 1 second), postoperative complications, and quality of life (physical, psychological, social, environmental) for both groups before and 6 months' post-therapy. **Results:** ① No significant difference in healing effect between the two groups (P>0.05). ② The segmentectomy group showed reduced chest drainage and hospitalization time compared to the lobectomy group (P<0.05), with no significant difference in surgery time and intra-operative blood loss (P>0.05). ③ No significant difference in pre-therapy micrometastasis indicators between the groups (P>0.05). Post-therapy, both groups showed similar levels of CEAmRNA (P>0.05). ④ Pre-therapy lung function was comparable between groups

($P>0.05$), but post-therapy, the segmentectomy group had better lung function ($P<0.05$). ⑤ No significant difference in postoperative complication rates ($P>0.05$). ⑥ The segmentectomy group exhibited superior quality of life post-therapy in all aspects. **Conclusion:** Both pulmonary lobectomy and segmentectomy are effective in treating NSCLC in fitness and athletic patients. Lobectomy showed better outcomes in altering tumor micrometastasis indicators post-surgery, while segmentectomy was more favorable for postoperative lung function, chest drainage, and hospital stay. The choice of procedure should be tailored to the patient's individual condition, considering their active lifestyle and physical demands.

KEYWORDS: Pulmonary lobectomy; Segmentectomy; Non-small cell lung cancer; Micrometastasis indicator; Prognosis

1. INTRODUCTION

Non-small cell lung cancer (NSCLC) represents a significant health challenge globally, and its management often requires surgical interventions such as pulmonary lobectomy and segmentectomy. These procedures, while effective, can have varying impacts on patients, particularly those leading an athletic lifestyle(Li et al., 2021; Popat et al., 2021). The physical demands and health dynamics of athletic patients necessitate a nuanced understanding of how surgical choices affect their outcomes, especially in terms of micrometastasis indicators and overall prognosis(Gong et al., 2021; H et al.).

Athletic individuals typically exhibit enhanced lung capacity and efficiency, traits that are crucial in their performance and overall health. Surgical intervention, therefore, must be optimized to preserve these attributes as much as possible. Additionally, the physiological resilience and recovery capabilities of this group might differ significantly from the general population, influencing their response to surgery and postoperative recovery (Bertaglia et al., 2021; Donington et al., 2018).

This study aims to analyze the changes in micrometastasis indicators and the prognostic implications of pulmonary lobectomy versus segmentectomy in athletic patients diagnosed with NSCLC. Considering their unique physiological characteristics, this research seeks to provide a comparative evaluation of these surgical approaches, focusing on various clinical outcomes. These include operative time, intra-operative blood loss, chest drainage, length of hospital stay, changes in lung function, occurrence of postoperative complications, and quality of life assessments (Chen et al., 2019; Passiglia et al., 2020).

By specifically focusing on athletic patients, this research addresses a gap in the current understanding of NSCLC surgical outcomes in this population. The findings aim to guide clinicians in making more informed surgical decisions and tailoring postoperative care to better suit the needs of patients who engage in regular athletic activities(Johnson, Pennell, & Borghaei, 2018; Van Laar, van Amsterdam, van Lindert, de Jong, & Verhoeff, 2020). This approach is pivotal for ensuring not just the effectiveness of the cancer treatment, but also the preservation of the patient's quality of life and ability to return to their athletic endeavors.

2. Athletic Patient Data and Methods

2.1 Patient Data

A total of 40 Athletic patients suffering from non-small cell lung carcinoma treating in our institution during the period from January 2020 to December 2021 were taken as the study subjects for retrospective analysis. These 40 Athletic patients were classified into two groups of 20 Athletic patients in each group: i.e. the controlling group and the observing group. In the controlled group, there were 12 men and 8 women; the minimum age was 44 years and the maximum was 76 years, with a mean measurement of (55.66 ± 6.11) years; the minimum tumour diameter was 1 cm and the maximum tumour diameter was 2 cm, and the average measured data was (1.54 ± 0.31) cm; there were 10 cases of adenocarcinoma, 7 cases of squamous cell carcinoma and 3 cases of other pathological types; there were 12 cases occurring in the right lung and 8 cases in the left lung.

There were 13 males and 7 females in the observation group; the youngest was 43 years old, while the oldest was 77 years old and the average measured data was (55.67 ± 6.12) years old; the minimum diameter of the tumors was 1 cm, the maximum diameter was 2 cm, and the average measured data was (1.55 ± 0.32) cm; there were 11 cases with adenocarcinoma, 6 cases with squamous cell carcinoma and 3 cases with other pathological types; there were 13 cases occurring in the right lung and 7 cases in the left lung. The above data between groups were evaluated by statistical software, and there was no difference, with $P > 0.05$.

Inclusion criteria of the Athletic patients: (1) Athletic Patients met the relevant clinical medical diagnostic criteria for non-small cell lung cancer; (2) All Athletic patients were confirmed by intraoperative pathological examination; (3) Athletic Patients with clear indications for surgical treatment. Exclusion criteria: (1) Athletic Patients combined with other malignant tumor diseases; (2) Patients with severe cognitive impairment; (3) Athletic Patients had received chemotherapy and radiotherapy before surgery.

2.2 Methods

The control group (performed by pulmonary lobectomy): Athletic Patients received general anesthesia and then were performed unilateral ventilation of the contralateral lung, and at the same time Athletic patients obtained a decubitus position in healthy side, and the upper limb of the operation side was suspended. The incision was made at the intersection of the 8th intercostal part and the anterior axillary midline of the patients' body to perform thoracoscopy for patients, and then 1-3 operative cannula incisions were made. The operating hole of retractor was made around the posterior axillary line of the 7th and 8th intercostal part of the patients' body.

A small incision was made at the anterior and posterior axillary line of the 6th intercostal part of the patients' body to place a surgical instrument needle to process wedge resection for the lung lobes, and then the specimens were taken out and sliced for examination. The upper lobe of the left lung was treated by traction with noninvasive lung forceps, and the mediastinal pleura under the aortic arch was cut by ultrasonic scalpel. After the vascular sheath was separated, the upper lobe artery branches were disconnected by disposable endoscope. The lung lobe tissues were lifted up after the lung lobe traction again, to fully free the upper lobe bronchus, and then the upper lobe bronchus was closed and disconnected.

Observation group (performed by segmentectomy): After anesthesia, the patients' posture, specific incision location, surgical placement, pulmonary arteriovenous and bronchial separation treatment were consistent with those of the control group. Then the intersegmental fissure was closed and disconnected along the plane of the segment surface, and the distance between the resection scope and the edge of the tumor was kept at more than 2 cm. The frozen pathological examination of the resection margin was rapidly carried out after resection. If the result was positive, lung lobe needed to be resected again, and if it was negative, then systematic lymph gland was cleaned and submitted for examination. After that, the chest was rinsed with warm saline and then number 28 intrathoracic drain was placed, and the chest was closed gradually if no abnormality was confirmed.

2.3 Evaluation Criteria

The treatment effects of both groups were compared. The clinical indicators (operative time, intra-operative blood loss, chest drainage and length of stay) of the two groups were compared. The positive rates of tumor micrometastasis indicators (CK20mRNA, CK19mRNA, CEAmRNA and LunxmRNA) in peripheral blood for both groups before and after 6 months of therapy were compared. The lung functions (forced vital capacity, forced expiratory volume in 1 second) for both groups before and after 6 months of therapy were compared. The occurrence of postoperative complications was compared for both groups. The quality of life (physical, psychological, social and environmental) for both groups before and after 6 months of therapy were compared. The treatment effects of both groups: The judgment basis of treatment effects was according to the tumor disease judgment standard formulated by the World Health Organization. It was divided into complete remission, partial remission, disease progression, and stable lesion. Among them, complete remission was that there were no lesions in the lung and no metastasis of the tumor found after the relevant medical imaging examination.

The partial remission was that the lesion area in the lung was reduced by more than 30% after the relevant medical imaging examination. Disease progressed was that the lesion area in the lung was reduced after relevant medical imaging examination, and the reduction degree was less than 30%. The stable lesion was that the lesions in the lungs have not improved after the relevant medical imaging examination, and even had the situations of increased area or metastasis. Total effectiveness rate = full remission rate + partial remission rate + disease progression rate. Tumor micrometastasis indicators in peripheral blood (CK20mRNA, CK19mRNA, CEAmRNA and LunxmrRNA): 4ml venous blood samples of patients in fasting state was collected and mixed with heparin, then the samples were shaken well and performed relevant operations according to the instructions of Trizol kit. And total RNA was extracted after cell lysis.

Lung functions (forced vital capacity, forced expiratory volume in 1 second): The relevant data results were measured according to the lung function test apparatus.

Postoperative complications: The complications included pulmonary infection, atelectasis and arrhythmia.

Quality of life (physical, psychological, social and environmental): According to the integrated quality of living assessment questionnaire, each area is scored out of 100. The upper the mark, the greater the quality of living of the patient.

2.4 Statistical methods

All index data were included in spss23.0. The count data were expressed in the form of % and $\chi^2$was used to verify. The measurement data were expressed in the form of $\bar{x}\pm s$ and t-value was used to verify. $P < 0.05$ was the inspection standard.

3. Results

3.1 Comparison of the treatment effects of the two groups of patients

There were no discrepancies in the data indicators comparing the therapeutic effects of the observed and controlled groups with P>0.05, as illustrated in Table 1 and Figure 1

Table 1: Comparison of treatment effects between the two groups (%)

GROUP	COMPLETE REMISSION	PARTIAL REMISSION	DISEASE PROGRESSION	STABLE LESION	TOTAL EFFECTIVE RATE OF TREATMENT
OBSERVATION GROUP	2 (10.00)	10 (50.00)	4 (20.00)	4 (20.00)	16 (80.00)
CONTROL GROUP	1 (5.00)	10 (50.00)	4 (20.00)	5 (25.00)	15 (75.00)
X^2					0.143
P					0.705

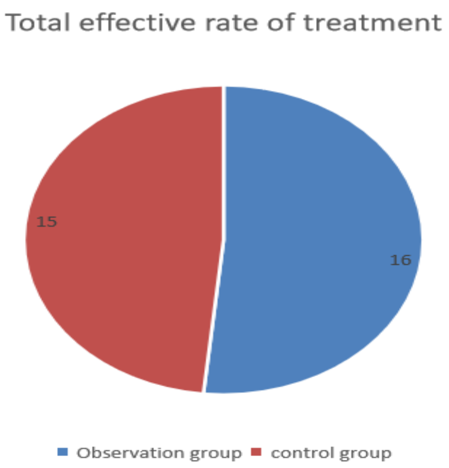

Figure 1: Comparison of treatment effects between the two groups

3.2 Comparing the clinical indicators of both groups (operating time, intra-operative blood loss, chest drainage and length of hospital stay)

The data indicators of chest drainage and hospital stay in the observed group were below those of the controlled group, and there was a discrepancy, $P<0.05$; however, there was no discrepancy in the data indicators of operating time and intra-operative blood loss between the observed group and the controlled group, $P>0.05$, see Table 2 and Figure 2.

Table 2: Comparing the clinical indicators of both groups (operative time, intra-operative blood loss, chest drainage and length of hospital stay)

GROUP	OPERATION TIME (MINUTES)	INTRAOPERATIVE BLOOD LOSS (ML)	THORACIC DRAINAGE VOLUME (ML)	LENGTH OF STAY (DAYS)
OBSERVATION GROUP	140.44 ± 5.55	156.66 ± 10.22	122.22 ± 4.44	7.77 ± 0.55
CONTROL GROUP	141.45 ± 5.56	156.77 ± 10.23	144.33 ± 6.66	9.89 ± 0.11
T	0.575	0.034	12.353	16.903
P	0.569	0.973	0.000	0.000

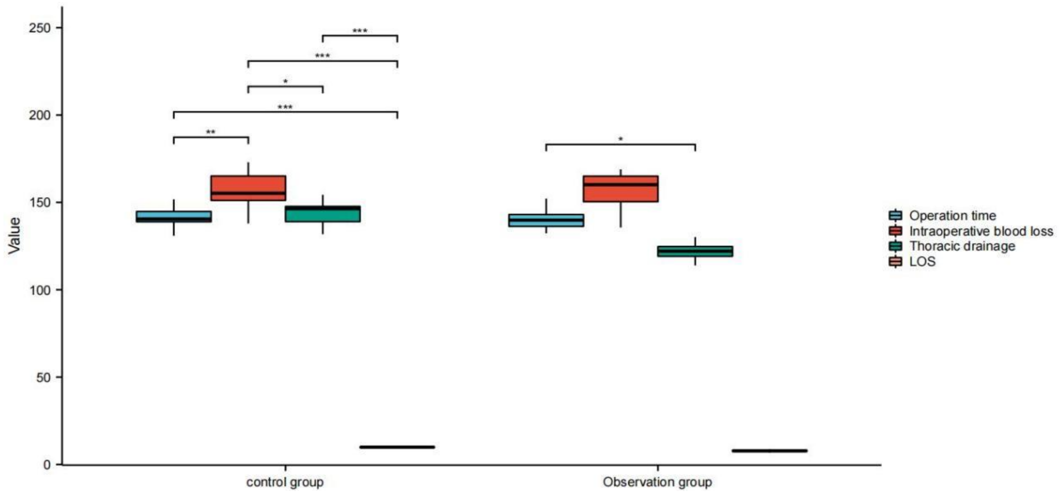

Figure 2: Comparison of clinical indicators (operation time, intraoperative blood loss, thoracic drainage and length of stay) of both groups

3.3 Comparison of positive rates of tumor micro metastasis indicators (CK20mRNA, CK19mRNA, CEAm RNA and LunxmRNA) in peripheral blood of both groups before therapy and after 6 months of therapy

There was no discrepancy in comparing the data index of the positive rate of tumor micro metastasis indicators in peripheral blood between observed group and controlled group before therapy, with P>0.05; after 6 months of therapy, the positive rates of CK20mRNA, CK19mRNA and Lunxm RNA in the controlled group were below those in the observed group, and the data differed, P<0.05. There was no discrepancy between the data indicators of CEAm RNA positivity in the observed and controlled groups after 6 months of therapy, P>0.05, see Table 3 and Figure 3.

Table 3: Comparison of the positive rates of tumor micrometastasis indicators (CK20mRNA, CK19mRNA, CEAmRNA and LunxmRNA) in peripheral blood for both groups before and after 6 months of therapy were compared. (%)

GROUP	CK20MRNA		CK19MRNA		CEAMRNA		LUNXMRNA	
	Before treatment	6 months of treatment	Before treatment	6 months of treatment	Before treatment	6 months of treatment	Before treatment	6 months of treatment
OBSERVATION GROUP	11.55 ± 4.55	6.66 ± 1.11	13.33 ± 4.44	7.77 ± 2.22	9.44 ± 0.55	5.55 ± 0.33	13.67 ± 4.33	6.66 ± 1.44
CONTROL GROUP	11.56 ± 4.53	4.55 ± 1.02	13.36 ± 4.43	5.66 ± 1.11	9.45 ± 0.56	5.53 ± 0.33	13.69 ± 4.32	5.55 ± 1.22
X^2	0.007	6.260	0.021	3.802	0.057	0.192	0.015	2.630
P	0.994	0.000	0.983	0.001	0.955	0.849	0.988	0.012

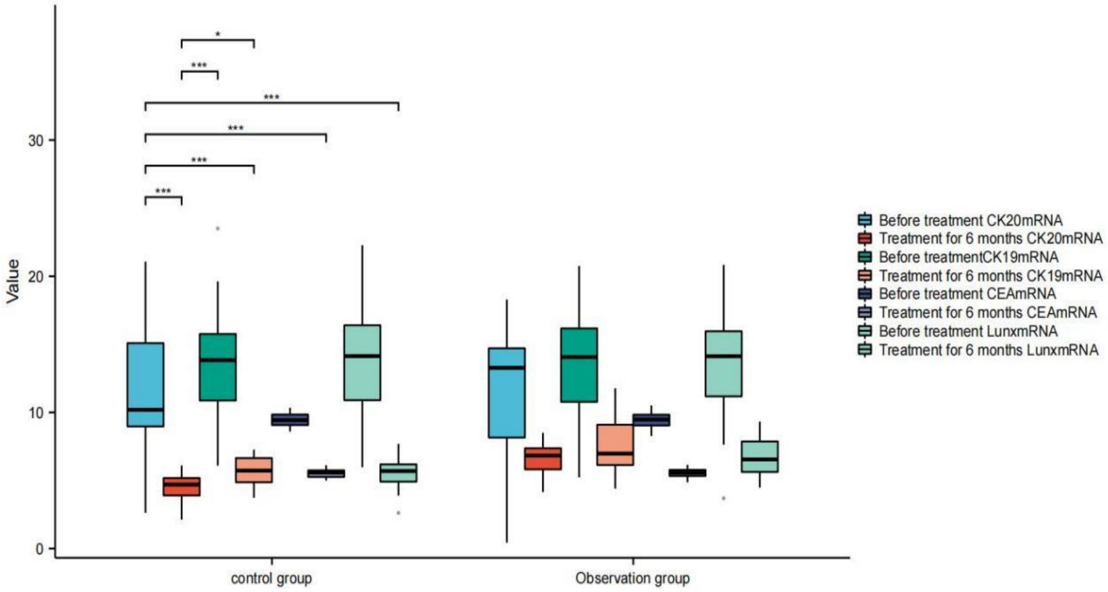

Figure 3: Comparison of the positive rates of tumor micrometastasis indicators (CK20mRNA, CK19mRNA, CEAmRNA and LunxmRNA) in peripheral blood for both groups before and after 6 months of therapy were compared.

3.4 Comparison of the lung functions (forced vital capacity, forced expiratory volume in 1 second) for both groups before and after 6 months of therapy were compared

There was no discrepancy between the observed group and the controlled group in the data indicators of forced vital capacity and first second forced expiratory volume before therapy, P>0.05; however, the forced vital capacity and first second forced expiratory volume of the observed group were above the controlled group after 6 months of therapy and there was a discrepancy in the data, P<0.05, see Table 4 and Figure 4.

Table 4: Comparison of lung functions (forced vital capacity, forced expiratory volume in 1 second) for both groups before and after 6 months of therapy were compared.

GROUP	FORCED VITAL CAPACITY		FORCED EXPIRATORY VOLUME IN 1 SECOND	
	Before treatment	6 months of treatment	Before treatment	6 months of treatment
OBSERVATION GROUP	91.22 ± 3.33	81.22 ± 3.11	92.22 ± 4.44	86.66 ± 3.33
CONTROL GROUP	91.23 ± 3.35	76.44 ± 2.22	92.23 ± 4.45	78.22 ± 3.11
T	0.009	5.594	0.007	8.284
P	0.992	0.000	0.994	0.000

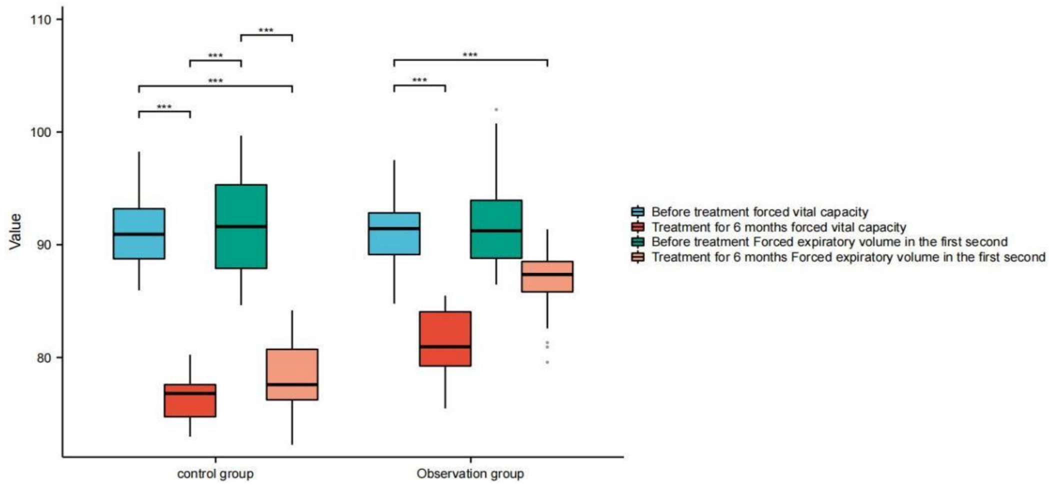

Figure 4: Comparison of lung functions (forced vital capacity, forced expiratory volume in 1 second) for both groups before and after 6 months of therapy were compared

3.5 Comparison of the occurrence of postoperative complications for both groups

There was no discrepancy in comparing the data index of postoperative complication rate between the observed group and the controlled group, with P>0.05, see Table 5 and Figure 5

Table 5: Comparison of the occurrence of postoperative complications for both groups (%)

Group	Pulmonary Infection	Atelectasis	Arrhythmia	Complication Rate
Observation Group	1 (5.00)	1 (5.00)	1 (5.00)	3 (15.00)
Control Group	1 (5.00)	2 (10.00)	1 (5.00)	4 (20.00)
X^2				0.173
P				0.677

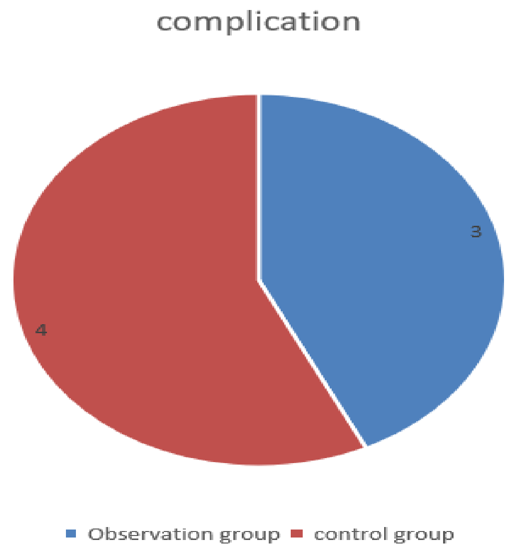

Figure 5: Comparison of postoperative complication rates for both groups

3.6 Comparison of the quality of living for both groups before and after 6 months of therapy (physical, psychological, social and environmental)

The quality of living indicators of the observed group was above the controlled group after 6 months of therapy and there was a discrepancy in the data, P<0.05, see Table 6 and Figure 6.

Table 6: Comparison of the quality of living for both groups of patients after 6 months of therapy (physical, psychological, social and environmental)

GROUP	PHYSIOLOGY	PSYCHOLOGY	SOCIETY	ENVIRONMENT
OBSERVATION GROUP	70.44 ± 2.22	70.56 ± 2.33	70.65 ± 2.11	70.98 ± 2.13
CONTROL GROUP	65.55 ± 1.22	65.67 ± 2.11	65.22 ± 1.35	65.23 ± 1.11
T	8.633	6.957	9.694	10.706
P	0.000	0.000	0.000	0.000

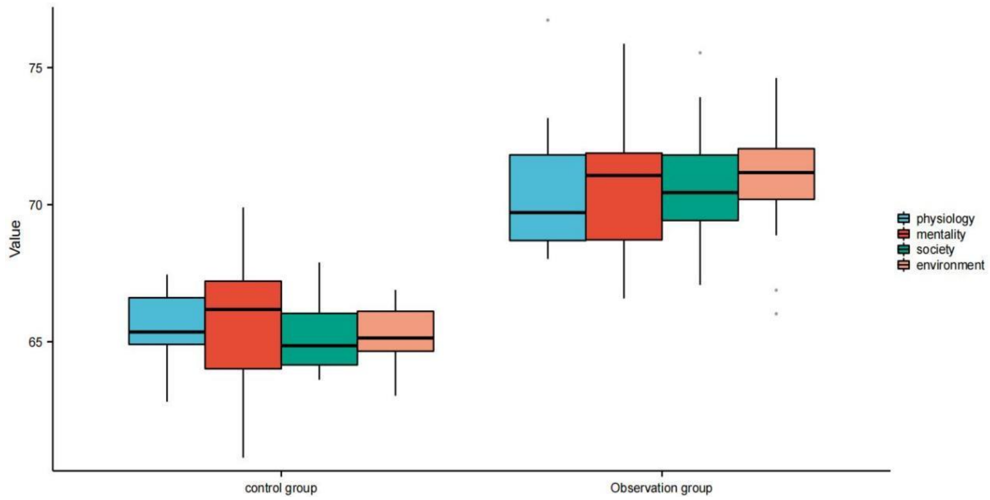

Figure 6: Comparison of the quality of life of the two groups of patients after 6 months of treatment (physical, psychological, social and environmental)

4. Discussion

There are many ways to treat non-small cell lung cancer, such as radiotherapy, chemotherapy and surgery. Among them, surgical treatment is conducive to removing tumor tissues and providing favorable conditions for other related treatment, so surgical treatment has been used frequently in clinic (Hayashi et al., 2022; Mennecier, Olland, Mascaux, & Falcoz, 2021). Thoracotomy is the main way to treat non-small cell lung cancer, which can directly contact with the lesion tissues and completely remove the lesions. However, this surgical method will bring greater body trauma to patients, and the risk of the incidence of complications after surgery is higher (Seto et al., 2022; Zou et al., 2022). Since thoracoscopic technology has been widely used in the treatment of clinical diseases, the degree of trauma brought to patients by surgical treatment has been reduced, and the risk of the incidence of postoperative complications has also been reduced (Huang et al., 2021; Mitchell et al., 2020). The pulmonary lobectomy performed based on thoracoscopy is beneficial to obtain the exact therapeutic effect, but this surgical method will have a certain impact on the lung functions of patients, while segmentectomy performed based on thoracoscopy can effectively remove the lesion tissues and effectively preserve the healthy lung tissues (Gao et al., 2022; Lococo, Chiappetta, Cesario, & Margaritora). This study mainly analyzes the specific efficacy of the above two surgical treatment methods.

With the continuous development and improvement of the current medical technology, the exploration of the structure of lung in body is more and more in-depth in clinic, and some studies have shown that the resection of the lesion lung segment can ensure the integrity of the patients' normal lung tissues to the greatest extent, and can effectively protect the lung function for patients with non-small cell lung cancer (Imai et al., 2021; Ryska et al., 2018). There are also relevant literature data showing that there is a close relationship between the prognostic effect of patients with non-small cell lung cancer and tumor cell metastasis indicators, in which tumor micrometastasis indicators in peripheral blood play a very important role in determination (Kodama et al., 2022; shimoyama et al.).

Tumor micrometastasis refers to that during the occurrence and development of malignant tumor, the adhesion between the cells is significantly reduced, and the tumor cells that have fallen off will be scattered along with lymph, blood and bone marrow in various organs and tissues inside the patients, and cannot be found after routine physical examination (Kiriu et al., 2019; Sun et al., 2020). Therefore, exploring the expression changes of tumor micrometastasis indicators in peripheral blood is the key factor to judge the prognosis of the disease. In this study, the data showed that the data indexes of treatment effects, operation time, intraoperative blood loss, positive rate of CEAmRNA after 6 months of therapy and postoperative complication rate of the observed group and the controlled group were compared showing that $P>0.05$ (De Silva & Jang, 2015).

The forced vital capacity, forced expiratory volume in the first second, and quality of life in the observed group after 6 months of therapy were greater than those in the controlled group, with $P<0.05$, while the index data of thoracic drainage volume and length of stay in the observed group were lesser than those in the controlled group. The positive rates of CK20mRNA, CK19mRNA, and LunxmRNA in the controlled group were lesser than those in the observed group after 6 months of therapy, with $P<0.05$ (Gharib, 2020).

According to this data, peripheral blood tumor micrometastasis indicators can be utilized to predict a patient's prognosis for non-small lung carcinoma, and specific surgical method can be selected according to various indicators and actual conditions of patients (Kojima et al., 2020; Lim et al., 2018). Among them, pulmonary lobectomy has a relatively low risk of micrometastasis, and the reasons may lie in that this surgical method can relatively and completely remove the lesion tissues to reduce the risk of tumor spread (Ma et al., 2020; Morita et al., 2022), while segmentectomy cannot completely rule out the possibility that there are still primary lesions, but it is conducive to effectively protecting the body's lung function, and reducing the irritation caused by surgical treatment to the body to the greatest extent (Cirenajwis, Lauss, Planck, Vallon-Christersson, & Staaf, 2020; Ostheimer et al., 2019).

5. Conclusion

In the context of fitness and athletic patients with non-small cell lung cancer (NSCLC), both pulmonary lobectomy and segmentectomy demonstrate significant therapeutic effectiveness. The study highlights that lobectomy is more advantageous in modifying tumor micrometastasis indicators in peripheral blood post-surgery. Conversely, segmentectomy shows a more favorable impact on postoperative lung function, chest drainage, and length of hospital stay. These findings are particularly relevant for patients engaged in regular physical activity, where lung function and rapid recovery are crucial. The decision between lobectomy and segmentectomy should be individualized, taking into account the patient's overall physical health, athletic demands, and specific clinical characteristics of NSCLC. This tailored approach ensures optimal treatment efficacy while supporting the unique health needs and lifestyle of fitness and athletic patients.

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