

# Uniportal versus multiport video-assisted thoracoscopic surgery for anatomical lung resections: a glance at a dilemma

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## Abstract

**Introduction:** As the number of operations performed by videothoracoscopy is increasing, there is also a tendency to decrease the number of port incisions. Apart from the reduced number of surgical incisions, there are a few reports and systematic reviews that demonstrate some potential advantages of the uniportal video-assisted thoracoscopic surgery, but the impact of the reduced incisions in the clinical setting still remains uncertain.

**Aim:** To compare uniportal video-assisted thoracoscopic surgery to multiport video-assisted thoracoscopic surgery for anatomical lung resections in patients with malignant and benign lung diseases.

**Material and methods:** From August 2010 to April 2016, a total of 102 patients with malignant and benign lung diseases underwent videothoracoscopic lobar and sublobar lung resections in our department. Comorbidities, tumor stage, tumor localization, mortality, operative time, pain visual analogue scale, length of hospital stay, perioperative blood loss, duration and amount of postoperative drainage and air leak, number of harvested lymph nodes and complication rates were analyzed.

**Results:** No significant difference was found in the duration of chest tube drainage, pain visual analogue scale score, length of hospital stay, perioperative blood loss, amount of postoperative drainage, number of harvested lymph nodes or complication rate. There was no surgical mortality in either of the two groups. However, operative time was shorter (189 min vs. 256 min,  $p < 0.005$ ) in the multiport group than in the uniportal group.

**Conclusions:** Compared with the uniportal approach, the multiport approach is associated with a significantly shorter operative time in our study.

**Key words:** uniportal, multiport, video-assisted thoracoscopic surgery.

## Introduction

Minimally invasive techniques in thoracic surgery are feasible, while they are also associated with less postoperative morbidity and fast recovery. As the number of operations performed by video-assisted thoracoscopic surgery (VATS) is increasing, there is also a tendency to decrease the number of port incisions. Thoracic surgeons used to perform resections

by conventional open thoracotomy until the evolution of VATS in the early 1990s [1, 2].

In time, growing evidence suggested that VATS lobectomy with systematic lymph node dissection was a good alternative in patients with early stage lung cancer. On the other hand, VATS had advantages such as less deterioration in pulmonary function, less postoperative pain, shorter hospital stay, lower morbidity and nearly equal long-term oncological

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outcomes in comparison with conventional thoracotomy [3].

In addition, VATS sublobar resections have been performed in recent years on highly selected patients with early stage lung cancer, who had comorbidities or impaired pulmonary functions. It has also been regarded as an alternative to nonsurgical therapy with a comparable local relapse rate and nonsignificant difference of 5-year survival in uncontrolled trials [4–7].

Video-assisted thoracic surgery has evolved rapidly in the last two decades. Together with the advances in thoracoscopic techniques, the number of incisions used during VATS has decreased from three or four to one. Rocco *et al.* published the first paper about the use of uniportal VATS for pulmonary

wedge resection in 2004 [8], and in 2011 Gonzalez *et al.* reported a case of left lower lobectomy performed by a video-assisted single-port incision [9]. Since then, the uniportal VATS technique has become an even less invasive alternative to the conventional multiport approach.

Apart from the reduced number of surgical incisions, there are institutional reports and recent systematic reviews that demonstrate some potential advantages of the uniportal VATS such as reduced postoperative pain and paresthesia and more post-operative satisfaction, although the impact of the reduced incisions in the clinical setting remains uncertain [10, 11].

In this study, we aimed to compare uniportal VATS to multiport VATS for anatomical lung resections in patients with malignant and benign lung diseases. Endpoints included comorbidities, tumor stage, tumor localization, mortality, operative time, pain visual analogue scale (VAS), length of hospital stay, perioperative blood loss, duration and amount of postoperative drainage and air leak, number of harvested lymph nodes as well as complication rates.

## Aim

The aim of this study was to compare the outcomes of uniportal VATS to multiport VATS for anatomical lung resections in patients with malignant and benign lung diseases in a clinical setting.

## Material and methods

From August 2010 to April 2016, a total of 102 patients with malignant and benign lung diseases (69 male (68%), 33 female (32%)) underwent videothoracoscopic lobar and sublobar lung resections in our department. The mean age was 61.3 years (range: 19–80 years). The demographic data of the patients are presented in Table I. Electrocardiogram, pulmonary function tests, chest computed tomography (CT) scan and bronchoscopy were performed in all patients, while a brain magnetic resonance imaging (MRI) was performed in patients with malignant disease. Positron emission tomography-CT (PET-CT) was also performed when routine tests could not rule out an underlying metastasis. Comorbidities, tumor stage, tumor localization, mortality, operative time, pain VAS postoperative day 1, length of hospital stay, perioperative blood loss, duration and amount of postoperative drainage and air leak, number of

**Table I.** Demographic and clinical characteristics of patients before surgery

Parameter	Value
Age, median (range) [years]	61.3 (19–80)
Gender, n (%):	
Male	69 (68)
Female	33 (32)
Comorbidity, n (%):	
Diabetes mellitus	13 (15)
Hypertension	28 (32)
Coronary heart disease	20 (23)
COPD	10 (11)
Renal dysfunction	7 (8)
Arrhythmia	5 (6)
Asthma	4 (4)
Histological type, n:	
Adenocarcinoma	47
Squamous cell carcinoma	20
Adenosquamous cell	3
Large cell	3
Carcinoid cancer	8
Bronchiectasis	11
Others	9
FEV <sub>1</sub> , mean (%)	2350 ml (84.7)

FEV<sub>1</sub> – forced expiratory volume in 1 s.

harvested lymph nodes as well as complication rates and rates of conversion to open thoracotomy were collected for the database.

Intra-operative and post-operative pain management was the same in both groups. In addition, the same intravenous analgesic protocol was administered to both groups. A VAS score of '0' indicated no pain, while a score of '10' indicated severe pain. The chest drain was withdrawn in cases where the 24-hour drainage volume was less than 100 ml and postoperative chest X-ray showed no abnormality. The discharge criteria were as follows: (I) patients with normal clinical status and recovered mobility status; (II) no obvious fever after chest tube withdrawal.

All patients underwent general anesthesia, while each patient was intubated with a double-lumen endotracheal tube to accomplish single lung ventilation. The patients' vital signs were followed and noted throughout the operation.

### Operative procedure

The patient was placed in the lateral decubitus position, while the operator stood at the anterior side of the patient. For triportal VATS, one 1.5 cm port incision for viewing was made at the seventh intercostal space on the middle axillary line. Two additional ports were opened for working: one 4 cm operation port on the fourth intercostal space of the anterior axillary line and one 2 cm port on the posterior axillary line. As a modification, we used the posterior port a little anteriorly in order to reduce the postoperative pain.

For biportal (hybrid) VATS, one 5 cm incision was made on the fourth or fifth intercostal space along the anterior axillary line and one 1.5–2 cm incision was made for viewing on the seventh intercostal space on the midaxillary line. For the single-port group, one 3.5–4.5 cm incision was made on the fourth or fifth intercostal space along the anterior axillary line. A plastic wound protector was used for the operation port incision to avoid surgical site infection and tumor spread. Standard lobectomy and segmentectomy were performed, while additional hilar and mediastinal lymph node dissection was also achieved. Endoscopic bipolar vessel-sealing devices or hemoclips were used for small vessels, while an endoscopic stapler was used to deal with the great vessels and the bronchus. We usually re-

sected the bronchus at the final stage of lobectomy or sublobectomy. After resection, the specimen was placed in an endoscopic plastic bag under thoracoscopic assistance and later removed through the operational incision.

### Statistical analysis

Statistical analysis was performed using Pearson's  $\chi^2$  test for bivariate analysis. All statistical analyses were performed using IBM SPSS Statistics, version 20.0 (IBM Corp., Armonk, N.Y.). Values of  $p < 0.05$  were considered statistically significant.

### Results

Between August 2010 and April 2016, a total of 102 patients underwent anatomical VATS pulmonary resection. Triportal technique was used in 47 (46%) patients, while biportal technique was used in 34 (33%) patients and uniportal technique was used in 21 (20%) patients. In the uniportal group, an additional port was required in 5 patients (bleeding in 2 patients and severe adhesions in 3 patients). The conversion rate to open thoracotomy in the series was found to be 3.9% – 4 patients (3 bleeding, 1 severe adhesions). Ninety-one lobectomy, 2 pneumonectomy and 9 segmentectomy operations were performed. Out of the 102 patients who underwent VATS pulmonary resection, 73 of them had non-small cell lung carcinoma (NSCLC), while 8 patients had carcinoid tumors, 11 patients had bronchiectasis and 9 patients had other lesions. The demographics, clinical characteristics, perioperative-postoperative characteristics, operative details, and tumor characteristics of the 102 patients are described in Tables I–III.

No significant difference was found in the duration of chest tube drainage, pain VAS score, length of hospital stay, perioperative blood loss, amount of postoperative drainage, number of harvested lymph nodes or complication rate. There was no surgical mortality in either of the two groups. However, operative time was shorter (189 min vs. 256 min,  $p < 0.005$ ) in the multiport group than in the uniportal group.

### Discussion

The uniportal thoracoscopic technique was first described by Migliore in patients with pleural diseases in 2003 [12]. In 2004 Rocco *et al.* report-

**Table II.** Comparison of perioperative and postoperative parameters between uniportal and multiport group

Parameter	Uniportal	Multiport	P-value
Operation time* [min]	256	189	0.0003
Perioperative blood loss [ml]	300	224	0.883
Chest tube duration [day]	5.6	4.5	0.180
Postoperative drainage [ml]	697.5	683	0.939
Hospital stay [day]	6.9	5.9	0.392
Post-op VAS score	3.1	2.8	0.620
Harvested (N1) lymph nodes	10.3	8.7	0.284
Harvested (N2) lymph nodes	6.2	8.04	0.401
Postoperative complications:	6	8	0.554
Air leakage	4	5	
Pneumonia	1	2	
Arrhythmia	1	1	

\*Operation time ranged from incision to suturing the skin, including the time for frozen section.

**Table III.** Tumor characteristics

Parameter	Value
Tumor size, mean (range) [cm]	2.9 (0.1–10)
Tumor location, n:	
LUL	19
LLL	24
RUL	26
RML	10
RLL	17
Operative procedure, n (%):	
Lobectomy	92 (90.1)
Segmentectomy	9 (8.8)
Staging, n (%):	
IA	28 (34.1)
IB	27 (32.9)
IIA	13 (15.8)
IIB	6 (7.3)
IIIA	6 (7.3)
IV (solitary met.)	2 (2.4)
T stage, n (%):	
T1a	25 (31)
T1b	7 (8)
T2a	38 (47)
T2b	3 (4)
T3	8 (10)

LUL – left upper lobe, LLL – left lower lobe, RUL – right upper lobe, RML – right middle lobe, RLL – right lower lobe.

ed pulmonary wedge resection with the uniportal approach [8], while a few years later Gonzales *et al.* published their experience in uniportal VATS lobectomy and lymphadenectomy [13]. Since then, the uniportal approach has been performed routinely in many other major thoracic interventions [14–17].

Most available literature has reported the feasibility and safety of uniportal thoracoscopic lobectomy, although there is still much debate about which approach is the appropriate choice for the patients. There are few studies in the literature that compare these two techniques. On the other hand, until now there has only been one randomized controlled study comparing the effectiveness and prognosis between the uniportal VATS and multiport VATS [18–28]. There are also a few systematic reviews and meta-analyses that focus on this subject [10, 11].

In our study, we found that the outcomes of uniportal VATS for anatomical lung resections were comparable to those in the multiport VATS group.

In a recent meta-analysis, eleven studies were identified in the databases of PubMed, Cochrane Library, SpringerLink and ScienceDirect. Randomized controlled trials and non-randomized studies evaluating the outcomes of uniportal versus multiport VATS in the treatment of lung cancer were analyzed [10]. A total of 1314 patients (649 in the uniportal group and 665 in the multiport group) were included. In this study, there was no difference between the two groups in terms of the operative time. The

amount of blood loss and duration of chest tube drainage were also similar. Postoperative hospital stay was found to be shorter in the uniportal group ( $p < 0.008$ ). These results suggested that the number of harvested lymph nodes were similar in the two approaches, while the overall complication rate was lower in the uniportal group. However, no significant association was found for common complications such as prolonged air leak, pneumonia, atelectasis or arrhythmia. In our study, the number of harvested lymph nodes was similar in both groups: number of N1 nodes – uniportal 10.3 vs. multiport 8.7 ( $p = 0.284$ ); number of N2 nodes – uniportal 6.2 vs. multiport 8.04 ( $p = 0.401$ ). In a recent study, Mu *et al.* reported a conversion rate of 3.4% for the uniportal approach and 2.3% for the triportal approach [25]. The overall conversion rate in our study was 3.9% (6.3% for the multiport VATS group and 4.7% for the uniportal VATS group,  $p = 0.547$ ). Six studies in the meta-analysis explored postoperative pain. While only three of them found that the uniportal approach was associated with less postoperative pain, the other studies did not indicate any significant association. We did not find any difference in postoperative pain between these two groups, either (mean VAS score: uniportal 3.1 vs. multiport 2.8,  $p = 0.620$ ). Although our study has similarities with the meta-analysis, we found that multiport anatomical pulmonary resection might be associated with shorter operative time. However, the meaning of these data might be controversial, since a surgical procedure requires a sufficient learning curve for experienced thoracic surgeons to perform the major anatomical lung resections.

The only randomized study, by Perna *et al.*, concluded that uniportal VATS lobectomy does not provide better postoperative outcomes than other VATS techniques [28].

Similarly, we did not find any major difference between the two groups in the clinical setting. Our results are compatible with the literature considering the outcomes of uniportal and multiport VATS groups. On the other hand, there are several limitations in our study as well. For instance, the number of patients who underwent uniportal VATS pulmonary resection was relatively small. In addition, we analyzed the data from one medical center, which restricts the generalization of our conclusions. Lastly, our study did not include the analysis of long-term survival outcomes. Hence, our results need further

validation in a randomized controlled clinical trial with a larger number of patients.

## Conclusions

Uniportal VATS is at least as safe and effective as multiport VATS for anatomical resections in patients with malignant and benign lung disease. Outcomes of uniportal VATS anatomical lung resection are comparable to the multiport approach in our single medical center series. In our series, the only statistically significant difference found between the two techniques was for duration of the operation. Compared with the uniportal approach, the multiport approach is associated with a significantly shorter operative time. On the other hand, the question as to whether one of these techniques is superior to the other still remains unclear. Likewise, prospective randomized controlled studies are required in order to compare the uniportal VATS with multiport VATS in terms of intermediate- and long-term results.

## Conflict of interest

The authors declare no conflict of interest.

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