Original Article

Learning curve for complex segmentectomy via uniportal video-assisted thoracoscopic surgery for the treatment of early-stage lung cancer

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Background: Recently, segmentectomy has emerged as a viable treatment option for early-stage lung cancer. Segmentectomy can be divided into simple segmentectomy and complex segmentectomy. While simple segmentectomy is a relatively straightforward surgical procedure, complex segmentectomy poses a considerable challenge because of its intricate anatomical variations and the need for a complex surgical approach. The introduction of uniportal video-assisted thoracoscopic surgery (VATS) further complicates matters. This study aimed to assess whether thoracic surgeons, who have previously conducted only uniportal VATS lobectomy and simple segmentectomy, could effectively navigate the learning curve when undertaking their first complex segmentectomy procedure.

Methods: A single surgeon with experience limited to uniportal VATS lobectomy and simple segmentectomy began performing uniportal VATS complex segmentectomy in 2019, completing 167 cases of complex segmentectomy during the same period and performing 70 cases of simple segmentectomy. We analyzed the learning curve by comparing the surgical outcomes and operative time curves between simple segmentectomy and complex segmentectomy.

Results: The complex segmentectomy group exhibited similarities with the simple segmentectomy group in terms of patient and tumor characteristics, operative outcomes, and postoperative outcomes, with the exception of the complex segmentectomy group showing slightly reduced chest tube drainage and shorter hospital stays. The operative times and time curve patterns showed no significant difference between the two groups, indicating a potential lack of a distinct learning curve for complex segmentectomy.

Conclusions: Complex segmentectomy via uniportal VATS, when performed by surgeons proficient in simple segmentectomy and lobectomy techniques, has comparable outcomes and potentially eliminates the need for an extensive learning curve. This approach expands the options for treating early-stage non-small-cell lung cancer (NSCLC), allowing for tailored patient care. Further studies are needed to assess long-term outcomes.

Keywords: Learning curve; complex segmentectomy; uniportal video-assisted thoracoscopic surgery (uniportal VATS); lung cancer

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Introduction

Lobectomy has been recognized as the predominant surgical method for early-stage lung cancer, exhibiting greater efficacy in comparison to sublobar resection techniques in patients with peripheral T1N0 non-small-cell lung cancer (NSCLC) (1,2). Nevertheless, recent findings from two prospective multicenter trials, namely the JCOG0802/WJOG4607L trial and the CALGB 140503 trial, have underscored that segmentectomy is a credible and practical alternative treatment option for individuals diagnosed with peripheral NSCLC, especially those with tumor sizes of 2 cm or smaller and confirmed absence of lymph node involvement (3,4). Consequently, there has been a rise in the adoption of segmentectomy as a therapeutic approach. Segmentectomy can be categorized into two types, specifically simple and complex, distinguished by the number of intersegmental planes requiring dissection. Surgical procedures falling under simple segmentectomy encompass superior segmentectomy, upper division segmentectomy, and lingular segmentectomy (5). While simple segmentectomy is not significantly different from lobectomy in terms of technical aspects and can be readily executed, complex segmentectomy presents a more demanding and intricate surgical procedure. This complexity can lead to various complications, leading to uncertainties regarding its benefits for the patient (6).

Due to the advancement of surgical instruments and techniques, uniportal video-assisted thoracoscopic surgery (VATS) lobectomy and simple segmentectomy are being performed by many surgeons (7). However, uniportal VATS complex segmentectomy is not attempted by many surgeons because of its anatomical complexity and surgical challenges, and there is little research reporting on its surgical outcome.

The aim of this study was to evaluate the ability of thoracic surgeons who had prior experience with uniportal VATS lobectomy and simple segmentectomy to navigate the learning curve successfully when performing complex segmentectomy procedures. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1615/rc).

Highlight box

Key findings

- Uniportal video-assisted thoracoscopic surgery (VATS) complex segmentectomy can be performed with proficiency by surgeons already skilled in simple segmentectomy and lobectomy techniques, as there was no substantial difference in operative times or patient outcomes between the two procedures.

What is known and what is new?

- Uniportal VATS complex segmentectomy is often regarded as more challenging. It involves a steeper learning curve in comparison to simple segmentectomy. This increased complexity arises from the necessity to dissect multiple intersegmental planes and the associated risk of complications.
- The quality control charts revealed that only a limited number of cases in both the simple and complex segmentectomy groups exceeded the upper control limits for operative times. Importantly, the cases that exceeded the limits were not concentrated at the beginning of the chronological case sequence.

What is the implication, and what should change now?

- As the indications for performing segmentectomy in early-stage lung cancer continue to expand, it becomes essential to adopt a proactive approach, especially when you are well-versed in simple segmentectomy and lobectomy techniques but are now facing indications for complex segmentectomy.

Methods

Patient population

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The Institutional Review Board of the Eunpyeong St. Mary's Hospital, College of Medicine, The Catholic University of Korea, approved the study protocol (No. PC23RASI0178). Individual consent was not required for this retrospective study. Between May 2019 and June 2023, a total of 578 patients diagnosed with lung cancer underwent surgery performed by a single surgeon at the Eunpyeong St. Mary's hospital, College of Medicine, The Catholic University of Korea. As of May 2019, the surgeon was skilled in performing simple segmentectomy and lobectomy but did not possess experience in complex segmentectomy. Within this cohort, 243 individuals underwent uniportal VATS segmentectomy, ensuring complete microscopic resection (R0). This count excludes 335 patients who underwent uniportal VATS wedge resection, lobectomy, bilobectomy, or pneumonectomy. Within this subset, 70 patients underwent uniportal VATS simple segmentectomy, 167 patients underwent uniportal VATS complex segmentectomy, and 6 patients underwent uniportal VATS basal segmentectomy. A flow chart of the study design is shown in *Figure 1*.

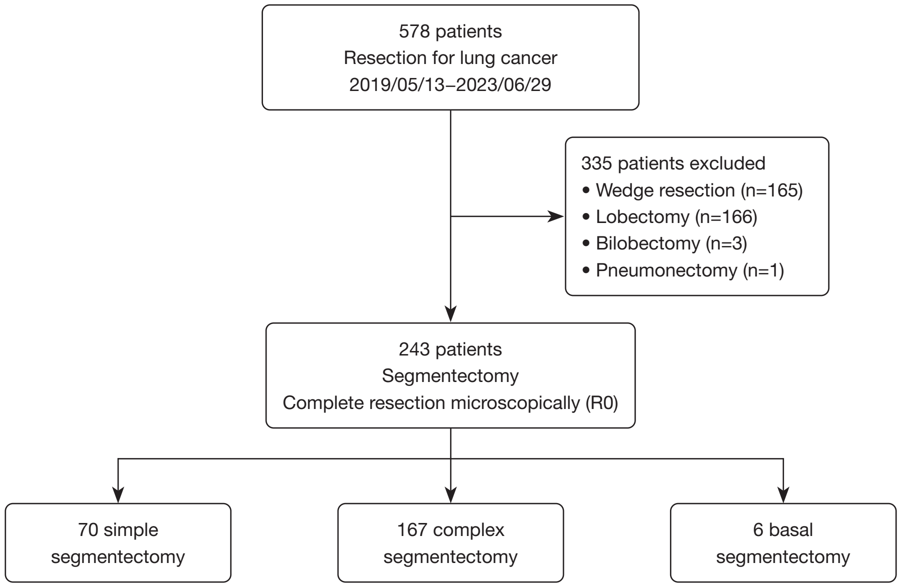

Figure 1 Flow chart of the study design.

Surgical technique

Within our institution, the preferred surgical approach for patients diagnosed with peripheral NSCLC is segmentectomy, contingent upon meeting specific criteria. These criteria include a tumor size of 2 cm or smaller, or a tumor size ranging from 2 to 3 cm with a consolidation-to-tumor ratio (C/T ratio) of less than 0.5, in conjunction with the absence of lymph node involvement. Moreover, if a surgical margin of at least 2 cm is attainable or is equal to or greater than the tumor size, segmentectomy is also favored. Additionally, for patients with non-peripheral lung cancer exhibiting tumors smaller than 2 cm and a C/T ratio of less than 0.25, as long as a sufficient surgical margin can be achieved, segmentectomy is the chosen approach. Simple segmentectomy involves pulmonary segments like the right and left superior segment, left upper division segment, and left lingular segment. All segmentectomies, excluding simple segmentectomy and basal segmentectomy, are categorized as complex segmentectomy. The surgeon carefully selects the lung segment to be excised after thoroughly examining a chest computed tomography (CT) scan. All surgeries were conducted with patients in a lateral position, involving a 2.5-cm incision along the anterior axillary line at the fourth or fifth intercostal space (ICS), depending on the lesion's location. The fourth ICS was used for upper lobe procedures, while the fifth ICS was used for lower lobe procedures. A small wound protector covered the working port. Utilizing a single incision, the surgical assistant positioned a 5-mm scope at the upper aspect, while the surgeon introduced instruments such as a curved suction tip, an energy device, and endostaplers. Before initiating the segmentectomy, we aimed to locate the lesions, marking them with a pen if palpable using a curved suction tip. If not palpable, we relied on CT scans and would palpate after segment retrieval, assuming the lesion was within. Target segmental pulmonary arteries and veins were clipped and then cut using a Harmonic scalpel. The target segmental bronchi were divided using endostaplers. To identify the intersegmental plane, we used an indocyanine green (ICG) injection and switched from a 5-mm, 30-degree scope to a 10-mm scope with near-infrared fluorescence imaging. Lung inflation was an alternative to ICG. Bronchial and vessel stumps were removed while dividing intersegmental planes. Individuals with tumors showing pure ground-glass opacity (GGO) and partially solid GGO with a C/T ratio of less than 0.5 underwent lobe-specific lymph nodal dissection. In individuals with tumors displaying partially solid GGO with a C/T ratio of more than 0.5 and solid patterns, systematic lymph node dissection was performed. For patients with standardized uptake values (SUVs) greater than 2.5 on fluorodeoxyglucose positron emission tomography (FDG PET)/CT, systematic lymph node dissection was also performed. Air leaks were checked post-segmentectomy and, if present, addressed with sutures,

Table 1 Resected segments during uniportal VATS simple segmentectomy

Simple segmentectomy (n=70)	Number of patients (%)
Right	
S6	19 (8.0)
Left	
S6	17 (7.2)
S1+2+3 (upper division)	21 (8.9)
S4+5 (lingular)	13 (5.5)

VATS, video-assisted thoracoscopic surgery.

polyglycolic acid sheets, or fibrin adhesives. Intercostal nerve blocks were administered, and a chest tube was inserted before closing the incision.

Postoperative management

Following the surgical procedure, a digital drainage system (DDS; Thopaz; Medela Healthcare, Baar, Switzerland) was connected to the chest tube with a suction pressure set at −15 cmH_2O. On the first postoperative day (POD), the suction pressure was reduced to −7 cmH_2O and maintained at this level until the chest tube was removed. The chest tube was removed when there was no air leakage for 12 consecutive hours and the drainage volume was less than 200 mL per day. Patients could choose to be discharged either one day after chest tube removal or after obtaining the final pathology report, for those patients who lived far from the hospital.

Statistical analysis

To compare the operative times for simple segmentectomy, complex segmentectomy, and both segmentectomy types, we constructed quality control charts using Excel (Microsoft Corporation). The concept of a quality control chart originated in the 1920s at Bell Labs and has since been extensively applied in various industries for monitoring and maintaining product quality (8). When a product fails to meet the control rules, it is typically removed from production. In this context, the mean time serves as the standard. The control rules, which signal that the time has exceeded the standard, encompass data points exceeding three standard errors above the average, the last two out of three consecutive values surpassing two standard errors, and the last four out of five consecutive values exceeding one standard error.

Continuous variables were expressed using medians [interquartile ranges (IQRs)], and categorical variables were presented using numbers (percentages). Fisher's exact test or Pearson's Chi-squared test was employed to compare simple and complex segmentectomies for categorical variables, while the Wilcoxon rank sum test was utilized to compare continuous variables. Statistical analyses were conducted using R software (RStudio version 4.2.0; https://www.r-project.org/). A P value of less than 0.05 was regarded as statistically significant.

Results

Complex segmentectomies were performed more than twice as often as simple segmentectomies throughout the study period, as illustrated in *Figure 1*. Significantly, there were no occurrences where a lobectomy or other extensive resections were necessary due to the presence of N1 node metastasis or misidentification of structures.

In uniportal VATS simple segmentectomy, left S1+2+3 (upper division segment) was the most frequent resected segment (8.9% of 237 patients), followed by right S6 (superior segment) in 8.0% and left S6 (superior segment) in 7.2%. Yet, in uniportal VATS complex segmentectomy, the frequently resected segment was left S1+2 (apicoposterior segment) in 10.1% of 237 patients, followed by right S1 (apical segment) in 9.7% and right S2 (posterior segment) in 7.2%. These findings are summarized in *Tables 1,2*.

Table 3 provides a comprehensive overview of the patients' demographic and baseline characteristics, as well as tumor-related details. No notable distinctions were observed between the two groups with regard to age, gender, smoking history, or history of malignant tumors. In the uniportal VATS simple segmentectomy group, adenocarcinoma was the predominant histological type, accounting for 98.6% of cases, with only one patient (1.4%) having squamous cell carcinoma. Out of the 167 patients who underwent uniportal VATS complex segmentectomy, all were diagnosed with adenocarcinoma. The predominant subtype of adenocarcinoma was invasive adenocarcinoma (IAC), constituting 60.9% of cases in the uniportal VATS simple segmentectomy group and 56.9% in the uniportal VATS complex segmentectomy group. It is crucial to note that there were no significant variations between the two groups concerning tumor histology, size on CT scans, or subtypes.

Table 2 Resected segments during uniportal VATS complex segmentectomy

Complex segmentectomy (n=167)	Number of patients (%)
Right	
S1	23 (9.7)
S2	17 (7.2)
S3	10 (4.2)
S8	14 (5.9)
S10	6 (2.5)
S1+2	9 (3.8)
S1+3	1 (0.4)
S2+3	1 (0.4)
S2+3a, 4	1 (0.4)
S2b+3a	1 (0.4)
S6+10a	1 (0.4)
S6+8a	1 (0.4)
S7+8	1 (0.4)
S8+6b	1 (0.4)
S8+9	2 (0.8)
S9+10	3 (1.3)
Left	
S1	8 (3.4)
S2	2 (0.8)
S3	15 (6.3)
S5	1 (0.4)
S7	1 (0.4)
S8	1 (0.4)
S9	1 (0.4)
S10	6 (2.5)
S1+2	24 (10.1)
S2+4+5	1 (0.4)
S3+4+5	2 (0.8)
S3+6+7+8+9	1 (0.4)
S7+8	7 (3.0)
S7+8+9	3 (1.3)
S8+9	1 (0.4)
S9+10	1 (0.4)

VATS, video-assisted thoracoscopic surgery.

Operative outcomes for uniportal VATS simple and complex segmentectomy are presented in *Table 4*. In the case of simple segmentectomy, the median anesthesia and operative times were 136 minutes (IQR, 112–160 minutes) and 101 minutes (IQR, 84–125 minutes), respectively. For complex segmentectomy, these times were 135 minutes (IQR, 120–160 minutes) and 104 minutes (IQR, 90–125 minutes), respectively. Both groups showed a comparable median estimated blood loss of 50 mL (IQR, 50–50 mL). Interestingly, no significant differences were observed between the two groups regarding invasive tumor size (P=0.193) or surgical margin distance (P=0.059). In the simple segmentectomy group, the invasive tumor size measured 7 mm (IQR, 2–12 mm), with a median distance of 23 mm (IQR, 17–35 mm), while in the complex segmentectomy group, the invasive tumor size was 6 mm (IQR, 2–10 mm), with a median distance of 20 mm (IQR, 15–29 mm). Remarkably, within the simple segmentectomy group, there was a singular case (specifically, upper division segmentectomy) that necessitated conversion to thoracotomy due to bleeding originating from a tear between the left main pulmonary artery and the apicoposterior segmental branch. No noteworthy distinctions were identified between the two groups concerning anesthesia time, operative time, estimated blood loss, invasive tumor size, surgical margin distance, ICG use, conversion to thoracotomy, or the presence of pleural adhesion.

Postoperative outcomes for uniportal VATS simple and complex segmentectomy are detailed in *Table 5*. Noteworthy differences were observed in the duration of chest tube drainage (P=0.019) and the length of postoperative hospital stays between the two groups (P=0.011). In the simple segmentectomy group, the median chest tube drainage duration was 1 day (IQR, 1–2 days), and the median hospital stay was 7 days (IQR, 4–8 days). In contrast, within the complex segmentectomy group, the median duration of chest tube drainage was 1 day (IQR, 1–1 day), and the median hospital stay was 6 days (IQR, 4–7 days). Postoperative complications after uniportal VATS segmentectomy included eight reported cases, comprising prolonged air leak, chylothorax, pneumothorax, pneumonia, vocal cord palsy, and transient ischemic attack. Nevertheless, there were no notable differences in the incidence of these complications between the two groups.

Patient and tumor characteristics, operative outcomes, and postoperative outcomes showed similarities between

Table 3 Patient and tumor characteristics (n=237 patients)

Variables	Simple segmentectomy (n=70)	Complex segmentectomy (n=167)	P value
Age (years)	52 [44–63]	57 [45–64]	0.598
Sex			0.813
Male	20 (28.6)	52 (31.1)	
Female	50 (71.4)	115 (68.9)	
Smoking history			0.700
Current/former	20 (28.6)	42 (25.1)	
Never	50 (71.4)	125 (74.9)	
History of malignant tumors			>0.99
Lung cancer	1 (1.4)	2 (1.2)	
Other malignancies	10 (14.3)	24 (14.4)	
Histology			0.295
Adenocarcinoma	69 (98.6)	167 (100.0)	
Squamous cell carcinoma	1 (1.4)	0	
Tumor size on CT (mm)	11 [9–15]	12 [9–14]	0.731
Subtype			0.818
AIS	11 (15.7)	27 (16.2)	
MIA	16 (22.9)	45 (26.9)	
IAC	43 (61.4)	95 (56.9)	

Values are presented as numbers (%) or median [IQR]. CT, computed tomography; AIS, adenocarcinoma in situ; MIA, minimally invasive adenocarcinoma; IAC, invasive adenocarcinoma; IQR, interquartile range.

Table 4 Operative outcomes (n=237 patients)

Variables	Simple segmentectomy (n=70)	Complex segmentectomy (n=167)	P value
Anesthesia time (min)	136 [112–160]	135 [120–160]	0.778
Operation time (min)	101 [84–125]	104 [90–125]	0.682
Estimated blood loss (mL)	50 [50–50]	50 [50–50]	0.509
Invasive size of tumor (mm)	7 [2–12]	6 [2–10]	0.193
Surgical margin distance (mm)	23 [17–35]	20 [15–29]	0.059
Use of ICG	67 (95.7)	165 (98.8)	0.155
Conversion to thoracotomy	1 (1.4)	0	0.295
Pleural adhesion			0.339
None	63 (90.0)	154 (92.2)	
Partial	5 (7.1)	12 (7.2)	
Whole	2 (2.9)	1 (0.6)	

Values are presented as numbers (%) or median [IQR]. ICG, indocyanine green; IQR, interquartile range.

Table 5 Postoperative outcomes (n=237 patients)

Variables	Simple segmentectomy (n=70)	Complex segmentectomy (n=167)	P value
Duration of chest tube drainage (days)	1 [1–2]	1 [1–1]	0.019
Duration of postoperative hospital stay (days)	7 [4–8]	6 [4–7]	0.011
Complications	3 (4.3)	5 (3.0)	0.697
Prolonged air leak	1 (1.4)	0	0.295
Chylothorax	1 (1.4)	0	0.295
Pneumothorax	1 (1.4)	1 (0.6)	0.504
Pneumonia	0	2 (1.2)	>0.99
Vocal cord palsy	0	1 (0.6)	>0.99
Transient ischemic attack	0	1 (0.6)	>0.99

Values are presented as numbers (%) or median [IQR]. IQR, interquartile range.

the complex segmentectomy group and the simple segmentectomy group, with the exception of marginally reduced chest tube drainage and hospital stays in the complex segmentectomy group. The analysis of operative times for both simple and complex segmentectomies was conducted using a quality control chart (*Figure 2*). The mean operative time was found to be 111 minutes, with an upper control limit (UCL) set at 217 minutes. Notably, the operative times for cases numbered 16, 108, 142, and 230 exceeded three standard errors above the mean operative time. Additionally, separate quality control charts were generated for simple segmentectomy (*Figure 3*) and complex segmentectomy (*Figure 4*). In the case of simple segmentectomy, the mean operation time was 110 minutes, and the UCL was set at 226 minutes. It is important to highlight that one case, specifically case number 40, exceeded the UCL within this group. For complex segmentectomy, the mean operation time was 112 minutes, and the UCL was set at 214 minutes. In this subgroup, four cases, with case numbers 8, 38, 89, and 161, exceeded the UCL.

Discussion

Numerous studies offer compelling evidence in support of anatomic segmentectomy as the preferred approach over lobectomy for patients diagnosed with small, peripheral NSCLC (3-5,9-11). This evidence is particularly well supported by the findings of three recent prospective randomized trials (3,4,11). The randomized trial JCOG0802/WJOG4607L, published in 2022, revealed that segmentectomy is not only non-inferior but also superior to lobectomy in overall survival outcomes for individuals diagnosed with small-sized peripheral NSCLC (3). In 2023, a phase 3 randomized trial, CALGB 140503, was conducted, demonstrating that sublobar resection is comparable to lobectomy in terms of disease-free survival for certain patients with peripheral NSCLC. This subgroup comprises individuals with tumor sizes of 2 cm or less and confirmed absence of pathological involvement in the hilar and mediastinal lymph nodes. Additionally, both sublobar resection and lobectomy demonstrated comparable overall survival outcomes (4). Moreover, in 2023, the JCOG1211 trial, which is another multicenter study, has furnished compelling evidence endorsing the incorporation of segmentectomy as the established treatment regimen for individuals who have predominantly GGO NSCLC with tumors measuring 3 cm or smaller in size (11). Our strategy for conducting uniportal VATS segmentectomy is appropriately tailored, involving the careful selection of patients diagnosed with clinical stage 1A NSCLC and confirming the absence of lymph node involvement in the hilar and mediastinal regions through frozen section analysis.

Segmentectomy can be classified into two categories, specifically simple and complex, based on the extent of dissection required for intersegmental planes (5). In our analysis, we excluded six basal segmentectomies from the complex segmentectomy group and categorized them separately because, despite entailing only one intersegmental plane, they are regarded as intricate and demanding procedures. Complex segmentectomies are seen as more challenging because of the deep location of

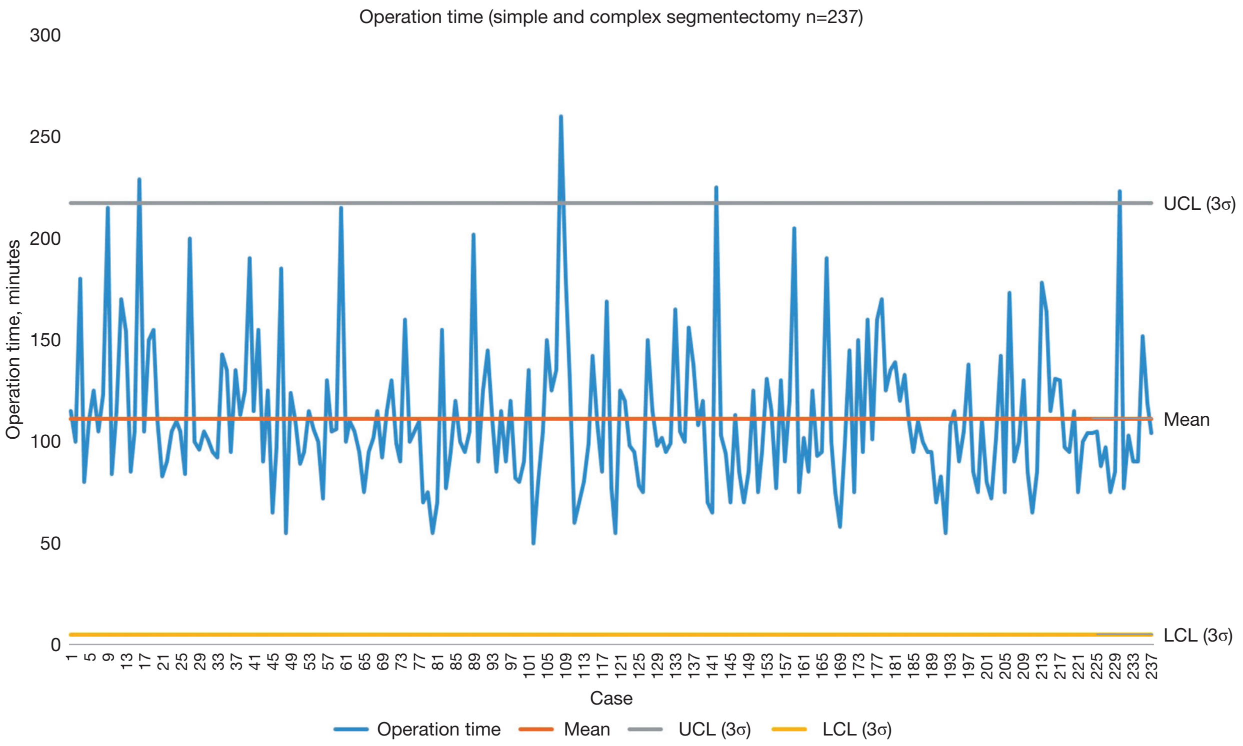

Figure 2 Operative time plotted in chronological case order (simple and complex segmentectomy). UCL, upper control limit; LCL, lower control limit.

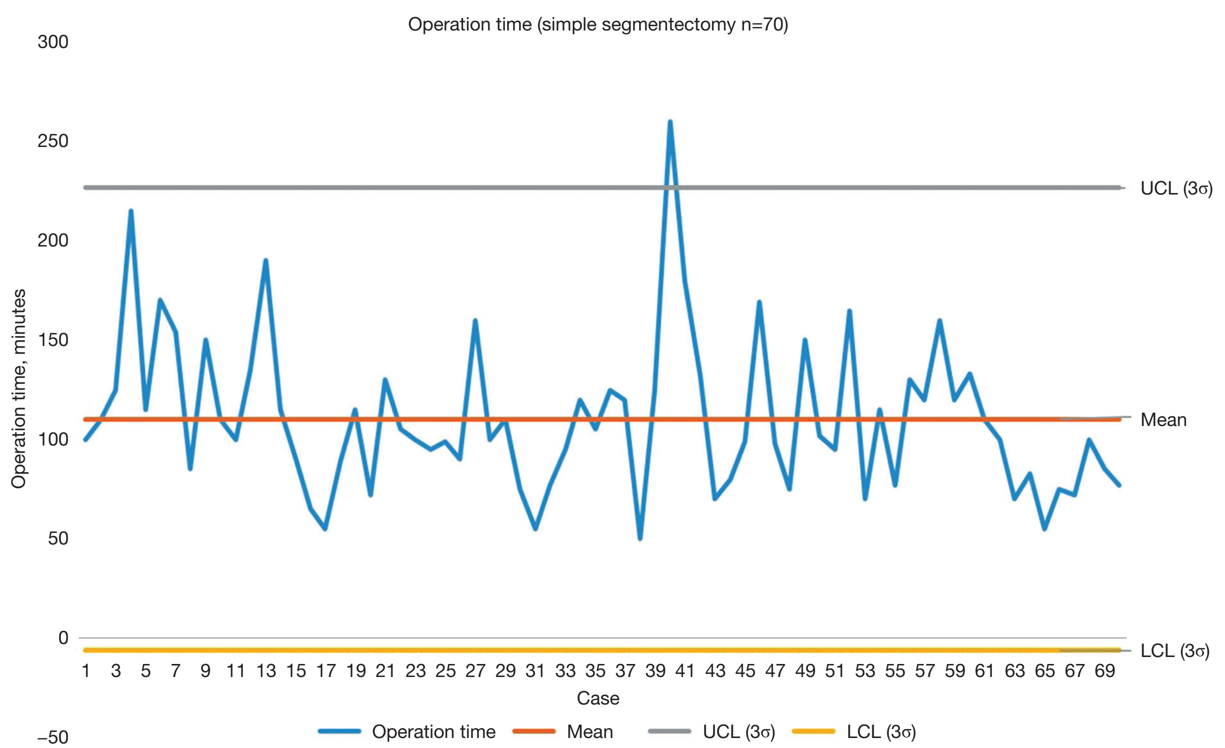

Figure 3 Operative time plotted in chronological case order (simple segmentectomy). UCL, upper control limit; LCL, lower control limit.

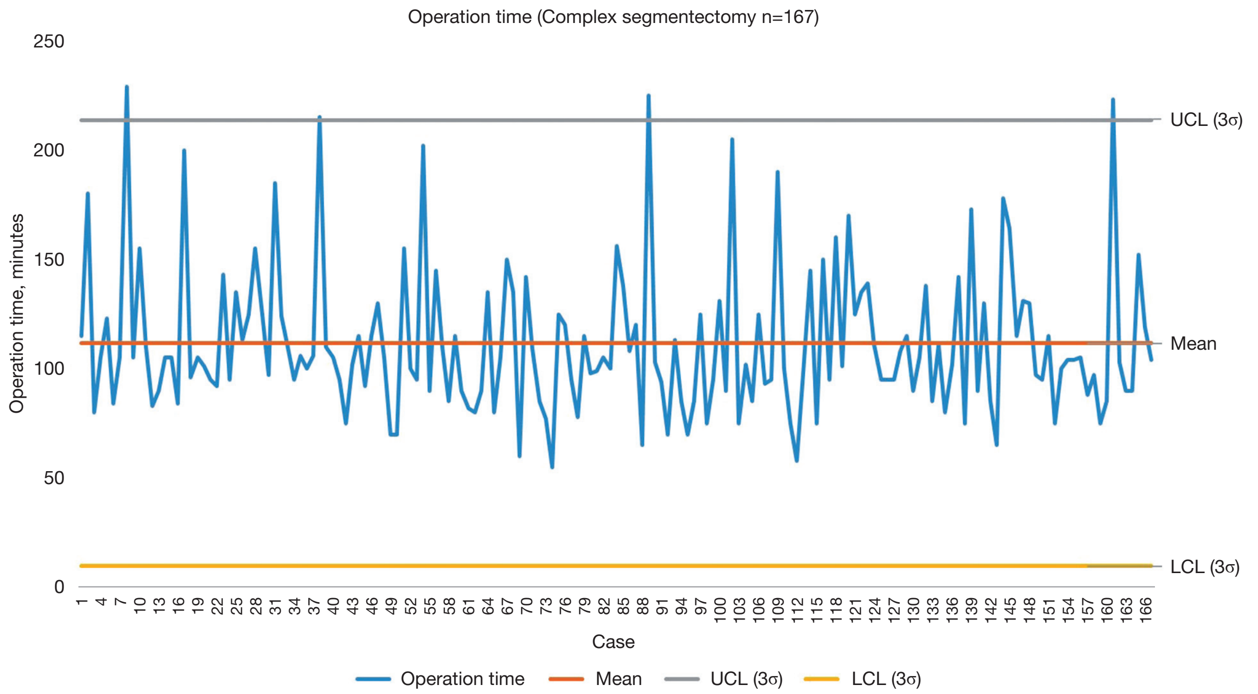

Figure 4 Operative time plotted in chronological case order (complex segmentectomy). UCL, upper control limit; LCL, lower control limit.

vascular structures and bronchi in lung tissue, coupled with the increased risk of anatomical variations that can lead to misidentification during surgery (6). The question we addressed is how many complex segmentectomies are needed to reach proficiency. Several studies have explored the learning curve for VATS anatomical segmentectomy, encompassing multiport, two-port, and uniportal access techniques (12-15). Dimitrovska and her colleagues observed that the inflection point in the learning curve was reached after conducting 47 cases, with surgeons attaining proficiency after performing 57 cases (13). Li and colleagues determined that mastering uniportal VATS anatomical segmentectomy required approximately 64 to 71 cases, while achieving proficiency necessitated around 90 to 100 cases (12). However, research on the learning curve for uniportal VATS complex segmentectomy is relatively limited. Matsuura and colleagues determined that the initial learning curve was achieved after 31 surgeries for uniportal VATS simple segmentectomy and 40 surgeries for uniportal VATS complex segmentectomy, with no significant difference between these numbers (15). In the present study, there was no statistically significant difference in the operative times between simple and complex segmentectomy. To be more specific, the median operative times were 101 minutes (IQR, 84–125 minutes) for simple segmentectomy and 104 minutes (IQR, 90–125 minutes) for complex segmentectomy.

Given that we perform complex segmentectomy twice as often as simple segmentectomy, we conducted further analysis and created a quality control chart to identify instances in which the operative duration exceeded the UCL in our current study. Upon analyzing the operative times for both simple and complex segmentectomies, as illustrated in *Figure 2*, we identified four cases with numbers 16, 108, 142, and 230 that exceeded three standard errors above the mean operative time. However, it is important to highlight that these four specific case numbers are not clustered at the beginning of the chronological case order. In the quality control chart for simple segmentectomy, only case number 40 exceeded the UCL among this subgroup. Case number 40 involved an upper division segmentectomy that necessitated conversion to thoracotomy due to bleeding originating from a tear between the left main pulmonary artery and the apicoposterior segmental branch.

Regarding the quality control chart for complex segmentectomy, it is noteworthy that four cases (specifically, case numbers 8, 38, 89, and 161) exceeded the UCL. Interestingly, three of these cases (case numbers 8, 89, and

161) involved left apicoposterior segmentectomies. In the case of number 8, the patient had synchronous lung cancer in the right middle lobe (RML) and underwent a uniportal VATS RML lobectomy and uniportal VATS left upper lobe apicoposterior segmentectomy during the same operation. Case number 38 involved a patient with a medical history of tuberculosis and pneumonia, resulting in severe pleural adhesions. In case 89, the patient presented with multiple nodules, leading to the performance of a uniportal VATS right upper lobe anterior segmentectomy (S3) and a right lower lobe superior, mediobasal, anterobasal, laterobasal segmentectomy (S6+7+8+9) during the operation. Lastly, case 161 involved a patient who declined a blood transfusion for religious reasons. This case required meticulous dissection with ample time and systematic lymph node dissection because of SUVs exceeding 2.5 on PET/CT.

While evaluating simple segmentectomy in comparison, the increased risk of postoperative complications and concerns related to cancer recurrence and incomplete cancer control have discouraged numerous surgeons from undertaking complex segmentectomies (5,6). In our prior study, we examined the early surgical outcomes of both simple and complex segmentectomy and reached the conclusion that complex segmentectomy cases are more likely to have a shorter resection margin (16). Furthermore, Okubo and colleagues discovered that the complex segmentectomy group had surgical margins that were closer, measuring 22 mm (IQR, 14–30 mm), as opposed to the simple segmentectomy group, which had margins of 25 mm (IQR, 17–35 mm). Consequently, they recommended that surgeons exercise caution and strive to achieve sufficient surgical margins (17). With a greater accumulation of complex segmentectomy cases, our current study revealed that there were no significant differences between the two groups regarding the distance of surgical margins.

Our current study also revealed differences in the duration of chest tube drainage (P=0.019) and the length of postoperative hospital stays between the two groups (P=0.011). The median duration of chest tube drainage was one day in both groups, but the IQR was narrower in the complex segmentectomy group. While the postoperative hospital stay for complex segmentectomy was one day shorter compared to that of simple segmentectomy, we contend that this finding holds limited practical significance due to various factors, as detailed in our study (16). The impact of patient preferences for extended hospital stays, combined with the absence of limitations on hospitalization periods within Korea's medical insurance system, contributed to these findings. Additionally, the absence of a statistically significant difference in chest tube drainage duration between the complex and simple segmentectomy groups diminishes the importance of comparing postoperative stay durations.

Our study has several limitations. Firstly, the sample size was restricted as the surgeries were performed by a single surgeon at a single center. Secondly, the study was retrospective and nonrandomized, possibly introducing bias into our results. Lastly, we lack long-term data, and we have not yet presented information on aspects such as disease-free survival and recurrence-free survival.

Conclusions

Based on the results of our study, we have reached the conclusion that there is no notable disparity in operative times between uniportal VATS simple segmentectomy and complex segmentectomy procedures. With only four cases in the complex segmentectomy group falling outside the three upper limits, we tentatively assert the need for a learning curve in complex segmentectomy may be unnecessary for surgeons who are already proficient in the techniques of simple segmentectomy and lobectomy. Moreover, our study indicated no noteworthy distinctions in patient and tumor characteristics, operative outcomes, or postoperative outcomes between the two groups.

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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-23-1615/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1615/dss

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Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1615/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 protocol was approved by the Institutional Review Board of the Eunpyeong St. Mary's Hospital, College of Medicine, The Catholic University of Korea (No. PC23RASI0178). Individual consent was not required for this retrospective study.

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