Original Article

Is faster better? Impact of operative time on postoperative outcomes after VATS anatomical pulmonary resection

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Background: Video-assisted thoracic surgery (VATS) is now the preferred approach for standard anatomical pulmonary resections. This study evaluates the impact of operative time (OT) on post-operative outcomes after VATS anatomical pulmonary resection for non-small cell lung cancer (NSCLC).

Methods: We retrospectively reviewed all consecutive patients undergoing VATS lobectomy or segmentectomy for NSCLC between November 2010 and December 2019. Postoperative outcomes were compared between short (<150 minutes) and long (≥150 minutes) OT groups. A multivariable analysis was performed to identify predictors of long OT and overall post-operative complications.

Results: A total of 670 patients underwent lobectomy (n=496, 74%) or segmentectomy (n=174, 26%) for NSCLC. Mediastinal lymph node dissection was performed in 621 patients (92.7%). The median OT was 141 minutes (SD: 47 minutes) and 387 patients (57.8%) were operated within 150 minutes. Neoadjuvant chemotherapy was given in 25 patients (3.7%). Conversion thoracotomy was realized in 40 patients (6%). Shorter OT was significantly associated with decreased post-operative overall complication rate (30% *vs.* 41%; P=0.003), shorter median length of drainage (3 *vs.* 4 days; P<0.001) and shorter median length of hospital stay (6 *vs.* 7 days; P<0.001). On multivariable analysis, long OT (≥150 minutes) (OR 1.64, P=0.006), ASA score >2 (OR 1.87, P=0.001), FEV_1 <80% (OR 1.47, P=0.046) and DLCO <80% (OR 1.5, P=0.045) were significantly associated with postoperative complications. Two predictors of long OT were identified: neoadjuvant chemotherapy (OR 3.11, P=0.01) and lobectomy (OR 1.5, P=0.032).

Conclusions: A prolonged OT is significantly associated with postoperative complications in our collective of patients undergoing VATS anatomical pulmonary resection.

Keywords: Video-assisted thoracic surgery (VATS); anatomical pulmonary resection; postoperative outcomes; operative time

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Introduction

The video-assisted thoracic surgery (VATS) approach has gradually become the gold standard for anatomical pulmonary resections. This technique sports several advantages over open thoracotomy such as lower perioperative morbidity, reduced acute and chronic postoperative pain and shorter durations of drainage and hospital stay (1-3). In our team's experience, operative time

(OT) generally reflects surgical complexity such as the presence of pleural adhesions, large tumors, fused fissures or calcified lymph nodes. It is also impacted by patient characteristics and surgeon experience. Some factors are not always predictable during the preoperative evaluation (4-7). Thus, surgical scheduling is sometimes difficult, decreasing operational efficiency and increasing surgery costs. When OT extends beyond a certain (undefined) threshold, conversion to thoracotomy may facilitate dissection (5). However, it is noteworthy that VATS anatomical pulmonary resections remain high-risk procedures (2,8,9) and that post-operative complication rates increase after prolonged OT (4). Hence, the surgeon must weigh the risks and benefits of pursuing an operation by VATS or convert to open thoracotomy. Although longer operations are sometimes inevitable, we found that knowledge of predictive factors of longer operative time may potentially limit the increased cost and related morbidity associated with a prolonged operation.

The aim of our study was to explore the impact of OT on the development of post-operative complications after VATS anatomical resection on a group of patients operated by our team. Additionally, we aimed to identify factors associated with prolonged OT in VATS anatomical pulmonary resections. We present the following article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-21-1774/rc).

Methods

Study design and patient selection

This retrospective monocentric study includes all consecutive patients undergoing a VATS lobectomy or segmentectomy between January 2010 and December 2019 in our institution. Patients were included if they were aged ≥18 years and if they presented a non-small cell lung cancer (NSCLC), for which they underwent a lobectomy or segmentectomy by VATS. Other types of anatomical or extra-anatomical lung resections and open procedures were excluded. Patients were separated in two groups according to the OT. The OT was defined as the time from skin incision to skin closure. As the overall median OT was 141 minutes (IQR 116–171 minutes), we defined the "short OT" group as the patients operated within less than 150 minutes (the next round number) and the "long OT" group as the patients operated within 150 minutes or more. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Local Ethics Committee (CER-VD) (approval number: N°2020-02181) and individual consent for this retrospective analysis was waived.

Data collection

Data was retrospectively collected from our electronic database and included: patient demographics, comorbidities, preoperative pulmonary functions, American Society of Anaesthesiologists (ASA) score, pulmonary lesion and surgical characteristics, postoperative outcomes up to 30 days after surgery including complications, length of drainage, length of hospital stay (LOHS), readmissions and reoperations. Postoperative complications were defined as any adverse event influencing patient management occurring during the 30-postoperative day period. Cardiopulmonary complications included arrhythmia, cardiac ischemia, cardiac failure, pneumonia, pneumothorax, hemothorax, pleural empyema, air leak (≥5 days), acute respiratory distress syndrome, subcutaneous emphysema and chylothorax.

Operation

All oncological patients were discussed by an interdisciplinary tumor board before operation to assess the indications for surgery. A preoperative cardio-respiratory physiological assessment was performed in all patients. This consisted in a transthoracic echocardiography and a spirometry, completed by an ergo-spirometry and a pulmonary scintigraphy if the forced expiratory volume in one second (FEV_1) and/or the diffusing capacity of the lung for carbon monoxide (DLCO) were lower than 80% of the predicted value (10). Three attending specialized surgeons performed or supervised the different operations during the entire study period and a fourth specialized surgeon joined the team since 2018. Anatomical pulmonary resections were performed under general anaesthesia with double-lumen intubation and single-lung ventilation. The VATS approach consisted in a standard three-port anterior approach and technique did not change during the study period. The extent of the resection depended on the size and localisation. Segmentectomy was generally reserved for peripherally located solid tumors with a diameter of less than 2 centimeters or small ground glass opacities. Simple segmentectomy were defined as tri-segmentectomy, lingulectomy and apical or basilar segmentectomy. Complex segmentectomy were defined as individual or bi-segmentectomy of the upper, middle and lower lobes. For the other cases, anatomical pulmonary resection was achieved through lobectomy. Mediastinal lymph node dissection was performed in case of suspected or proven primary lung cancer. A protective bag was used to extract the specimens. Patients were transferred to the ward or to the continuous or intensive care units in case of severe comorbidities or need for vasoactive drugs. All cases were discussed by the interdisciplinary tumor board after surgery to plan the follow-up and assess the need for adjuvant treatment.

Statistical analysis

Binary variables are reported as numbers with percentages. Normally distributed continuous variables are reported as means [standard deviation (SD)]. Other variables (nominal with large number categories or non-normally distributed continuous) are reported as medians [interquartile range (IQR)]. Numerical variables were tested by the unpaired Student's t-test (if normally distributed) or by the Mann-Whitney U test (if not normally distributed). Categorical variables were tested by the Chi-squared test. FEV_1 and DLCO were categorized (below or above 80% of predicted value) to strengthen the correlation. Learning curve for VATS anatomical pulmonary resections was supposed to be achieved after 50 cases, thus number of cases were categorized (below or over 50 cases per surgeon) to evaluate the effect of surgeon's experience on study outcomes (11). The factors associated with OT and postoperative complications were identified using a stepwise backward multi-variable regression. A P value <0.05 was defined as the threshold for statistical significance. Data are reported as odds ratio (OR) with 95% confidence intervals (CI). The Stata version 14 software (StataCorp, Texas, USA) was used for statistical analyses.

Results

A total of 670 patients [female/male: 314/356; median age: 67 years (IQR 60–73)] underwent anatomical pulmonary resection for NSCLC. *Table 1* summarizes the patients' characteristics. Lobectomy was performed in 496 (74%) and segmentectomy in 174 (26%) patients. Most of the patients (n=621, 92.7%) underwent an associated mediastinal lymph node dissection. Forty (6%) VATS procedures were converted to open thoracotomy. Pleural adhesions were the main reason for conversion (n=19, 2.3%), followed by intraoperative bleeding (n=14, 1.7%), vascular or bronchial infiltration (n=12, 1.5%), calcified lymph nodes (n=6, 0.7%) and other reasons (n=9, 1.1%).

Of those 670 patients, 387 (57.8%) were operated within 150 minutes (*Table 1*). When comparing short and long OT groups, we observed that patients with shorter OT were predominantly female (50.6% *vs.* 41.7%; P=0.02), had a lower body mass index (BMI) [mean (SD): 24.8 (4.8) *vs.* 25.9 (5.4) kg/m^2; P=0.01] and presented fewer arrhythmia (10.3% *vs.* 15.5%; P=0.05). The mean preoperative FEV_1 was also significantly higher in the short OT group [mean (SD): 88 (22.5) *vs.* 84.2 (20.0); P=0.03]. Tumoral stage was similar between both groups. Neoadjuvant chemotherapy was more frequently administered in the long OT group (6% *vs.* 2.1%; P=0.01) and conversion thoracotomy was more frequent in the long OT group (9.9% *vs.* 3.1%; P<0.001). In terms of post-operative outcomes, the overall morbidity rate was significantly lower in the short OT group (30% *vs.* 41%; P=0.003). Both the median length of drainage (3 *vs.* 4 days; P<0.001) and the median LOHS (6 *vs.* 7 days; P<0.001) were significantly reduced in the short OT group. Readmission (4.4% *vs.* 2.1%; P=0.12) and reoperation (3.6% *vs.* 3.2%; P=0.76) rates were similar between both groups. Readmissions were mainly due to pleural effusion (n=5 over both groups, 0.7%), pneumonia (n=3, 0.4%) or subcutaneous emphysema (n=3, 0.4%). The main reasons for reoperation were haemothorax (n=4 over both groups, 0.6%), subcutaneous emphysema (n=4, 0.6%), pleural empyema (n=4, 0.6%) or pneumothorax (n=4, 0.6%). Two patients from the long OT group died during the 30-day postoperative follow-up. The first patient died on the 29^{th} postoperative day because of a respiratory insufficiency due to a severe pneumonia. The second patient was readmitted and died because of a mesenteric ischemia and renal infarction.

Multivariable analysis of factors associated with an increased risk of 30-day overall postoperative morbidity is given in *Table 2*. Some factors were significantly associated with postoperative morbidity: ASA score >2 (OR 1.87, P=0.001), FEV_1 <80% (OR 1.47, P=0.046) and DLCO <80% (OR 1.5, P=0.045). Finally, it is noteworthy that OT ≥150 minutes was significantly associated with overall postoperative morbidity (OR 1.64, P=0.006). On the other hand, we did not observe a significantly increased complication rate for the type of anatomical resection, laterality, tumor size >40 mm, neoadjuvant chemotherapy

Table 1 Patient and surgical characteristics

Variables	Total (n=670)	Short OT (n=387)	Long OT (n=283)	P value
Sex				
Female	314 (46.9)	196 (50.6)	118 (41.7)	0.022
Male	356 (53.1)	191 (49.4)	165 (58.3)	
Age, years, median [IQR]	67 [60–73]	67 [60–73]	67 [61–73]	0.801
BMI, kg/m^2 (mean ± SD)	25.3±5.1	24.8±4.8	25.9±5.4	0.01
Comorbidities				
High blood pressure	347 (51.8)	191 (49.4)	156 (55.1)	0.14
Cardiopathy	99 (14.8)	57 (14.7)	42 (14.8)	0.968
Arrhythmia	84 (12.5)	40 (10.3)	44 (15.5)	0.045
Tobacco exposure	569 (84.9)	323 (83.5)	246 (86.9)	0.217
Diabetes	103 (15.4)	58 (15.0)	45 (15.9)	0.746
Renal failure	56 (8.4)	32 (8.3)	24 (8.5)	0.922
Immunosuppression	15 (2.2)	10 (2.6)	5 (1.8)	0.483
ASA score (mean ± SD)	2.5±0.5	2.5±0.5	2.5±0.5	0.563
Preoperative pulmonary functions				
FEV1, % (mean ± SD)	86.4±21.5	88±22.5	84.2±20	0.026
DLCO, % (mean ± SD)	71.6±19.7	72±19.5	71.1±19.9	0.584
Tumoral stage (TNM 8th edition)				
Stage I	465 (69.4)	275 (71.1)	190 (67.1)	0.609*
Stage II	117 (17.5)	66 (17.1)	51 (18.0)	
Stage III	63 (9.4)	34 (8.8)	29 (10.2)	
Stage IV	25 (3.7)	12 (3.1)	13 (4.6)	
Type of cancer				
Adenocarcinoma	461 (68.8)	271 (70.0)	190 (67.1)	0.587*
Squamous cell carcinoma	144 (21.5)	78 (20.2)	66 (23.3)	
Others non specified	65 (9.7)	38 (9.8)	27 (9.5)	
Neoadjuvant chemotherapy	25 (3.7)	8 (2.1)	17 (6.0)	0.011
Type of resection				
Segmentectomy	174 (26.0)	113 (29.2)	61 (21.6)	0.026
Lobectomy	496 (74.0)	274 (70.8)	222 (78.4)	
Mediastinal lymph nodes dissection	621 (92.7)	358 (92.5)	263 (92.9)	0.834

Table 1 (*continued*)

Table 1 (*continued*)

Variables	Total (n=670)	Short OT (n=387)	Long OT (n=283)	P value
Lesion localization				
Right side	383 (57.2)	218 (56.3)	165 (58.3)	0.61
Left side	287 (42.8)	169 (43.7)	118 (41.7)	
Superior lobe	404 (60.3)	224 (57.9)	180 (63.6)	0.135*
Middle lobe	45 (6.7)	32 (8.3)	13 (4.6)	
Inferior lobe	220 (32.8)	130 (33.6)	90 (31.8)	
Conversion thoracotomy	40 (6.0)	12 (3.1)	28 (9.9)	<0.001
Postoperative destination				
Ward	165 (24.6)	106 (27.4)	59 (20.8)	0.072
Continuous care	486 (72.5)	273 (70.5)	213 (75.3)	
Intensive care	19 (2.8)	8 (2.1)	11 (3.9)	
Overall morbidity (30-day)	232 (34.6)	116 (30.0)	116 (41.0)	0.003
Cardiopulmonary complications	219 (32.7)	108 (27.9)	111 (39.2)	0.002
Mortality (30-day)	2 (0.3)	0	2 (0.7)	NA
Length of drainage, days, median [IQR]	3 [2–6]	3 [1–5]	4 [2–6]	<0.001
Redrainage	37 (5.5)	16 (4.1)	21 (7.4)	0.07
LOHS, days, median [IQR]	6 [4–10]	6 [4–9]	7 [5–11.5]	<0.001
Readmission (30-day)	23 (3.4)	17 (4.4)	6 (2.1)	0.118
Reoperation (30-day)	23 (3.4)	14 (3.6)	9 (3.2)	0.759

Data are expressed as mean ± standard deviation or medians and interquartile ranges or numbers (percentages). *, Fisher's exact test. OT, operative time; IQR, interquartile range; BMI, body mass index; SD, standard deviation; COPD, chronic obstructive pulmonary disease; ASA, American Society of Anaesthesiologists; FEV1, forced expiratory volume in one second; DLCO, diffusing capacity of the lung for carbon monoxide; LOHS, length of hospital stay; N/A, not applicable.

or during the surgeons' learning curve.

Table 3 shows the multivariable analysis of factors associated with a prolonged OT (≥150 minutes). Only two factors were statistically significant: neoadjuvant chemotherapy (OR 3.11, P=0.01) and lobectomy (OR 1.5, P=0.032). Other factors, such as patient comorbidities, lesion characteristics or surgeon learning curve were not statistically associated with a prolonged OT.

Discussion

We present the influence of OT on postoperative outcomes in a large series of 670 patients undergoing VATS anatomical pulmonary resection. For the 387 patients (57.8%) operated within 150 minutes, the 30-postoperative days overall morbidity rate was significantly lower and both the length of drainage and LOHS were shorter by one day. Our study shows that a prolonged OT is associated with an increased rate of postoperative complications in this group of patients.

In a recent meta-analysis by Cheng *et al.* including 81 studies in a wide range of surgical specialties, surgical site infections were 17% and 37% more frequent for every 30 min and 60 min of surgery duration, respectively (12). Similarly, Daley *et al.* reviewed 104,632 surgical procedures and found an increased risk of infections in various organs, as well as an increased risk of mortality for long duration procedures (13). In thoracic surgery, Mori *et al.* found an increased rate of postoperative complications after VATS

Table 2 Uni- and multivariable analyses of factors associated with 30-day postoperative overall morbidity

Variables	Univariable			Multivariable		
	OR	95% CI	P value	OR	95% CI	P value
Sex (male)	1.33	0.97–1.83	0.081	0.91	0.63–1.32	0.640
Age >70 years	1.65	1.17–2.24	0.008	1.31	0.90–1.89	0.160
BMI >30 kg/m^2	0.75	0.48–1.17	0.209			
High blood pressure	1.48	1.07–2.05	0.016	1.00	0.69–1.45	0.980
Cardiopathy	1.34	0.86–2.07	0.192			
Arrhythmia	1.76	1.11–2.80	0.016	1.25	0.74–2.09	0.407
Diabetes	1.18	0.76–1.82	0.453			
Renal failure	2.01	1.15–3.48	0.013	1.57	0.84–2.93	0.158
ASA score >2	2.52	1.82–3.50	<0.001	1.87	1.27–2.73	0.001*
FEV_1 <80 %	2.24	1.61–3.12	<0.001	1.47	1.01–2.14	0.046*
DLCO <80 %	1.89	1.31–2.73	0.001	1.50	1.01–2.24	0.045*
Neoadjuvant chemotherapy	0.46	0.17–1.24	0.126			
Tumor size >40 mm	1.31	0.85–2.01	0.208			
Adenocarcinoma	0.76	0.55–1.08	0.131			
Upper lobes	1.03	0.74–1.43	0.854			
Left sided surgery	0.86	0.63–1.19	0.378			
Fewer than 50 cases per surgeon	0.74	0.47–1.17	0.203			
Lobectomy	0.85	0.59–1.22	0.379			
Complex segmentectomy	0.70	0.38–1.31	0.270			
Mediastinal lymph node dissection	0.40	0.22–0.72	0.002	0.54	0.29–1.02	0.060
Conversion thoracotomy	2.44	1.28–4.65	0.007	1.62	0.81–3.24	0.174
Operative time ≥150 minutes	1.62	1.18–2.23	0.003	1.64	1.15–2.32	0.006*

*P<0.05. OR, odds ratio; CI, confidence interval; BMI, body mass index; ASA, American Society of Anaesthesiologists; FEV_1, forced expiratory volume in one second; DLCO, diffusing capacity of the lung for carbon monoxide.

anatomical pulmonary resections in patients operated during ≥360 minutes (30% *vs.* 16%; P<0.001) (4). In our study, a prolonged OT was significantly associated with an increased rate of postoperative morbidity (OR 1.64, P=0.006). However, our cut-off of 150 minutes defined according to our median OT rounded to the next round number was shorter than theirs (≥360 minutes) and seems to better reflect the normal duration for this procedure in our experience. This is corroborated by other series, which report a median OT range from 110 to 150 minutes (9,14,15).

Other factors were also statistically significantly associated with post-operative morbidity in our study: ASA score >2 (OR 1.87, P=0.001), FEV_1 <80% (OR 1.47, P=0.046), DLCO <80% (OR 1.5, P=0.045). These factors are frequently reported to be associated with increased postoperative morbidity. In the EuroLung1 risk model (8) including 47,960 anatomical pulmonary resections, eight variables were identified to be associated with cardiopulmonary complications, of which male sex, chronic kidney disease, FEV_1 and induction therapy were also reported in our results (8). In the same way, Gonzalez-Rivas *et al.* reviewed 442 anatomical pulmonary resections by uniportal VATS and identified the presence of pleural

Table 3 Uni- and multivariable analyses of factors associated with prolonged operative time (≥150 minutes)

Variables	Univariable			Multivariable		
	OR	95% CI	P value	OR	95% CI	P value
Sex (male)	1.43	1.05–1.95	0.022	1.36	0.98–1.89	0.061
Age >70 years	1.04	0.76–1.42	0.826			
BMI >30 kg/m^2	1.45	0.97–2.19	0.069	1.43	0.94–2.17	0.096
High blood pressure	1.26	0.93–1.71	0.140			
Cardiopathy	1.01	0.65–1.55	0.968			
Arrhythmia	1.59	1.01–2.52	0.045	1.46	0.91–2.34	0.113
Diabetes	1.07	0.70–1.64	0.746			
Renal failure	1.02	0.59–1.79	0.922			
ASA score >2	1.15	0.85–1.56	0.370			
FEV_1 <80 %	1.42	1.03–1.95	0.031	1.37	0.98–1.91	0.063
DLCO <80 %	1.04	0.74–1.46	0.812			
Neoadjuvant chemotherapy	3.02	1.29–7.11	0.011	3.11	1.317–7.44	0.010*
Adenocarcinoma	0.87	0.62–1.21	0.427			
Tumor size >40 mm	1.08	0.71–1.64	0.723			
Upper lobes	1.27	0.92–1.74	0.135			
Left sided surgery	0.92	0.68–1.25	0.610			
Fewer than 50 cases per surgeon	1.35	0.88–2.06	0.160			
Lobectomy	1.50	1.04–2.14	0.026	1.50	1.03–2.16	0.032*
Complex segmentectomy	0.93	0.51–1.72	0.826			
Mediastinal lymph node dissection	1.06	0.59–1.92	0.834			

*P<0.05. OR, odds ratio; CI, confidence interval; BMI, body mass index; ASA, American Society of Anaesthesiologists; FEV_1, forced expiratory volume in one second; DLCO, diffusing capacity of the lung for carbon monoxide.

adherence, pulmonary emphysema and a tumor size (≥3 cm) to be predictors of postoperative complications (16).

Interestingly, in our study, we did not observe a significant association between conversion thoracotomy and postoperative morbidity in the multivariable analysis, although the OR remained elevated and the association was statistically significant in the univariable analysis (the reasons behind these observations being unclear to us). However, our conversion rate to thoracotomy was similar to other previous VATS lobectomy studies (7–9%), which reported a higher morbidity rate in patients undergoing conversion thoracotomies (14,15,17,18). Seitlinger *et al.* reviewed 501 patients undergoing VATS anatomical pulmonary resections and found a higher postoperative morbidity rate in patients who underwent conversion thoracotomy than in complete VATS patients (40.9% *vs.* 16.8%; P=0.001) as well as a higher perioperative mortality (6.8% *vs.* 0.2%; P=0.003) (17). This was also demonstrated by a large series including 20,565 patients undergoing VATS pulmonary resections with a higher rate of postoperative pulmonary complications in the conversion group (37.3% *vs.* 26%; P=0.01) (18). Yet, none of these studies performed a multivariable analysis including conversion thoracotomy as a potential predictor of postoperative complications.

Prolonged OT was associated with an increased rate of postoperative complications by various authors (4,12,13,19). In their retrospective study including 17,852 patients with NSCLC undergoing lobectomy by thoracotomy, VATS or robotic, Dexter *et al.* found a significant association between OT and a prolonged LOHS (>5 days) (P<0.001), pneumonia

(P<0.001), atelectasis (P<0.001) and ICU admission (P=0.006) (19). They also emphasized the need to identify predictors of prolonged OT and measures to decrease OT, as raised by other authors (7,19,20). The analysis of the Society of Thoracic Surgeons Database including 19,337 patients undergoing lobectomy for primary lung cancer identified that for every 10-unit increase in BMI, the mean OT was increased by 7.2 minutes (P<0.0001) (7). In our study, a BMI >30 kg/m^2 was significantly associated with an OT of ≥150 minutes in the univariable analysis only. However, we identified two other patient variables individually associated with prolonged OT: neoadjuvant chemotherapy (OR 3.11, P=0.01) and lobectomy (OR 1.5, P=0.032). Neoadjuvant chemotherapy is known to promote tissue fragility, especially vessels, which can lead to pleural adhesion, thus increasing surgical difficulty and extending OT (18,21). It is thus important to take this factor into account when planning surgical schedule.

Interestingly, our results did not demonstrate any correlation between surgeon's experience, represented by the number of cases per surgeon, and OT. This can be explained by the fact that all attending surgeons had a strong previous experience in VATS for extra-anatomical pulmonary resections and other basic procedures. In Switzerland, thoracic surgeons must pass a board exam of general surgery, thus all surgeons were familiarized with endoscopic procedure during their training. It is possible that the introduction of VATS would have been facilitated and that the usual learning curve cut-off of 50 cases for VATS anatomical pulmonary resections was set too high in our case (22,23). Furthermore, our study period spanned 9 years, which diluted the learning curve in a high number of cases since more than 200 VATS anatomical pulmonary resections were performed each year in our institution. Finally, our team is experienced, has long worked together, and is careful to observe the clear standardized routine practices that govern operations in our institution.

This study presents several limitations, the first one being the retrospective design allowing a selection bias. This selection bias is compounded by the unavoidable fact that several aspects that ultimately make for a surgically simple or complicated situation are entangled in various patient specificities due to factors which are not measurable (e.g., vascular anatomic variations, position of the tumor, invasion of hilar structures, etc.). In addition, we did not have any data on teaching during surgeries. In this case, it is difficult to draw conclusions on factors associated with OT, since teaching might independently prolong OT. Furthermore, due to the retrospective nature of the study, several otherwise interesting intra-operative parameters, such as blood loss, presence of pleural adherences or calcified lymph nodes could not be analyzed because the source information was missing from the files we were allowed to review. Finally, this study does not report data on surgical schedule or costs. It would be interesting to know if the daily or weekly schedule might influence OT and how they impact the hospital costs. All these limitations tend to decrease the generalizability of our study but do not decrease the informative value of our observations. If nothing else, these might be of use as a standard for other teams, as they were of use for us in our daily practice.

Conclusions

In conclusion, in this group of patients undergoing VATS anatomical pulmonary resection, male sex and neoadjuvant chemotherapy are associated with a prolonged OT, although this latter element is also associated with a decreased rate of post-operative complications. An OT 150 minutes is significantly correlated with postoperative complications.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-21-1774/rc

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-21-1774/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Local Ethics Committee (CER-VD) (approval number: No. 2020-02181) and individual consent for this retrospective analysis was waived.

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