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Research Article

Video-Assisted Thoracoscopic Lobectomy. Fissureless Technique. Study with 500 Cases

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Abstract

Objectives: Main reason why patients remain in the hospital after a pulmonary resection is prolonged air leak (PAL). This implies an increment of hospital costs and of stay-derived complications. The objective of this study has been to evaluate the real impact of fissure less technique in video-assisted (VATS) lobectomy in duration of air leak compared with other patients with open lobectomy.

Methods: This is a two-institution study. An observational analysis on prospectively collected data. A total of 250 consecutive patients (Group 1) underwent pulmonary VATS fissureless- lobectomy (VFL) and systematic mediastinal lymph node dissection (MLND). 250 consecutive patients (Group 2) treated with conventional postero-lateral thoracotomy lobectomy (CTL) and MLND.

Two groups were compared according to preoperative, operative and postoperative parameters.

Results: No differences were found when comparing patient characteristics.

VATS fissureless technic reduces significantly operation time (Group 1 = 160 min; Group 2 = 230 min; P = 0.004), reduce the incidence of (PAL) prolonged air leak (Group 1 = 6(2,4%) patients; Group 2 = 15(6%) patients; p = 0.01) and duration of chest tube (Group 1 = 3.2 days; Group 2 = 5.4 days; p = 0.002). No difference was observed in intraoperative loss of blood (Group 1 = 230 ml; Group 2 = 280 ml; P = 0.54).

In addition, no difference was observed in postoperative complications: bronchopneumonia, empyema, or haemothorax. Nevertheless, patients with VATS-fissureless technic also showed benefit on decreasing atrial tachyarrhythmia after lobectomy (Group 1 = 18 (7,2%) patients; Group 2 = 45(18%) patients; p = 0.001).

Conclusions: VFL appears to be a superior technique to CTL lobectomy in terms of PAL prevention and duration of chest tube. In addition, the appearance of postoperative atrial fibrillation is less frequent in the group of patients who undergo surgery using less invasive technique. More randomized controlled trials are required to confirm the validity of our findings.

Keywords: *Fissureless; Vats Lobectomy; Air Leak; Atrial Fibrillation; Lung Cancer; Chest Tube*

Abbreviations

PAL: Prolonged Air Leak; VATS: Video-Assisted Thoracic Surgery; VFL: VATS Fissureless- Lobectomy; CTL: Conventional Postero-Lateral Thoracotomy Lobectomy; ASA: American Society of Anesthesiologists; DLCO%: Carbon Monoxide Diffusion Lung Capacity; FEV1: Forced Expiratory Volume in 1 Second; METS: Metabolic Equivalents in Exercise Testing; ILB: Intraoperative Loss Of Blood; AT: Atrial Tachyarrhythmia; RUL: Right Upper Lobectomy; RML: Middle Lobe Lobectomy; RLL: Right Lower Lobectomy; LUL: Left Upper Lobectomy; LLL: Left Lower Lobectomy

Introduction

The role of minimally invasive surgery, through VATS, in pulmonary oncological resections has been widely discussed since early 1990s. Currently, it is accepted as a safe and effective procedure for treatment of early stage non-small cell lung cancer. Some groups defend this technique as the procedure of choice in surgical treatment of pulmonary neoplasms in stage I and II [1-4].

The incidence of leakage from the thoracic drainage is a cause of prolonged hospital stay. There are studies in which the incidence of prolonged air leakage through chest drainage can reach up to 15% of major lung resections.

Classically, the dissection of the pulmonary artery and segmental branches has been described, dissecting the artery in the fissure. The direct consequence of this dissection is an increase of air leak [5-7].

In the VFL surgical technique, a dissection of the pulmonary vein, the segmental arterial branches and the bronchus without opening fissure is performed. Then lung parenchyma is divided in order to minimize postoperative air leak.

Materials and Methods

A total of 500 patients underwent pulmonary lobectomy and systemic MLN dissection. This is a prospective observational study in which data were collected from 2 hospitals in Madrid (Spain) with 3 thoracic surgeons trained in open lung surgery and video-assisted thoracoscopy.

Data has been collected from January 2014 to January 2018 from 2 groups of patients. First group (group 1) underwent a lobectomy with systematic lymphadenectomy by videothoracoscopy (2 or 3 ports) using a technique without dissection of the artery in the fissure. The inclusion criteria for this group were to complete pulmonary resection by VATS and extubate the patient in the operating room. Patients who underwent pneumonectomy, those who required bronchoplastic reconstruction or were reconverted to open surgery have been excluded.

Second group (group 2) underwent thoracotomy with muscle preservation and costal retractor. Patients who required a pneumonectomy or who were intubated from the operating room were excluded. None of the patients should have firm pleural adhesions.

Surgery

VATS-fissureless (VFL)

To perform pulmonary resections by video-assisted thoracoscopy, we used 2 ports. Sometimes we need a third port if the angle of the endostapler is not adequate for dividing vascular or bronchial structure.

Working port is a 2 cm incision in the anterior axillary line above the fifth intercostal space. The port for the camera incised 12 mm in the eighth intercostal space. If necessary, we used a third port on the eighth intercostal space posterior to the scapular line.

Right upper lobectomy (RUL): We expose the hilum with a posterior traction of the lung. First we dissected pulmonary vein, then mediastinal artery and recurrent segmental branches. Finally we divided bronchus. Then we completed the fissure with (Figure 1).

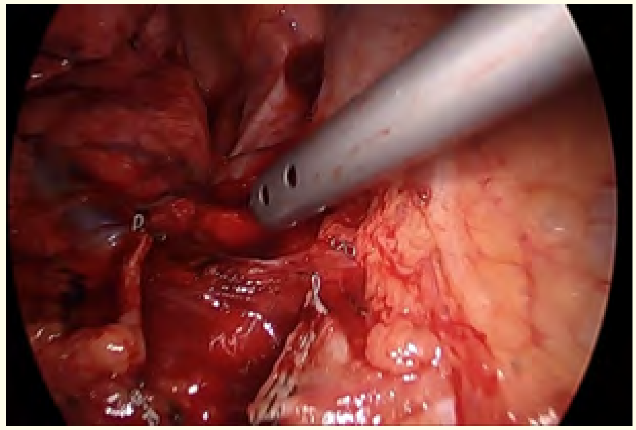

Figure 1: *Right upper lobectomy. Anterior view with vein divided.*

Middle lobe lobectomy (RML): We place the lung in the same way as for right upper lobectomy. First we dissect the pulmonary vein, then bronchus and then arteries. Finally we complete the fissures with the upper lobe and the lower lobe.

Right lower lobectomy (RLL): We perform a posterior and superior traction of the lung. First we dissected the inferior pulmonary vein, then bronchus for the lower lobe and finally basal segments and segment six arteries.

To conclude, we completed the fissure.

Left upper lobectomy (LUL): Begins with the anterior exposure of the hilum. We dissected left superior pulmonary vein, then dissected upper lobe bronchus and finally the arterial branches. Sometimes before dissecting the bronchus we need to dissect and resect a branch for the anterior segment. Finally we completed the fissure.

Left lower lobectomy (LLL): We perform a posterior and superior traction of the lung. First we dissected the inferior pulmonary vein, then bronchus for the lower lobe and finally basal segments and segment six arteries. At last complete de fissure.

Postero-lateral thoracotomy lobectomy (CTL)

For hilar dissection by thoracotomy we begin the dissection by the artery in the fissure. We expose the arterial crossroads in the fissure and divide arterial branches for each lobe. Then we complete the fissures with endostaplers. After that we dissected pulmonary vein and divided it. Finally we proceed to divide bronchus.

After surgery, a 28Fr pleural drainage was placed with aspiration at -20cmH_2O under water seal. Drain was removed after 24 hours without air leak. If air leak persisted on fifth day, a drainage system was placed to discharge the patient and control it on an outpatient basis.

Statistical analysis

Continuous variables are presented as means with standard deviations, while categorical variables are presented as frequencies and percentages. To compare 2 groups, the independent-samples t-test was used for continuous variables, while the Fisher exact test was used for categorical variables. IBM SPSS ver. 20.0 (IBM Corp., Armonk, NY, USA) was used for all statistical analyses. All p-values < 0.05 were considered to indicate statistical significance

Results and Discussion

As seen in table 1, both groups have homogeneous epidemiological characteristics. There are no differences in age (p 0.27), sex distribution (p 0.42), ASA (p 0.12), DLCO% (p 0.31), FEV1% (p 0.49), METS (p 0.33), heart disease (p 0.23) or preoperative chemotherapy (p 0.22).

	Group 1 (n = 250)		Group 2 (n = 250)		P-value
	Mean	Range	Mean	Range	
Age	68	37 - 82	69.4	40 - 80	0.27
Saxe (male)	130 (52%)		145 (58%)		0.42
ASA	3	1 - 4	3	1 - 4	0.12
DLCO%	72	48 - 116	77	51 - 122	0.31
FEV1%	77	42 - 122	74	46 - 112	0.49
METS	4.1	3 - 6	4,9	3 - 6	0.33
Heart disease	42 (16.8%)		50 (20%)		0.23
Preoperative chemotherapy	19 (7.6%)		22 (8.8%)		0.22

***Table 1**: Preoperative characteristics.*

ASA: American Society of Anesthesiologists; DLCO%: Carbon Monoxide Diffusion Lung Capacity; FEV1: Forced Expiratory Volume in 1 Second; METS: Metabolic Equivalents in Exercise Testing.

Table 2 describes the distribution of lobes resected by group. This distribution does not present differences between both. In the same way, the intraoperative blood loss is similar.

	Group 1 (n = 250)		Group 2 (n = 250)		P-value
	Mean	Range	Mean	Range	
Lobectomy					0.037
RUL	112		98		
RML	12		21		
RLL	36		25		
LUL	73		84		
LLL	17		22		
ILB (ml)	230	50 - 450	280	100 - 500	0.3
PAL	6 (2,4%)		15 (6%)		0.01
Days chest tube (median)	3.2	2 - 12	5.4	2-14	0.002
Postoperative complications	21 (8.4%)		23 (9.2%)		0.20
Atelectasis/pneumonia Empyema	3 (1.2%)		2 (0.8%)		0.22
Haemothorax	2 (0.8%)		3 (1.2%)		0.12
AT	18 (7.2%)		45 (18%)		0.001

***Table 2**: Comparison between Group 1 (VFL) an Group 2.*

ILB: Intraoperative Loss of Blood; PAL: Prolonged Air Leak; AT: Atrial Tachyarrhythmia

There is a statistically significant difference in patients with prolonged air leakage. 6 cases in VFL group and 15 in CTL group, p 0.01.

Furthermore, we also see a significant difference in thoracic drainage duration with a median of 3.2 days for VFL group and 5.4 days for the CTL group, p 0.002.

Postoperative complications analyzed presented a similar frequency in both groups (pneumonia/atelectasis, empyema and haemothorax). However, the incidence of supraventricular tachyarrhythmia (TA) is significant lower (18 cases) in VFL group compared to CTL (45 cases), p 0.001.

Discussion

Lung surgery has changed during the last decade. Video-assisted techniques are being implemented and aim to reduce hospital stay, perioperative complications, and an early incorporation to habitual activity.

Classically, dissection of pulmonary artery has been carried out by opening the fissure and identifying segmental arterial branches corresponding to each lung lobe or segment.

Most groups transfer dissection maneuvers from open surgery to minimally invasive surgery. This implies that they continue dissecting the artery and its segmental branches in the fissure. Opening pulmonary fissure when it is not complete leads to an increase in postoperative air leakage and, therefore, a longer hospital stay and costs [8,9].

When we perform a pulmonary resection avoiding the opening of the pulmonary fissure, we significantly minimize the risk of air leakage by avoiding the dissection of arterial branches by opening lung parenchyma. We complete division of lung lobes by endostaplers after carrying out the dissection of pulmonary hilum.

There are few studies in the literature that compare the dissection of the hilum without fissure with respect to classic dissection. Most authors analyze a limited number of cases and do not compare them with classical dissection of the pulmonary hilum [10-12].

Our technique without fissure is not exclusive to minimally invasive surgery. It can also be applied to open surgery. It was described by Temes., *et al* [13]. It is a simple technique to learn and easily reproducible and that together with the advantages of video-assisted thoracoscopy surgery. They allow to diminish drainage duration and they allow a precocious discharge to his address.

Another advantage of fissureless technique is the standardization of pulmonary artery dissection for cases with complete fissure and for those without. This allows to reduce surgical time in incomplete fissures.

Therefore, fissureless lobectomy appears to be a superior technique to conventional lobectomy for preventing the PAL and limiting the days with chest drainage. Furthermore fissureless lobectomy is similar to conventional lobectomy in terms of complications as we can see in literature and in our patients. Nevertheless in our study we can see lower incidence of atrial tachyarrhythmia in fisureless technique [14]. Similar conclusion has been drawn in other studies when compare conventional open lobectomy with vats lobectomy. Probably minimally invasive surgery is related with less incidence of atrial tachyarrhythmia as we can see in our study [15].

Nonetheless, this study is associated with certain drawbacks. Firstly in order to limit the deviations we have excluded all cases in the initial phase when we begin to perform VATS lobectomies. The learning curve of fissureless lobectomy might be different between surgeons. Secondly, this study is limited by its non-randomized character. Finally this is a study with a limited number of cases.

Conclusion

Fissureless lobectomy by VATS appears to be a superior technique to conventional lobectomy in terms of reducing air leak, PAL and lower incidence of atrial fibrillation. More multicenter and randomized clinical trials are required to confirm our results.

Conflict of Interest

No financial interest or any conflict of interest exists.

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