

## Operational Risk Indicators in Largest Pulmonary Resections By Uniportal Vats

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### Abstract

**Introduction:** Lung resection by video-assisted thoracic surgery (VATS) is the first choice of treatment for early stage lung cancer. For this purpose is necessary have a precise and objective evaluation about surgical risk to offer this treatment to as many patients as possible. Based on this is necessary to combine the surgeon experience with risk calculator objectives. Exist different validated method for the calculation of risk in thoracic surgery, however their feasibility can be influenced by the approach chosen: VATS or open Thoracotomy calculating validated in thoracic surgery but their reliability may be different in VATS or open surgery.

**Methods:** We performed a comparative analysis in 137 patients who underwent major lung resection of which 75 were operated by UNIPORTAL VATS and 62 by thoracotomy. The behavior of the Charlson Index (CI), the Thoracscore (TH) and a functional index (IF) based on the classification of the ACCP, was analyzed in overall and comparatively between the VATS and thoracotomy.

**Results:** We obtained a cutoff of each index in each technique, from which significantly increased complications; -3.44 for the thoracscore and 0 for the functional index.

**Conclusion:** Both functional Index and thoracscore proved to be a useful index in predicting serious complications in patients who received major lung resection, especially if this is performed by VATS.

**Keywords:** Lung Cancer; Video-Assisted Thoracic Surgery; Thoracotomy; Lobectomy; Surgical Risk and Risk Calculator

### Introduction

Pulmonary resection surgery using VATS is currently the treatment of choice in the treatment of lung carcinoma in the early stages [1]. However, Thoracic surgery is inevitably associated with the risk of complications. In order to offer this treatment to the greatest possible number of patients with good results, it is necessary to combine the careful selection of the patients with the use of a minimally invasive technique and probably to this day the uniportal VATS is the less aggressive approach [2]. Therefore, in addition to using minimally invasive approaches, it is essential to predict as accurately as possible the probability of serious complications in a particular patient proposed for a larger pulmonary resection. The assessment of operability is usually established based on: demographic data, medical history of the patient (understood as baseline risks presented), and functional studies particularized for the type of lung resection expected.

The final decision to recommend surgery results from the combination of risks deduced by the surgeon after analyzing the data mentioned, which implies a subjective judgment influenced by different factors such as the personal risk policy, the surgeon's experience and even the emotional status of the patient. Consequently, there is a real risk of acting with a marked clinical variability that penalizes some patients and results in a suboptimal global functioning of the department.

For this reason, recent guidelines have recommended the use of surgical risk calculators to objectify decision making and to optimize clinical practice [3]. Among the most used are Thoracscore, Euroscore, and ESOS (European Society Objective Score), although some authors have tried to evaluate even the utility of the Charlson index. However the usefulness of these indexes is controversial although there is agreement that they can help in the decision making.

Our objective was to analyze and validate in our patients some of the risk indices described and to evaluate their behavior in patients submitted to uniportal VATS comparing them with the patients undergoing thoracotomy. On the other hand, we theorize the possibility of obtaining a statistical indicator that allows us to establish a personalized limit value, independent for VATS and for thoracotomy that calculated in the patient allows us to know the limit of what is recommended to minimize the risk of serious complications.

### Material and Methods

Retrospective study of the patients operated in our institution between January 2012 and December 2013 to perform a major pulmonary resection. Patients were classified into two groups: Group A: patients who had no complications or were minor and group B patients who presented major complications or deceased. Severe complications have been defined and collected as: those involving admission to or permanence in the intensive care unit, invasive treatment (mechanical ventilation, hemofilter, etc.) or reintervention.

Demographic data were collected from patients (age, sex) as well as the type of resection performed and the technique used (VATS/ postero-lateral thoracotomy). The use of one technique or another did not depend on clinical criteria but on the assignment of surgeon responsible for the case. Only patients with tumors who requiring the use of the ribs-spreading for specimen removal, those with hilar involvement, and those required wall resection were excluded from VATS surgery.

The combined Charlson (CH) and Thoracscore (TH) index were determined in each patient.

The values of the preoperative FEV<sub>1</sub>, calculated postoperative, and the FVC were recorded. whose values were reflected in a functional index (FI) established in 3 functional categories based on the classification of the ACCP. In this way value 0, 1, or 2 according to the values of the FEV<sub>1</sub>, the DLCO (VALUE 0: FEV<sub>1</sub> + DLCOppo: > 60%, VALUE 1: FEV<sub>1</sub>ppo + DLCOppo: 30 - 60%, VALUE 2: FEV<sub>1</sub>ppo + DLCOppo < 30%).

### Statistical Study

#### Results

Between January 2012 and December 2013, 137 major pulmonary resections were performed in our department. The mean age was 63.3 years (range 37 - 81). Of the 137 patients 75 (54.7%) were operated by uniportal VATS and 62 (45.25%) by thoracotomy. Of the total number of patients 9 (6.5%) patients presented severe complications of them 3 were from the VATS group and the remaining 6 from the thoracotomy group.

With respect to age, it was observed that below 69 years the major complications decreased (p-value = 0.074).

When analyzing the efficacy of the different indices, thoracscore (TH) was found to be statistically significant in the prediction (p-value), since the risk of major complication is multiplied by 8 when the index increases by one point (See table 1).

Complications		N	Media	Standard Deviation	Median	Minimum	Maximum
Thoracscore	WC or MiC	128	-4,24	0,67	-4,01	-2,55	-6,63
	MaC or D	9	-3,51	0,63	-3,77	-2,55	-4,22
	Total	137	-4,20	0,69	-4,01	-2,55	-6,63

**Table 1:** Relationship between complications and Thoracscore (TH).

WC: Without Complications; MiC: Minor Complication; MaC: Major Complication; D: Deceased.

With respect to the functional index (FI), a capacity to discriminate the risk of very significant complications was observed (p-value), so that the risk of complications increases almost linearly (p-value). These findings are described in table 2.

Complications		WC or MiC	CMA or D	Total	
Count	FI	0	81	2	83
		1	40	6	46
		2	3	1	4
	Total	124	9	133	
% of FI	FI	0	97,6%	2,4%	100%
		1	87,0%	13,0%	100%
		2	75,0%	25,0%	100%
	Total	93,2%	6,8%	100%	
% of Complications	FI	0	65,3%	22,2%	62,4%
		1	32,3%	66,7%	34,6%
		2	2,4%	11,1%	3,0%
	Total	100%	100%	100%	

**Table 2:** Relationship between complications and Functional Index (FI).

WC: Without Complications; MiC: Minor Complication; MaC: Major Complication; D: Deceased

The Charlson (CH) index failed to reach statistical significance with respect to the prediction of complications although it was somewhat higher in group B patients in post-lateral thoracotomy resections (PLT). See relation in table 3.

Complications		N	Media	Standard Deviation	Median	Minimum	Maximum
Index Charlson	WC or MiC	128	4,19	2,16	4,00	0,10	9,40
	MaC or D	9	5,66	2,08	6,20	2,60	8,60
	Total	137	4,28	2,18	4,10	0,10	9,40

**Table 3:** Relationship between complications and the Charlson Index (CI).

WC: Without Complications; MiC: Minor Complication; MaC: Major Complication; D: Deceased

With the objective of determining the cut-off point of each index from which the complications are triggered, the Youden index was used. In terms of this index, an optimal point of -3.44 was obtained for TH, corresponding to a sensitivity of 44.4% and a specificity of 95%. The outcome variables of these data are described in table 4.

Positive If It Is ≤	Sensitivity	Specificity
-1,55	0,00	0,00
-2,63	0,11	0,01
-2,87	0,22	0,02
-3,06	0,33	0,02
-3,44	0,44	0,05
-3,85	0,67	0,27
-4,08	0,78	0,53
-4,30	1,00	0,66

**Table 4:** Contrast result variables: Thoracscore.

The FI (functional index) would have its optimum value at 0 for a sensitivity of 77.8% and a specificity of 65.3%. With the optimum FI (functional index) set at 0, it is assumed that the value of 1 or 2 is associated with complications (See table 5).

Vats Group 0		Functional Index			Total
		1	2	0	
Count	WC or MiC	49	20	3	72
	MaC or D	0	2	1	3
	Total	49	22	4	75
% of Complications	WC or MiC	68,1%	27,8%	4,2%	100%
	MaC or D	0%	66,7%	33,3%	100%
	Total	65,3%	29,3%	5,3%	100%
% of functional index	WC or MiC	100%	90,9%	75%	96%
	MaC or D	0%	9,1%	25%	4%
	Total	100%	100%	100%	100%
Toracotomy Group		Functional Index			Total
		0	1		0
Count	WC or MiC	32	20		52
	MaC or D	2	4		6
	Total	34	24		58
% of Complications	WC or MiC	61,5%	38,5%		100%
	MaC or D	33,3%	66,7%		100%
	Total	58,6%	41,4%		100%
% of functional index	WC or MiC	94,1%	83,3%		89,7%
	MaC or D	5,9%	16,7%		10,3%
	Total	100%	100%		100%

**Table 5:** Relationship between complications and functional index with respect to the surgical technique.

WC: Without Complications; MiC: Minor Complication; MaC: Major Complication; D: Deceased

The low capacity CH showed a cut-off point of 6.15 for a sensitivity of 55.6% and a specificity of 83.6%.

We decided to analyze the results separately according to the technique used. Although HT was higher in patients in group B, the differences were not significant in any of the two groups, although P = 0.063 was observed for group A corresponding to those operated with VATS. Likewise, the FI (functional index) was significant for the VATS group, but not for the thoracotomy group. The percentage of complications is 3 times higher when the FI (functional index) equals 1. (P = 0.020) These data are reflected in table 6.

Group	Complications	N	Media	Standard Deviation	Median	Minimum	Maximum
VATS	WC or MiC	72	-4,28	0,71	-4,17	-2,55	-6,63
	MaC or D	3	-3,29	0,49	-3,32	-2,79	-3,77
	Total	75	-4,24	0,73	-4,01	-2,55	-6,63
PLT	WC or MiC	56	-4,20	0,61	-4,01	-2,71	-6,13
	MaC or D	6	-3,62	0,71	-3,89	-2,55	-4,22
	Total	62	-4,14	0,64	-4,01	-2,55	-6,13

**Table 6:** Relationship between complications and Thoracscore (TH) regarding the surgical technique.

WC: Without Complications; MiC: Minor Complication; MaC: Major Complication; D: Deceased

Regarding the cut-off points for HT, an optimum point of -3.85 for the VATS group and -4.29 for the thoracotomy group was shown for a sensitivity of 100% and specificity of 72%.

In the case of CH, the optimal point for the VATS group was 6.15 while for the open surgery group it would be 6.05 for a sensitivity of 100% and a specificity of 87.5%.

## Discussion

We included in our study 137 patients who underwent pulmonary resection, most of them with primitive lung carcinoma. Of these, just over half of them were operated through uniportal VATS. The overall rate of serious complications was higher than expected (6.5%) at the expense of the thoracotomy group, more than double (9.67%) than in the VATS group (4%).

Although in different studies, age has been related to the likelihood of complications, most authors recommend not discriminating patients only by age in decision making in the face of scheduled surgery. In our study we found that being 69 years old or more increased the probability of complications with this association being close to the statistical significance p-value.

In addition to age, other factors related to the appearance of complications (obesity, COPD, etc.) have been described. The most relevant ones have been grouped and related to create predictive indexes complications or life expectancy such as ASA, Torrington and Henderson scale, CH, TH or ESOS. The latter has been validated by different authors showing a good predictive capacity even greater than the TH and with less computational complexity [4]. However, probably the most used index has been the HT and found useful in several studies [5]. In our study it was shown as a fairly reliable index in predicting major complications. This agrees with the data provided by other authors.

However, in our series the best prediction was obtained with the functional index, reaching an important statistical significance, exceeding the capacity to classify the patients obtained by the HT. The particularity of this finding is that in this index only the functional capacity of the patient is valued without taking into account their comorbidities.

The CH is an index designed for the evaluation of life expectancy in function of the existing comorbidities. Its value is determined based on the presence or absence of a series of pathologies known to be closely related to life expectancy. In this way, its value could be extrapolated to be used as a measure of the risk related to the comorbidity of a patient before a surgical intervention. There are several studies that have tried to evaluate the utility of this index in the assessment of operative risk [6] and in particular in the surgery of the tórax [7]. In our analysis we did not find much usefulness since, although it reached higher values in the group of patients with complications, it did not reach the statistical significance p-value.

Since patients undergoing VATS surgery suffer less surgical aggression and because of this lower rate of complications compared to patients with thoracotomy, it is possible that the indices may behave differently depending on the technique used. For that reason we decided to analyze the behavior of the indices according to the techniques separately.

When analyzing separately the patients of the VATS group and thoracotomy we found a decrease in the predictive capacity of the indices. The TH and CH were not useful in the thoracotomy group and only approached but did not reach the statistical significance in the VATS group p-value.

Likewise, the functional index was significant only for the VATS group.

Therefore, it could be thought that the appearance of major complications in the VATS depends mainly on factors of comorbidity and functional when being reduced by the less aggressiveness the purely technical ones as opposed to the patients submitted to thoracotomy.

In clinical practice it may be very useful to know what is the optimal point of an index from which the complications trigger. This value, when measuring the overall result of the process translates a reflection of the quality of the set of actions of the same. This value is a personal measure or from the environment at the point where complications arise, providing a measure of the risk that can be assumed in these specific circumstances without increasing complications. Therefore it may be different depending on the surgeon or the technique used.

Thus, for the entirety of our series, a cut-off point was obtained of 3.44 for the TH, a value 0 for the functional index and 6.15 for the CH.

Analyzing the techniques separately the cutoff points were for TH -3.85 and -4.29 for the VATS and thoracotomy groups respectively, for FI 0 in both groups, and for CH 6,15 and 6,05.

These results reflect how both CH and TH are more demanding when selecting a patient for thoracotomy as predicted. The latter more importantly accuses the difference between techniques in expecting complications and is therefore the most useful index in our series.

Our work has some limitations such as the retrospective nature of the study and the small number of patients included in each group. Further studies are necessary, evaluating other indices and with more patients, in order to obtain firmer conclusions.

### Conclusions

HT is an index that is useful in the prediction of serious complications in patients submitted to major pulmonary resection, increasing their discrimination capacity in patients who will be operated with VATS.

Based on this argument, we could recommend the use of Thoracoscore's combination of results and functional assessment of the patient to include a greater number of high-risk patients, provided the procedure is performed using minimally invasive techniques.

Our study has the limitation that, being a retrospective study, the collected patients have already been filtered in the preoperative studies, which results in that the sample is very heterogeneous with respect to the risk factors, which prevents the correct determination of cut-off points specific.

Studies that allow the determination of a cut-off point of all variables (age, comorbidities, risks associated with the surgical technique and lung function) are combined in the same index or specific risk score for thoracic surgery.

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