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ORIGINAL ARTICLE

Video-assisted thoracoscopic lobectomy with a single utility port is feasible in the treatment of elderly patients with peripheral lung cancer

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Abstract

Background: Video-assisted thoracoscopic (VATS) lobectomy with a single utility port has emerged as a new technology in recent years. The aim of this study is to review the technology in the treatment of elderly patients with peripheral lung cancer.

Methods: We retrospectively analyzed the clinical data of 21 elderly patients with peripheral lung cancer who underwent single utility port VATS lobectomy from February 2011 to February 2013 in the First Affiliated Hospital of Soochow University (VATS group). The clinical outcomes and postoperative complications were then compared to data from 32 elderly patients who underwent lobectomy by thoracotomy (TL group).

Results: No mortality occurred during the postoperative period in either group. There was no statistical difference in surgery duration, the quantity of lymph node dissection or intraoperative blood loss between the VATS and TL groups. However, significant differences existed in the postoperative hospital stay (6.19 ± 1.69 days vs. 8.22 ± 2.55 days), time to first activity out of bed (20.57 ± 7.72 hours vs. 26.81 ± 9.27 hours), chest drainage duration (4.24 ± 1.04 days vs. 5.22 ± 1.29 days), and total postoperative drainage volume (642.86 ± 158.18 mL vs. 787.81 ± 211.55 mL) between the VATS and TL groups ($P < 0.05$). The percentage of patients with no complications in the VATS group (85.71%) is significantly higher when compared with the TL group (56.25%, $P < 0.05$).

Conclusion: VATS lobectomy with a single utility port is a safe and feasible surgical procedure for selected elderly patients with peripheral lung cancer.

Introduction

Lung cancer is now the leading cause of malignant tumor related death in the world, and was expected to account for 26% of all female cancer deaths and 29% of all male cancer deaths in the United States in 2012.[1] In China, the issue may be even worse because of the dramatic increase of tobacco consumption. It has been reported that Chinese smokers represent about one-third of all smokers worldwide.[2] There has also been an increase in the incidence of primary lung cancer observed in never smokers, with increased incidence in females and a higher occurrence of adenocarcinoma compared with lung cancer in smokers.[3] Although the etiology of lung cancer in never or light smokers remains indefinite, there are several candidates for risk factors, such as environmental tobacco smoke, cooking fumes, and exposure to radon.[4] Never smokers were also characterized by a higher occurrence of peripheral lung cancer, which could be more easily detected at an early stage by a computed tomography (CT) scan.[5]

Progress in early diagnoses of lung cancer has been made in recent years, mainly attributed to the wide use of low-dose spiral CT scans.[6] Research has shown that annual spiral CT screening can effectively detect lung cancer at clinical stage I when it is still curable.[7]

Surgical resection remains the most effective therapy, especially for patients in early stages.[8] Lobectomy by thoracotomy (TL) has been the "golden standard" for early stage non-small cell lung cancer (NSCLC) compared with other treatment options.[9,10] However, thoracotomy is not a suitable treatment option for elderly patients, as many carry chronic diseases, such as diabetes, hypertension, and coronary heart disease, and, subsequently, have poor cardio-pulmonary function.[11,12] Video-assisted thoracoscopic (VATS) lobectomy, which has developed significantly during the past decade and become widely accepted, has provided opportunities to this category of patients because of the advantage of minimal invasion.[13,14] However, the use of conventional approaches for VATS, characterized by three or four ports in the chest wall, are restricted on elder patients with lung cancer because of complications caused, such as backache after surgery, sensory disorder, and bleeding from the incision.[15,16] In recent years, the use of VATS with a single utility port has become prevalent, requiring fewer incisions and providing quicker recovery times.[17] In this study, we retrospectively compared the surgical outcomes in elderly lung cancer patients who underwent VATS lobectomy with a single utility port and lobectomy by thoracotomy to elucidate the feasibility of the former in the treatment of lung cancer.

Patients and methods

We performed a retrospective review of all patients undergoing lobectomy for NSCLC in our institution from February 2011 to February 2013. The investigational review board at the First Affiliated Hospital of Soochow University approved this study. The inclusion criterion was as follows: patients over 70 years of age; with operable peripheral NSCLC; with a tumor the diameter of less than 5 cm; without enlarged hilar or mediastinal lymph nodes shown on enhanced CT scan; and who accepted lobectomy by VATS with a single utility port or thoracotomy as treatment. Patients who had received neo-adjuvant therapy, or accepted only wedge resection or segmentectomy, were excluded from the study. A total of 53 patients were enrolled in the study, including 21 patients who accepted VATS lobectomy with single utility port (VATS group), and 32 patients who accepted lobectomy by thoracotomy (TL group). The basic information available regarding the 53 patients included age, gender, tumor location, pathological type, and tumor node metastasis (TNM) grade and are summarized in Table 1.

Table 1 Comparison of clinical characteristics between groups

Clinical characteristics	VATS group ($n = 21$)	TL group ($n = 32$)	$t/\chi 2$	P
Gender			1.457	0.227
Male	14	26		
Female	7	6		
Age	73.90 ± 3.48	73.34 ± 2.55	0.678	0.501
Tumor location			1.557	0.858
Left upper	5	6		
Left lower	3	7		
Right upper	7	7		
Right middle	2	4		
Right lower	4	8		
Pathological types			0.910	0.340
Squamous cell carcinoma	9	18		
Adenocarcinoma	12	14		
T grade			0.602	0.889
1	9	12		
2	11	19		
3	1	1		
N grade			0.554	0.790
0	9	16		
1	9	13		
2	3	3		
TNM			0.840	0.686
I	8	16		
II	10	12		
III	3	4		

TL, lobectomy by thoracotomy; VATS, Video-assisted thoracoscopic lobectomy.

The preoperative workup for all patients included a complete medical history, a physical examination, pulmonary functions test, electrocardiogram, and a routine biochemical test. An enhanced CT scan of the chest and abdomen, brain magnetic resonance imaging (MRI) and a bone scan were performed in all cases to exclude distant metastasis. Fiberoptic bronchoscopy was performed in every case before surgery to exclude the involvement of the initial parts of the lobar bronchus. Each patient was scaled on the Charlson comorbidity index (CCI), which is a composite score of comorbid conditions that have been validated in cohorts of men and women with both malignant and nonmalignant disease,[18] and the scores were then divided into four grades: 0, 1–2, 3–4, ≥5.

Lobectomy in all patients was conducted with general anesthesia using a double-lumen endotracheal tube. The patient was positioned on the operating table in the lateral decubitus position, and an additional jackknife position was used in the VATS group. VATS lobectomy with a single utility port was performed with a 3 cm incision in the anterior axillary line in the fifth intercostal space, and a camera port placed in the posterior axillary line in the eighth intercostal space. Rib spreading was avoided, with a plastic round retractor put into the work port. Surgery was performed only in the work port, and the specimen of resected lobe covered by an endoscopic retriever was taken out from it. Conventional lobectomy by thoracotomy was performed with a standard posterolateral approach, and the procedure was routine.

All patients in this study accepted lobectomy and a systematic mediastinal lymphadenectomy as radical resection of

lung cancer. In the VATS group, the operation began with an incision in the posterior axillary line in the eighth intercostal space for the camera. When the camera was put into the thorax, a first look was taken to determine whether there were any adhesions or pleural effusion. In our experience, adhesion in most patients can be solved by electrotome with an extension, but particular attention should be paid when dealing with an adhesion near the mediastinum. The utility port in the fifth intercostal space was located according to the direction of the fissure, which may greatly facilitate the management of vessels, especially for pulmonary artery branches. An examination of frozen section by wedge was performed prior to the lobectomy when possible. Once diagnosis was confirmed, lobectomy began. Pulmonary veins were processed first in most patients. The process of hilar conformed to the sequence of vein, artery, and bronchus; occasionally the bronchus would be processed first in cases where dissection of artery branches was difficult. Endo-GIA was conventionally used in VATS surgeries, while in lobectomy by thoracotomy ligations were used more frequently. There are often difficulties when dealing with arteries and fissures, mainly because Endo-GIAs are difficult to put in the right position. We can overcome this problem in two ways: the routine use of angle staplers when difficult, and a silicone drainage tube used as guide for the stapler. In our experience, using the guide made the dividing of arteries and fissures safer and more convenient. We routinely asked the anesthetist to inflate lungs to confirm before dealing with the bronchus, it is very important to avoid errors. The dissecting range of lymph nodes in all patients were the same, including station 2~4, 7~9 in the right, or station 5~9 in the left.

The following characteristics of both groups were studied in each case: surgery duration, intraoperative blood loss, postoperative hospital stay, quantity of lymph node dissection, time to first activity out of bed, chest drainage duration, and postoperative drainage volume. Postoperative complications were recorded and the outcomes were compared between groups.

Statistical methods

All data was analyzed by SPSS 20.0 statistical software. Quantitative variables were summarized by mean ± standard deviation (SD) and the student's t-test was used to compare differences in mean values. Categorical variables were summarized by frequency (%) and analyzed by the chi-square tests or the Fisher exact test. A P value of <0.05 was considered significant.

Results

Of the 53 patients who accepted radical resection of lung cancer as treatment, 21 patients with a median age of 74 underwent VATS lobectomy with a single utility port, and 32 patients with a median age of 73 underwent lobectomy by thoracotomy. No mortality occurred during the postoperative period.

Table 2 Comparison of comorbidities between groups

Comorbidity	VATS group	TL group
Coronary artery disease	1	2
Congestive heart failure	2	4
Chronic pulmonary disease	14	20
Peptic ulcer disease	5	7
Mild liver disease	3	5
Cerebrovascular disease	3	3
Diabetes	4	6
Moderate to severe renal disease	1	2

TL, lobectomy by thoracotomy; VATS, Video-assisted thoracoscopic lobectomy.

There was no significant difference between the VATS and TL groups in age, gender, tumor location, pathological type, and TNM grade (Table 1). Some common chronic diseases or comorbidities, such as chronic pulmonary disease, congestive cardiac insufficiency, and diabetes, were found in patients of both groups (Table 2), and the comorbid conditions were measured by CCI (Table 3). The smoking status of each patient was also recorded. The results of statistic analysis showed no significant difference of the CCI grade and smoking status between the two groups.

The variables of intra-operation, postoperative characteristics, and complications in both groups are recorded in Table 4. The study shows that there is no significant difference in surgery duration, intraoperative blood loss, or quantity of lymph node dissection ($P > 0.05$). The VATS group showed superiority in postoperative hospital stay, time to first activity out of bed, chest drainage duration, and postoperative drainage volume results when compared with the TL group ($P < 0.05$).

Three patients in the VATS group experienced four kinds of complications, while 27 complications in 14 patients were

Table 3 Comparison of Charlson comorbidity index (CCI) grade and smoking status between groups

	VATS group	TL group	$t/\chi 2$	P
CCI grade			0.488	0.905
0	2	5		
1~2	16	22		
3~4	3	5		
≥5	0	0		
Smoking status			0.001	0.972
Smokers	15	23		
Non-smokers	6	9		

CCI, Charlson comorbidity index; TL, lobectomy by thoracotomy; VATS, Video-assisted thoracoscopic lobectomy.

Table 4 Comparison of perioperative period characteristics between groups

Outcome	VATS group	TL group	$t/\chi 2$	*P*
Surgery duration (minutes)	151.90 ± 28.04	165.00 ± 36.01	1.408	0.165
Intraoperative blood loss (ml)	196.43 ± 76.83	235.31 ± 64.96	1.982	0.053
Postoperative hospital stay (days)	6.19 ± 1.69	8.22 ± 2.55	3.207	0.002**
Quantity of lymph node dissection	12.24 ± 2.34	13.22 ± 1.86	1.613	0.116
Time to first activity out of bed (hours)	20.57 ± 7.72	26.81 ± 9.27	2.556	0.014*
Chest drainage duration (days)	4.24 ± 1.04	5.22 ± 1.29	2.913	0.005**
Postoperative drainage volume (ml)	642.86 ± 158.18	787.81 ± 211.55	2.683	0.010*
Postoperative complications				
Total number of complications	4 (3 patients)	27 (14 patients)		
Atrial fibrillation	1	5	0.605	0.437
Persistent air leak (>5 days)	2	6	0.276	0.599
Lobar atelectasis	1	5	0.605	0.437
Pneumonia	0	4	1.330	0.249
Prolonged mechanical ventilation	0	2	0.186	0.666
Tracheostomy	0	1	0.000	1.000
Wound infection	0	2	0.186	0.666
Recurrent laryngeal nerve palsy	0	2	0.186	0.666
No complications	18 (85.71%)	18 (56.25%)	5.052	0.025*

*$P < 0.05$; **$P < 0.01$; TL, lobectomy by thoracotomy; VATS, Video-assisted thoracoscopic lobectomy.

found in the TL group. The most common complications in both groups were atrial fibrillation, persistent air leak, and lobar atelectasis, while pneumonia, prolonged mechanical ventilation, tracheostomy, wound infection, and recurrent laryngeal nerve palsy were found only in the TL group. Although there were no significant differences in the incidence rate in each complication ($P > 0.05$), the cases occurred more frequently in the TL group than the VATS. There were 18 patients with no complications in the VATS group, and the percentage (85.71%) is significantly higher than in the TL group (56.25%).

Discussion

Although comprehensive treatments in lung cancer have made rapid progress, surgical resection still plays an important role in patients with early stage.[8–10,19] VATS lobectomy with systematic lymph node dissection has been widely accepted as a safe and effective choice for early-stage lung cancers, and has now been recommend by the American College of Chest Physicians' evidence-based clinical practice guidelines.[20]

Elderly patients with lung cancer face more comorbidity or poor cardio-pulmonary function and are, therefore, correlated with a higher possibility of postoperative complications.[11,12,21] These patients can benefit from VATS lobectomy as there is minimal invasion.[13,14] The conventional VATS lobectomy characterized by three or four ports in the chest wall, including a working incision beneath the tip of the scapula (assist port), still has some shortcomings. Persistent backache and paresthesia which attributes to the assist port is common, and in some cases it can be the reason for prolonged hospital stay. The narrow intercostal spaces in the posterior and injury of the intercostal neurovascular bundle may contribute to more blood loss during surgery because of the friction between the chest wall and trocar.[22]

In recent years, VATS lobectomy with a single utility port has been reported as a safe and reliable procedure with lesser invasion in several thoracic conditions, including lung cancer in selected patients.[17,23] However, reports of VATS lobectomy with a single utility port used in elderly patients are extremely rare. In this study, we retrospectively reviewed the surgical outcomes in elder patients who underwent VATS lobectomy with a single utility port in our institution.

There was no significant difference between groups in the study regarding surgery duration and blood loss, which could partly be attributed to extensive use of Endo-GIA and specialized instruments, such as the harmonic scalpel, clips, and Hem-o-Lock. In our experience, surgery by VATS can be performed in a similar time as conventional thoracotomy by a well-trained surgeon, and this is consistent with other reports in the literature.[24–26]

A systematic mediastinal lymphadenectomy is crucial to radical resection of lung cancer,[20] therefore, we perform lymph node resection in every patient. The results show no significant difference in the quantity of lymph node dissection between the VATS and TL groups, and this outcome is superior to similar studies.[27,28] In our experience, the selection of patients is important, and those patients with enlarged or invasive lymph nodes shown via CT scan, especially with suspicious metastasis lymph nodes in hilar, should be strictly excluded. Wang *et al*. reported 15 cases of lung cancer patients who had accepted single-incision thoracoscopic lobectomy or segmentectomy with radical lymph node dissection, and

the median number of lymph nodes retrieved was 22.9 ± 9.8.[29] In fact, most mediastinal lymph nodes can be removed by appropriate surgical technique.

Our study shows that the postoperative hospital stay in the VATS group was significantly shorter than in the TL, consistent with results reported in the literature.[30–32] This could be partly attributed to the shorter duration of chest tube drainage, which was also verified in the study. The time to first activity out of bed in the VATS group was significantly shorter than in the TL, and this may also contribute to the decreased length of stay.

Another factor that has great influence on postoperative hospital stay is complication, which is of more importance in elderly patients.[33] Our study showed that the majority of elderly patients had several comorbidities and a history of smoking, which could relate to the higher possibility of complications. Although statistical significance was not achieved in the study, major complications, such as atrial fibrillation, persistent air leak, and lobar atelectasis, occurred less frequently in the VATS group compared with the TL, as well as the occurrence of no complications, which was significantly higher in the VATS group. This outcome could be attributed to the lesser invasion of VATS surgery, a result that is also consistent with reported studies.[26,30,31,34,35]

Conclusion

Although long-term follow-up data requires further investigation, VATS lobectomy with a single utility port can provide a similar result compared with thoracotomy, and most important of all, the lesser invasion and more rapid recovery offers elderly patients who were reluctant to undergo conventional therapy methods a better opportunity for treatment.

In conclusion, our study shows that VATS lobectomy with single utility port is feasible in the treatment of elderly patients with peripheral lung cancer, and may be a promising approach.

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Disclosure

No authors report any conflict of interest.

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