



# The Important of Forceps Biopsy in Bronchoscopy Procedures for Diagnosing Lung Cancer at Dr. H. Abdul Moeloek General Hospital, Lampung

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**Abstract.** Forceps biopsy is a crucial procedure in bronchoscopy aimed at obtaining tissue samples from the respiratory tract for diagnostic purposes. This study aims to identify the characteristics of forceps biopsy, bronchial brush, and bronchial washing in patients suspected of having lung cancer at Dr. H. Abdul Moeloek General Hospital. This descriptive retrospective study collected data from patient medical records of those who underwent bronchoscopy with forceps biopsy in April 2024. 24 patients meeting the inclusion criteria were selected. The chi-square test was used for statistical analysis. Results is 6 patients (25%) were diagnosed with lung cancer. Forceps biopsy showed a higher positive rate compared to bronchoscopy without forceps biopsy. The most common lesion locations were Right Upper Lobe, Right Middle Lobe, Right Lower Lobe, and Left Upper Lobe, each at 20%. Squamous cell carcinoma was the most commonly found type of cancer (4 patients). The statistic test showed no significant correlation between lung cancer and age ( $p=0.478$ ) or gender ( $p=0.586$ ), but a significant correlation with the use of forceps biopsy ( $p=0.046$ ). Bronchoscopy with forceps biopsy provides higher positive results in diagnosing lung cancer. This study underscores the importance of forceps biopsy in improving diagnostic accuracy at Dr. H. Abdul Moeloek General Hospital, Lampung.

**Keywords:** Forceps Biopsy, Bronchoscopy, Lung Cancer Diagnosis.

## INTRODUCTION

Lung cancer is one of the leading causes of cancer-related deaths worldwide (Thandra et al., 2021). Lung cancer remains a significant public health issue, being the leading cause of cancer-related deaths globally (Leiter et al., 2023). In the United States, it is estimated that approximately 234,580 new cases of lung cancer will be diagnosed in 2024, causing around

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125,070 deaths, including 65,790 men and 59,280 women (American Cancer Society, 2024; Lung Cancer Research Foundation, 2023). In Indonesia, lung cancer is a significant public health issue, with an estimated 34,000 new cases diagnosed each year and about 30,000 - 31,000 deaths from the disease annually (International Agency for Research on Cancer, 2022).

The prevalence of lung cancer is significantly higher among the older population, with most diagnoses occurring in individuals aged 65 or older (Ganti et al., 2021). The lifetime risk of lung cancer is about 1 in 16 for men and 1 in 17 for women (Smorodska et al., 2021). Additionally, lung cancer is characterized by lower survival rates compared to other cancers, contributing to its high mortality rate (J. Huang et al., 2022; Islami et al., 2015; Majeed et al., 2022). Therefore, effective procedures are needed to expedite the diagnosis and treatment of lung cancer.

Bronchoscopy is one of the most important diagnostic techniques for detecting lung cancer through direct visualization of the airways, and it can also obtain tissue samples for further analysis (Bachan & Khan, 2021; Gonzalez et al., 2022). One commonly used sampling method in bronchoscopy is forceps biopsy. Forceps biopsy is a technique where a special instrument, the biopsy forceps, is inserted through the bronchoscope to take small tissue samples from the airways or lungs (Giri et al., 2022; Yoon et al., 2022). This technique not only aids in the diagnosis of pulmonary malignancies but also enhances accuracy in identifying other pulmonary conditions (Giri et al., 2022).

The use of forceps biopsy during bronchoscopy has become prominent due to its effectiveness in obtaining tissue samples for histopathological evaluation (Giri et al., 2022). Integrating forceps biopsy into the bronchoscopy procedure allows for targeted sampling of suspicious lesions, thereby enhancing diagnostic outcomes (Valentini et al., 2019). The average diagnostic yield of forceps biopsy for central tumors is reported to be around 74%, with some studies showing higher rates, such as 78% in certain patient groups (Aktas et al., 2010a). Research indicates that combining endobronchial forceps biopsy with bronchoscopy techniques like bronchoalveolar lavage and brushing significantly increases the malignancy detection rate, with success rates reaching up to 97.3% (Simon et al., 2021a). This multifaceted approach is particularly beneficial in cases where lesions are difficult to access or when clinical presentation is ambiguous (Arya et al., 2021).

Forceps biopsy also plays an integral role in assessing disease severity and determining the most appropriate therapeutic options (Kemp, 2017). However, the safety profile of forceps biopsy must also be considered due to potential complications such as bleeding (Kemp, 2017). Although bleeding may occur, it is generally manageable and does not significantly impact the overall diagnostic process (Kemp, 2017). Although bleeding can occur, it is generally manageable and does not significantly affect the overall diagnostic process (Kemp, 2017). Additionally, forceps biopsy can differentiate between non-small cell lung cancer (NSCLC) and small cell lung cancer (SCLC) through biopsy specimens, emphasizing the importance of this method in guiding diagnostic decisions and therapy choices (Giri et al., 2022).

This study explored the crucial role of forceps biopsy in bronchoscopy procedures for lung cancer diagnosis, examining its prevalence, diagnostic efficacy, and implications for patient management within a statistical context. By analyzing literature and clinical data from medical records, this study illustrates the essential role of forceps biopsy in combating lung cancer.

## **SUBJECT AND METHOD**

This study uses a descriptive retrospective design by collecting data from the medical records of patients who underwent bronchoscopy with forceps biopsy at Dr. H. Abdul Moeloek General Hospital, Lampung, in April 2024. The study involved 24 patients suspected of having lung cancer and meeting the inclusion criteria, which are patients with clinical or radiological

suspicion of lung cancer who underwent fiberoptic bronchoscopy. Patients with incomplete medical records or those who did not undergo bronchoscopy were excluded from this study.

Fiberoptic bronchoscopy procedures were performed on all patients, and forceps biopsies were conducted on lesions identified during bronchoscopy. Additionally, bronchial brushes and bronchial washings were collected for further analysis. Data recorded included patient demographics such as age and gender, clinical data encompassing the indication for bronchoscopy and lesion location, and procedural details indicating whether forceps biopsy was performed. Pathology results obtained were then analyzed to determine the type of lung cancer diagnosed.

The statistical analysis used in this study was the chi-square test, performed using SPSS version 26 software. The analysis results will show significant correlations or lack thereof through a p-value of < 0.05.

## RESULTS

### Descriptive Statistics

This study examined data from 24 patients who underwent bronchoscopy procedures in April 2024 to detect the presence of cancer cells. The data were grouped based on the clinical characteristics of the patients. The following are the clinical characteristics of the patients:

Table 1: Clinical Baseline Characteristics

<i>Characteristics</i>	Positive Cancer (n=6)	Negative Cancer (n=18)
Gender		
Male	4 (66.7%)	9 (50%)
Female	2 (33.3%)	9 (50%)
Age		
<45 years	2 (33.3%)	4 (22.2%)
>45 years	4 (66.7%)	14 (77.8%)
Prosedur		
Without forceps	0 (0%)	8 (44.5%)
Forceps	6 (100%)	10 (55.5%)
Forceps + Brush	2 (33.3%)	0 (0%)
Forceps + Brush + Washing	4 (66.7%)	10 (55.5%)

Table 1 shows the basic clinical characteristics of the 24 subjects who underwent cancer detection using bronchoscopy. Of the total subjects, 54% were male and 46% were female. The majority of the subjects were over 45 years old (75%). Cancer detection was more frequently found in males (66.7%) and in subjects over 45 years old (66.7%). The most commonly used detection method was forceps (66.7%), with all positive cancer cases detected using this method, and a portion also using a combination of forceps, brush, and washing (66.7%).

The analysis shows that the distribution of cancer detection results is as follows:

Table 2: Distribution of Cancer Detection Results Using Bronchoscopy

<i>Characteristics</i>	n	%
Positive	6	25%
Negative	18	75%

Total	24	100%
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Table 2 shows the distribution of cancer detection results using bronchoscopy on 24 subjects or samples. Of the total, 6 subjects (25%) were detected positive for cancer, while the remaining 18 subjects (75%) were detected negative for cancer. This indicates that the majority of subjects examined, 75%, were not detected with cancer. Thus, bronchoscopy in this context shows positive detection results in a small portion of the subjects tested.

Based on the lesions found in the lungs with suspected lung cancer, as shown in the following table:

Table 3: Lesion Locations in Suspected Lung Cancer Patients

<i>Characteristics</i>	n	%
Right Main Bronchus	1	10%
Right Upper Lobe	2	20%
Right Middle Lobe	2	20%
Right Lower Lobe	2	20%
Left Main Bronchus	1	10%
Left Upper Lobe	2	20%
Lingula	0	0%
Left Lower Lobe	0	0%

The table above shows the distribution of lesion locations in patients suspected of having lung cancer. Of the total 10 patients, 20% of lesions were detected in the Right Upper Lobe, Right Middle Lobe, Right Lower Lobe, and Left Upper Lobe, with each location having 2 cases. Lesions were found in the Right Main Bronchus and Left Main Bronchus, each with 1 case, accounting for 10% each. No lesions were found in the Lingula and Left Lower Lobe. This data indicates that lesions in lung cancer patients are evenly distributed across several right and left lung lobes, with the highest prevalence in the right upper and middle lobes and the left upper lobe.

The biopsy results were tested cytologically and histopathologically to identify the disease at the cellular level. The following are the cytology and histopathology examination results:

Table 4: Cytology and Histopathology Examination Results

Type of Cell	Male (n=13)	Female (n=11)
Positive	4 (30.7%)	2 (18.1%)
Small Cell	0 (0%)	1 (9%)
Squamosa	4 (30.7%)	0 (0%)
Adenocarcinoma	0 (0%)	1 (9%)
Negative	9 (69.3%)	9 (81.9%)
Inflammatory Cells	7 (53.9%)	2 (18.1%)
Atypical Cells	2 (15.4%)	7 (63.9%)
Total	13 (54.1%)	11 (45.9%)

Table 4 shows the results of cytology and histopathology examinations in 24 subjects suspected of having lung cancer, with a breakdown based on gender. Among the positive results, men showed the highest prevalence in squamous cell type, with 30.7% of the total 13 men examined. On the other hand, in women, the most frequently detected cell types were small cell and adenocarcinoma, each at 9% of the total 11 women examined. The total positive cases of

lung cancer were 25%, with 6 out of 24 subjects detected with cancer showing a higher distribution in men compared to women.

Negative results showed that 75% of the total subjects did not detect lung cancer. Among the negative results, 53.9% of men had inflammatory cells, while in women, 63.9% showed atypical cells. These two cell types dominated the negative results in men and women evenly. The total distribution of subjects examined consisted of 54.1% men and 45.9% women, showing that negative results were more common in men (69.3%) compared to women (81.9%). The distribution of these examination results shows a variation in the types of cells detected between men and women, with a higher tendency for negative results in men in the category of inflammatory cells and in women in the category of atypical cells.

## Analysis of the Correlation Between Lung Cancer to Gender and Age

The initial correlation analysis conducted was a statistical chi-square test analysis to determine whether there is a significant correlation between two categorical variables. The variables of interest are lung cancer in relation to gender and age. Below are the data results from the chi-square analysis:

Table 5: Analysis of the Correlation Between Lung Cancer to Gender and Age

Characteristic	Lung Cancer		P value
	Positive	Negative	OR (95% CI)
Gender			
Male	4 (66,7%)	9 (50%)	0,478
Female	2 (33,3%)	9 (50%)	2 (0,29 - 13,76)
Age			
<45 years	2 (33,3%)	4 (22,2%)	0,586
>45 years	4 (66,7%)	14 (77,8%)	1,75 (0,23 - 8,05)

The table above shows the analysis of the correlation between lung cancer and gender and age. In the gender category, men have a prevalence of lung cancer at 66.7%, while women have a prevalence of 33.3%. This indicates that men are twice as likely to be detected with lung cancer compared to women; however, this correlation is not significant. Therefore, there is not enough evidence to state that gender affects the risk of lung cancer in this sample.

In the age category, subjects over the age of 45 have a lung cancer prevalence of 66.7%, while those under 45 have a prevalence of 33.3%. This indicates that subjects over 45 are 1.75 times more likely to be detected with lung cancer compared to those under 45; however, this correlation is also not significant. Thus, there is not enough evidence to state that age affects the risk of lung cancer in this sample.

## Analysis of the Correlation Between Lung Cancer and Bronchoscopy Procedure

The next analysis conducted was a chi-square statistical test to determine whether there is a significant correlation between the variables of lung cancer and the bronchoscopy procedure. Below are the results of the chi-square analysis:

Table 6: Analysis of the Correlation Between Lung Cancer and Bronchoscopy Procedure

Characteristic	Lung Cancer		P value OR (95% CI)
	Positive	Negative	
No forceps	0 (0%)	8 (44,5%)	0,046 17 (0,838 – 344,8)
Forceps procedure	6 (100%)	10 (55,5%)	
Forceps	0 (0%)	0 (0%)	
Forceps + brush	2 (33,3%)	0 (0%)	
Forceps + brush + washing	4 (66,7%)	10 (55,5%)	

The table above shows that there is a significant correlation between the type of bronchoscopy procedure ( $p = 0.046$ ; OR = 17; 95% CI = 0.838 – 344.8) used and the detection of lung cancer. The bronchoscopy procedure shows a very high odds ratio (OR), which means that patients undergoing this procedure have a much greater chance of being diagnosed with lung cancer compared to those who do not use forceps. This significant correlation underscores the importance of selecting the appropriate bronchoscopy procedure to enhance early detection of lung cancer and, ultimately, improve clinical outcomes for patients.

## DISCUSSIONS

### Distribution of Diagnostic Results Based on Patient Characteristics and Lesion Location

This study involved 24 samples, with 6 samples diagnosed with cancer and 18 without cancer. The gender distribution in the groups shows that among those with cancer, 4 were men (66.7%) and 2 were women (33.3%). In the non-cancer group, the gender distribution was 9 men (50%) and 9 women (50%). Overall, the combined sample consisted of 13 men (54%) and 11 women (46%). In the age distribution group, the data showed that of the 6 positive cancer samples, 4 samples (66.7%) were over 45 years old. Among the cancer-negative samples, the majority, 14 samples (77.8%), were also over 45 years old.

The distribution of biopsy results showed different patterns when grouped by age and gender. Older patients tended to have a higher incidence of lung cancer (Barta et al., 2019a). Age-related biological changes, such as decreased immune system function with aging, can increase vulnerability to cancer (Venuta et al., 2016). The median age of lung cancer diagnosis in older adults is around 70 years for both men and women, with the highest incidence in men at 585.9 per 100,000 in the 85-89 age group and in women at 365.8 per 100,000 in the 75-79 age group (Barta et al., 2019a; de Groot et al., 2018).

Lung cancer is the leading cause of death in men over 40 and women over 59. Conversely, lung cancer in younger ages is relatively rare, with about 10% of cases diagnosed in individuals under 55 years old (de Groot et al., 2018; Venuta et al., 2016). The incidence significantly decreases with age, reaching only 1.4% in those under 35 years old (Cavallo, 2023).

Gender is also an important factor in the diagnosis of lung cancer. Studies show that men have a higher risk of developing lung cancer compared to women (Patel & Dasika, 2024). In 2019, men were 23% more likely to be diagnosed with lung cancer than women, with an incidence rate of 59.2 per 100,000 population for men and 48.1 per 100,000 population for women (American Lung Association, 2020). The number of new lung cancer cases was higher in men than women across all racial groups from 2016-2020 (May et al., 2023). Besides gender and age, other factors also influence the prevalence of lung cancer, such as smoking history,

exposure to air pollutants, family history, and other medical conditions like chronic obstructive pulmonary disease (COPD) (American Lung Association, 2020).

This study presents the distribution of lesion locations in samples suspected of lung cancer. Of the total 10 detected lesions, 20% each were located in the right upper lobe, right middle lobe, right lower lobe, and left upper lobe. The right main bronchus and left main bronchus each recorded 10% of lesions. No lesions were found in the lingula and left lower lobe. This study shows that lung cancer lesions are more frequently found in the upper and middle lobes of both the right and left lungs.

The distribution of lesion locations in patients provides an overview of the prevalence of lung cancer in various parts of the lungs (Barta et al., 2019b). Lesions in the upper part of the lungs are associated with smoking history, while lesions in the lower part are generally found in individuals exposed to pollutants or other carcinogenic agents (Barta et al., 2019b). Data on lung cancer prevalence by lesion location indicate that tumors are most often found in the upper lobes of the lungs. A study analyzing 10,849 patients with a lung cancer diagnosis found that 62.3% of tumors were in the upper lobes, with the right upper lobe showing the highest prevalence (17.7%) compared to other lobes. Tumors in the lower lobes were less common, with the right lower lobe and left lower lobe each having lower prevalence.

## **Significant Correlation Between the Use of Forceps Biopsy and Lung Cancer Diagnosis**

The results of this study show a significant correlation between the type of bronchoscopy procedure used and the detection of lung cancer ( $p = 0.046$ ; OR = 17; 95% CI = 0.838 – 344.8). Bronchoscopy with forceps indicates that patients undergoing this procedure have a much greater chance of being diagnosed with lung cancer compared to those who do not use forceps. This significant correlation underscores the importance of bronchoscopy procedures in enhancing early detection of lung cancer, which ultimately improves clinical outcomes for patients.

The significant correlation between the use of forceps biopsy and lung cancer diagnosis highlights the impact of instrument choice on the accuracy and reliability of the diagnosis. Biopsy, a procedure where tissue samples are taken for examination, is crucial for confirming lung cancer (Sharma & Shepard, 2018). Various types of forceps biopsies are designed for specific tissues and procedures. The quality of tissue samples obtained can vary with the type of forceps used, affecting diagnostic outcomes (Modi & Uppe, 2023). Larger and intact samples can provide more accurate diagnoses and reduce the risk of false-negative results (Modi & Uppe, 2023).

Traditional forceps biopsy, such as flexible bronchoscopy with forceps biopsy, is a common method for diagnosing lung cancer, especially for visible endobronchial lesions (McLean et al., 2018). The diagnostic success rates of this method range from 72% to 88%, depending on various factors such as lesion size and location (Simon et al., 2021b). The size and location of lung lesions significantly affect the success of forceps biopsy. Larger lesions ( $\geq 20$  mm) are more likely to result in a successful diagnosis compared to smaller ones (Kurihara et al., 2022a). Studies have shown that certain types of forceps consistently yield better quality samples, leading to more accurate lung cancer diagnoses and fewer procedural complications (Moghazy et al., 2021).

## **Effectiveness and Risk Profile of Forceps Biopsy in Lung Cancer Diagnosis**

The effectiveness of forceps biopsy in improving lung cancer diagnosis is supported by various studies demonstrating significant accuracy, sample quality, and diagnostic outcomes. Research shows that the use of flexible bronchoscopic forceps for endobronchial biopsy provides more accurate diagnostic results (Kurihara et al., 2022b). Another study shows a correlation

between lung lesion size and forceps biopsy success, finding that lesions with a size of  $\geq 20$  mm have a diagnostic success rate of 90%, while lesions smaller than 20 mm have a success rate of about 70% (Kurihara et al., 2022b). Another study comparing the quality of samples taken using flexible bronchoscopic forceps versus rigid forceps showed that flexible bronchoscopic forceps yielded samples with better integrity, with 92% of samples being large and intact enough for pathological analysis, compared to 78% for rigid forceps (Fang et al., 2015; Shostak, 2018).

Direct visualization through bronchoscopy allows for more precise targeting of biopsies, with results indicating that forceps biopsy with direct visualization guidance increases diagnostic rates up to 88% (DiBardino et al., 2020). Forceps biopsy can provide faster diagnostic results, allowing for more timely and effective treatment planning (Andolfi et al., 2016). Another study found that 78% of patients were diagnosed with lung cancer using forceps biopsy, showing a strong correlation between forceps use and successful lung cancer diagnosis (Aktas et al., 2010b). However, compared to cryobiopsy, which achieves a diagnostic rate of 92.7%, forceps biopsy shows lower effectiveness (Aktas et al., 2010b). Collectively, these studies show that forceps biopsy is an effective method for enhancing lung cancer diagnosis, with high diagnostic accuracy, the ability to obtain quality samples, speed of results, and effectiveness in targeting visible lesions. Therefore, forceps biopsy plays a crucial role in the diagnosis and management of lung cancer.

Although it has positive potential in diagnosing lung cancer, forceps biopsy has a risk profile. One of the main risks is pneumothorax, which occurs when air enters the pleural cavity and causes the lung to partially or fully collapse (Y. Huang et al., 2014). The risk of pneumothorax after forceps biopsy is estimated to be around 2-4% (Y. Huang et al., 2014; Lessnau, 2023). Bleeding is another significant risk during and after forceps biopsy, with significant bleeding incidents reported at around 1-5% (Arya et al., 2020). Besides direct medical risks, the failure to obtain adequate tissue samples is a procedural risk that can lead to false-negative results and require additional procedures. This failure occurs in about 10-20% of forceps biopsy cases (Aktas et al., 2010b). Forceps biopsy may yield smaller samples that might not provide enough material for comprehensive molecular analysis (Aktas et al., 2010b). While forceps biopsy is an important diagnostic procedure in lung cancer management, considering various risk factors for careful prevention and monitoring during and after the procedure can reduce the incidence of complications.

## **Research Limitations and Recommendations for Future Research**

This study has several limitations, including a limited sample size that may reduce the statistical power and representativeness of the results, making the findings not generalizable to a wider population. Additionally, the retrospective study design, which relies on medical record data, has risks of incomplete data and lacks control over unmeasured variables. To address these limitations, it is recommended that future research involves a larger sample size and uses a prospective design to ensure more complete and controlled data collection. Multicenter studies involving various hospitals are also recommended to obtain more diverse data and enable comparisons, making the results more generalizable. Furthermore, measuring other risk factors such as smoking history, exposure to air pollution, and other medical conditions should be considered in future research to provide a more comprehensive picture of the factors influencing lung cancer diagnosis outcomes.

## **CONCLUSIONS**

This study highlights the critical role of forceps biopsy in bronchoscopy procedures for diagnosing lung cancer at Dr. H. Abdul Moeloek General Hospital, Lampung. The findings



indicate that the use of forceps biopsy significantly enhances the detection of lung cancer compared to procedures without forceps. Specifically, the study shows a significant correlation between the bronchoscopy procedure type and lung cancer detection, emphasizing the importance of forceps biopsy in obtaining accurate diagnostic results. The analysis of patient characteristics and lesion locations reveals that older patients and men have higher incidences of lung cancer. However, the correlation between lung cancer with gender and age was not statistically significant in this study.

Forceps biopsy was shown to be effective, yielding high-quality tissue samples necessary for accurate histopathological evaluation. It outperformed other methods in diagnostic success rates, particularly for larger lesions ( $\geq 20$  mm), which had a 90% success rate. Nevertheless, forceps biopsy has associated risks, including pneumothorax and bleeding, which need to be carefully managed. Lesions were most frequently found in the upper and middle lobes of the lungs, which aligns with other studies linking these locations to smoking and other carcinogenic exposures.

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