Thoracoscopic segmentectomy versus lobectomy: A propensity score–matched analysis

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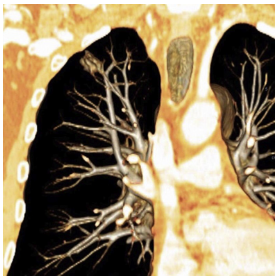
ABSTRACT

Objectives: The aim of this study is to compare the postoperative complications, perioperative course, and survival among patients from the multicentric Spanish Video-assisted Thoracic Surgery Group database who received video-assisted thoracic surgery lobectomy or video-assisted thoracic surgery anatomic segmentectomy.

Methods: From December 2016 to March 2018, a total of 2250 patients were collected from 33 centers. Overall analysis (video-assisted thoracic surgery lobectomy = 2070; video-assisted thoracic surgery anatomic segmentectomy = 180) and propensity score–matched adjusted analysis (video-assisted thoracic surgery lobectomy = 97; video-assisted thoracic surgery anatomic segmentectomy = 97) were performed to compare postoperative results. Kaplan–Meier and competing risks method were used to compare survival.

Results: In the overall analysis, video-assisted thoracic surgery anatomic segmentectomy showed a lower incidence of respiratory complications (relative risk, 0.56; confidence interval, 0.37-0.83; $P = .002$), lower postoperative prolonged air leak (relative risk, 0.42; 95% confidence interval, 0.23-0.78; $P = .003$), and shorter median postoperative stay (4.8 vs 6.2 days; $P = .004$) than video-assisted thoracic surgery lobectomy. After propensity score–matched analysis, prolonged air leak remained significantly lower in video-assisted thoracic surgery anatomic segmentectomy (relative risk, 0.33; 95% confidence interval, 0.12-0.89; $P = .02$). Kaplan–Meier and competing risk curves showed no differences during the 3-year follow-up (median follow-up in months: 24.4; interquartile range, 20.8-28.3) in terms of overall survival (hazard ratio, 0.73; 95% confidence interval, 0.45-1.7; $P = .2$), tumor progression–related mortality (subdistribution hazard ratio, 0.41; 95% confidence interval, 0.11-1.57; $P = .2$), and disease-free survival (subdistribution hazard ratio, 0.73; 95% confidence interval, 0.35-1.51; $P = .4$) between groups.

Conclusions: Video-assisted thoracic surgery segmentectomy showed results similar to lobectomy in terms of postoperative outcomes and midterm survival. In addition, a lower incidence of prolonged air leak was found in patients who underwent video-assisted thoracic surgery anatomic segmentectomy. (JTCVS Open 2022;9:268-78)



VATS anatomic segmentectomy is a suitable treatment for select patients with lung cancer.

CENTRAL MESSAGE

VATS anatomic segmentectomy is a suitable treatment for lung cancer with outcomes comparable to those of VATS lobectomy.

PERSPECTIVE

VATS anatomic segmentectomy was associated with some postoperative improved outcomes, with no survival difference in patients with lung cancer compared with VATS lobectomy. VATS segmentectomy is a suitable treatment in select patients with lung cancer with outcomes comparable to those of lobectomy.

See Commentary on page 279.

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Johnson & Johnson provided funding for the database.

Ethics Committees: The project was approved by the ethics committees of all the participating centers, and informed consent was obtained from the recruited patients to use their clinical data for scientific purposes (PI15/0072, 20/05/2015).

* Spanish Video-Assisted Thoracic Surgery Group members are listed in the Appendix E1.

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Abbreviations and Acronyms

CI = confidence interval
IQR = interquartile range
RR = relative risk
VASG = VATS anatomic segmentectomy group
VATS = video-assisted thoracic surgery
VLG = VATS lobectomy group

Video clip is available online.

Parenchymal-sparing resections could be important in patients with small pulmonary lesions, decreased pulmonary reserve, poor performance, or previous lung resections.[1-3] Over time, improvements in imaging and wider use of screening have allowed earlier detection of treatable lung lesions.[4] As video-assisted thoracic surgery (VATS) continues to expand, a special interest in thoracoscopic sublobar procedures has naturally arisen among thoracic surgeons.[5-8] There are still few and limited studies that compare the postoperative outcomes of VATS anatomic segmentectomy versus VATS lobectomy.[9-13] The main advantage previously described is the value of lung preservation after segmentectomy but at the cost of prolonged air leaks.[9,10] This study aims to compare the postoperative outcomes and midterm survival between VATS anatomic segmentectomy and lobectomy in 2250 patients from the prospective multicentric Spanish Video-assisted Thoracic Surgery Group database.

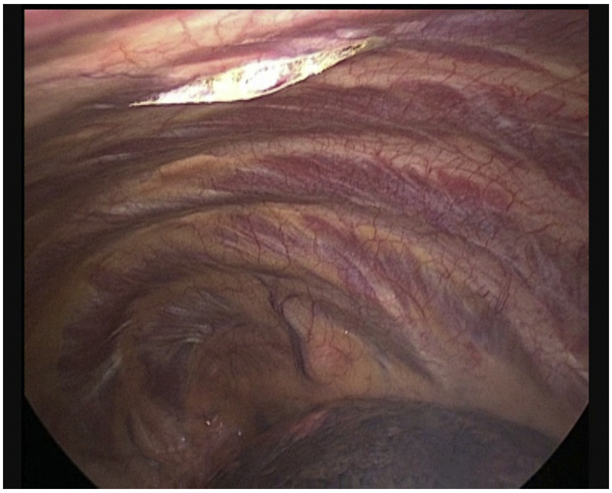
MATERIALS AND METHODS

Patients

In 2016, the Spanish Society of Thoracic Surgery developed a prospective multicentric database with the participation of 33 certified Spanish thoracic surgery centers, all of them members of the Spanish Video-assisted Thoracic Surgery Group.[14] This project was approved by the ethics committees of all the participating centers, and informed consent was obtained from the recruited patients to use their clinical data for scientific purposes (PI15/0072, 20/05/2015). Each center included all consecutive patients undergoing VATS anatomic lung resections from December 20, 2016, to March 20, 2018. Inclusion criteria were patients aged more than 18 years undergoing VATS anatomic lung resections (lobectomy or segmentectomy). Wedge resections, bilateral procedures, pneumonectomies, bilobectomies, non-VATS interventions, and those VATS procedures that required conversion to thoracotomy were excluded. Patients were then included in the VATS lobectomy group (VLG) or the VATS anatomic segmentectomy group (VASG).

Surgical Technique

VATS cases were defined as the absence of rib separation (regardless number of incisions) and the visualization performed via the optic system



VIDEO 1. Multiportal VATS approach to perform anatomic resection (lobectomy or segmentectomy). Utility incision is placed in the fifth intercostal space, and additional ports are placed inferior and posteriorly. Video available at: https://www.jtcvs.org/article/S2666-2736(22)00021-3/fulltext.

alone (Video 1). Anatomic segmentectomy was defined as any sublobar resection following the intersegmental plane with individual division of arterial, venous, and bronchial branches from the involved segment. In lung cancer cases, lymphadenectomy was performed by sampling or systematic lymph node dissection.[15]

Descriptive, Explicative, and Outcome Variables

All descriptive and outcome variables were adapted from the standardization documents of the Society of Thoracic Surgeons and the European Society of Thoracic Surgeons.[16] Cases of postoperative morbidity and mortality included those occurring during the first 30 days after surgery. Two composite dependent variables were defined: *Severe complications* included death or any complication considered IIIb or worse in the Clavien-Dindo classification,[17] and *respiratory complications* were defined as the presence of any respiratory complication listed in Table 1. In a 3-year follow-up, overall survival, tumor-progression survival, and disease-free survival were also evaluated. The explanatory predictive variable was the type of VATS resection (anatomic segmentectomy vs lobectomy).

Patients' Follow-up

Patients' follow-up included computed tomography every 3 months for the first year, every 6 months for second year, and yearly thereafter.

Statistical Analysis

Data were processed and explored. Variables with more than 10% missing values were deleted. For descriptive analysis, continuous variables were tested for normal distribution (Shapiro–Wilk test) and homoscedasticity (Levene test). Normally distributed variables were reported as mean and standard deviation, and non-normal variables were reported as median and interquartile range (IQR). Mean differences were assessed with a *t* test. Categorical variables were reported as absolute (count) and relative (percentage) frequencies and compared with a chi-square test. Dependent variables were postoperative complications and perioperative course (Table 1). The remaining descriptive variables were considered for statistical adjustment. An unadjusted analysis was performed for outcome variables. Risk ratio

TABLE 1. Unadjusted analysis of results

	VLG (N = 2070)	VASG (N = 180)	RR/MD	95% CI	*P* value
Severe complications*	73 (3.5%)	4 (2.2%)	0.63	0.23-1.70	.36
Postoperative mortality	22 (1.1%)	2 (1.1%)	1.05	0.25-4.41	.95
Clavien–Dindo IIIb	30 (1.5%)	0	0		.1
Clavien–Dindo IVa	24 (1.2%)	3 (1.7%)	1.44	0.44-4.73	.55
Clavien–Dindo IVb	7 (0.3%)	0	0		.43
Respiratory complications	455 (21.0%)	22 (12.2%)	0.56	0.37-0.83	.002
Prolonged intubation	2 (0.1%)	0	0		.68
Reintubation	23 (1.1%)	1 (0.6%)	0.50	0.07-3.68	.49
Prolonged air leak (>5 d)	272 (13.1%)	10 (5.6%)	0.42	0.23-0.78	.003
Pleural effusion/pneumothorax	49 (2.4%)	2 (1.1%)	0.47	0.12-1.91	.28
Atelectasis	71 (3.4%)	7 (3.9%)	1.13	0.53-2.43	.75
Pneumonia	72 (3.5%)	4 (2.2%)	0.64	2.24-1.73	.37
ARDS	18 (0.9%)	0	0		.21
Bronchopleural fistula	8 (0.4%)	0	0		.40
Empyema	13 (0.6%)	0	0		.27
Chylothorax	3 (0.1%)	1 (0.6%)	3.83	0.4-36.7	.21
Pulmonary thromboembolism	5 (0.2%)	0	0		.51
Other respiratory complications	42 (2.0%)	1 (0.6%)	0.27	0.04-1.98	.17
Reintervention	60 (2.9%)	4 (2.2%)	0.77	0.28-2.08	.6
Wound infection	23 (1.1%)	2 (1.1%)	1	0.24-4.21	1
Cardiovascular complications	108 (5.2%)	8 (4.4%)	0.85	0.42-1.72	.65
Blood transfusion	21 (1.0%)	4 (2.2%)	2.19	0.76-6.39	.14
Other complications	114 (5.5%)	11 (6.1%)	1.11	0.61-20.2	.73
Perioperative outcomes					
Surgical time (min)	180	177	3.7	−6.5 to 13.9	.47
Type of care					.32
Basic care	278 (13.4%)	20 (11.1%)			
Intermediate care	668 (32.3%)	70 (38.9%)			
Intensive care unit	1123 (54.3%)	90 (50.0%)			
Intraoperative death	1 (0.1%)	0	0		.76
Postoperative stay (d)	6.2	4.8	1.4	0.43-2.31	.004
Readmission	109 (5.5%)	6 (3.5%)	0.64	0.28-1.43	.26
Intermediate care or ICU readmission	69 (3.3%)	7 (3.9%)	1.17	0.54-2.50	.69

VLG, VATS lobectomy group; *VASG*, VATS anatomic segmentectomy; *RR*, relative risk; *MD*, mean difference; *CI*, confidence interval; *ARDS*, Acute respiratory distress syndrome; *ICU*, intensive care unit. *Severe complications: death or any complication considered IIIb or superior in the Clavien-Dindo classification.

was used as association measure for categorical variables. Continuous and multicategorical variables were tested for mean or frequency differences. For adjusted analysis, a propensity score–matched 1:1 sample was selected using logistic regression with the nearest neighbor method and a caliper of 0.1. All descriptive variables showing significant differences between groups was included in the model. Baseline characteristics were checked again in the matched sample. Adjusted analyses with relative risk (RR) and mean/frequencies comparison were performed in the propensity score–matched sample. A risk ratio confidence interval (CI) excluded the value one. Survival analysis was performed with the resulting groups after propensity matching.

For the univariate analysis of survival, the Kaplan–Meier method was used. Global survival curves were compared with log-rank test. Mortality by a specific cause and recurrences were analyzed by competing risks method because other-cause mortality is a competing risk for relapse and disease-related mortality. Survival between groups was assessed with the Gray test. Stata 14 Statistical Software: Release 14 (StataCorp LP) was used for the analysis.

RESULTS

The analysis identified 2070 patients in the VLG, 1404 male and 666 female, with a median age of 66 years (IQR, 59-73); and 180 patients in the VASG, 124 male and 56 female, with a median age of 67 years (IQR, 59-74).

Overall Results

Preoperatively (Table 2), the VLG showed less frequency of previous thoracic surgery (4.7% vs 10%; $P = .001$), previous oncological history (37.8% vs 49.4%; $P < .001$), and better predicted postoperative diffusing capacity for carbon monoxide (72.9% vs 65.7%; $P = .001$), whereas the VASG exhibited better predicted postoperative forced expiratory volume in 1 second (75.2% vs 72.2%; $P = .001$). Upper lobectomies were the most frequent procedures in the VLG,

TABLE 2. Patient demographics and baseline characteristics

Variables: Median (IQR) or No. (%)	VLG (N = 2070)	VASG (N = 180)	*P* value
Age (y)	66 (59, 73)	67 (59, 74)	.9678
Sex (male)	1404 (67.8%)	124 (68.9%)	.77
BMI (kg/m^2)	26.6 (23.7, 29.7)	26.6 (24.2, 29.7)	.65
Smokers (current or ex-smokers)	1707 (82.5%)	136 (75.5%)	.04
Previous thoracic surgery	96 (4.7%)	18 (10.0%)	.001
Ipsilateral	32 (1.6%)	4 (2.2%)	
Contralateral	53 (2.6%)	14 (7.8%)	
Bilateral	11 (0.5%)	0	
Previous oncological disease	719 (37.8%)	89 (49.4%)	<.001
Previous lung cancer	53 (2.9%)	14 (11.1%)	<.001
Predicted postoperative FEV1 (%s)	72.2 (61.2, 84.5)	75.2 (62.6, 90.9)	.002
Predicted postoperative DLCO (%)	65.7 (54.7, 78.1)	72.9 (59.9, 85.9)	.001
Diagnosis			.001
Lung carcinoma	1819 (87.9%)	126 (70.0%)	
Lung metastases	141 (6.8%)	31 (17.2%)	
Other	110 (5.3%)	23 (12.8%)	
Pathologic stage			<.001
0	14 (0.8%)	5 (4.0%)	
I	1178 (56.9%)	101 (56.1%)	
II	344 (16.6%)	8 (4.4%)	
III	216 (10.4%)	7 (3.9%)	
IV	27 (1.3%)	3 (1.7%)	
Tumor location			<.001
Central	501 (27.6%)	15 (11.9%)	
Peripheral	1317 (72.4%)	111 (88.10%)	
ASA			.57
I	50 (2.4%)	5 (2.8%)	
II	907 (43.9%)	70 (38.9%)	
III	1066 (51.6%)	102 (56.7%)	
IV	44 (2.1%)	3 (1.7%)	
Hemithorax			<.001
Right	1302 (62.9%)	54 (30.0%)	
Left	768 (37.1%)	126 (70.0%)	
No. of incisions			<.001
1	176 (8.5%)	34 (18.9%)	
2	1349 (65.2%)	114 (63.3%)	
Multiportal (≥3)	545 (26.3%)	32 (17.8%)	
Lobes or segments resected	2070 (100.0%)	180 (100.0%)	N/A
Right upper lobectomy	757 (36.6%)		
Middle lobectomy	150 (7.2%)		
Right lower lobectomy	393 (19.0%)		
Left upper lobectomy	444 (21.5%)		
Left lower lobectomy	326 (15.8%)		
S1		15 (8.3%)	
S2		9 (5.0%)	
S3		8 (4.4%)	
S6		31 (17.2%)	
Basal pyramid		10 (5.6%)	
Nonbasal pyramid lower segmentectomies (S7, S8, S9, S10 or combination)		5 (2.8%)	
S1 + S2		5 (2.8%)	
Left S1 + S2 + S3		59 (32.8%)	
Left S4 + S5		24 (13.3%)	
Other combination		14 (7.8%)	

IQR, Interquartile range; *VLG*, VATS lobectomy group; *VASG*, VATS anatomic segmentectomy group; *BMI*, body mass index; *FEV1*, forced expiratory volume in 1 second; *DLCO*, diffusing capacity for carbon monoxide; *ASA*, American Society of Anesthesiologists; *N/A*, not applicable.

TABLE 3. Patient demographics and characteristics after propensity score matching

Variables: Median (IQR) or number (%)	VLG (N = 97)	VASG (N = 97)	*P* value
Age (y)	67 (61, 72)	69 (61, 74)	.5998
Sex (male)	97 (62.9%)	97 (66.0%)	.653
BMI (kg/m^2)	27.7 (25.0, 30.8)	26.7 (24.2, 30.0)	.1521
Smokers (current or ex-smoker)	82 (84.5%)	81 (83.5%)	.957
Previous thoracic surgery			.747
No	86 (88.9%)	88 (90.7%)	
Ipsilateral	3 (3.1%)	2 (2.1%)	
Contralateral	7 (7.2%)	7 (7.2%)	
Bilateral	1 (1.0%)	0	
Previous oncological disease	30 (38.1%)	41 (42.3%)	.558
Predicted postoperative FEV1 (%)	75.9 (63.4, 86.8)	72.47 (59.7, 86.8)	.8019
Predicted postoperative DLCO (%)	70.7 (61.6, 82.5)	73.1 (56.4, 85)	.90
Diagnosis			1
Lung carcinoma	97 (100%)	97 (100%)	
Histology			.5
Adenocarcinoma	63 (64.9%)	55 (56.7%)	
Epidermoid	22 (22.7%)	26 (26.8)	
Others	12 (12.4%)	16 (16.5%)	
Tumor size (mm)	17 (12, 25)	15 (12, 20)	.09
Pathologic stage			.97
0	5 (5.2%)	4 (4.1%)	
IAI	15 (15.5%)	16 (16.5%)	
IA2	38 (39.2%)	41 (42.3%)	
IA3	6 (6.2%)	9 (9.3%)	
IB	12 (12.4%)	13 (13.4%)	
IIA	1 (1.0%)	1 (1.0%)	
IIB	10 (10.3%)	5 (5.6%)	
IIIA	8 (8.3%)	6 (6.2%)	
IIIB	1 (1.0%)	1 (1.0%)	
IVB	1 (1.0%)	1 (1.0%)	
Lymph nodes resected	6 (4, 10)	4 (2.5, 8)	.001
Hilar-mediastinal* stations resected	3 (3, 4)	3 (2, 3)	.01
Patients with pathological hilar-mediastinal lymph node involvement	11 (11.3%)	9 (9.3%)	.22
Patients with pathological Intrapulmonary lymph node involvement	4 (4.1%)	2 (2.1%)	.407
Previous lung cancer	9 (9.3%)	8 (8.3%)	.8
ASA			.741
I	2 (2.1%)	1 (1.03%)	
II	41 (42.3%)	35 (36.1%)	
III	52 (53.6%)	59 (60.8%)	
IV	2 (2.1%)	2 (2.1%)	
Hemithorax			.869
Right	24 (24.7%)	25 (25.8%)	
Left	73 (75.3%)	72 (74.2%)	
No. of incisions			.22
1	8 (8.3%)	16 (16.5%)	
2	66 (68.0%)	61 (62.8%)	
Multiportal (≥3)	23 (23.7%)	20 (20.6%)	

IQR, Interquartile range; *VLG*, VATS lobectomy group; *VASG*, VATS anatomic segmentectomy group; *BMI*, body mass index; *FEV1*, forced expiratory volume in 1 second; *DLCO*, diffusing capacity for carbon monoxide; *ASA*, American Society of Anesthesiologists. *Hilar-mediastinal: N2 stations or 10 station.

TABLE 4. Propensity-matched analysis of results

	VLG (97)	VASG (97)	RR/MD	95% CI	*P* value
Severe complications*	3 (3.1%)	3 (3.1%)	1	0.21-4.8	1
Postoperative mortality	1 (1.0%)	2 (2.1%)	2	0.18-21.7	.56
IIIb	1 (1.0%)	0 (0%)	0		.31
Iva	2 (2.1%)	2 (2.1%)	1	0.14-6.96	1
Ivb	0 (0%)	0 (0%)			N/A
Respiratory complications	24 (24.7%)	14 (14.4%)	0.58	0.32-1.06	.07
Prolonged intubation	0 (0%)	0 (0%)			N/A
Reintubation	0 (0%)	1 (1.0%)			N/A
Prolonged air leak (>5 d)	16 (16.5%)	6 (6.2%)	0.38	0.15-0.92	.02
Pleural effusion/pneumothorax	1 (1.0%)	1 (1.0%)	1	0.06-15.8	1
Atelectasis	2 (2.1)%	4 (4.1)%	2	0.38-10.7	.41
Pneumonia	3 (3.1%)	3 (3.1%)	1	0.21-4.83	1
ADRS	0 (0%)	0 (0%)			N/A
Bronchopleural fistula	0 (0%)	0 (0%)			N/A
Empyema	0 (0%)	0 (0%)			N/A
Chylothorax	2 (2.1%)	1 (1.0%)	0.5	0.05-5.42	.56
Pulmonary thromboembolism	0 (0%)	0 (0%)			N/A
Other respiratory complications	2 (2.1%)	1 (1.0%)	0.5	0.05-5.42	.56
Reintervention	3 (3.1%)	3 (3.1%)	1	0.21-4.83	1
Wound infection	0 (0%)	2 (2.1)%			N/A
Cardiovascular complications	6 (6.2%)	7 (7.2%)	1.17	0.41-3.35	.77
Blood transfusion	2 (2.1%)	3 (3.1%)	1.5	0.26-8.78	.65
Other complications	6 (6.2%)	6 (6.2%)	1	0.33-2.99	1
Perioperative outcomes					
Surgical time (min)	191	179	12	−6.7 to 30.8	.2
Basic care	11 (11.3%)	4 (4.1%)			
Intermediate care	33 (34.0%)	38 (39.2%)			
intensive care unit	53 (54.6%)	55 (56.7%)			.16
Intraoperative death	0 (0%)	0 (0%)			
Postoperative stay	5.7	5.3	0.4	−0.75 to 1.58	.49
Readmission	7 (7.2%)	6 (6.2%)	0.86	0.30-2.45	.77
Intermediate care or ICU readmission					

VLG, VATS lobectomy group; *VASG*, VATS anatomic segmentectomy; *RR*, relative risk; *MD*, mean difference; *CI*, confidence interval; *N/A*, not applicable; *ARDS*, acute respiratory distress syndrome; *ICU*, intensive care unit. *Severe complications: death or any complication considered IIIb or superior in the Clavien-Dindo classification.

whereas left upper trisegmentectomy was the most frequent in the VASG. Primary lung cancer was the most frequent diagnosis in both groups but more prevalent in VLG (87.9% vs 70%; $P = .001$). The majority of cases were performed by the biportal or multiportal VATS approach (91.3% of all cases) (Videos 1 and 2).

In the postoperative data analysis (Table 1), VASG showed less respiratory complications (RR, 0.56; 95% CI, 0.37-0.83; $P = .002$), less postoperative prolonged air leak (RR, 0.42; 95% CI, 0.23-0.78; $P = .003$), and shorter postoperative stay (4.8 vs 6.2 days; $P = .004$). Severe complications were lower in VASG, but this difference did not reach statistical significance (RR, 0.63; 95% CI, 0.23-1.70; $P = .36$). No other significant differences were found.

Matched Results

After propensity score–matching analysis, a sample of 97 VASG patients were 1:1 matched to 97 VLG patients (Table 3) according to the following variables: smokers, previous thoracic surgery, previous oncological disease, previous lung cancer, postoperative predicted forced expiratory volume in 1 second, postoperative predicted diffusing capacity for carbon monoxide, diagnosis, stage, tumor location, hemithorax, and number of incisions. All patients in both groups had a diagnosis of primary lung cancer, and there were no significant differences in the preoperative variables, including staging. The VLG showed a greater number of lymph nodes resected (6 [IQR, 4-10] vs 4 [IQR, 2.5-8]; $P = .001$) and a greater number of hilar-mediastinal stations resected (3 [IQR, 3-4] vs 3 [IQR, 2-3]; $P = .01$).

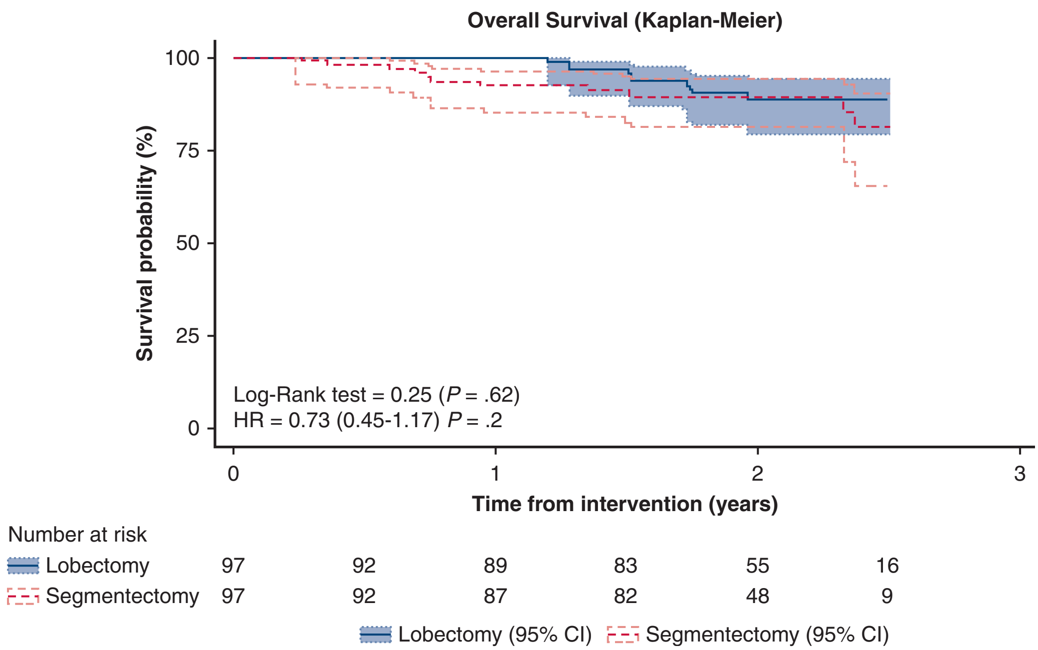


FIGURE 1. Overall survival in the VASG versus VLG. *CI*, Confidence interval; *HR*, hazard ratio;

However, neither intrapulmonary (4.1% vs 2.1%; $P = .407$) nor hilar-mediastinal (10.3% vs 8.3%; $P = .39$) lymph nodes involvement showed differences between groups.

After adjusted analysis (Table 4), the only postoperative difference between groups was a significantly lower incidence of prolonged air leak in the VASG (RR, 0.33; 95% CI, 0.12-0.89; $P = .02$). No other differences were found in terms of postoperative complications and perioperative outcomes between groups.

The 36-month follow-up (24.4; IQR, 20.8-28.3) time curve analysis for overall survival (HR, 0.73; 95% CI, 0.45-1.7; $P = .2$) (Figure 1), tumor progression–related survival (loco-regional or distant metastasis) (subdistribution

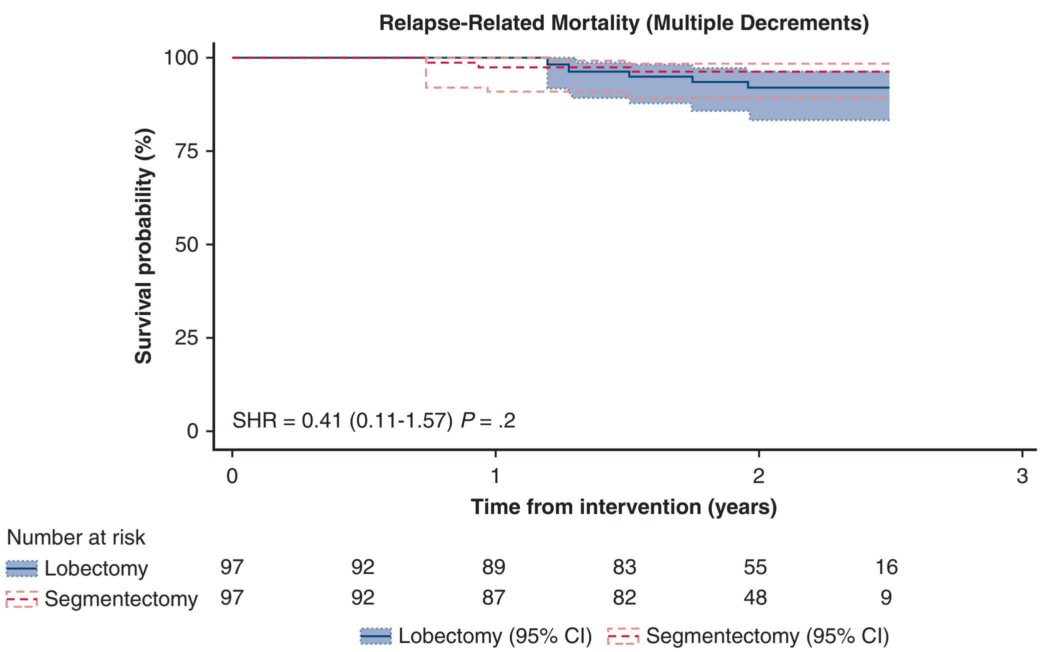


FIGURE 2. Relapse-related mortality in the VASG versus VLG. *CI*, Confidence interval; *SHR*, subdistribution hazard ratio.

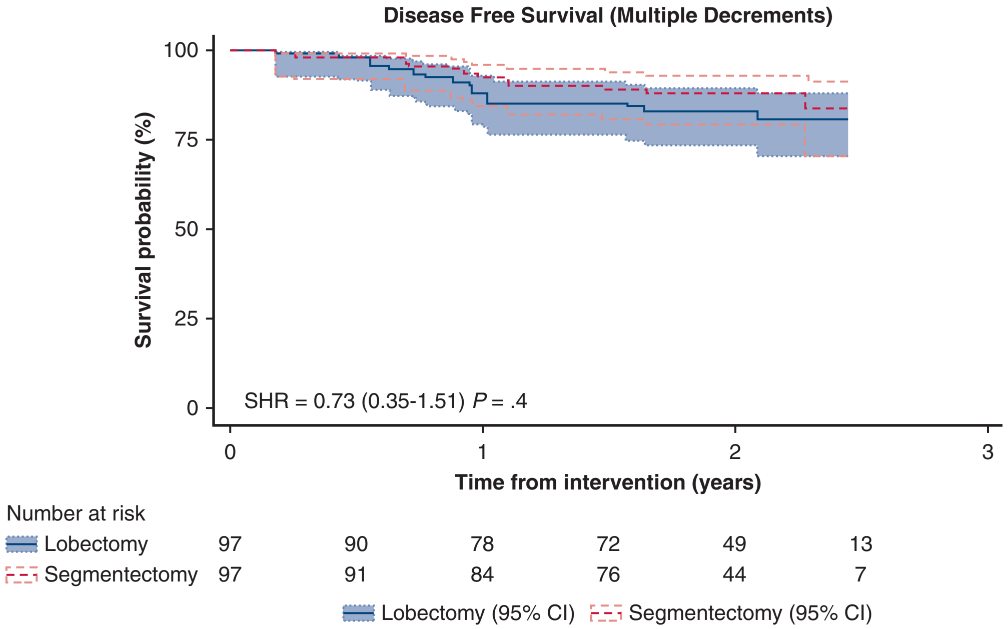


FIGURE 3. Disease-free survival in the VASG versus VLG. *CI*, Confidence interval; *SHR*, subdistribution hazard ratio.

hazard ratio, 0.41; 95% CI, 0.11-1.57; $P = .2$) (Figure 2), and disease-free survival (subdistribution hazard ratio, 0.73; 95% CI, 0.35-1.51; $P = .4$) (Figure 3) showed no differences between groups.

DISCUSSION

Postoperative results and midterm survival after VATS anatomic segmentectomy have been explored by different authors showing postoperative results similar to those for VATS lobectomy, but studies are mostly retrospective,[2,9-13,18-20] focusing on patients with limited functional reserve or very small lung lesions, with occasional attempts of patient matching.[21,22] Although our study is retrospective, it is characterized by a reasonably large cohort of patients (2250 VATS patients) and the application of propensity score–matching methodology. A significant postoperative finding in the present study is the lower incidence of prolonged air leak in VATS segmentectomies that have been greater in previous studies.[9,10] We suspect this is due to greater apposition of the remaining lung parenchyma; however, there was no homogeneous way to construct the intersegmental plane in all centers, so future studies will be necessary to confirm this finding.

In the survival analysis, we did not find differences between groups, which is consistent with previous studies.[2,8-12,16,17] Although there were differences in lymphadenectomy patterns, the definitive pathological lymph node involvement did not show differences between groups. Despite the inherent diversity of stages, histology, and lymphadenectomy technique of a multicentric study, midterm survival results were similar when comparing thoracoscopic anatomic segmentectomy with lobectomy (Figures 1-3). Midterm survival and recurrence were tested in 3 years of follow-up (24.4; IQR, 20.8-28.3) because the median time from surgical resection of the primary lung cancer to loco-regional recurrent disease or distant recurrence is less than 15 months.[23]

Not limited to VATS approaches only, there are currently 2 randomized trials being conducted to compare lobectomy versus sublobar resections in terms of survival and disease-free survival: the Cancer and Leukemia Group B (140503)[24] and the Japan Clinical Oncology Group (0802).[25] It is hoped that the future results will provide strong, sufficient evidence to overcome the limitations not only in our study but also in the available literature. However, the issue of adopting the VATS approach for sublobar resections, even in the absence of strong randomized studies, seems to have been overcome by clinical evolution of surgical units toward noninvasive approaches.[26]

Study Limitations

This study has several limitations. Although the entry of data was made in a prospective manner, the decision to perform each procedure was not randomized and was left up to the individual clinician's judgment. This supposes a risk of selection bias and a lack of control of confounding factors with the need of statistical adjustment techniques. In addition, this is not an intention-to-treat analysis. Moreover, the nature of the multicenter collaboration implies that some units would be more versed in performing more

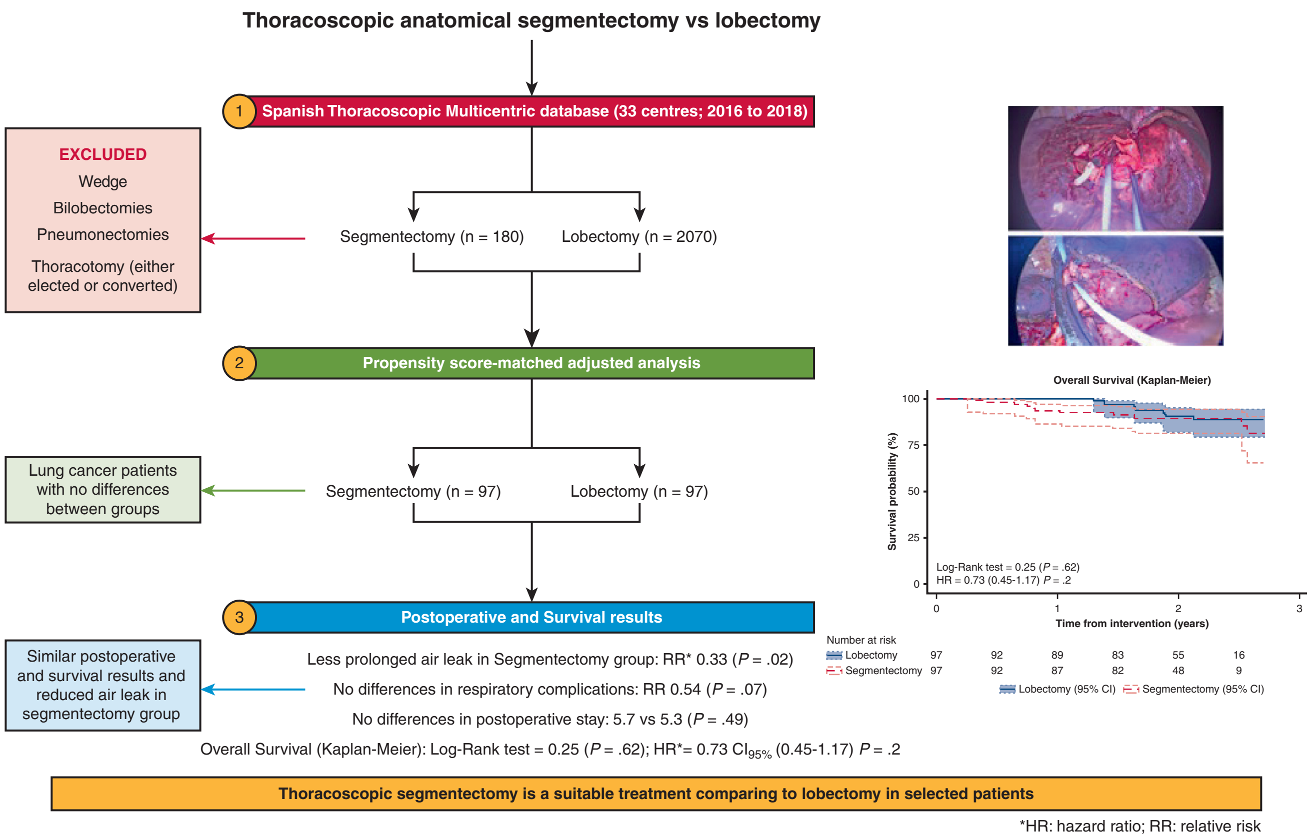
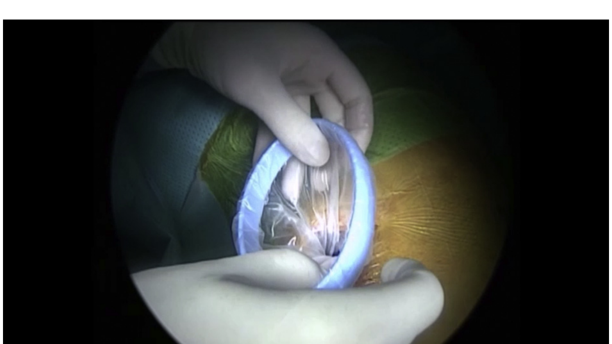


FIGURE 4. VATS segmentectomy has similar postoperative and midterm survival compared with lobectomy. Air leak was decreased in the segmentectomy group. *CI*, Confidence interval; *HR*, hazard ratio; *RR*, relative risk.

complex or unusual segmentectomies than others. Missing is higher than 10% in the variable tumor location. We acknowledge that accurate information about the location of the tumors, peripheral versus central, might have an effect, depending on the surgeon's experience, on having more prolonged air leaks. In addition, there was no requirement to disclose the method of lung parenchyma division, although is assumed that this was performed by the use of endo-staplers in the majority of cases.



VIDEO 2. Uniportal VATS approach through the fifth intercostal space to perform anatomic resection (lobectomy or segmentectomy). Video available at: https://www.jtcvs.org/article/S2666-2736(22)00021-3/fulltext.

CONCLUSIONS

VATS anatomic segmentectomy has similar postoperative results when compared with VATS lobectomy in terms of postoperative morbidity, midterm overall survival, and disease-free survival. As a newly reported finding, VATS segmentectomy decreases the risk of postoperative prolonged air leak compared with VATS lobectomy (Figure 4).

Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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Key Words: anatomic segmentectomy, lobectomy, lung cancer, sublobar resection, thoracoscopy, VATS

APPENDIX E1

Multicentric Spanish Video-Assisted Thoracic Surgery Group Database Members

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