

# Cost and Outcomes of VATS Lobectomy for Operable Non-Small Cell Lung Cancer in Low-Income Country (Morocco)

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## Abstract

**Background:** The aim of this study is to evaluate the costs and the outcomes comparing lung lobectomy by video-assisted thoracoscopic surgery (VATS) versus thoracotomy for operable non-small cell lung cancer.

**Methods:** A retrospective review of a prospectively maintained patient's database who had lobectomy for lung cancer at a single institution between 2016 and 2019 was performed. Direct hospital cost, operative time, complications rates and length of stay were collected and compared between two approaches.

**Results:** Ninety six patients underwent lobectomy for lung cancer. Sixty nine (72%) of them by VATS and 27 (28%) by thoracotomy. In the VATS lobectomy, mean surgery duration, mean chest tube removal and length of hospital stay were significantly shorter than the thoracotomy group. The complication rate and mortality were not significantly different between two groups. The costs were lower but not significantly different for VATS versus thoracotomy.

**Conclusion:** The costs of VATS were not significantly lower compared with thoracotomy because the length of hospital stay was shorter and the costs of hospitalization were lower in our country compared with developed countries.

**Keywords:** Cost • Lobectomy • Surgery • Video-assisted thoracic surgery (VATS) • Thoracotomy

## Introduction

Lobectomy is the most major operation performed in thoracic surgery practice. Thoracotomy remains the most common approach and video-assisted thoracoscopic surgery lobectomy (VATS) has become a cornerstone of the management of operable non-small cell lung cancer (NSCLC). Cost analyses about VATS procedure for NSCLC have been published all over the world but this study remains the first in low-income country like Morocco.

Therefore, this study aimed to evaluate the cost and outcomes of lobectomy by VATS and thoracotomy for operable NSCLC.

## Materials and Methods

### Patients

The retrospective monocentric study of a prospectively collected data

of all patients who had lobectomy for lung cancer between January 2016 and December 2019 was performed. Written informed consent was obtained from the participants.

Exclusion criteria were pneumonectomy, bilobectomy, segmentectomy, chest wall invasion, sleeve resection, conversion and neo adjuvant therapy.

The primary endpoints of this study was to compare the cost of VATS lobectomy and open lobectomy. The secondary endpoints was to compare the outcome of these approach, in term of morbidity, operative time, duration of drainage and length of hospital stay.

All patients received thorough examinations including conventional blood tests and CT scan, PET-CT and head CT or magnetic resonance imaging (MRI) to exclude distant metastasis. Transthoracic needle biopsy or bronchoscopy-guided biopsy was performed for diagnosis. Mediastinoscopy was performed when chest CT scan or PET indicated N2 or N3 diseases.

Demographic, clinical, surgical and pathological data were collected.

## Surgery Methods

The decision to perform either approach was made by the individual surgeon.

All the surgical procedures were performed under general anesthesia in a right or left sided position, with double-lumen endotracheal intubation.

For thoracotomy lobectomy, a standard posterolateral incision at the 5<sup>th</sup> intercostal space was performed. The thoracic cavity was opened layer by layer and the ribs were separated carefully with a thoracic retractor to avoid fracture. The division of major vascular branches was made with silk ligature and suture. The pulmonary parenchyma, lobar and main bronchi were divided using a surgical stapling device.

For VATS lobectomy, a 3-5 cm single incision is placed in the 4<sup>th</sup> intercostals space in the anterior axillary line. There was no rib retractors used. The incision was protected with an incision protector (Ring Protector<sup>®</sup>). 1-cm incision was made in the 6<sup>th</sup> or 7<sup>th</sup> intercostal space in the midaxillary line to create an access port and another 1-cm incision was made in the 7<sup>th</sup> or 8<sup>th</sup> intercostals space in the posterior axillary line. After dissection, the lobar artery, vein, and bronchus were divided using endostaplers. Finally, the utility incision was extended for removal of the specimen. In all patients an ipsilateral mediastinal dissection was performed.

## Histopathological Examination

Pathological staging was performed according to the 8<sup>th</sup> International Staging System for Lung Cancer.

## Analysis of cost

The total costs were calculated: cost of the length of surgery time, cost of the length of time at the intensive care unit (ICU) postoperatively and hospitalization cost. The total hospital cost included all the costs incurred from the operative day to the discharge day.

All the direct costs related to the procedure is given in Moroccan dirhams (MAD) and in Euros at the current exchange rate (1 MAD =0.094 Euro).

## Statistical Analysis

Continuous variables were reported as mean and standard deviation. Categorical variables were reported as frequency and proportion. The statistical analysis has been performed by Fisher's exact test for categorical variables and Student's t-test for continuous variables, using SPSS version

17.0 software. The difference was considered as significant for *p* values ≤0.05.

**Results**

From January 2016 to December 2019, 96 patients with lung cancer underwent lobectomy. Of these, 27 (28%) underwent thoracotomy and 69 (72%) underwent VATS lobectomy

There were 78 (81%) males and 18 (19%) females with a median age of 58 years (range 18-78 years). Fifty-nine (61.5%) patients had a smoking history and 87 (90.6%) had symptoms. Tumors were most frequently located in the upper lobe (45.8%). The patients' demographics and perioperative data are summarized in (Table 1).

Mean operation time was shorter in VATS group than in thoracotomy group (148 min versus 162 min; *p*<0.05). In the VATS group, mean drainage time and length of hospital stay were significantly shorter than the thoracotomy group (*p*<0.05). The complication rate and mortality were not significantly different between two groups. Perioperative and postoperative outcomes are illustrated in (Table 2).

The pathological staging according to the 8<sup>th</sup> classification are listed in (Table 3).

The VATS group had a less total hospital cost but not significantly compared with the thoracotomy group (47711 DH versus 48400 DH, *p* =0.38). The principal factor associated with this finding was shorter length of hospitalization. Comparison of costs between VATS and thoracotomy for lobectomy are illustrated in (Table 4).

**Table 1:** Demographic, clinical and preoperative data.

Characteristics	N=96
Age in years	
• Mean	58
• Range	18-78
Sex, n, %	
• Male	78 (81%)
• Female	18 (19%)
Smoking history	
• Never smoker	37 (38.5%)
• Active smoker	59 (61.5%)
Underlying disease	
• Hypertension	14 (14.6%)
• Diabetes	10 (10.4%)
• Tuberculosis	22 (23%)
• COPD	4 (4.2%)
Reason for admission	
• Symptom	87 (90.6%)
• Discovery	9 (9.4%)
Tumor location	
• RUL	20 (20.8%)
• RML	15 (15.6%)
• RLL	19 (19.8%)
• LUL	24 (25%)
• LLL	18 (18.8%)

RUL right upper lobe; RML right middle lobe; RLL right lower lobe; LUL left upper lobe; LLL left lower lobe.  
Underlying disease included hypertension, diabetes mellitus, tuberculosis, and chronic obstructive pulmonary disease.

**Table 2:** Comparison of postoperative outcomes between VATS and thoracotomy for lobectomy.

Data	Thoracotomy N=27 (28%)	VATS N= 69 (72%)	P
Operation time, min, mean	162	148	<0.05
Chest tube duration, day, mean	6	3	<0.05
Length of hospital stay, days, mean	11	4	<0.05
Complication, n (%)	9 (34%)	13 (19%)	0.17
mortality, n (%)	1 (4%)	0 (0%)	0.28

**Table 3:** Stade P TNM.

Stade P TNM	N (%)
Stade I	27 (28.3%)
IA	8 (8.5%)
IB	19 (19.8%)
Stade II	51 (53%)
IIA	13 (13.5%)
IIB	38 (39.5%)
Stade III	17 (17.7%)
IIIA	15 (15.6%)
IIIB	2 (2.1%)
IIIC	0 (0%)
Stade IV	1 (1%)
IVA	1 (1%)
IVB	0

**Table 4:** Comparison of costs between VATS and thoracotomy for lobectomy.

Data	Thoracotomy	VATS	P
Surgical fee, mean, DH	30670	31177	0.67
Ward stay cost, mean, DH	7788	5289	0.47
Total hospital cost, mean, DH	48400	47711	0.38

**Discussion**

Pulmonary lobectomy remains the operation of choice for the standard treatment of lung cancer. Video-assisted thoracoscopic surgery lobectomy was first reported in the early 1990s [1] and has become a cornerstone of the management of lung cancer [2, 3].

In the literature, different studies demonstrated shorter length of stay, lower complication rates [2], less pain, quicker recovery and greater tolerance and receipt of adjuvant chemotherapy [4,3] of VATS lobectomy.

In our study, mean operation time, mean drainage time and length of hospital stay were significantly shorter in the VATS group. However, the complication rate and mortality were not significantly different between two approaches.

All studies reported that VATS lobectomy was less costly than thoracotomy lobectomy [5,4,6-8]. The reasons for the higher total hospital cost for thoracotomy lobectomy are longer length of stay, longer chest tube duration, the need for more medications to control pain and the costs and duration of chemotherapy in patients with advanced stages of lung cancer [9-13].

Dedes et al. [13] demonstrated that the major part of the total cost was due to hospitalization costs.

The costs of VATS were not significantly lower compared with thoracotomy because the length of hospital stay was shorter and the costs of hospitalization were lower in our country compared with developed countries.

This retrospective study has some limitations, such as a small number of cases. A multicenter study with a larger number of patients requiring neo adjuvant treatment would be a logical next step.

**Conclusion**

VATS lobectomy had lower cost with cost with decreased per and postoperative outcomes. Further studies are needed to estimate the cost of lung cancer in Morocco according to stage and histological type of cancer, total chemotherapy cycles.

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