Clinical Outcomes of Lung Cancer Patients After Lobectomy Surgery Using Thoracotomy and VATS Methods at Persahabatan Hospital from 2021 to 2024

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Abstract.
Lobectomy is the primary surgical treatment for lung cancer and can be performed using thoracotomy or video-assisted thoracoscopic surgery (VATS). This study aimed to describe patient characteristics, preoperative clinical conditions, intraoperative findings, and postoperative outcomes of lung cancer patients undergoing lobectomy using both techniques at Persahabatan General Hospital from 2021 to 2024. A retrospective descriptive cohort study was conducted involving 49 patients, consisting of thoracotomy (n=35) and VATS (n=14). Data included demographic characteristics, comorbidities, lung function, cancer type, intraoperative variables, and postoperative outcomes, which were analyzed descriptively. The mean age was 50 ± 12.2 years with a median of 54 years, and most patients were in late adulthood. Males predominated in the thoracotomy group, while females were more common in the VATS group. Smoking history was frequent, whereas diabetes mellitus and COPD were only found in the thoracotomy group. Most patients had normal preoperative lung function and primary lung cancer, although lung metastases were more common in thoracotomy cases. Thoracotomy was more frequently associated with longer operative time (>3 hours), greater intraoperative blood loss, and higher need for blood transfusion compared to VATS, which more often had shorter operative duration (≤3 hours). Postoperative morbidity was low in both groups, and mortality was similar at 2%. Length of hospital stay was generally shorter in the VATS group compared to thoracotomy. In conclusion, thoracotomy is more often used in complex cases, while VATS offers advantages in selected patients, particularly in terms of operative efficiency and recovery, supporting individualized surgical decision-making
Keywords: *Lung Cancer, Lobectomy, Thoracotomy and VATS.*

I. INTRODUCTION

Lung cancer is one of the major health problems globally and nationally due to its high incidence and mortality rates. Biologically, lung cancer originates from lung tissue or is a metastasis from other organs due to genetic changes in the epithelial cells of the respiratory tract. This carcinogenesis process is mainly triggered by exposure to carcinogens, particularly cigarette smoke, through mechanisms of DNA damage, oxidative stress, chronic inflammation, and gene mutations such as TP53 and KRAS, which can be exacerbated by genetic predisposition. In addition to smoking, exposure to air pollution and other environmental factors also contribute to an increased risk of lung cancer[1], [2].

Epidemiologically, based on the 2022 Global Burden of Cancer (GLOBOCAN) report, lung cancer is the leading cause of cancer deaths worldwide, with 2,480,675 new cases (12.4%). In Indonesia, lung cancer is also among the most common malignancies with the highest incidence and is most frequently found in men. The high burden of this disease is closely related to the high prevalence of risk factors and delayed diagnosis, so that most patients still present at an advanced stage, which ultimately limits curative therapy options and contributes to high mortality rates[1].

Histopathologically, primary lung cancer is classified into non-small cell lung cancer (NSCLC) and small cell lung cancer (SCLC), with NSCLC being the most common type[3], [4]. In early-stage NSCLC, surgical resection remains the primary curative treatment modality, especially for small tumors without lymph node involvement or distant metastasis. Lung lobectomy has long been established as the gold standard because it provides optimal oncological control and improves long-term survival compared to

limited lung resection[3], [5].

Lobectomy can be performed through several surgical approaches, including open thoracotomy, video-assisted thoracoscopic surgery (VATS), and robotic-assisted thoracic surgery (RATS). Each approach has a different level of invasiveness and has the potential to affect intraoperative conditions and postoperative clinical outcomes, such as pain, morbidity, mortality, and length of hospital stay[6]. The thoracotomy approach has long been used because it provides visual access and ample space for manipulation of intrathoracic structures, especially in cases with anatomical complexity or more advanced disease. However, this technique is more invasive and is often associated with more severe postoperative pain and longer hospital stays[7].

Conversely, VATS has developed as a minimally invasive technique that aims to reduce tissue trauma, decrease postoperative pain, and accelerate recovery without compromising oncological principles. A number of international studies have reported that lobectomy using the VATS approach is associated with lower intraoperative blood loss, a lower risk of complications, and a shorter length of hospital stay compared to thoracotomy[7], [8]. However, post-lobectomy mortality remains low overall, ranging from 0.9–4.1% in the first 30 days, with variations in outcomes influenced by the duration of surgery, case complexity, and patient clinical condition[7].

However, most of the available scientific evidence comes from countries with health care systems, patient characteristics, and resource availability that differ from those in Indonesia. At the national level, several studies have described the characteristics of lung cancer patients, but data specifically evaluating clinical outcomes after lobectomy, especially comparisons between thoracotomy and VATS methods, are still limited[9], [10]. This limitation in local data poses a challenge in assessing the contextual application of pulmonary surgical approaches in accordance with clinical practice in Indonesia.

Persahabatan General Hospital is one of Indonesia's national referral centers for lung disease, routinely performing lobectomy on lung cancer patients using various surgical approaches. To date, publications comprehensively describing the clinical outcomes of lung cancer patients after lobectomy using thoracotomy and VATS methods at Persahabatan General Hospital are still limited. Therefore, this study aims to describe the characteristics of patients, preoperative clinical conditions, intraoperative findings, and postoperative clinical outcomes, including morbidity, mortality, and length of hospital stay in lung cancer patients undergoing lobectomy using the thoracotomy and VATS methods at Persahabatan General Hospital from 2021 to 2024. The results of this study are expected to provide an initial overview based on local data and serve as a basis for the development of scientific evidence and further research in the field of respiration and thoracic surgery in Indonesia.

II. METHODS

This study is a descriptive study with a retrospective cohort approach conducted at Persahabatan General Hospital, Jakarta. The study aims to describe the clinical characteristics and postoperative outcomes of lung cancer patients who underwent lobectomy using thoracotomy and Video-Assisted Thoracoscopic Surgery (VATS). Data were obtained from patient medical records during the period from January 2021 to December 2024.

The study population consisted of all patients with primary or metastatic lung cancer who were at least 18 years of age and had undergone lobectomy using the thoracotomy and VATS methods during that period and had complete medical records. Sampling was performed using total sampling, excluding patients with incomplete medical records. A total of 49 patients were analyzed, consisting of 35 patients who underwent thoracotomy lobectomy and 14 patients who underwent VATS.

Data collection was conducted retrospectively from the electronic medical records of patients treated at Persahabatan General Hospital during the period January 2021 – December 2024, which were systematically reviewed. The variables collected included demographic characteristics (age, gender, and smoking history), preoperative clinical conditions (comorbidities, lung function, histopathological diagnosis, and cancer stage), intraoperative data (duration of surgery, blood loss, and need for blood transfusion), and postoperative clinical outcomes in the form of morbidity, in-hospital mortality, and length of stay.

The research instrument was a data collection sheet compiled based on the variables and operational definitions of the study. Data analysis was performed descriptively, with categorical data presented in the form of frequencies and percentages, while numerical data were presented as means and standard deviations or medians and ranges according to the characteristics of the data distribution. The results of the study were presented in tables and narratives to describe the clinical outcomes of lung cancer patients after lobectomy by thoracotomy and VATS.

III. RESULTS

Preoperative Characteristics and Clinical Conditions of Patients

A total of 49 lung cancer patients who underwent lobectomy at Persahabatan General Hospital between 2021 and 2024 met the inclusion criteria for this study. Of these, 35 patients underwent lobectomy using the thoracotomy method and 14 patients underwent video-assisted thoracoscopic surgery (VATS).

The characteristics and preoperative clinical conditions of the patients are shown in Table 1.

Table 1. The characteristics and preoperative clinical conditions of the patients

Variables		Thoracotomy (n = 35)	VATS (n = 14)
Sex	Male	18 (51.4)	6 (42.9)
	Female	17 (48.6)	8 (57.1)
Age group, n (%)	Early adulthood (18–39 years)	7 (20.0)	5 (35.7)
	Late adulthood (40–59 years)	18 (51.4)	9 (64.3)
	Early elderly (60–69 years)	8 (22.9)	0 (0)
	Late elderly (70–79 years)	2 (5.7)	0 (0)
Smoking history, n (%)	Yes	23 (65.7)	11 (78.6)
	No		
Preoperative comorbidities, n (%)	Diabetes mellitus	5 (14.3)	0 (0)
	Hypertension	10 (28.6)	3 (21.4)
	COPD	5 (14.3)	0 (0)
Preoperative pulmonary function, n (%)	Normal	28 (80.0)	11 (78.6)
	Mild ventilatory impairment	6 (17.1)	3 (21.4)
	Moderate ventilatory impairment	1 (2.9)	0 (0)
Cancer type, n (%)	Primary lung cancer	20 (57.1)	9 (64.3)
	Pulmonary metastasis	15 (42.9)	5 (35.7)

Description:

Patient age 23–73 years (mean 50 ± 12.2 years; median 54 years).

COPD = chronic obstructive pulmonary disease; VATS = video-assisted thoracoscopic surgery.

Most patients were in the late adult age group. The gender distribution was relatively balanced in both surgical groups. A history of smoking was found in the majority of patients, both in the thoracotomy and VATS groups. Comorbidities such as diabetes mellitus and chronic obstructive pulmonary disease (COPD) were only found in the thoracotomy group, while hypertension was found in both groups. The majority of patients had normal preoperative lung function. Based on cancer characteristics, most patients were diagnosed with primary lung cancer, with a higher proportion of lung metastases in the thoracotomy group. In this study, all primary lung cancers were non-small cell lung cancer (NSCLC), while the metastasis group originated from primary malignancies outside the lungs, such as malignancies originating from the breast, renal sarcoma, Hodgkin's lymphoma, liver, and colon.

Intraoperative Condition Overview

The intraoperative condition overview of patients undergoing lobectomy using thoracotomy and VATS methods is shown in Table 2.

Table 2. Intraoperative Condition Overview

Variables		Thoracotomy (n = 35)	VATS (n = 14)
Operative duration, n (%)	≤ 3 hours	13 (37.1)	12 (85.7)
	> 3 hours	22 (62.9)	2 (14.3)
Intraoperative blood loss, n (%)	≤ 275 mL	21 (60.0)	11 (78.6)
	> 275 mL	14 (40.0)	3 (21.4)

Variables		Thoracotomy (n = 35)	VATS (n = 14)
Blood transfusion, n (%)	Yes	12 (34.3)	2 (14.3)
	No	23 (65.7)	12 (85.7)

Description:
Duration of surgery 60–430 minutes (mean 203 ± 75 minutes; median 210 minutes).
Intraoperative blood loss 5–3000 mL (median 200 mL).
VATS = video-assisted thoracoscopic surgery.

The duration of surgery in the thoracotomy group was more often longer than 3 hours compared to the VATS group. Intraoperative blood loss tended to be greater in the thoracotomy group, with bleeding of more than 275 mL and the need for blood transfusions being more common than in the VATS group. Most patients undergoing VATS did not require blood transfusions during surgery.

Postoperative Morbidity and Mortality Clinical Outcomes

Postoperative morbidity and mortality clinical outcomes in lung cancer patients undergoing lobectomy by thoracotomy and VATS are shown in Table 3.

Table 3. Postoperative morbidity and mortalities

Variable		Thoracotomy (n = 35)	VATS (n = 14)
Post Operation Morbidity, n (%)	Yes	7 (20.0)	2 (14.3)
	No	28 (80.0)	12 (85.7)
Pulmonary, pleural, and/or bronchial complications (%)	Yes	3 (8.6)	1 (7.1)
	No	32 (91.4)	13 (92.9)
Cardiovascular complications, n (%)	Yes	2 (5.7)	0 (0)
	No	33 (94.3)	14 (100)
Systemic infection complications, n (%)	Yes	2 (5.7)	1 (7.1)
	No	33 (94.3)	13 (92.9)
Postoperative mortality, n (%)	Died	1 (2.0)	1 (2.0)
	Survived	34 (98.0)	13 (98.0)
Causes of mortality, n (%)			
Pulmonary, pleural, and/or bronchial complications, n (%)	Yes	0 (0)	0 (0)
	No	35 (100)	14 (100)
Cardiovascular complications, n (%)	Yes	0 (0)	1 (7.1)
	No	35 (100)	13 (92.9)
Systemic infection complications, n (%)	Yes	1 (2.9)	0 (0)
	No	34 (97.1)	14 (100)

Most patients in both groups did not experience postoperative morbidity, with a slightly higher proportion of patients without morbidity in the VATS group compared to the thoracotomy group. The most common types of morbidity were pulmonary, pleural, and/or bronchial complications, especially in the thoracotomy group. In the VATS group, the number of complications was relatively lower and no cardiovascular complications were found. The postoperative mortality rate in this study was low and showed a similar proportion between the thoracotomy and VATS groups. The majority of patients in both groups did not experience death during their hospital stay. Based on the cause, no deaths were due to pulmonary, pleural, or bronchial complications. One case of mortality in the VATS group was due to cardiovascular complications, while one case of mortality in the thoracotomy group was due to systemic infection complications.

Length of Hospital Stay

The distribution of postoperative hospital stay for patients undergoing lobectomy by thoracotomy and VATS is shown in Table 4.

Table 4. Length of Hospital Stay

Variable	Thoracotomy (n = 35)	VATS (n = 14)
≤ 7 days	17 (48.6)	11 (78.6)
> 7 days	18 (51.4)	3 (21.4)

In the thoracotomy group, the proportion of patients with a hospital stay of more than 7 days was slightly higher than that of patients with a hospital stay of 7 days or less. In contrast, in the VATS group,

most patients had a hospital stay of 7 days or less.

IV. DISCUSSION

Patient Characteristics and Preoperative Clinical Conditions

This study shows that thoracotomy is still the most commonly used method of lobectomy compared to video-assisted thoracoscopic surgery (VATS), reflecting the important role of the open approach in clinical practice at the service centre where the study was conducted. These findings are consistent with observational studies reporting that thoracotomy is more frequently chosen in patients with higher clinical complexity, such as large or centrally located tumours, advanced disease stage, and significant comorbidities, as it provides more optimal visualization and anatomical control[11].

However, these results do not fully reflect the global trend over the past five years, which shows an increase in the use of VATS, especially in early-stage lung cancer, along with evidence of benefits such as less postoperative pain, shorter hospital stays, and lower short-term morbidity[12]. These differences are likely influenced by the challenges of implementing VATS in developing countries, including a long learning curve, limited facilities and specialized instruments, the need for experienced surgical teams, as well as stricter financing considerations and case selection[13], [14]. Therefore, the distribution of surgical methods in this study reflects not only clinical preferences but also the readiness of the healthcare system and local thoracic surgery resources, so the study results need to be interpreted contextually and cannot be generalized broadly.

Patient characteristics indicate that most lung cancer patients undergoing lobectomy are in the adult to late adult age group, with a relatively balanced gender distribution. This pattern is consistent with lung cancer epidemiology reports showing an increase in incidence in the productive to advanced age groups due to the accumulation of risk factor exposure and a decline in lung physiological reserves[15]. A history of smoking was found in the majority of patients, confirming the role of smoking as a major risk factor for lung cancer. This finding is consistent with the report by Rahmadhaniah et al. (2019), which shows that most lung cancer patients in Indonesia have a history of smoking[9].

Comorbidities such as diabetes mellitus and chronic obstructive pulmonary disease (COPD) were only found in the thoracotomy group. This reflects the clinical selection process, where patients with more complex clinical conditions and higher perioperative risks tend to be selected for open surgical approaches to provide optimal intraoperative access and control. The literature states that COPD and metabolic comorbidities play an important role in determining the choice of lung resection method because they are associated with the risk of postoperative pulmonary complications[16], [17].

The majority of patients had preoperative lung function within normal limits, reflecting strict preoperative selection in accordance with recommendations that lobectomy should ideally be performed in patients with adequate lung function reserve to reduce the risk of postoperative complications[18]. In terms of cancer characteristics, the predominance of early to intermediate stage primary lung cancer indicates that most patients were in a phase of the disease that still allowed for curative resection.

In addition to age and gender, the preoperative clinical characteristics of patients in this study emphasize the importance of the selection process prior to lobectomy. The predominance of patients with lung function still within normal limits indicates that most patients underwent rigorous preoperative evaluation, in accordance with clinical practice recommendations that emphasize the role of lung function reserve in reducing the risk of postoperative complications. This indicates that the favorable clinical outcomes in this study reflect not only the success of the surgical technique, but also the quality of patient selection and preparation prior to surgery. Thus, the comparison of outcomes between thoracotomy and VATS in this study should be understood in the context of a selected patient population, rather than as representative of the entire spectrum of lung cancer patients.

Intraoperative Overview of Thoracotomy Lobectomy and VATS

In terms of intraoperative aspects, the longer duration of surgery in the thoracotomy group compared to VATS reflects the greater invasiveness and complexity of the procedure. Meta-analyses and observational studies report that minimally invasive approaches are generally associated with shorter operating times in

selected cases, although these differences are greatly influenced by anatomical complexity, tumor stage, and operator experience[11], [19].

The higher intraoperative blood loss and transfusion requirements observed in the thoracotomy group in this study are consistent with the literature, which indicates that VATS is associated with lower blood loss due to less tissue trauma and minimal chest wall dissection[20], [21]. However, in cases with high complexity or the presence of intrathoracic adhesions, these advantages may diminish, making the differences between approaches less pronounced[11].

The findings of differences in surgical duration, intraoperative bleeding, and blood transfusion requirements between the two surgical methods also reflect the different technical complexities during lobectomy procedures. In clinical practice, the thoracotomy approach is often chosen in cases with intrathoracic adhesions, larger tumors, or more complex anatomy, so it is reasonable that the intraoperative outcomes tend to be less favorable compared to VATS. Therefore, the differences in intraoperative conditions found in this study cannot be viewed solely as a direct effect of the surgical technique, but rather as a consequence of the characteristics of the cases and the clinical considerations underlying the choice of surgical method.

Postoperative Morbidity and Mortality Outcomes

Most patients in both groups did not experience postoperative morbidity, indicating that lobectomy is a relatively safe procedure when performed with appropriate patient selection. Although the proportion of patients without morbidity was slightly higher in the VATS group, the difference was relatively small and needs to be understood contextually.

Pulmonary and pleural complications were the most common types of morbidity, particularly in the thoracotomy group. The literature reports that chest wall trauma, postoperative pain, and respiratory mechanics disorders in thoracotomy contribute to an increased risk of pulmonary complications compared to VATS[6], [22]. On the other hand, the minimally invasive approach is considered to reduce systemic inflammatory responses and accelerate functional lung recovery, thereby reducing the risk of respiratory complications[19], [23].

However, registry-based studies show that after adjusting for age, comorbidities, preoperative lung function, and disease stage, the difference in morbidity rates between VATS and thoracotomy may become statistically insignificant[11]. This confirms that patient factors play a more dominant role than the surgical approach alone.

The low postoperative morbidity rates in both groups in this study may also reflect the implementation of optimal perioperative management, including pain management, respiratory physiotherapy, and strict postoperative monitoring. Variations in the definition and classification of morbidity between studies also influence the differences in complication rates reported in the literature. Therefore, the interpretation of morbidity rates in this study should focus on the clinical patterns that emerge, rather than on a comparison of absolute numbers alone. This approach is in line with the descriptive nature of the study, which is to describe the clinical outcomes of patients in real practice without concluding a cause-and-effect relationship.

The postoperative mortality rate in this study was low and similar in both surgical groups. The absence of deaths due to respiratory complications reflects advances in surgical techniques, anesthesia, and perioperative management in lobectomy procedures. Meta-analyses and large cohort studies report that post-lobectomy mortality is generally low and often shows no significant difference between VATS and thoracotomy[11].

The differences in causes of mortality found were cardiovascular complications caused by pulmonary embolism and systemic infection. This suggests that postoperative mortality is more influenced by the individual clinical condition of the patient and systemic factors than by the surgical technique itself. Other studies emphasize that the risk of cardiovascular events and severe postoperative infections after thoracic surgery is influenced by age, comorbidities, and perioperative inflammatory response[21].

The low and rare incidence of mortality after lobectomy found in this study is consistent with reports that postoperative mortality is a relatively rare outcome in selected lung cancer patients[11]. The very limited

number of mortality events also limits the ability of this study to make more in-depth comparative interpretations between the two surgical methods. Therefore, the similarity in mortality rates between the thoracotomy and VATS groups in this study is more appropriately understood as an indication of the safety of the procedures in a selected population, rather than as evidence of the clinical equivalence of the two surgical approaches in a broader context.

Length of Hospital Stay

The length of hospital stay after surgery in this study showed a tendency to be shorter in the VATS group compared to the thoracotomy group. This finding is in line with various reports stating that a minimally invasive approach can accelerate mobilization, reduce postoperative pain, and reduce the need for analgesics, thereby enabling faster recovery[19], [21].

In addition to surgical techniques, the implementation of the Enhanced Recovery After Surgery (ERAS) protocol has been reported to play an important role in reducing the length of hospital stay after lobectomy through the optimization of pain management, nutrition, and early mobilization[24]. However, observational studies indicate that length of hospital stay is also significantly influenced by postoperative complications, hospital policies, and facility readiness, so differences between approaches do not always reflect the superiority of surgical techniques alone[11].

The length of post-operative hospitalization is an outcome that is influenced not only by the patient's clinical condition and surgical technique, but also by factors related to the healthcare system. In national referral hospitals, patient discharge policies, availability of rehabilitation facilities, and the need for follow-up monitoring often contribute to variations in length of stay. Thus, the tendency for shorter length of stay in the VATS group in this study should be understood as the result of an interaction between clinical and systemic factors, rather than solely as a reflection of the technical superiority of the minimally invasive approach.

Overall, this discussion shows that the differences in clinical outcomes between thoracotomy and VATS lobectomy in this study need to be understood in the context of patient selection, disease complexity, and the perioperative management applied. The minimally invasive approach shows a tendency for better short-term outcomes in selected patients; however, the choice of lobectomy method should still be based on individual clinical evaluation without concluding the absolute superiority of one surgical technique over another.

V. CONCLUSION

This study shows that lobectomy using either thoracotomy or video-assisted thoracoscopic surgery (VATS) in lung cancer patients at Persahabatan General Hospital from 2021 to 2024 produces good clinical outcomes. The postoperative morbidity and mortality rates for both methods were low and relatively comparable, so both can be considered safe and effective surgical approaches in the management of lung cancer according to clinical indications.

Thoracotomy is more commonly used in patients with clinical complexity and more advanced disease stages due to its advantages in hemostasis control and intrathoracic visualization. Conversely, VATS is generally applied in selected patients with better physiological conditions and lower case complexity, and offers advantages such as shorter operating time, minimal intraoperative bleeding, and shorter hospital stay. However, these differences in clinical outcomes cannot be interpreted as an absolute advantage of one surgical method over the other, as the choice of lobectomy approach is greatly influenced by the patient's clinical condition, comorbidities, preoperative lung function, and disease complexity.

Limitation

This study has several limitations, including a retrospective design that could potentially cause selection bias, a limited sample size, and limited intraoperative technical data. Detailed information regarding the brand and type of VATS equipment, the number and level of experience of the surgical team, and variations in surgical techniques were not fully documented in the medical records, thereby limiting the inferential power of the study results. Therefore, prospective studies with larger sample sizes and more comprehensive intraoperative data recording are needed to strengthen the findings of this study.

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Conflict of Interest

The author declares that there are no conflicts of interest, either financial or non-financial, that could influence the conduct of the research, analysis of data, or writing of this manuscript. The entire research process was conducted independently and objectively in accordance with the principles of scientific research ethics.

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REFFERENCE

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