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Bronchial Washing Yield Before And After Forceps Biopsy In Patients With Endoscopically Visible Lung Tumors

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ABSTRACT

Introduction: Different factors, including tumor size and location and the operator's level of expertise, can affect the diagnostic yield of bronchial washing both before and after forceps biopsy in patients showing endoscopically evident lung tumors. The current study aimed to compare the diagnostic yield of bronchial washing conducted before and after forceps biopsy in patients presenting with visible lung tumors during endoscopy.

Materials and methods: A prospective study was carried out on 50 patients with endoscopically visible tumors in Shar teaching hospital and endoscopic units of Smart and Baxshin hospitals over a period of 18 months. The patients were divided into a bronchial washing before forceps biopsy (pre-biopsy) group and a biopsy group. Bronchial washing and forceps biopsy were performed under cytological and histopathological analysis respectively. The collected data were analyzed using SPSS (24.0).

Results: The patients' mean age was 72.06 years, ranging from 50 to 99 years. Most of the patients (72%) were males, and 28% were females. The main complaint was reported to be chronic cough (56%), followed by dyspnea (20%), and hemoptysis (12%). CXR was abnormal in 76% of them. Their mass size ranged from 3 to 7 cm. The most frequent previous medical history was hypertension (20%), followed by ischemic heart disease (14%). Most of the endobronchial lesions (80%) were tumorous, and 14% were infiltrative. Pre-BW and post-BW were positive in 42% and 46% of the patients, respectively. Also, 44% of the lesions were squamous, 36% were adeno, and 16% were SCLC. A significant difference was seen between the pre-BW and post-BW (p-value<0.001). No significant relationships were seen between the morphology of endobronchial lesions and pre-BW and post-BW (p-value>0.05). Moreover, biopsy of the endobronchial lesions was not significantly correlated with pre-BW and post-BW (p-value>0.05).

Conclusion: As suggested by the results of the current study, bronchial washing before forceps biopsy (pre-biopsy) and bronchial washing after forceps biopsy (post-biopsy) do not have a significant effect on the yield of the diagnostic outcomes.

Keywords: bronchial washing yield, forceps biopsy, lung tumor, cytological and histopathological analysis

INTRODUCTION

Bronchial washing is a clinical procedure utilized for the retrieval of cellular samples from the respiratory passages that connect to the lungs. This technique necessitates the use of a bronchoscope, which is a pliant and slender instrument outfitted with a light and a lens to facilitate visualization, to navigate through the nasal or oral cavity and into the lungs (Rao et al., 2014). The process of bronchial washing involves the gentle irrigation of the airway surface with a saline solution, which is then collected and examined under a microscope. This technique is commonly employed for the purpose of identifying infections, as well as for detecting potential cancerous or pre-cancerous cellular changes (Roncarati et al., 2020). The technique of bronchial washing entails irrigating the bronchial system with a saline solution in order to obtain cells and secretions for subsequent microscopic analysis. In contrast, forceps biopsy involves the use of a specialized instrument to extract a small tissue sample from the tumor for further scrutiny (Schramm et al., 2021).

Empirical evidence has shown that the application of both diagnostic techniques, in conjunction, can result in a diagnostic yield exceeding 90% in patients with observable lung cancers during endoscopy. Consequently, it has been demonstrated that the utilization of both techniques in combination outperforms the diagnostic accuracy of either technique used in isolation (Patil et al., 2023). Among the diagnostic procedures conducted through bronchoscopy, forceps biopsy stands out for enhancing the diagnostic yield by almost 95%. In contrast, the diagnostic yield associated with bronchial washing for lung cancers featuring visibly observable tumors during endoscopy ranges widely from 45% to 85%, and generally falls below that achieved by forceps biopsy (Xia et al., 2023). The necessity of coupling bronchial washing with forceps biopsy has been a topic of debate. Several studies have indicated that the addition of bronchial washing can augment the overall diagnostic yield by up to 25%, when compared to relying solely on forceps biopsy. Specifically, certain investigations have reported a substantial increase in diagnostic yield by incorporating bronchial washing alongside forceps biopsy. Conversely, other studies have found no significant improvement in the overall diagnostic yield by employing bronchial washing in conjunction with forceps biopsy (Wang et al., 2023).

The diagnostic yield of bronchial washing, both prior to and following forceps biopsy, in patients exhibiting endoscopically evident lung tumors may be subject to variations stemming from a range of factors, including tumor size and location, as well as the operator's level of expertise. Nonetheless, in broad terms, bronchial washing performed prior to forceps biopsy may yield higher diagnostic results compared to bronchial washing carried out after forceps biopsy (Zhang et al., 2021). A study was conducted to determine the most effective sequence for conducting bronchial brushing and forceps biopsy in diagnosing lung cancer. The study discovered that bronchial brushing produces a diagnostic yield ranging from 52% to 77% for tumors observed during endoscopy, which is not significantly more effective than biopsy alone. It is plausible that the effectiveness of brushing may be contingent on its placement in the sequence, either before or after biopsy, although this aspect has not been thoroughly researched. Another study investigating the optimal washing sequence, either prior to or following biopsy, found no discernible difference in diagnostic yield between the two sequences of steps (Sun et al., 2015).

Chen et al. (2022) conducted a study that revealed that pre-biopsy washing and post-biopsy washing exhibited comparable levels of sensitivity for nearly 50% of infective lesions, while providing limited data for other diagnoses on account of the characteristics of the lesions. Although post-biopsy washing exhibited greater sensitivity than pre-biopsy washing, both methods demonstrated equivalent sensitivity in all transbronchial biopsy-negative lesion samples in the subgroup analysis. This same conclusion was corroborated by Dionísio's research (2012) on the sensitivities of pre-biopsy and post-biopsy washing in transbronchial biopsy-negative tumor lesions. In addition to the ongoing debate surrounding the utility of bronchial washing, various other elements of this methodology, such as the ideal quantity of saline to be administered and the appropriate timing of the procedure in relation to biopsy or brushing, have yet to be definitively established. The majority of bronchoscopists collect washing samples in a seemingly arbitrary sequence in accordance with their own personal preferences (Lim et al., 2020). In theory, it is conceivable that the diagnostic yield of bronchial washing could be elevated subsequent to forceps biopsy or brushing, as these techniques may prompt the shedding of additional malignant cells from the tumor into the washing samples. Nonetheless, this hypothesis was not substantiated by a recent investigation carried out by Hogea et al. (2023), in which bronchial washing was conducted both before and after biopsy or brushing in all patients.

It is crucial to acknowledge that bronchial washing and forceps biopsy are complementary techniques that ought to be employed in conjunction to optimize the diagnostic yield in patients exhibiting observable lung tumors during endoscopy. The output of these procedures, combined with other diagnostic evaluations such as imaging and laboratory tests, can facilitate the diagnosis and treatment of lung cancer (Hou et al., 2016). The objective of this study was to compare the diagnostic yield of bronchial washing conducted before and after forceps biopsy in patients presenting with visible lung tumors during endoscopy.

MATERIALS AND METHODS

The present multicenter prospective study was carried out in Shar teaching hospital and Smart and Baxshin endoscopic units over a period of 14 months. The study sample consisted of 50 patients who were diagnosed with endoscopically visible tumors. The patients were chosen based on some inclusion criteria, including adult patient above 18 years old, those with mass or suspected lesion on CT chest, and those with endoscopically visible mass within bronchial tree. However, those who were below 18 years of age, those with previous dx BGC, and those with mucosal changes and external compression were excluded from the study. The patients were randomly assigned into a bronchial washing before forceps biopsy (pre-biopsy) group and a bronchial washing after forceps biopsy (post-biopsy) group. Bronchial washing and forceps biopsy were performed under cytological and histopathological analysis respectively. The data collected from the patients' medical profiles and from the examinations were analyzed through Statistical Package for Social Sciences (SPSS version 24.0). For this purpose, both descriptive and inferential statistical tests were utilized. A p-value of <0.05 was regarded statistically significant.

RESULTS

The results demonstrated that of the 50 patients, 17 (34%) aged 70 to 79, 12 (24%) were 60 to 69 years old, 11 (22%) were 80 to 89, 8 (16%) were 50 to 59, and 2 (4%) were 90 to 99. Their mean age was found to be 72.06 years. Regarding their smoking habit (pack-year = PY), it was seen that it was 30 – 50 in 56% of them and 50 – 120 in 18% of them (See Table 1).

Table 1. The patients' age and smoking habit

	Frequency (N)	Percentage (%)
Age group		
Mean± Std (72.06 ± 10.27)	**Min – Max (52.0 - 93.0)**	
50 - 59	8	16.0
60 - 69	12	24.0
70 -79	17	34.0
80 - 89	11	22.0
90 - 99	2	4.0
Total	50	100.0
Smoking habit PY		
Mean± Std (37.0 ± 26.29)	**Min – Max (30 - 120.0)**	
None	13	26.0
30 - 50	28	56.0
50 - 120	9	18.0
Total	50	100.0

Regarding the patients' age group, the results showed that 34% were 70 to 79 years old, 24% were 60 to 69, 22% were 80 to 89, 16% were 50 to 59, and 4% were 90 to 99 (See Figure 1).

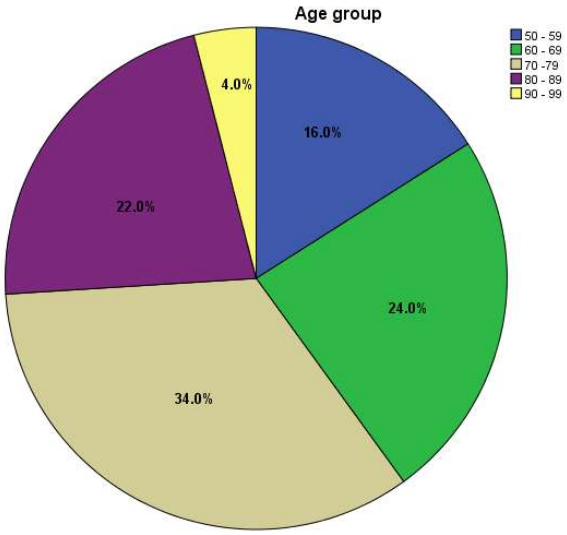

Figure 1. The patients' age groups

The results showed that most of the patients (72%) were males, and 28% were females. Regarding their occupation, most of them (58%) were retired, 22% were workers, 18% were housewives, and 2% were employees. Chronic cough was the most frequent complaint (56%), followed by dyspnea (20%), hemoptysis (12%), cough (8%), and productive cough (4%). The CXR results showed that most of them (76%) had abnormal conditions. Regarding their mass size, CT scan results showed that it was 5 to 7 in 28% of them, over 7 in 24%, 3 to 5 in 22%, and below 3 in 10%. Regarding their previous medical history, 20%

had hypertension (HTN), 14% had ischemic heart disease (IHD), 12% had diabetes mellitus (DM), 4% had both DM and hypertension (HTN), 2% had chronic lung disease (CLD), 2% had chronic obstructive pulmonary disease (COPD), and 2% had rheumatoid arthritis (RA). However, 40 had no previous medical history (See Table 2).

Table 2. The patients' age, job, main complaint, CXR, mass size, and medical history

	Frequency (N)	Percentage (%)
Gender		
Male	36	72.0
Female	14	28.0
Total	50	100.0
Occupation		
Retired	29	58.0
Housewife	9	18.0
Worker	11	22.0
Employee	1	2.0
Total	50	100.0
Main complaint		
Productive cough	2	4.0
Dyspnea	10	20.0
Chronic cough	28	56.0
Cough	4	8.0
Hemoptysis	6	12.0
Total	50	100.0
CXR		
Abnormal	38	76.0
None	12	24.0
Total	50	100.0
CT Mass Size		
< 3	5	10.0
3 - 5	11	22.0
5 - 7	14	28.0
> 7	12	24.0
None	4	8.0
Collapse	3	6.0
Suspect	1	2.0
Total	50	100.0
Previous Medical History		
None	20	40.0
CLD	1	2.0
IHD COPD	1	2.0
Negative	1	2.0
IHD	7	14.0
DM	6	12.0
COPD	1	2.0
Hypertension (HTN)	10	20.0

DM and HTN	2	4.0
RA	1	2.0
Total	50	100.0

Morphological analysis of the lesions showed that most of them (80%) were tumorous, followed by infiltrative (14), tumorous and necrosis (2%), submucosal (2%), and fungating (2%). Regarding their locations, 26% of them were located in right lower lobe (RLL), 22% in left upper lobe (RUL), 20% in left lower lobe (RLL), 20% in right upper lobe (RUL), 10% in RIGHT MIDDLE LOBE (RML), and 2% in RMB. Pre-biopsy bronchial wash (pre-BW) was positive in 21 patients (42%), and post-biopsy bronchial wash (post-BW) was positive in 23 patients (46%). Biopsy results showed that 44% of the cases were squamous, 36% were adeno, 16% were SCLC, 2% were acinar, and 2% were none (See Table 3).

Table 3. Morphology and biopsy of the endobronchial lesions

	Frequency (N)	**Percentage (%)**
Morphology of endobronchial lesion		
Tumorous	40	80.0
Tumorous and Necrosis	1	2.0
Infiltrative	7	14.0
Submucosal	1	2.0
Fungating	1	2.0
Total	50	100.0
Location		
Right upper lobe (RUL)	10	20.0
Left lower lobe (RLL)	10	20.0
Left upper lobe (RUL)	11	22.0
Right lower lobe (RLL)	13	26.0
Right middle lobe (RML)	5	10.0
RMB	1	2.0
Total	50	100.0
Pre-BW		
Positive	21	42.0
Negative	29	58.0
Total	50	100.0
Biopsy		
Adeno	18	36.0
SCLC	8	16.0
Squamous	22	44.0
Acinar	1	2.0
None	1	2.0
Total	50	100.0
Post-BW		
Positive	23	46.0
Negative	27	54.0
Total	50	100.0

The results of analyzing the morphology of the endobronchial lesions revealed that most of them (80%) were tumorous, 14% were infiltrative, 2% were tumorous and necrosis, 2% were submucosal, and 2% were fungating (See Figure 2)

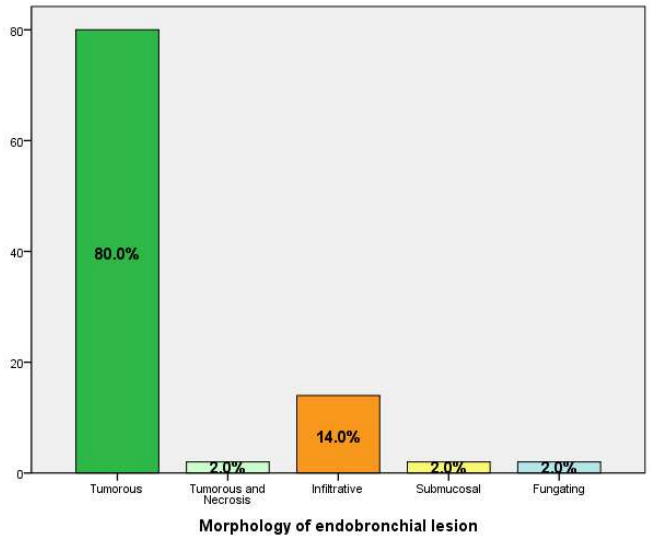

Figure 2. The results of morphological analysis of the endobronchial lesions

Regarding the location of the endobronchial lesions, the results showed that 26% of them were located in right lower lobe (RLL), 22% in left upper lobe (RUL), 20% in left lower lobe (RLL), 20% in right upper lobe (RUL), 10% in right middle lobe (RML), and 2% in RMB (See Figure 3).

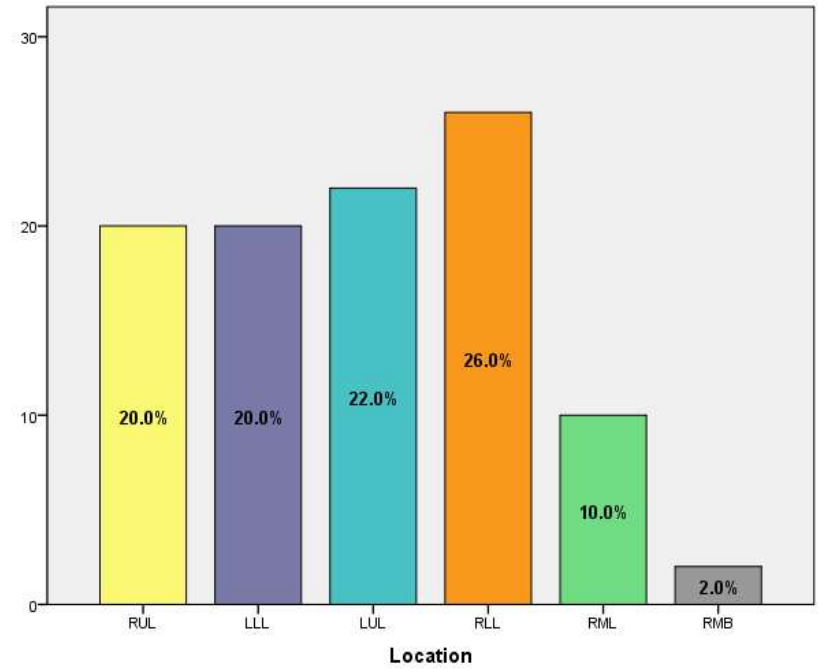

Figure 3. The location of the endobronchial lesions

The biopsy results indicated that 44% of the cases were squamous, 36% were adeno, 16% were SCLC, 2% were acinar, and 2% were none (See Figure 3).

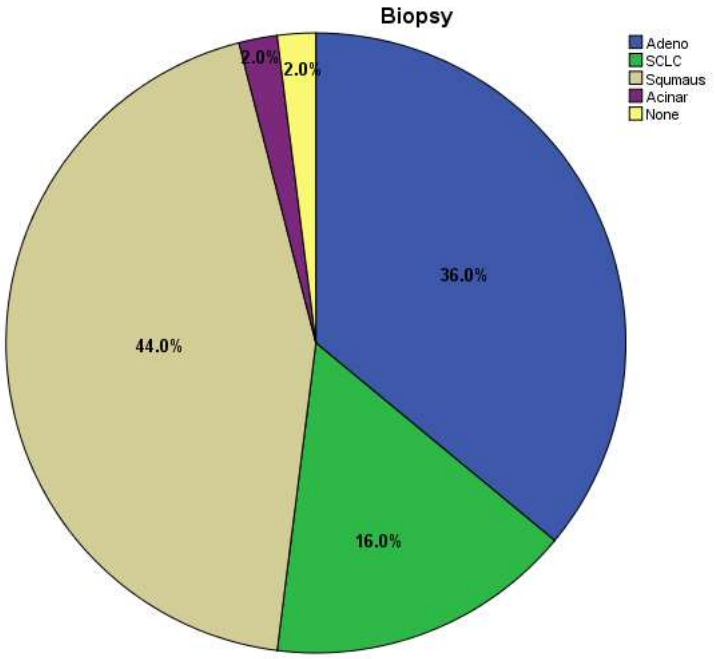

Figure 3. Biopsy results

Comparison between pre-biopsy bronchial wash (pre-BW) and post-biopsy bronchial wash (post BW) revealed that there was a statistically significant difference between them (p-value<0.001) (See Table 4).

Table 4. Comparison between pre-BW and post BW

Pre-BW * Post-BW		Post-BW		Total	P-Value
		Positive	Negative		
Pre-Bw	Positive	17(73.9)	4(14.8)	21(42.0)	<0.001
	Negative	6(26.1)	23(85.2)	29(58.0)	
Total		23(100.0)	27(100.0)	50(100.0)	

The results indicated that there were no significant relationships between the morphology of endobronchial lesions and pre-BW and post-BW (p-value>0.05) (See Table 5).

Table 5. Relationship between the morphology of endobronchial lesions and pre-BW and post-BW

		Morphology of endobronchial lesion					Total	p-Value
		Tumorous	Tumorous and Necrosis	Infiltrative	Submucosal	Fungating		
Pre-BW	Positive	19(47.5)	0(0.0)	2(28.6)	0(0.0)	0(0.0)	21(42.0)	0.757

	Negative	21(52.5)	1(100.0)	5(71.40	1(100.0)	1(100.0)	29(58.0)	
Total		40(100.0)	1(100.0)	7(100.0)	1(100.0)	1(100.00	50(100.0)	
Post-BW	**Positive**	21(52.5)	1(100.0)	1(14.3)	0(0.0)	0(0.0)	23(46.0)	0.08
	Negative	19(47.5)	0(0.0)	6(85.7)	1(100.0)	1(100.0)	27(54.0)	
Total		40(100.0)	1(100.0)	7(100.0)	1(100.0)	1(100.00	50(100.0)	

According to the results, biopsy of the endobronchial lesions was not significantly correlated with pre-BW and post-BW (p-value>0.05) (See Table 6).

Table 6. Relationship between biopsy of endobronchial lesions and pre-BW and post-BW

		Biopsy					**Total**	**P-Value**
		Adeno	**SCLC**	**Squamous**	**Acinar**	**None**		
Pre-Bw	**Positive**	6(33.3)	4(50.0)	10(45.5)	1(100.0)	0(0.0)	21(42.0)	0.6
	Negative	12(66.7)	4(50.0)	12(54.5)	0(0.0)	1(100.0)	29(58.0)	
Total		18(100.0)	8(100.0)	22(100.0)	1(100.0)	1(100.00	50(100.0)	
Post-BW	**Positive**	5(27.8)	4(50.0)	14(63.6)	0(0.00	0(0.0)	23(46.0)	0.09
	Negative	13(72.2)	4(50.0)	8(36.4)	1(100.0)	1(100.0)	27(54.0)	
Total		18(100.0)	8(100.0)	22(100.0)	1(100.0)	1(100.00	50(100.0)	

DISCUSSION

The effectiveness of using bronchial washing as a diagnostic tool for visually detectable lung cancers during endoscopy is a subject of debate. Certain individuals argue against its use, citing cost and time constraints without significant improvements in diagnostic yield. On the other hand, others disagree and present evidence of improved diagnostic accuracy compared to relying solely on forceps biopsy, suggesting that it may even be cost-effective. However, some scholars question the value of bronchial washing, pointing out that it may result in inefficient spending without clearly enhancing cancer detection. These critics argue for the need for more evidence to support its inclusion in diagnostic protocols, particularly when combined with

other sampling methods (Carvalho et al., 2017; Roncarati et al., 2020). The present study's findings indicated that the majority of patients in the cohort were between the ages of 70 and 79, with an average age of 72.06. Smoking habits were also evaluated, revealing that more than half of the patients smoked 30-50 packs of cigarettes per year, while 18% had a smoking history of 50-120 packs per year, indicating varying levels of smoking exposure within the group.

According to emerging researchers, smoking represents a significant risk factor in the development of lung cancer. The duration and intensity of smoking contribute to an elevated likelihood of developing this condition. Carcinogenic substances found in cigarette smoke have the potential to harm the lung's epithelial cells, consequently fostering tumor growth. It is worth highlighting that lung cancer can also manifest in individuals who have never smoked or been extensively exposed to secondhand smoke. Regrettably, there is a paucity of research pertaining to the impact of smoking on forceps biopsy outcomes in patients presenting with visually detectable lung tumors (Endalie et al., 2023).

This retrospective investigation examined the demographic and clinical profiles of 100 individuals diagnosed with lung cancer and subsequently referred for surgical assessment. The majority of patients were male smokers, frequently presenting with persistent coughing. More than 70% exhibited abnormal findings on chest radiography, while computed tomography scans revealed that nearly half of the cohort had masses larger than 5 cm. Approximately half of the patients had comorbidities, including hypertension, heart disease, and diabetes, although 40% had no prior medical history. These characteristic distributions offer valuable insights into factors influencing surgical candidacy and post-operative outcomes within this population. In a related study, Stanzel et al. (2013) recommended selecting the area with the most prominent abnormality observed on chest radiographs or CT scans as the preferred site for bronchial washing in patients exhibiting substantial radiographic heterogeneity or localized lesions due to inflammatory infiltrates, malignant growths, or other causes. Some researchers advocate performing bronchial washing at two or three different sites to enhance sample representation.

The analysis of the morphological features revealed that a majority of the observed lesions were tumorous in nature, predominantly located in the lower lobes of the lungs. Bronchial washing, performed both before and after biopsy procedures, resulted in positive cytology findings in approximately half of the cases. Histopathological examination further identified squamous cell carcinoma as the most prevalent subtype, followed by adenocarcinoma, with small cell lung cancer accounting for 16% of the cases. These findings provide valuable insights into the morphological and histological characteristics of the lung tumors within this particular group of patients. Further exploration and discussion could focus on the implications of these findings for diagnostic approaches and clinical management. In a study conducted by Lee et al. (2020), the impact of lung tumors located in the lower lobes on patient outcomes was investigated. The findings indicated that lower lobe cancer was associated with higher overall mortality in lung cancer patients, potentially due to lower rates of beneficial epidermal growth factor receptor mutations. The location of these tumors in the lower lungs may therefore contribute to poorer prognoses, particularly in cases of endobronchial lesions. In a separate study, ALQudah et al. (2021) reported an increased prevalence of lung cancer cases with advancing age and in individuals with a history of smoking. Histopathologically, this type of cancer encompassed more than half of the cases, followed by squamous cell carcinoma and neuroendocrine tumors in both males and females.

The outcomes of the study demonstrated that the predominant morphology of endobronchial lesions was tumorous, accounting for 80% of the cases, followed by an infiltrative pattern observed in 14% of the lesions. Uncommon morphologies, including tumorous necrosis, submucosal features, and a fungating appearance, were also detected, suggesting a diverse range of growth presentations within the analyzed cohort. These distributions raise important points for discussion regarding the implications for diagnostic and therapeutic strategies. In line with these findings, a study conducted by Biciuşcă et al. (2022) reported that the majority of endobronchial lesions exhibited a tumorous morphology. However, infiltrative patterns, as well as less common characteristics such as necrosis, submucosal involvement, and fungating features, were also observed in some patients. This highlights the heterogeneity in the morphological characteristics of the lesions. Considering this diversity, it is necessary to further examine how specific growth presentations might impact diagnostic evaluations and treatment planning approaches in order to optimize patient outcomes.

Additionally, our findings indicated that the distribution of lesion locations revealed a higher prevalence in the lower lobes, with the right lower lobe being the most frequently affected at 26%. The left upper lobe and both lower lobes each accounted for 20% of cases, while the right sites exhibited slightly higher overall involvement. Less frequent involvement was observed in the right middle lobe and right main bronchus. These results align with the findings reported by Xie et al. (2022).

Based on the findings of the present study, which provide valuable insights into the diagnostic characteristics of the lesions, squamous cell carcinoma emerged as the most prevalent histological type, followed by adenocarcinoma and small cell lung cancer. While there were significant differences between pre-biopsy and post-biopsy bronchial wash cytology, no correlation was observed between the morphology and biopsy features of the lesions and the yield of the wash. This has implications for the use of flexible bronchoscopy techniques. Although washing enhanced detection compared to biopsy alone, the appearance, size, or location of the lesion did not influence the performance of the wash or biopsy. Further investigation is necessary to

optimize diagnostic modalities, such as exploring the sequence of obtaining samples or integrating multiple techniques. Understanding the relationships among these findings may assist in tailoring flexible bronchoscopy protocols to maximize diagnostic accuracy and improve clinical decision-making. In a similar study, Hou et al. (2016) reported a diagnostic yield of 52-77% for bronchial brushing in endoscopically visible tumors, which was not significantly superior to the yield achieved with biopsy alone. It is possible that the efficacy of brushing may depend on the order in which it is performed relative to the biopsy, although this aspect has not been extensively studied. However, another study examining the optimal sequence of washing before or after the biopsy found no significant difference in the diagnostic yield between the two sequences (Lim et al., 2020).

A study conducted by Rao et al. (2014) demonstrated that bronchial wash cytology has low sensitivity in the detection of pulmonary lesions. However, it can still provide value for patients who have contraindications for biopsy. In situations where biopsy is not feasible, morphometry can serve as a useful adjunct to cytomorphology. Interestingly, the study by Hou et al. (2016) revealed that pre-biopsy brushings outperformed post-biopsy brushings in diagnosing exophytic tumors, which contrasts with the findings of Chaudhary's study on the sequencing of bronchial washing and biopsy. Chaudhary's study suggested that post-biopsy washing yielded higher diagnostic rates. Consistent with the results of the current investigation, Huang et al. (2019) reported that besides the choice of diagnostic modalities and tools, the details of the bronchoscopic procedures could impact their diagnostic yield. According to their study, whether bronchial washing was performed before or after the endobronchial biopsy did not affect the diagnostic yield of either procedure.

CONCLUSION

The present study examines the diagnostic effectiveness of bronchial washing in cases of endoscopically visible lung cancers. There is ongoing debate regarding the inclusion of bronchial washing in diagnostic protocols due to concerns about its cost, time requirements, and limited improvement in detection rates. However, contrasting arguments suggest that bronchial washing can enhance diagnostic outcomes when used in conjunction with forceps biopsy and may yield potential cost savings. Nevertheless, some scholars question the value of bronchial washing, as they argue that it represents inefficient use of resources without clear evidence of improved detection rates compared to sampling alone. The study analyzed the demographic and clinical characteristics of a cohort of 50 lung cancer patients who were referred for diagnosis. The majority of patients were males with chronic coughs. More than 70% of the patients had abnormal chest radiography results, and computed tomography revealed that nearly half of them had masses larger than 5 cm. Morphological evaluation indicated that the majority of the lesions were tumoral in nature, with a higher frequency in the lower lung lobes. Bronchial washing produced positive cytology results in approximately half of the cases, both before and after biopsy procedures. Histopathological examination identified squamous cell carcinoma as the most common subtype, followed by adenocarcinoma, while small cell lung cancer accounted for 16% of the cases. The study provides valuable insights into the diagnostic features of these lesions, yet further investigation is necessary to optimize diagnostic modalities.

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