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Dividing inferior pulmonary ligament may change the bronchial angle

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ABSTRACT

Background: Whether dissecting the inferior pulmonary ligaments (IPLs) during superior video-assisted thoracoscopic (VATS) lobectomy for early stage lung cancer remains controversial. This study aimed to evaluate the influence of dissecting the IPLs during VATS superior lobectomy on bronchial distortion and recovery of pulmonary function.

Materials and methods: This was a retrospective study of 72 patients with non–small cell lung cancer who underwent VATS superior lobectomy from March 2012–August 2013 at the First People's Hospital of Yunnan Province. Patients were grouped according to IPLs preservation (group P) or dissection (group D). The preoperative and postoperative pulmonary function and the postoperative complications were analyzed. The changes in bronchi angles and pulmonary capacity were measured using computed tomography.

Results: There were no significant differences in the complication rate and volume of chest drainage between the two groups. The changes in bronchus angle in group P were significantly smaller than those in group D after left lung operation ($P = 0.046$ at 3 mo; $P = 0.038$ at 6 mo); in the right lung, the changes were not significant between the two groups ($P = 0.057$ at 3 mo; $P = 0.541$ at 6 mo). The forced expiratory volume of 2% and forced expiratory volume in 1 s (FEV1%) were significantly better in group P than those in group D at 3 and 6 mo ($P < 0.05$). The pulmonary capacity in group P was significantly larger than that in group D at 6 mo ($P = 0.002$).

Conclusions: Preservation of IPLs during VATS lobectomy might have an impact on the bronchus angle, lung function, and lung volume.

1. Introduction

Lobectomy is recommended for stage I or II lung cancer in patients who are medically fit and when the pretreatment staging suggests no lymph node involvement [1,2]. In an experienced center, minimally invasive resection is recommended for patients with stage I disease. Video-assisted thoracoscopic surgery (VATS) lobectomy has been suggested to reduce the likelihood of systemic recurrence and improve the 5-y overall survival compared with those of open lobectomy [1,3,4]. In addition, VATS lobectomy is associated with fewer complications compared with thoracotomy [1,5,6].

When considering all types of lung cancers, nearly two-thirds of the patients have lesions in the right or left superior lobe [7]. During superior lobectomy, thoracic surgeons routinely dissect the inferior pulmonary ligaments (IPLs),

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which can reduce the limitation of the range of motion of the inferior lobe, improve the reexpansion of the inferior lobe, and improve the filling of the residual cavity of the superior lobe. Theoretically, dissecting the IPLs can avoid the occurrence of atelectasis and pleural effusion [8]. However, IPLs are important to fix the lobes in the thoracic cavity [9].

Currently, there is no evidence confirming that dissecting IPLs can improve the prognosis and reduce the complication rate; thus, whether to dissect the IPLs remains controversial [9]. Using three-dimensional imaging techniques, Ueda *et al.* [10] found that 41% of the patients were suffering from varying degrees of bronchial distortion and stenosis after superior lobectomy and found that distortion and stenosis correlated with chronic dry cough and shortness of breath, as well as with significantly decreased pulmonary function. On the other hand, dissecting the IPLs may lead to bronchial stenosis, distortion, and pulmonary torsion, and patients may present with refractory dry cough and shortness of breath, which can be confirmed by computed tomography (CT) scan, x-ray, and bronchoscopy. Seok *et al.* [11] consider that bronchial distortion can affect the postoperative recovery of pulmonary function. Many authors observed that dissecting IPLs during superior lobectomy caused bronchial distortion, but they failed to find methods to prevent or reduce its incidence [8,9,12].

How to relieve the impact of bronchial distortion on postoperative pulmonary function and quality of life is an important subject. Therefore, the main purpose of the present study was to compare the outcomes between patients in whom IPLs were preserved or not during superior VATS lobectomy.

2. Materials and methods

2.1. Patients

This was a retrospective study of patients admitted from March 2012–August 2013 at the First People's Hospital of Yunnan Province. The inclusion criteria were (1) patients with non–small cell lung cancer (stage I–III); (2) candidate for superior lobectomy (no severe pleural adhesion according to CT scan and all other examinations before operation, no chronic obstructive pulmonary disease history); and (3) underwent VATS lobectomy. The exclusion criterion was being lost to follow-up.

The patients were divided into two groups according to the surgery method: group D (dissection of IPLs) and group P (preservation of IPLs). VATS lobectomy was performed with IPL dissection between March 2012 and October 2012, whereas VATS lobectomy with IPL preservation was performed between November 2012 and August 2013.

The present study was approved by the ethical committee of the First People's Hospital of Yunnan Province. The need for individual consent was waived by the committee because of the retrospective nature of the study.

2.2. Operative method

All operations were performed by the same team (including a professor, an associate professor, and a resident) at the First People's Hospital of Yunnan Province. Patients were placed in the standard lateral position and were given general anesthesia. A thoracoscope (10-mm HD, 1080P Thoracoscope system; Karl Storz, Tuttlingen, Germany) was deployed through three incisions along the affected side: one in the seventh midaxillary intercostal space (observation port), one in the fourth intercostal space in the anterior line (main operation port), and the other in the seventh intercostal space in the shoulder angle line (assistant operation port). Lymph node dissection was performed (including two groups).

A chest tube was placed in all patients during and after the operation, and the 24-h postoperative drainage was no more than 100 mL. There was no air overflow in the chest tube even when patients got severe continuous cough. The chest tube was removed when the residual cavity was less than two intercostal spaces on thoracic x-ray.

2.3. Outcomes

2.3.1. Angle measurement

All patients underwent thin-slice scan (supine position, 2.5-mm thickness) using a 64 multidetector helical CT before the operation and at 3 and 6 mo after operation. Raw data were transferred to the central database and reconstructed into three-dimensional images of the bronchi. The changes in the bronchus angle were measured according to the following principles. (1) For patients who underwent left superior lobectomy, the long axis of the left proximal primary bronchus was considered as the baseline on the coronal plane and came into an angle with the axis of the inferior pulmonary bronchus. (2) For patients who underwent right superior lobectomy, the baseline came into an angle with the axis of the middle pulmonary bronchus. The change of angle was determined as the preoperative angle minus the postoperative angle (Figure). The axes were drawn by a resident of radiology and examined and adjusted by a professor of radiology.

2.3.2. Pulmonary function test

Pulmonary function was examined in all patients using a pulmonary function test apparatus (Minato, Tokyo, Japan) before the operation, and at 3 and 6 mo after operation. Pulmonary function tests included forced vital capacity (FVC), forced expiratory volume in 1 s (FEV_1), and maximal ventilator volume (MVV).

2.3.3. Pulmonary capacity

The pulmonary capacity was measured 6 mo after operation using a 64-detector CT (top to bottom) after patients were trained to hold their breath. Volume was calculated using the Siemens (Stuttgart) Pulmo pulmonary quantitative automatic analysis software.

2.4. Statistical analysis

Data were processed using SPSS 17.0 (IBM, Armonk, NY). Continuous data are presented as mean ± standard deviation and were analyzed using the Student *t*-test. Categorical data are presented as frequencies and were analyzed using the chi-square test. Two-tailed *P* values <0.05 were considered to be statistically significant.