Original Article

Minimally invasive surgery role in central squamous lung cancer after neoadjuvant chemoimmunotherapy

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Background: The present body of literature provides restricted evidence concerning the application of video-assisted thoracoscopic surgery (VATS) in individuals diagnosed with centrally located, locally advanced, and initially surgically challenging squamous cell lung carcinoma (SqCLC) following neoadjuvant chemoimmunotherapy (CIT). Further research is warranted to elucidate the role and potential benefits of VATS in this particular patient population.

Methods: We performed a retrospective analysis on individuals diagnosed with centrally located and locally advanced SqCLC who received preoperative CIT at a single institution. The study evaluated the percentage of VATS performed, conversion rates, and perioperative outcomes. Furthermore, survival outcomes related to the resection extent were compared between patients who underwent standard lobectomy (SL) and extended lobectomy (EL, e.g., sleeve, bilobectomy or pneumonectomy) after neoadjuvant CIT.

Results: A total of 27 cases of centrally located SqCLC underwent neoadjuvant CIT followed by VATS, with one case requiring conversion to thoracotomy due to adhesions. Comparison of perioperative outcomes and long-term cancer-specific mortality between the VATS group (N=24) and the thoracotomy group (N=13) did not yield any statistically significant differences. However, the VATS group exhibited a significantly higher frequency of SL (66.7% *vs.* 30.8%, P=0.046). Notably, within the VATS group, all three patients who experienced tumor relapse or died due to tumor recurrence were from the SL subgroup.

Conclusions: This study contributes valuable real-world evidence demonstrating the feasibility and safety of utilizing VATS in the management of patients with centrally located and locally advanced SqCLC following neoadjuvant CIT. However, careful consideration might be given to the extent of resection to optimize patient long-term outcomes.

Keywords: Video-assisted thoracoscopic surgery (VATS); neoadjuvant chemoimmunotherapy (neoadjuvant CIT); squamous cell lung carcinoma (SqCLC); centrally located; extended resection (ER)

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Introduction

Squamous cell lung carcinoma (SqCLC) is a predominant subtype within the category of non-small cell lung cancer (NSCLC), characterized by its central location, heavy smoking history, and impaired pulmonary function. In the case of patients exhibiting these specific characteristics, the utilization of extended resections (ERs), such as sleeve lobectomy or complex reconstruction, has been

contemplated as a potentially more efficacious therapeutic approach. Evidence has indicated that this surgical intervention can result in improved long-term survival and enhanced quality of life, without concomitant increases in morbidity or mortality rates (1,2).

Video-assisted thoracoscopic surgery (VATS), which is associated with less pain but rapid recovery (3,4), has been demonstrated to be a safe and effective approach in surgically-complex cases, e.g., centrally located lung tumors (5,6) or those treated with neoadjuvant chemotherapy and/or radiotherapy (7-9), which typically cause fibrosis in the hilar and mediastinal structures (7). In recent years, immune checkpoint inhibitors (ICIs) have shown remarkable success in the treatment of lung cancer. Neoadjuvant chemoimmunotherapy (CIT) has been approved as the first-line therapy for locally advanced SqCLC, irrespective of the programmed cell death ligand 1 (PD-L1) status (10,11).

However, concerning that both ICIs and chemotherapy can increase more fibrosis, open thoracotomy is typically preferred when neoadjuvant immunotherapy is combined with chemotherapy. A considerable rate of conversion to open thoracotomy has been reported at early attempts (12,13). As such, there is currently a lack of real-world evidence for the feasibility of VATS in patients with locally advanced and initially difficult-to-resect SqCLC following neoadjuvant CIT (14-16).

Furthermore, studies have shown that neoadjuvant CIT leads to high rates of major or pathological complete response (MPR or pCR), which facilitates the surgical resection of locally advanced NSCLC, particularly SqCLC (16,17). For centrally located disease that initially required ER and/or reconstruction (e.g., sleeve, bilobectomy, or pneumonectomy), it remains unknown whether standard lobectomy (SL) is sufficient, provided radical resection can be guaranteed.

In this study, we examined the clinical data of individuals diagnosed with centrally located and locally advanced SqCLC after neoadjuvant CIT. Our results demonstrate that for such cases, VATS yields comparable perioperative outcomes to open thoracotomy, thereby suggesting the feasibility of VATS in managing such cases. Notably, all patients, including those with MPR, who experienced tumor relapse after radical surgery had undergone SL, arguing against the choice of SL instead of ER for this specific type of disease. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1241/rc).

Highlight box

Key findings

- Video-assisted thoracoscopic surgery (VATS) approach has comparable perioperative outcomes to those of open thoracotomy for centrally located squamous cell lung carcinoma (SqCLC) after neoadjuvant chemoimmunotherapy.
- The VATS approach was found to be significantly associated with a higher percentage of standard lobectomy (SL).
- In the VATS group, all patients who experienced tumor relapse after radical surgery had undergone SL rather than extended lobectomy.

What is known and what is new?

- The feasibility of the VATS approach in treating lung cancer following neoadjuvant chemotherapy has been demonstrated. However, there is a lack of evidence regarding the use of VATS for centrally located SqCLC after neoadjuvant chemotherapy combined with immunotherapy.

What is the implication, and what should change now?

- Caution should be exercised when using the VATS approach for centrally located SqCLC cases that were initially expected to undergo extended resections, despite comparable perioperative outcomes with the open approach.

Methods

Patients

In order to gather long-term survival data, we conducted a retrospective review of the clinical records of patients with NSCLC who underwent surgery at Shanghai Chest Hospital between 2018 and 2020. The inclusion criteria for this study were as follows (*Figure 1*): (I) patients diagnosed with locally advanced SqCLC who received neoadjuvant chemotherapy and immunotherapy prior to surgery, and (II) patients with centrally located tumors (defined as lung cancer located in the segment, lobe, or main bronchus) that were difficult to completely resect or required extended lobectomy (EL), as determined by a multidisciplinary lung tumor board. We obtained their clinical data, encompassing demographic information, clinico-pathological characteristics, treatment regimens, and survival data, for further analysis. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Institutional Review Board of Shanghai Chest Hospital [#KS(Y)21039], and all patients

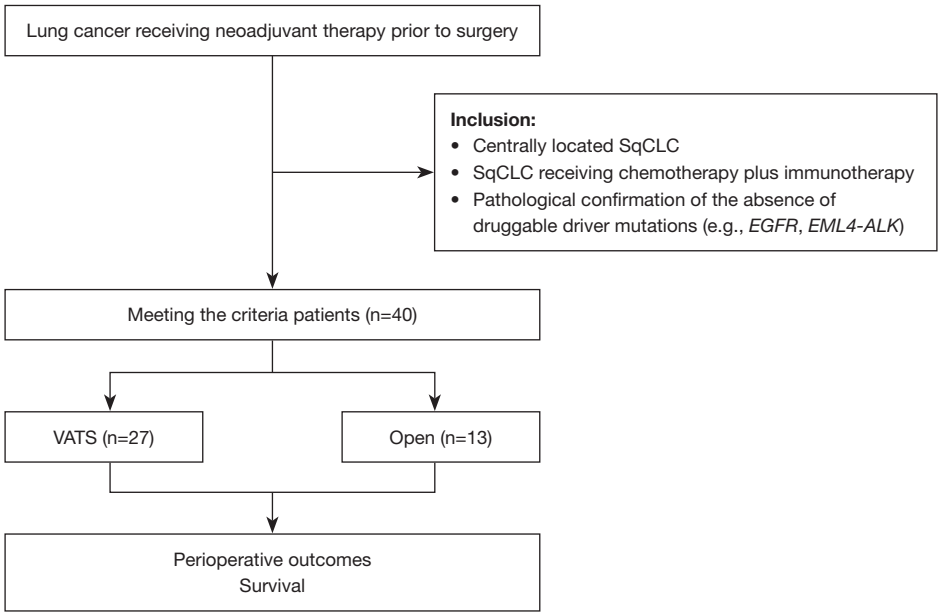

Figure 1 Workflow of this study. SqCLC, squamous cell lung carcinoma; VATS, video-assisted thoracoscopic surgery.

provided informed consent to include their clinical data for use in research projects.

Preoperative examinations and neoadjuvant CIT regimens

Prior to surgery, all patients underwent pretreatment tumor biopsies to confirm the presence of SqCLC, and routine whole-body examinations were conducted to assess the feasibility of surgical resection. Targetable genetic mutations, such as EGFR (epidermal growth factor receptor), ROS1 (repressor of silencing 1), EML4-ALK (echinoderm microtubule-associated protein-like 4-anaplastic lymphoma kinase fusion oncogene), or MET (mesenchymal epithelial transition factor), were routinely assessed and excluded as potential candidates for immunotherapy. PD-L1 status was not routinely examined for SqCLC. Tumoral PD-L1 expression was evaluated by a senior pathologist using the PD-L1 tumor proportion score before neoadjuvant CITs, and samples were divided into three subgroups: PD-L1 high (>50%), PD-L1 moderate (1–50%), and PD-L1 low (<1%). The primary antibody employed for PD-L1 scoring was anti-human PD-L1 (DaLo, monoclonal mouse anti-human, clone 22C3). All patients who underwent surgery exhibited a performance status of 0–1, normal organ function, and adequate lung function reserve for resection.

Detailed information regarding neoadjuvant therapy, including the administered agents, treatment courses, doses, and duration of the final neoadjuvant treatment before surgery, can be found in *Table 1*. For the ICI component, one of the approved ICIs was administered: (I) nivolumab [anti-PD-1 (programmed cell death protein) agent, Opdivo® (Bristol-Myers Squibb, New York, NY, USA)], another, at a dose of 240 mg intravenously every two weeks; (II) pembrolizumab [anti-PD-1 agent, KEYTRUDA® (Merck, Rahway, NJ, USA), at a dose of 200 mg intravenously every three weeks; (III) sintilimab [anti-PD-1; co-developed by Innovent Biologics (Rockville, MD, USA) and Eli Lilly (Indianapolis, IN, USA)], at a dose of 200 mg administered intravenously every three weeks. As for the chemotherapy component, platinum doublets were administered. The initial dose of immunotherapy was administered concurrently with chemotherapy, followed by subsequent doses given every two or three weeks (based on corresponding indications) for a total of 2–5 cycles. Chemotherapy was administered every three weeks for a total of 2–3 cycles.

Surgical procedure

The surgical approach, whether VATS or posterolateral thoracotomy (open), with systemic lymph node dissection, was performed based on the patient's condition, informed consent, and the surgeon's preference. Detailed records

Table 1 Clinicopathological characteristics

Factors	Subgroups	VATS (n=27)	Open (n=13)	P value
Sex, n (%)	Female	1 (3.7)	2 (15.4)	0.242†
	Male	26 (96.3)	11 (84.6)	
Age (years), mean (SD)		60.52 (5.88)	58.77 (12.05)	0.538
Smoking history, n (%)	No	4 (14.8)	6 (46.2)	0.052†
	Yes	23 (85.2)	7 (53.8)	
BMI (kg/m^2), mean (SD)		25.03 (2.59)	23.88 (2.73)	0.202
FEV1 (L), mean (SD)		2.68 (0.69)	2.23 (0.53)	0.047
FEV1 %predicted, mean (SD)		88.43 (16.47)	82.29 (16.51)	0.277
FEV1/FVC (%), mean (SD)		77.49 (8.10)	70.73 (9.68)	0.026
FEV1/FVC %predicted, mean (SD)		99.56 (10.30)	90.00 (11.69)	0.012
DLCO-SB %predicted, mean (SD)		78.73 (16.22)	85.93 (22.30)	0.252
cT, n (%)	T1	2 (7.4)	2 (15.4)	0.263†
	T2	9 (33.3)	4 (30.8)	
	T3	9 (33.3)	1 (7.7)	
	T4	7 (25.9)	6 (46.2)	
cN, n (%)	N0	5 (18.5)	1 (7.7)	0.155†
	N1	5 (18.5)	1 (7.7)	
	N2	13 (48.1)	11 (84.6)	
	N3	4 (14.8)	0 (0.0)	
Operation duration (hours), mean (SD)		2.38 (0.80)	2.43 (0.55)	
Blood lose (mL), mean (SD)		137.41 (72.09)	156.92 (85.28)	0.808
Radiotherapy, n (%)	No	16 (59.3)	8 (61.5)	0.455
	Yes	11 (40.7)	5 (38.5)	>0.99
Neoadjuvant treatment cycles, mean (SD)		2.26 (0.76)	2.00 (1.08)	
Interval between CIT and surgery (days), mean (SD)		43.81 (28.14)	40.08 (9.67)	0.386
Chemotherapy regimen, n (%)	Docetaxel	3 (11.1)	2 (15.4)	0.646
	Gemcitabine	7 (25.9)	1 (7.7)	0.491†
	Paclitaxel	16 (59.3)	10 (76.9)	
	Pemetrexed	1 (3.7)	0 (0.0)	
Chest tube removal (days), mean (SD)		7.93 (5.99)	7.85 (4.24)	
ICI regimen, n (%)	Nivolumab	10 (37.0)	4 (30.8)	0.966
	Pembrolizumab	15 (55.6)	6 (46.2)	0.248†
	Sintilimab	0 (0.0)	2 (15.4)	
	Tislelizumab	2 (7.4)	1 (7.7)	

Table 1 (*continued*)

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Factors	Subgroups	VATS (n=27)	Open (n=13)	P value
Resection, n (%)	Standard lobectomy	18 (66.7)	4 (30.8)	0.046†
	Extended lobectomy			
	Sleeve	6 (22.2)	4 (30.8)	
	Bilobectomy	3 (11.1)	3 (23.1)	
	Pneumonectomy	0 (0.0)	2 (15.4)	
Resection margin, n (%)	R0	26 (96.3)	12 (92.3)	
	R1	1 (3.7)	1 (7.7)	>0.99†
Pathological response, n (%)	MPR	9 (33.3)	3 (23.1)	
	Non_pCR_MPR	9 (33.3)	4 (30.8)	0.769†
	pCR	9 (33.3)	6 (46.2)	
ypT, n (%)	T0	10 (37.0)	6 (46.2)	
	T1	7 (25.9)	2 (15.4)	0.275†
	T2	8 (29.6)	2 (15.4)	
	T3	0 (0.0)	2 (15.4)	
	T4	2 (7.4)	1 (7.7)	
ypN, n (%)	N0	15 (55.6)	8 (61.5)	
	N1	6 (22.2)	1 (7.7)	0.532†
	N2	6 (22.2)	4 (30.8)	
No. of retrieved LN, mean (SD)		17.44 (9.24)	15.08 (6.51)	
Recurrence, n (%)	No	24 (88.9)	11 (84.6)	0.413
	Yes	3 (11.1)	2 (15.4)	>0.99†
Death, n (%)	No	25 (92.6)	9 (69.2)	
	Yes	2 (7.4)	4 (30.8)	0.075†

†, Fisher exact test. VATS, video-assisted thoracoscopic surgery; SD, standard deviation; BMI, body mass index; FEV1, forced expiratory volume in the first second; FVC, forced vital capacity; DLCO-SB, single-breath diffusing capacity of the lung for CO; CIT, chemoimmunotherapy; ICI, immune checkpoint inhibitor; MPR, major pathological response; pCR, pathological complete response; ypT, pathological T stage after neoadjuvant treatment; ypN, pathological N stage after neoadjuvant treatment; LN, lymph node.

were maintained regarding the operative approach, extent of resection, operative time, blood loss, the length of hospital stay, and other pertinent details associated with the surgery. Clinical and pathological staging of patients were evaluated according to the 8th edition of the American Joint Committee on Cancer (AJCC) Lung Cancer Staging (14). Clinical IIa-IIIb stages were included. Surgical complications were recorded according to the criteria outlined by the Society of Thoracic Surgeons and the European Society of Thoracic Surgeons general thoracic surgery databases (15).

Evaluation of treatment response

After completing neoadjuvant treatment, a PET/CT or CT scan was conducted, ideally two weeks post the final therapy dose, to evaluate the therapeutic response and assess resectability. The response was evaluated according to the Response Evaluation Criteria in Solid Tumors (RECIST) version 1.1 (18). Subsequently, patients who did not show

disease progression received surgery within 5–6 weeks. Pathological response was graded according to the Junker criteria and evaluated in resected samples (18). pCR was defined as the complete absence of viable tumor cells (ypT0N0M0) in the surgical resection specimen. MPR was defined as the presence of 10% or fewer viable tumor cells in the surgical resection specimen. Non-pCR/MPR was categorized as a partial response of tumor beds, in which the surgical resection specimen contained more than 10% viable tumor cells.

Follow-up and survival

The initial follow-up appointment was scheduled four weeks after discharge, typically marking the initiation of adjuvant therapies, usually one month postoperatively. Subsequent follow-up visits were planned every 3–6 months and encompassed chest CT scans, brain MRI, abdominal sonography or CT, and serum tumor marker assessments. Additional examinations were conducted as deemed necessary by the oncologists. Follow-up information was gathered through phone calls or clinic revisit records.

Recurrence-free survival (RFS) was characterized as the period between the surgery date and the identification of tumor relapse by any cause or the last follow-up date. Overall survival (OS) was delineated as the span between the surgery date and the date of death from any cause or the last follow-up date (in April 2023).

Postoperatively adjuvant treatment

Typically, similar preoperative treatment regimens were continued into the postoperative adjuvant phase. In cases where the resection margin was positive, postoperative adjuvant radiotherapy was administered. Furthermore, patients with pathologically confirmed lymph node metastasis after surgery or tumor relapse commonly received adjuvant radiotherapy as determined by the multidisciplinary oncology team.

Statistical analysis

Continuously distributed variables with a normal distribution were expressed as mean ± standard deviation (SD), whereas non-normally distributed continuous variables were represented as median and range. Categorical variables were reported as counts and percentages. Survival analysis was conducted using the "survminer" and "survival" R packages. Data summary and statistical analysis were performed using R software (version 4.0). A significance level of $P<0.05$ was considered statistically significant.

Results

Clinical characteristics

This study included a total of 27 cases of centrally located SqCLC, comprising 26 males and 1 female, who underwent neoadjuvant CIT followed by VATS. In addition, 13 patients who underwent open thoracotomy during the same period were included, with one case necessitating conversion to thoracotomy due to adhesions. The clinical characteristics of patients in the VATS and open thoracotomy groups are presented in *Table 1*. In both groups, patients received a median of two doses of ICIs prior to resection, with a range of one to four doses. The median time interval between the last dose of therapy and surgery was 37 days (range, 31–181 days) for the VATS group and 38 days (range, 31–70 days) for the open thoracotomy group. Overall, patients in the VATS group exhibited significantly better pulmonary function compared to those in the open thoracotomy group (*Table 1*). There were no significant differences in the remaining baseline characteristics, such as sex, age, smoking history, body mass index, neoadjuvant treatment cycles and regimens, and the interval between the last dose of therapy and surgery (*Table 1*).

Surgery and postoperative course

In the VATS group, the most prevalent type of resection was SL (18 cases, 66.7%), followed by EL, including sleeve lobectomy (six cases, 22.2%), and bilobectomy (three cases, 11.1%) (*Table 1*). Conversely, in the open group, EL was the most common type of resection, with sleeve lobectomy being the most frequent (four cases, 30.8%), followed by bilobectomy (three cases, 23.1%), and pneumonectomy (two cases, 15.4%). Therefore, the VATS group exhibited a significantly lower percentage of EL in this cohort ($P=0.046$). There were no significant differences in other characteristics, such as pathological response to neoadjuvant chemotherapy, post-treatment pathological stage, positive margin status, number of retrieved lymph nodes, and postoperative hospital stay (*Table 1*). Of the 23 patients undergoing surgery, 20 (87.0%) successfully underwent complete resections, while three (13.0%) exhibited positive bronchial margins. The presence of positive surgical

margins was attributed to limited lung function reserve, which could have posed a risk to patients if a more extensive resection had been performed.

Five out of the 23 patients encountered one or more postoperative complications, with four falling into the grade I–II category (minor complications) and one categorized as grade III–IV (major complication) according to the Clavien-Dindo classification. Prolonged air leak was the most frequent complication (n=3), followed by pneumonia (n=1) and chylothorax (n=1). Additionally, one patient in the open group experienced surgery-related death due to a bronchopleural fistula (BPF) on postoperative day 29. Another patient in the open group, who was discharged without complications on postoperative day 7, died for unknown reasons on postoperative day 47. No treatment-related deaths were reported in the VATS group.

Postoperative survival

At the end of the follow-up period, three patients (11.1%, all three having achieved a MPR in their primary tumor beds in response to neoadjuvant chemotherapy) in the VATS group experienced tumor relapse, and two (7.4%) of them died due to tumor recurrence (*Table 1*). In the open group, there were two cases (15.4%) of tumor relapse and four cases of death (including the two surgery-related deaths mentioned above). Overall, the open group exhibited a higher percentage of death compared to the VATS group, although statistical significance was not achieved (P=0.075). Consequently, OS was significantly longer in the VATS group compared to the open group in the entire cohort (*Figure 2A*). However, in terms of cancer-specific death, the two groups showed similar outcomes (*Figure 2B*). It is worth noting that in the VATS group, all cases (including two R0 cases and one R1 case) with tumor relapse after surgery involved patients who had undergone SL, although statistical significance was not reached, possibly due to the small sample size (*Figure 2C*). These findings suggest a potential preference for ERs rather than SL for those cases after neoadjuvant CIT. Concerning the open group, there is no statistically significant difference in postsurgical survival between the SL and EL groups (*Figure 2D*). However, it is worth noting that the EL group tends to exhibit a shorter OS. More specifically, in the EL group, two out of the three deceased cases did not achieve MPR/pCR following induction CIT therapy, and one case succumbed to BPF after surgery. In the open surgery group, one deceased case also did not achieve MPR/pCR after neoadjuvant CIT therapy. These observations suggest that the disparity in OS may be attributed to the EL group having a higher number of patients with a poor response to induction therapy within the EL group.

Discussion

Considering the potential challenges posed by neoadjuvant ICIs in surgical resection, early attempts at VATS often resulted in a high rate of conversion to open thoracotomy. Limited studies have investigated the feasibility and safety of VATS surgery for centrally located SqCLC cases that were initially unresectable or required complex resection/reconstruction after neoadjuvant ICIs combined with chemotherapy (14,16,19-21). Both treatment regimens are known to induce increased fibrosis in the hilar and mediastinal structures (22). Furthermore, determining the extent of resection raises an important question: should it be based on the original tumor involvement extent or the current situation that exhibits obvious tumor regression following neoadjuvant CIT? In this study, we have demonstrated the feasibility of VATS for centrally located SqCLC cases, although ERs might be favored over SL (*Figure 3*).

Previous studies have shown that neoadjuvant CIT could result in a high rate of radical resection in NSCLC, particularly in cases of SqCLC, without increasing obvious risk of surgery (10,11,14,21,23). However, the necessity of surgery and its potential survival benefits remain to be defined due to limited long-term follow-up. A recent retrospective study with a small clinical cohort has provided evidence supporting the survival benefits of radical surgery in stage III NSCLC (24), highlighting the need for further prospective studies with larger cohorts. Based on our clinical experience, we have observed cases where the primary tumor beds showed no evidence of tumor cells (pCR), while metastatic tumor cells were still present in the matched lymph nodes (25), implying the need for additional surgery following neoadjuvant CIT.

Given the high rate of MPR/pCR after neoadjuvant CIT, the determination of the extent of resection for centrally located SqCLC cases with obvious tumor regression following neoadjuvant CIT becomes a critical question: should it be based on the original tumor involvement extent (typically EL) or directly on SL, provided that a negative margin could be guaranteed? In our study, the VATS approach exhibited a significantly higher proportion of SL as the surgical choice, in comparison to the open approach.

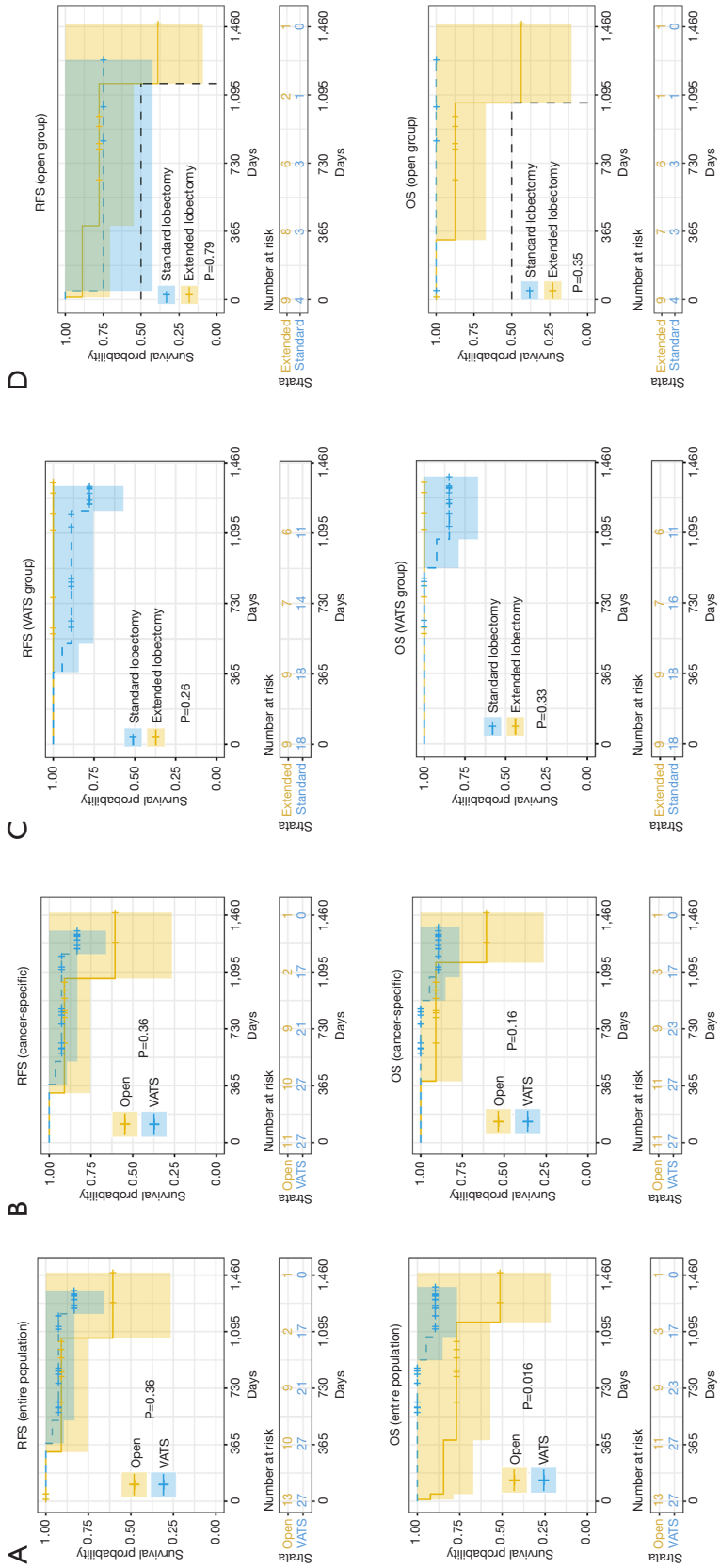

Figure 2 RFS and OS of SqCLC patients in this study cohort. (A,B) RFS and OS analysis stratified by surgical approaches (VATS *vs.* open). (A) The analysis of RFS and OS in the entire population of SqCLC patients in this study cohort, categorized according to the surgical approaches employed (VATS *vs.* open thoracotomy). (B) RFS and OS analysis excluding patients with non-cancer-related deaths (N=2). (C,D) RFS and OS analysis stratified by resection extent (standard lobectomy *vs.* extended lobectomy) in SqCLC patients receiving VATS (C) and open surgery (D), respectively. RFS, recurrence-free survival; VATS, video-assisted thoracoscopic surgery; OS, overall survival; SqCLC, squamous cell lung carcinoma.

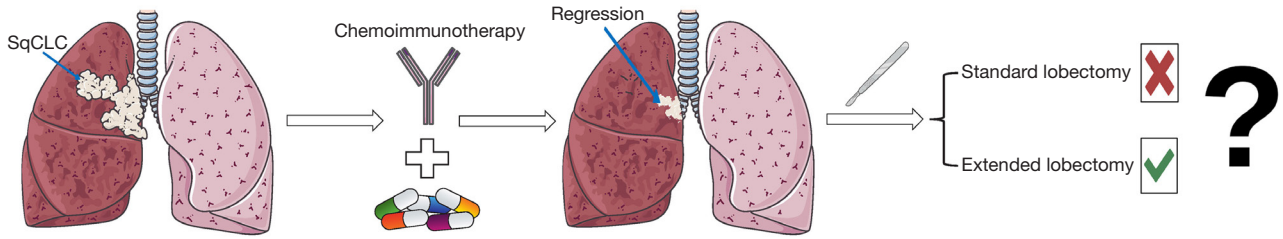

Figure 3 A schematic model delineating the extent of surgical resection in patients with locally advanced and initially difficult-to-resect SqCLC following neoadjuvant chemoimmunotherapy. The adoption of extended lobectomy using VATS may be considered as a potentially desirable approach. SqCLC, squamous cell lung carcinoma; VATS, video-assisted thoracoscopic surgery.

Interestingly, all three cases experiencing tumor relapse in the VATS-treated group were from the SL group rather than the EL group. This observation raises questions about whether this is a mere coincidence or if there may be a meaningful pattern. This might suggest that caution should be exercised when using the VATS approach for centrally located SqCLC cases that were initially expected to undergo ERs, despite comparable perioperative outcomes with the open approach. It is essential to pay close attention to these findings in future research. A larger cohort involving multiple centers with long-term follow-up may offer more insights and help address this question definitively.

Generally, the selection criteria for choosing between VATS and open surgery primarily depended on the individual preferences of the surgeons, as well as factors such as tumor location assessed through CT scans and bronchoscopy, along with the degree of tumor response. There was no consensus regarding the choice of surgical approach within our institution. Recently, our team, along with other researchers, has thoroughly investigated and discussed the limited efficacy of PET-CT scans in evaluating lymph node involvement in lung cancer patients undergoing immunotherapy (17,25,26). For lung cancer patients with cN0–N2 & M0 stage, those with initial cN2 stage (indicating metastasis to ipsilateral mediastinal lymph nodes) and a reduction in metabolic activity in the affected lymph nodes (N2) following treatment are typically deemed suitable candidates for surgery. Conversely, patients with distant metastases, cN3 stage (indicative of contralateral mediastinal lymph node metastasis), or an increase in metabolic activity post-treatment are generally not considered appropriate candidates for surgical intervention.

Limitations

Limitations of our study include the inherent biases of a retrospective design and the small sample size. Additionally, the patients included in this study were highly selected, and there was heterogeneity in the definition of surgically challenging patients, which can vary among different surgeons and institutions. Furthermore, the patients received different neoadjuvant treatments, such as variations in the number of cycles of neoadjuvant immunotherapy, which could potentially impact the subsequent surgical decision-making process. These limitations should be taken into consideration when interpreting the results and extrapolating them to broader patient populations.

Conclusions

VATS for centrally located and initially surgically challenging SqCLC following neoadjuvant CIT was found to be feasible, with perioperative outcomes comparable to those of thoracotomy. Notably, the use of SL was associated with unfavorable survival outcomes when compared to the ER.

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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-23-1241/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1241/dss

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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). This study was approved by the Institutional Review Board of Shanghai Chest Hospital [#KS(Y)21039], and all patients provided informed consent to include their clinical data for use in research projects.

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