



Outcomes following minimally invasive approaches vs. open extended lobectomy for non-small cell lung cancer: a propensity-matched analysis of the National Cancer Database

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Background: Traditional thoracotomy, an invasive surgical procedure, has been the standard approach for extended lobectomy in treating non-small cell lung cancer (NSCLC). However, minimally invasive surgery (MIS) has gained traction with advancements in surgical techniques. Despite this, the outcomes of extended lobectomy via a minimally invasive approach remain largely uncharted. Using the comprehensive National Cancer Database (NCDB), our research aimed to clarify the safety, feasibility, and efficacy of minimally invasive extended lobectomy in patients diagnosed with NSCLC.

Methods: Our study encompassed a selection of patients with NSCLC who underwent extended lobectomy (defined as lobectomy or bilobectomy with chest wall, diaphragm or pericardial resection) between 2010 and 2014. Through propensity score matching (PSM), we ensured a balanced comparison between patients who underwent MIS and those who opted for the traditional open extended lobectomy. Both univariate and multivariate analyses were employed to discern whether the surgical approach had any significant impact on the prognosis of patients undergoing this specific procedure.

Results: Before PSM, our dataset included 3,934 patients. After 1:2 PSM, the MIS group included 683 cases, while the open group included 1,317 cases. One notable finding was the reduced average postoperative hospital stay for the MIS group at 7.15 days compared to the open group at 8.40 days ($P < 0.001$). Furthermore, the 5-year survival rate was similar, with the MIS group at 53.1% and the open group at 51.3% ($P = 0.683$).

Conclusions: The results of our study suggest that MIS for extended lobectomy not only is safe and feasible but also is oncologically effective. However, it is imperative to note that these encouraging findings necessitate further validation through prospective studies to ascertain the full scope of benefits and potential risks associated with MIS.

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Introduction

Lung cancer remains one of the leading causes of cancer death worldwide (1). Surgery is widely accepted as an essential treatment option for this disease, offering the best potential for cure in patients with lesions amenable to resection. As the technology in the surgical field advances, the approach to lung resection surgery is shifting to offering minimally invasive techniques as the standard approach (2-7).

In many extensive database studies, video-assisted thoracoscopic surgery (VATS) approaches to lobectomy are superior to open approaches. In a propensity-matched analysis based on the Society of Thoracic Surgeons (STS) database, Paul *et al.* found the thoracoscopic approach to lobectomy was associated with a lower incidence of postoperative complications and an overall shorter length of stay (LOS) compared to the open approach (2). This has been validated several times in other databases, including the Surveillance, Epidemiology, and End Results (SEER)-

Medicare database as well as the National Cancer Database (NCDB) (3,4). These studies have paved the way for a paradigm shift that has led to the VATS approach for classic lobectomy becoming the standard of care for patients with resectable lung cancer confined to one anatomic lobe.

Unfortunately, some patients require additional dissection to achieve an R0 resection for the best oncologic results depending on disease progression and location (8-10). The recent literature attests to a broader adoption of the minimally invasive approach for extended lung resections, including chest wall resections, bronchoplastic and arterial sleeve resections, and pneumonectomy (11-18). Although the results of these single-institution studies have been impressive, it is unclear whether these same results can be achieved in the broader surgical community.

There have been no prospective clinical trials comparing open *vs.* minimally invasive surgery (MIS) for extended lobectomy. In the NCDB, extended lobectomy is defined to include surgery codes 45 [lobectomy or bilobectomy extended, not otherwise specified (NOS)], 46 (lobectomy or bilobectomy extended, with chest wall), 47 (with pericardium), and 48 (with diaphragm). Using the NCDB, we analyzed the national outcomes of the minimally invasive approach to extended lobectomy with the primary outcome of 5-year overall survival following surgery. We also evaluated safety and feasibility after surgery. We present this article in accordance with the STROBE reporting checklist (19) (available at <https://tlcr.amegroups.com/article/view/10.21037/tlcr-24-37/rc>).

Methods

Cohort selection

We performed a retrospective analysis of the NCDB, a joint project of the Commission on Cancer (CoC) of the American College of Surgeons and the American Cancer Society. We identified patients diagnosed with non-small cell lung cancer (NSCLC) undergoing extended lobectomy between 2010 and 2014. We chose 2010 as the starting year because this was when the NCDB began to include the

Highlight box

Key findings

- Minimally invasive surgery (MIS) for extended lobectomy in non-small cell lung cancer (NSCLC) is safe and feasible. It can offer shorter hospital stays than traditional open surgery, without lowering 5-year survival rates.

What is known, and what is new?

- Video-assisted thoracoscopic surgery is superior to open lobectomy, with MIS for extended lobectomy being previously limited and challenging.
- According to the National Cancer Database, a national database in the United States, this study is one of the first to use propensity score matching to report outcomes between open and MIS extended lobectomy. The MIS approach to extended lobectomy can be adopted in various hospital settings not just academic centers.

What is the implication, and what should change now?

- The study findings support a potential shift toward broader adoption of MIS for extended lobectomy in NSCLC, emphasizing the need for enhanced surgeon training, patient selection, and further research to validate and refine this approach.

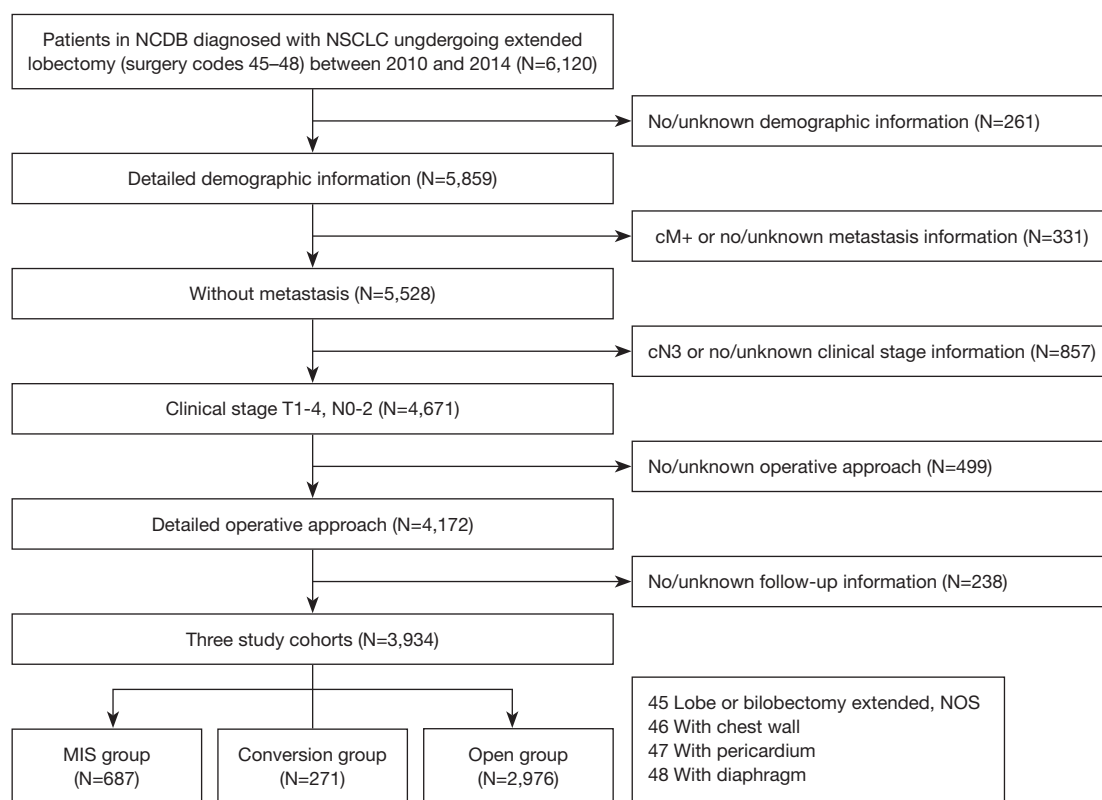


Figure 1 Study population flow diagram of NSCLC patients in NCDB who underwent extended lobectomy between 2010 and 2014. The content at the bottom right explains what these surgery codes mean here. NCDB, National Cancer Database; NSCLC, non-small cell lung cancer; MIS, minimally invasive surgery; NOS, not otherwise specified.

approach data. We chose 2014 as the cutoff year because this was the latest dataset with follow-up information when we started our study. Extended lobectomy was defined as the Facility Oncology Registry Data Standards manual site-specific surgery codes 45 (lobectomy or bilobectomy extended, NOS), 46 (lobectomy or bilobectomy extended, with chest wall), 47 (lobectomy or bilobectomy extended, with pericardium), and 48 (lobectomy or bilobectomy extended, with diaphragm). The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

The inclusion criteria of this study were as follows: according to the intention-to-treat analysis, patients diagnosed with NSCLC undergoing extended lobectomy via either MIS or thoracotomy between January 2010 and December 2014 were analyzed, including converted patients. The MIS group included VATS and robot-assisted thoracoscopic surgery (RATS). The exclusion criteria consisted of patients with missing demographic information, metastatic disease, no/unknown metastasis information, cN3 cases, no/unknown clinical-stage information, and

missing or no/unknown operation approach information and follow-up information (Figure 1).

Patients' demographics and clinicopathological characteristics were compared between the two groups (open *vs.* MIS). Postoperative LOS, unplanned readmission, 30-day mortality, and 90-day mortality were measured as the primary perioperative outcomes. The following was analyzed to measure oncological outcomes: examined lymph nodes, positive lymph nodes, R0 rates, and 1-, 3-, and 5-year overall survival.

Statistical analysis

Continuous variables are expressed as the mean \pm standard deviation (SD), and the Student's *t*-test or Mann-Whitney test was used for comparison. Comparison of categorical variables was performed with the Chi-squared test or Fisher exact test when appropriate. Survival curves were plotted with the Kaplan-Meier formula. The log-rank test was used to compare survival between different groups.

As the baseline characteristics in the two groups were not balanced, propensity score matching (PSM) analysis was performed with SPSS 23 software (IBM Corp., Armonk, NY, USA). Propensity scores were estimated using a logistic regression model. PSM was performed in a 1:2 ratio according to gender, age, race, insurance, income, education, reporting facility, Charlson Comorbidity Index, clinical T stage, clinical N stage, surgery codes, histological classification, neoadjuvant therapy, and tumor location, with a SD of less than 0.20 logit of the propensity score. Patients who underwent MIS were ordered and sequentially matched to the nearest unmatched patients who underwent thoracotomy. Surgical and postoperative outcomes were then compared between the matched groups. Multivariable analysis was performed with a Cox proportional model and the enter method. We selected demographic and clinicopathological characteristics, as well as surgical information, as our variables of Cox proportional hazard model. Entry limits were a P value <0.2.

Subgroup analyses were performed, including comparisons between VATS and RATS, conversion and open procedures, and MIS and open surgeries in community hospital settings. Statistical significance was defined as P<0.05 throughout the study.

Results

Cohort characteristics

Between January 2010 and December 2014, 6,120 patients were diagnosed with NSCLC and underwent extended lobectomy according to our inclusion criteria. Based on our inclusion and exclusion criteria, 958 extended lobectomies were attempted with a conversion to open thoracotomy occurring in 28.3% [271] of patients. Therefore, for our analysis, 687 patients were included in the MIS group, 271 in the conversion group, and 2,976 in the open group (*Figure 1*). *Figure 2* shows the annual number of patients who underwent extended lobectomy. The MIS rate steadily increased, and the conversion rate essentially decreased. The postoperative LOS, unplanned readmission rates, 30-day mortality, and 90-day mortality mainly decreased in the MIS group year by year. The patients' demographics and clinical characteristics are listed in *Table S1*. Most of the clinicopathologic factors were not comparable between the two groups. MIS patients were slightly older (mean age 67.46±9.74 vs. 66.29±9.74 years), and a higher proportion of MIS patients were female (51.5% vs. 46.5%, P=0.018). The

average tumor size of the open group was larger than that of the MIS group (39.87±25.38 vs. 49.00±51.02 mm, P<0.001). Therefore, more MIS group patients were diagnosed with clinical T1 stage (39.4% vs. 28.6%, P<0.001). *Table 1* shows the perioperative outcomes before PSM in the overall cohort.

PSM analysis of the MIS and open groups

After 1:2 PSM was completed, 683 MIS and 1,317 open-surgery patients were included for further analysis. The baseline was well-balanced between the two groups (*Table S1*). MIS was significantly associated with a greater number of dissected lymph nodes (12.18±9.74 vs. 10.61±8.55, P=0.001) and shorter postoperative LOS (7.15±7.02 vs. 8.40±7.74 days, P<0.001). The R0 rates, unplanned readmission rates, 30-day mortality, and 90-day mortality were similar between the MIS and open surgery groups (*Table 1*).

We also compared the perioperative results and demographic and oncological characteristics between the RATS and the VATS groups. The details of the demographic and oncological characteristics of the RATS and the VATS group before and after PSM are shown in *Table S2*. There was no significant difference in lymph nodes examined, R0 rates, LOS, unplanned readmission rates, 30-day mortality, or 90-day mortality between the RATS and VATS groups before and after PSM (*Table 2*). It should be noted that RATS was not performed as often before 2014 as it is presently.

Figure 3A, 3B show the overall survival curves for extended lobectomy in an unmatched and matched cohort of the open and MIS groups. The MIS group achieved slightly better survival than the open group in the unmatched cohorts (P=0.041). After PSM was conducted, the two groups had no significant difference in overall survival (*Figure 3B*; P=0.683). We also performed univariable and multivariable analyses and found that the surgical approach [MIS vs. open: hazard ratio (HR), 0.967; 95% confidence interval (CI): 0.832–1.123; P=0.657] was not associated with the survival of patients undergoing extended lobectomy (*Table S3*).

PSM analysis of the conversion to thoracotomy and open groups

Perioperative outcomes and demographic and oncological characteristics were compared between the conversion and

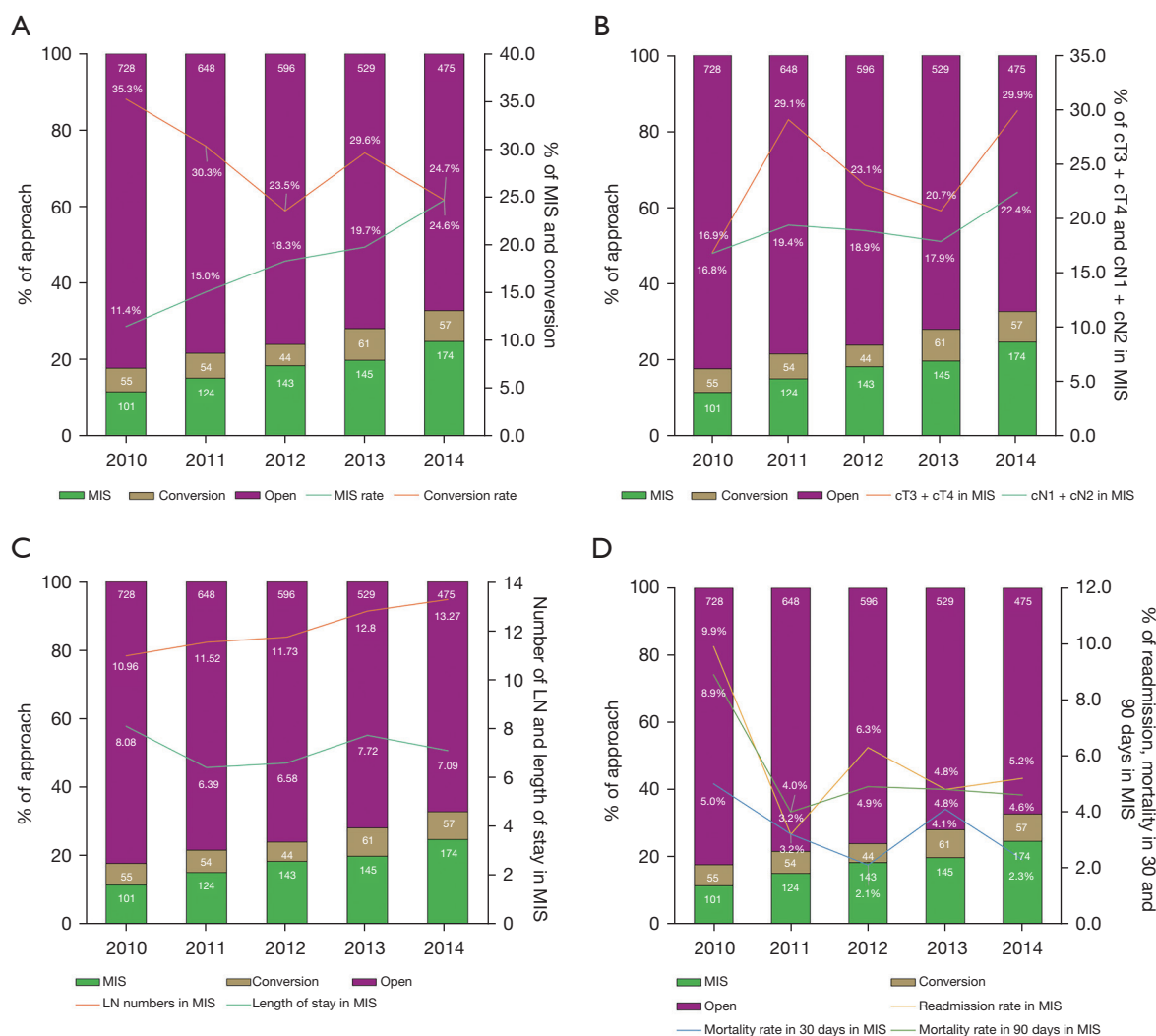


Figure 2 Annual numbers and perioperative results of patients undergoing extended lobectomy. (A) Annual numbers, MIS rates, and conversion rates of patients undergoing extended lobectomy. (B) Annual data for cT3 + cT4 stage and cN1 + cN2 stage patients undergoing MIS extended lobectomy. (C) Annual data for mean lymph nodes harvested and mean postoperative LOS of patients undergoing MIS extended lobectomy. (D) Annual readmission rates, 30-day mortality, and 90-day mortality of patients undergoing MIS extended lobectomy. MIS, minimally invasive surgery; LN, lymph node; LOS, length of stay.

open groups. The details of demographic and oncological characteristics of the conversion and the open group before and after PSM are shown in Table S4. The R0 rates, postoperative LOS, unplanned readmission rates, 30-day mortality, and 90-day mortality were similar between the conversion and open groups after PSM (Table 3). The conversion group had more examined lymph nodes than the open surgery group (13.91 ± 12.36 vs. 11.34 ± 8.98 , $P=0.034$). The overall survival was similar between the two groups (Figure 3C).

Comparison of the MIS and open groups in the community/comprehensive hospital setting

The details of demographic and oncological characteristics of the community cohort before and after PSM are shown in Table S5. The MIS group had a shorter postoperative LOS than the open group in the matched cohort in the community and comprehensive community hospitals (6.89 ± 5.85 vs. 8.43 ± 6.39 days, $P<0.001$). The R0 rates were higher in the MIS group after PSM (90.2% vs. 85.5%,

Table 1 MIS vs. open surgery: surgical results before and after PSM

Results	Unmatched cohort			Matched cohort		
	MIS (n=687)	Open (n=2,976)	P value	MIS (n=683)	Open (n=1,317)	P value
R0	625 (91.0)	2,575 (86.5)	0.001	621 (90.9)	1,163 (88.3)	0.081
LN number	12.59±9.62	11.17±8.79	0.001	12.18±9.74	10.61±8.55	0.001
Positive LN number	0.66±1.76	0.69±1.86	0.673	0.66±1.78	0.64±1.76	0.462
Pathological T stage			<0.001			0.472
T0	15 (2.2)	54 (1.8)		15 (2.2)	18 (1.4)	
T1	196 (28.5)	690 (23.2)		193 (28.3)	389 (29.5)	
T2	233 (33.9)	864 (29.0)		233 (34.1)	414 (31.4)	
T3	183 (26.6)	1,060 (35.6)		183 (26.8)	369 (28.0)	
T4	49 (7.1)	185 (6.2)		48 (7.0)	74 (5.6)	
Tx	11 (1.6)	123 (4.1)		11 (1.6)	53 (4.0)	
Pathological N stage			0.833			0.706
N0	487 (70.9)	2,143 (72.0)		484 (70.9)	952 (72.3)	
N1	121 (17.6)	442 (14.9)		120 (17.6)	200 (15.2)	
N2	55 (8.0)	246 (8.3)		55 (8.1)	97 (7.4)	
N3	1 (0.1)	1 (<0.1)		1 (0.1)	0 (0.0)	
Nx	23 (3.3)	144 (4.8)		23 (3.4)	68 (5.2)	
Postoperative LOS (days)	7.14±7.01	8.75±7.90	<0.001	7.15±7.02	8.40±7.74	<0.001
Readmission	39 (5.7)	170 (5.7)	0.971	38 (5.6)	72 (5.5)	0.920
30-day mortality	22 (3.2)	104 (3.5)	0.816	22 (3.2)	44 (3.3)	0.887
90-day mortality	36 (5.2)	211 (7.1)	0.091	36 (5.3)	87 (6.6)	0.280
Adjuvant radiotherapy	66 (9.6)	373 (12.5)	0.037	65 (9.5)	150 (11.4)	0.223
Adjuvant chemotherapy	200 (29.1)	908 (30.5)	0.490	199 (29.1)	353 (26.8)	0.269

Data are presented as n (%) or mean ± SD. MIS, minimally invasive surgery; PSM, propensity score matching; R0, no residual tumor; LN, lymph node; LOS, length of stay; SD, standard deviation.

Table 2 RATS vs. VATS: surgical results before and after PSM

Results	Unmatched cohort			Matched cohort		
	RATS (n=154)	VATS (n=533)	P value	RATS (n=149)	VATS (n=286)	P value
R0	139 (90.3)	486 (91.2)	0.750	134 (89.9)	261 (91.3)	0.727
LN number	11.53±8.48	12.27±9.58	0.382	11.46±8.56	11.67±8.96	0.812
Positive LN number	0.60±1.39	0.63±1.82	0.826	0.58±1.36	0.64±1.87	0.762
Postoperative LOS (days)	6.70±5.43	7.26±7.40	0.383	6.74±5.47	7.63±8.36	0.774
Readmission	7 (4.5)	32 (6.0)	0.559	7 (4.7)	23 (8.0)	0.234
30-day mortality	5 (3.2)	17 (3.2)	0.972	5 (3.4)	12 (4.2)	0.798
90-day mortality	7 (4.5)	29 (5.4)	0.838	7 (4.7)	21 (7.3)	0.410
Adjuvant radiotherapy	9 (5.8)	57 (10.7)	0.087	9 (6.0)	31 (10.8)	0.117
Adjuvant chemotherapy	46 (29.8)	154 (28.9)	0.841	46 (30.9)	73 (25.5)	0.258

Data are presented as n (%) or mean ± SD. RATS, robot-assisted thoracoscopic surgery; VATS, video-assisted thoracoscopic surgery; PSM, propensity score matching; R0, no residual tumor; LN, lymph node; LOS, length of stay; SD, standard deviation.

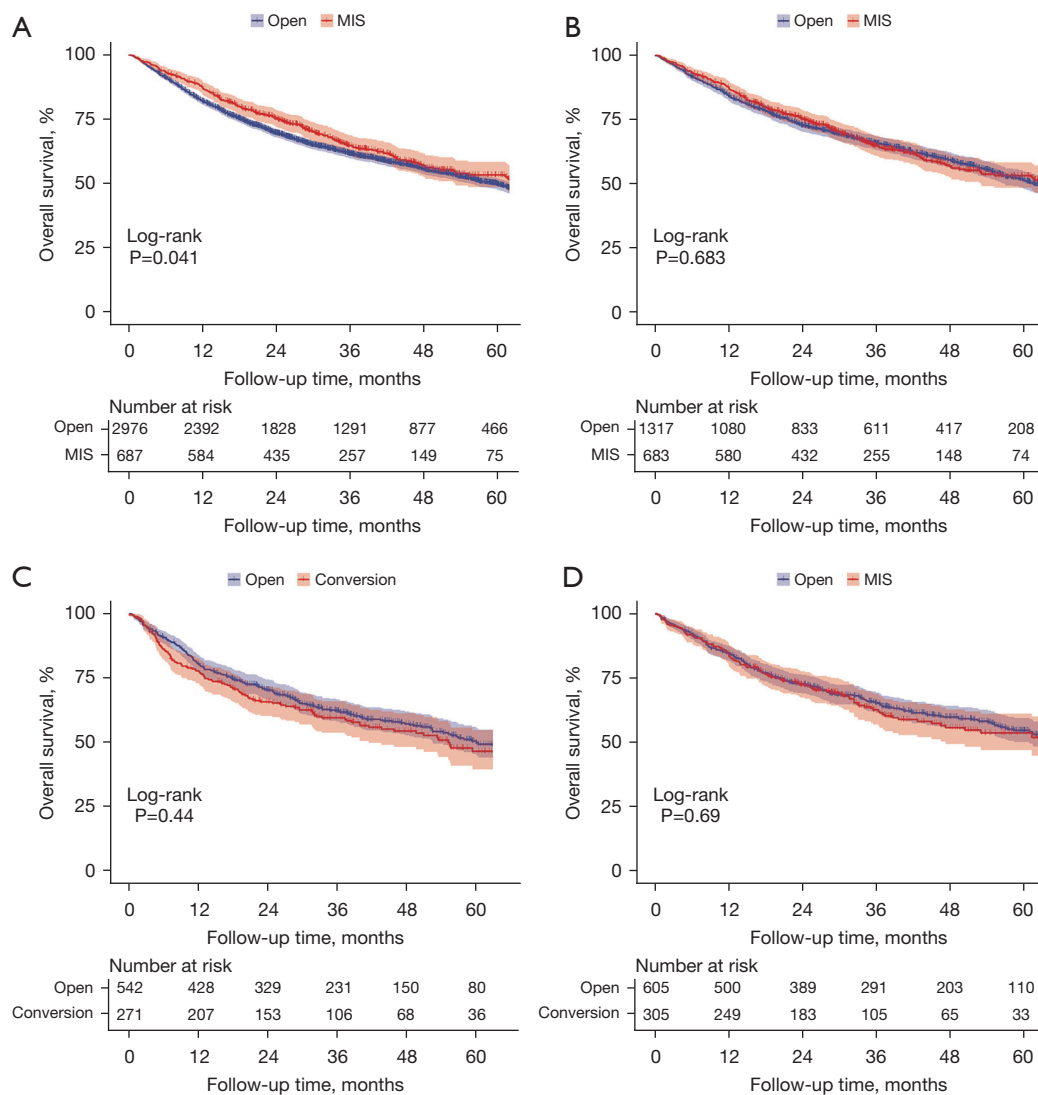


Figure 3 Overall survival curves for extended lobectomy in different groups. (A) Comparison of overall survival between the open group and MIS group (unmatched). (B) Comparison of overall survival between the open group and MIS group (matched). (C) Comparison of overall survival between the open group and conversion group (matched). (D) Comparison of overall survival between the open and MIS groups in the community/comprehensive community cancer program cohort (matched). MIS, minimally invasive surgery.

P=0.047). The unplanned readmission rate within 30 days of discharge, number of lymph nodes examined, number of positive lymph nodes, 30-day mortality, and 90-day mortality were similar between the MIS and open surgery groups in both the unmatched and matched cohorts (Table 4). There was no significant difference in overall survival between the two groups after PSM (Figure 3D).

Discussion

This is one of the first PSM studies to report outcomes

between open and MIS extended lobectomy based on a national database in the United States. In a cohort of over 6,000 patients who underwent extended lobectomy, a minimally invasive approach was used in roughly 11.2% of these cases. The PSM analysis showed no difference in R0 resection rates, readmission rates, 30-day mortality, and 90-day mortality. Patients who underwent a MIS approach had more lymph nodes harvested and a decreased overall postoperative LOS. Similar results were observed in the separate PSM analysis of patients undergoing MIS extended lobectomy for NSCLC in the community/comprehensive

Table 3 Conversion vs. open: surgical results after PSM

Results	Unmatched cohort			Matched cohort		
	Conversion (n=271)	Open (n=2,976)	P value	Conversion (n=271)	Open (n=542)	P value
R0	242 (89.3)	2,575 (86.5)	0.224	242 (89.3)	458 (84.5)	0.068
LN number	13.91±12.36	11.17±8.79	<0.001	13.91±12.36	11.34±8.98	0.034
Positive LN number	0.76±1.70	0.69±1.86	0.136	0.76±1.70	0.74±2.00	0.624
Postoperative LOS (days)	9.49±8.00	8.75±7.90	<0.001	9.49±8.00	8.73±7.88	0.197
Readmission	22 (8.1)	170 (5.7)	0.107	22 (8.1)	32 (5.9)	0.235
30-day mortality	10 (3.7)	104 (3.5)	0.863	10 (3.7)	19 (3.5)	0.894
90-day mortality	27 (10.0)	211 (7.1)	0.088	27 (10.0)	38 (7.0)	0.143
Adjuvant radiotherapy	24 (8.8)	373 (12.5)	0.081	24 (8.8)	66 (12.2)	0.192
Adjuvant chemotherapy	85 (31.3)	908 (30.5)	0.783	85 (31.3)	174 (32.1)	0.873

Data are presented as n (%) or mean ± SD. PSM, propensity score matching; R0, no residual tumor; LN, lymph node; LOS, length of stay; SD, standard deviation.

Table 4 Surgical results after PSM in community and comprehensive community cancer program cohort

Results	Unmatched cohort			Matched cohort		
	MIS (n=305)	Open (n=1,683)	P value	MIS (n=305)	Open (n=605)	P value
R0	275 (90.2)	1,450 (86.2)	0.066	275 (90.2)	517 (85.5)	0.047
LN number	10.15±8.47	9.26±7.45	0.288	10.15±8.47	9.10±7.39	0.257
Positive LN number	0.59±1.70	0.62±1.61	0.836	0.59±1.70	0.70±1.64	0.337
Postoperative LOS (days)	6.89±5.85	8.84±7.37	<0.001	6.89±5.85	8.43±6.39	<0.001
Readmission	19 (6.2)	90 (5.3)	0.497	19 (6.2)	24 (4.0)	0.138
30-day mortality	16 (5.2)	68 (4.0)	0.352	16 (5.2)	22 (3.6)	0.292
90-day mortality	21 (6.9)	136 (8.1)	0.564	21 (6.9)	37 (6.1)	0.668
Adjuvant radiotherapy	33 (10.8)	216 (12.8)	0.349	33 (10.8)	76 (12.6)	0.517
Adjuvant chemotherapy	86 (28.2)	530 (31.5)	0.282	86 (28.2)	190 (31.4)	0.359

Data are presented as n (%) or mean ± SD. PSM, propensity score matching; MIS, minimally invasive surgery; R0, no residual tumor; LN, lymph node; LOS, length of stay; SD, standard deviation.

community cancer program setting.

An initial criticism of MIS approaches for any cancer operation is the potential to compromise the overall oncologic results. Our study showed that the MIS approach to extended lobectomies did not compromise oncological outcomes in terms of R0 resection rates. Some studies have reported that MIS could provide similar or even better lymph node evaluation than the open approach in simple lobectomy (20–22). In our study, there was no difference in the number of positive lymph nodes between groups,

and the total number of lymph nodes were examined. Additionally, our study showed no difference in overall survival after MIS or open extended lobectomies. These results show that adopting MIS approaches to an oncologic extended lobectomy can produce at least equivalent oncologic outcomes to the standard open thoracotomy approach. Furthermore, the nearly identical results in the matched community hospital cohort suggest that the MIS approach to extended lobectomy can be adopted in many hospital settings and should be open to more than academic centers.

According to the literature, the conversion rates of MIS extended lobectomies are significantly higher than those of standard MIS lobectomy. Yang *et al.* reported a 17.5% rate of conversion to open surgery in a VATS cohort and 10.3% in a robotic lobectomy cohort in the same NCDB (4). Our study's conversion rate was 28.3% for patients undergoing MIS extended lobectomies. Although the NCDB does not readily provide the cause of these conversions, this may be due to the learning curve. Many studies on standard VATS and robotic lobectomies have reported a continual decrease in conversion rates with experience (23,24).

Similarly, with the improvement of experience and technique, we observed a marked reduction in conversion rates and increased use of MIS for extended lobectomy in this study. However, other factors may ultimately affect conversion rates, such as disease location, lymph node calcification, pleural adhesions, and surgeon experience (25). Additional studies will be necessary to identify this elevated conversion rate associated with MIS-extended lobectomies.

Preoperative imaging is often inaccurate in determining advanced T stage. Extended lobectomy for advanced T stage tumor remains an essential option if a complete resection can be accomplished (26-28). Although the conversion rate was high in extended lobectomy, the number of T3 and T4 cases increased yearly in the MIS group indicating that the surgeons were more likely to attempt the MIS approach for more challenging cases as experience was gained. Moreover, the perioperative results were also generally improved year on year. Our study found that the number of lymph nodes examined increased, and the postoperative LOS, readmission rates, 30-day mortality, and 90-day mortality decreased from 2010 to 2014. These promising results support the MIS approach as feasible in extended lobectomy and worth attempting.

Consistent with our results, previous studies have demonstrated that postoperative morbidity and mortality rates are similar between conversion cases and thoracotomy (29,30). The R0 rates, postoperative LOS, unplanned readmission rates, 30-day mortality, and 90-day mortality were similar between the conversion and open groups. The overall survival was also similar between the two groups, indicating that MIS is safe and that the conversion to thoracotomy during the operation does not compromise treatment outcome.

Limitations

Due to the nature and design of this study, some limitations

should be noted. First, due to the retrospective study design, confounding and selection biases might have been introduced. Moreover, there was quite a large number of T1 or T2 stage patients who required extended lobectomy. The exact reasons for this are still being determined, and the details could not be obtained. The centrally located small tumors may still require bronchial sleeve resection. Second, because the analysis was performed on a nationally collected database, there needs to be more granularity in the data recorded on both the patient and institutional levels. Similarly, many specific and important intraoperative and postoperative complications regarding the surgery, therefore, could not be analyzed. For example, whether MIS requires more operative time than the open operation remains to be seen. Third, the analysis of relapse-free survival could not be assessed, as these data are not recorded in the NCDB. Nonetheless, this study represents one of the first reports on minimally invasive approaches to extended lobectomy using a national US database.

Conclusions

Minimally invasive approaches to extended lobectomy are challenging and only used in a small minority of patients. However, minimally invasive extended lobectomy is a safe and feasible option for NSCLC. As conversion does not compromise the outcomes and as the perioperative results appeared to improve year on year, MIS can at least be attempted first in certain patients by experienced surgical teams. Perioperative management for open conversion is essential if extended lobectomy is anticipated preoperatively. MIS extended lobectomy can achieve similar oncologic results and is associated with similar or even better perioperative outcomes if not converted to open surgery. However, prospective studies are needed to confirm this conclusion.

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Footnote

Reporting Checklist: The authors have completed the

STROBE reporting checklist. Available at <https://tldr.amegroups.com/article/view/10.21037/tlcr-24-37/rc>

Peer Review File: Available at <https://tldr.amegroups.com/article/view/10.21037/tlcr-24-37/prf>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://tldr.amegroups.com/article/view/10.21037/tlcr-24-37/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).

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