Original Article

Division of inferior pulmonary ligament did not impact on the postoperative recovery or recurrence in patients undergoing video-assisted thoracoscopic surgery for primary spontaneous pneumothorax

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Background: Division of inferior pulmonary ligament (IPL) after upper lobectomy was reported to prevent air leak. The research purpose is to investigate whether division of IPL for primary spontaneous pneumothorax (PSP) would decrease air leak and recurrence.

Methods: Between 2013/10 and 2015/9, all the patients younger than 30 years old in our institution undergoing video-assisted thoracoscopic surgery (VATS) for PSP were included in this study. Patient with odd chart number underwent division of IPL in addition to VATS wedge resection and pleurodesis for PSP, whereas patients with even chart number underwent VATS wedge resection and pleurodesis without division of IPL. The patient's age, gender, operative time, and recurrence were all recorded. Chest plain films were taken on the postoperative day 1 (POD1), postoperative day 7 (POD7), and two months after discharge to observe residual pleural space.

Results: A total of 110 patients were included in this study. The IPL was divided in 51 patients (rIPL group), and preserved in the other 59 patients (control group). The operative time increased in rIPL group slightly without significant difference (rIPL 81.1 verse control 88.4 minutes, P=0.539). The residual pleural space on the follow-up chest X-ray did not differ between these two groups. They both had similar chest tube drainage days (rIPL 2.7 days versus control 3.1 days, P=0.393). During the follow-up period, one patient in rIPL group (2.0%) and three patients (5.1%) in control group had recurrent pneumothorax (P=0.622).

Conclusions: Division of IPL for PSP did not provide clinical benefit of reduction air leak or recurrence rate.

Keywords: Pneumothorax; thoracoscopy; video-assisted thoracoscopic surgery (VATS)

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Introduction

Primary spontaneous pneumothorax (PSP) has been a worldwide health problem, with the incidence around 18–28/100,000 cases per annum for men and 1.2–6/100,000 for women (1). Video-assisted thoracoscopic surgery (VATS) has been proved as a safe and reproducible approach for PSP. The recurrence rate of PSP was reduced to 10–20% with bullectomy alone, and 1–6% with bullectomy and

chemical or mechanical pleurodesis (1-5). The occurrence of PSP mostly results from rupture of apical blebs or bulla. Successful treatment of PSP lies in elimination of air-leaking blebs or bulla, and ablation of apical pleural space. Besides blebectomy, bullectomy, and pleurodesis, division of inferior pulmonary ligament (IPL), which has been reported to prevent postoperative complications associated with residual pleural space and prolonged air leak, might contribute to the reduction of postoperative air leakage and recurrence in patients undergoing VATS for PSP (6). Herein we retrospectively analyzed the impact of IPL division on the surgical outcome of VATS for PSP.

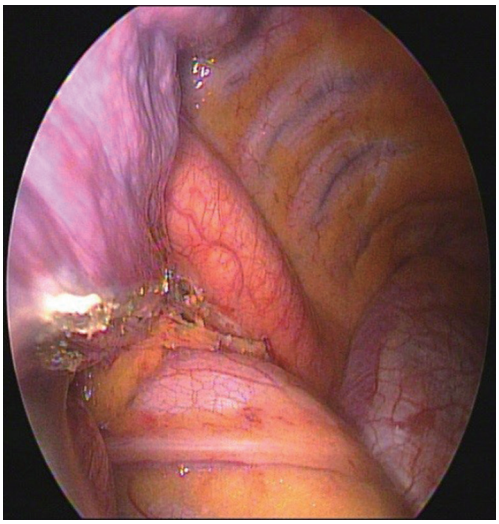

Figure 1 Release of IPL after bullectomy. The IPL was divided from the dome of hemidiaphragm until inferior pulmonary vein. IPL, inferior pulmonary ligament.

Methods

Patients younger than 30 undergoing VATS for PSP between Dec. in 2013 and Sep. in 2015 were enrolled in this study. All these patients underwent VATS blebectomy or bullectomy followed by mechanical and chemical pleurodesis with tetracycline 1000mg. Patients with odd chart numbers underwent additional procedure as division of IPL, and were classified as rIPL group demonstrated in *Figure 1*. Patients who did not undergo division of IPL were classified as control group. A 20 Fr chest tube was placed in the pleural space postoperatively, and negative pressure suction with –10 cmH2O was applied only if there was air leakage. The chest tube was removed when there was no more air leakage. The 1st postoperative chest plain film (CXR) was done on the 1st postoperative day (POD1), the 2nd was done on POD 7, and the 3rd was done at the clinic 2 months after the surgery (*Figure 2*). Recurrence was defined as postoperative ipsilateral pneumothorax, whereas contralateral pneumothorax was defined as new episode of pneumothorax. The follow-up period ranged from 44

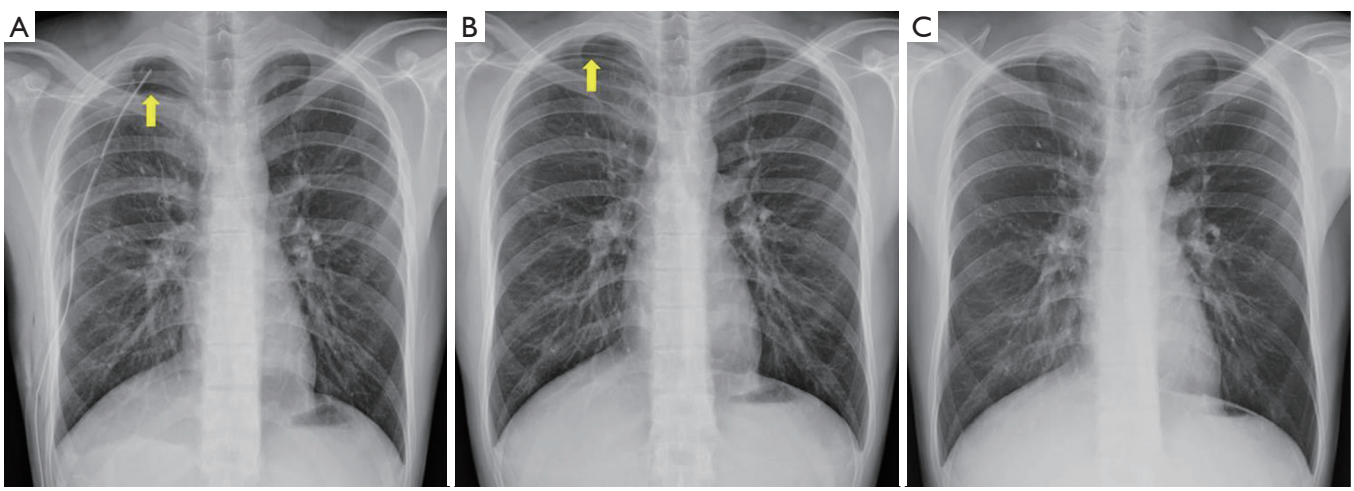

Figure 2 Following chest X-ray after VATS. (A) CXR1 was taken on postoperative day 1. The plain film revealed residual pleural space at apex and mild subcutaneous emphysema.(B) CXR2 was taken at first outpatient department after discharge. The plain film showed the chest tube was removed and there was still residual pleural space at apex. The yellow arrow points the pleural line. (C) CXR3 was taken after two months. The residual pleural space was resolved completely. VATS, video-assisted thoracoscopic surgery.

Table 1 Patients' characteristics and postoperative following data

Variables	rIPL, n=51	Control, n=59	P
Gender (male)	48 (94.1%)	55 (93.2%)	1.000
Age	21.5±6.5	21.6±5.1	0.926
OP time (min)	81.1±25.7	88.4±80.4	0.539
Postoperative chest tube drainage(day)	2.7±1.9	3.1±2.6	0.393
Residual pleural space in CXR1	33 (64.7%)	41 (69.5%)	0.742
Residual pleural space in CXR2	16 (31.4%)	29 (49.2%)	0.090
Residual pleural space in CXR3	0 (0%)	3 (5.1%)	0.247
Recurrence	1 (2.0%)	3 (5.1%)	0.622

to 67 months. Surgical outcomes such as operative time, days of chest tube drainage, postoperative recurrence, and the residual pleural space on the postoperative serial CXRs were included for analysis.

Statistic

Categorical data were presented as number (percentages), and non-categorical data as the mean ± standard deviation. Comparison of categorical variables between the study groups was performed using Chi square test, whereas comparison of continuous variables was performed using Student's *t*-test. The Kaplan-Meier method was used to calculate recurrence-free survival (RFS). A P value of ≤0.05 was set to indicate statistical significance. SPSS system (IBM SPSS Statistics, Version 22.0, Armonk, NY, USA) was used for statistical analysis.

Results

A total of 110 patients underwent VATS wedge resection and pleurodesis for PSP between Oct. 2013 and Dec. 2015. Fifty-one of the 110 patients underwent division of IPL as the rIPL group, and the rest 59 did not (control group). Patients in both groups were male predominant [rIPL 48 (94.1%) versus control 55 (93.2%), P=1.000] and at young age (rIPL 21.5±6.5 years versus control 21.6±5.1 year, P=0.926). Patient demographics and postoperative follow-up information were listed in *Table 1*. The operative time was longer in the rIPL group, and the difference was not significant (rIPL 81.1±25.7 min versus control 88.4±80.4 min, P=0.539). The period of time for chest tube drainage was not different between the two groups (rIPL 2.7±1.9 days versus control 3.1±2.6 days, P=0.393). The patient number with visible residual pleural space on POD1 CXR in each group was 33 (64.7%) in the rIPL group and 41 (69.5%) in the control group (P=0.742). The patient number with visible residual pleural space on POD7 CXR in each group was 16 (31.4%) in the rIPL group and 29 (49.2%) in the control group (P=0.090). There were 3 patients (5.1%) with visible residual pleural space in the control group and none in the rIPL group on the 2-month follow-up CXR (P=0.247). There was no postoperative hemothorax in each group or complication necessitating invasive procedure. One patient (2.0%) in the rIPL group and 3 (5.1%) in the control group had recurrence. The Kaplan-Meier curve for recurrence-free period revealed no difference (P=0.394) (*Figure 3*).

Discussion

Our surgical results demonstrated that division of IPL did not influence the postoperative recovery or recurrence in patients undergoing VATS for PSP. The CXR on POD1 revealed residual pleural space in more than 60% in each group. The residual pleural space remained visible on the POD7 CXR, and mostly did not impact on the decision of postoperative care and chest drain management. The residual pleural space was compensated eventually because of hyperinflation of the remaining parenchyma.

The IPL is a thin structure of fused triangular-shaped sheet of parietal and visceral pleura, connecting the inferior pulmonary vein and the dome of hemidiaphragm. After lung resection, the pleural space for remaining lung increases, and then gradually diminished because of the compensation mechanism consisting of mediastinal

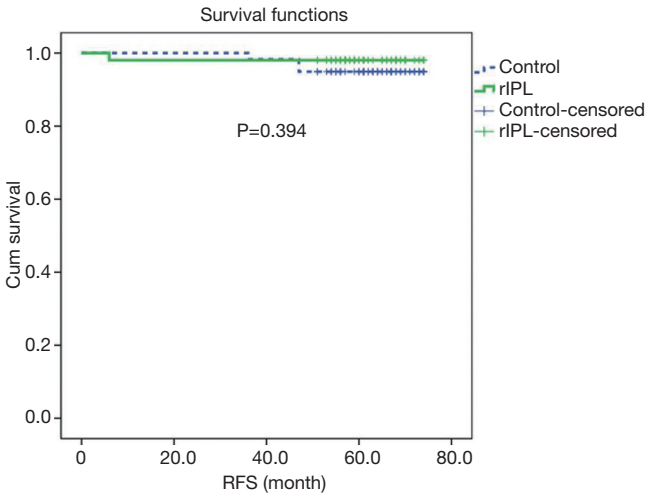

Figure 3 Kaplan-Meier curve of recurrence free survival.

shifting, diaphragm elevation, and overexpansion of the remaining lung parenchyma. It has been reported that division of IPL increased operative time but had no impact on the postoperative pulmonary expansion and recurrence rate, which is similar with our results (7). Thoracic surgeons supporting division of IPL after upper lobectomy suggested that this maneuver increased the mobility of the remaining lung parenchyma and decreased the likelihood of postoperative air leakage (6). On the contrary, division of IPL after upper lobectomy might change the angle of bronchus and lead to bronchial distortion, bronchial stenosis, or atelectasis (8-10). Moreover, preservation of IPL might preserve the postoperative pulmonary function (10). These aforementioned results concluded that division of IPL did not pose substantial advantage on the postoperative recovery (9-12).

In our series, the postoperative hospital stay for PSP was 2 to 3 days, and the postoperative recurrence rate was low compared to the literature report. The potential benefit of IPL division might not be clinically evident in patients undergoing wedge resection with pleurodesis for PSP. The extent of surgery for PSP was limited without upper lobectomy, and the remaining upper lobe parenchyma prevented bronchial distortion and the occurrence of a large residual pleural space. Division of IPL might therefore contribute little to the postoperative recovery of VATS wedge resection for PSP, and the procedure per se might injury the inferior pulmonary vein or parenchyma of lower lobe.

Conclusions

VATS IPL division for PSP does not impact on the postoperative recovery or reduction of air leak and recurrence.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Institutional Review Board of National Cheng Kung University Hospital (B-ER-104-141) and written informed consent was obtained from all patients.

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