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Role of Bronchoscopy in Suspected Cases of Lung Malignancies at Tertiary Care Center

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Abstract: ***Background**: Bronchoscopy is a key diagnostic procedure for evaluating suspected lung malignancies, allowing direct visualization of the tracheobronchial tree and acquisition of tissue samples for pathological diagnosis. **Objectives**: To assess the diagnostic role of bronchoscopy in patients with suspected lung malignancy and evaluate the diagnostic yield of various bronchoscopic procedures in a tertiary care center. **Methods**: This hospital-based observational study was conducted at a tertiary care teaching hospital which included 88 patients with clinical and/or radiological suspicion of lung malignancy. Demographic characteristics, smoking history, clinical presentation, radiological findings, bronchoscopic findings, procedure-specific diagnostic yields, histopathological diagnoses, and final diagnostic outcomes were analyzed. Bronchoscopic procedures included bronchoalveolar lavage (BAL), endobronchial biopsy (EBB), transbronchial lung biopsy (TBLB), transbronchial needle aspiration (TBNA), and brush cytology. **Results**: The mean age of participants was 48.98 ± 17.10 years, with most patients belonging to the 61-70 year's age group. Current or former smokers constituted 77.3% of the study population. CT thorax commonly demonstrated central masses (31.8%) and peripheral lesions (30.7%). Bronchoscopy established a malignant diagnosis in 58 patients (65.9%), while 15.9% had benign findings and 18.2% were inconclusive. Mucosal abnormalities showed a significant association with bronchoscopic diagnostic outcomes (p=0.023). Among bronchoscopic techniques, brush cytology demonstrated the highest malignant yield (61.5%), followed by TBLB (56.0%) and EBB (50.0%). Squamous cell carcinoma was the most common histopathological subtype (55.2%). Subsequent investigations identified additional malignancies, increasing the overall confirmed malignancy rate to 79.5%. **Conclusion**: Bronchoscopy is a safe, effective, and indispensable first-line diagnostic modality for suspected lung malignancy, providing high diagnostic yield and facilitating early histopathological confirmation, particularly when combined with complementary diagnostic investigations.*

Keywords: Bronchoscopy, lung malignancy, Brush cytology, Bronchoscopic biopsy, Smoking

1. Introduction

Lung malignancy remains a leading cause of cancer-related morbidity and mortality worldwide, making early and accurate diagnosis essential for improving outcomes and guiding treatment [1]. Patients commonly present with nonspecific symptoms such as chronic cough, hemoptysis, dyspnea, chest pain, weight loss, or recurrent respiratory infections, requiring a systematic diagnostic approach. Although chest radiography, computed tomography, and positron emission tomography provide important diagnostic information, definitive diagnosis depends on histopathological or cytological confirmation. Bronchoscopy plays a central role in this process by enabling direct visualization of the tracheobronchial tree and facilitating tissue sampling from suspected malignant lesions [2].

Flexible bronchoscopy is a key diagnostic tool in suspected lung malignancies because of its minimally invasive nature, favorable safety profile, and high diagnostic yield in appropriate clinical settings. It enables direct visualization of endobronchial lesions, mucosal abnormalities, and extrinsic compressions, while allowing tissue sampling through techniques such as endobronchial biopsy, transbronchial biopsy, bronchial brushing, bronchoalveolar lavage, and needle aspiration [3]. Current guidelines recommend bronchoscopy as a first-line investigation, particularly for central lesions and airway involvement, where diagnostic tissue acquisition is more likely [4]. Additionally, bronchoscopy aids in assessing disease extent, airway patency, and suitability for therapeutic interventions, contributing to comprehensive patient evaluation.

Peripheral pulmonary lesions pose a diagnostic challenge because they are often beyond the reach of conventional bronchoscopy. Advances such as radial probe endobronchial ultrasound have improved lesion visualization and guided transbronchial biopsy of peripheral lesions [5]. Studies and meta-analyses have shown that radial endobronchial ultrasound significantly enhances the diagnostic yield of bronchoscopy compared with blind sampling techniques, particularly when combined with accurate lesion localization [6]. These advances have expanded the role of bronchoscopy in the diagnosis of suspected lung malignancies.

By systematically analyzing bronchoscopic findings and outcomes in patients with suspected lung malignancies, the present study aims to contribute evidence that supports informed clinical decision-making and enhances diagnostic efficiency in real-world practice.

2. Materials and Methods

The cross-sectional observational study was conducted at a tertiary care center over a period of one year.88 patients fulfilling the inclusion criteria were selected for the study using a systematic random sampling technique. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki after receiving ethical clearance from the Institutional Ethics Committee.

Inclusion Criteria

Patients age 18 years and older, with clinical or radiological suspicion of malignancy, referred for bronchoscopy who provided informed consent for participation in the study.

Exclusion Criteria

Patients with a known diagnosis of malignancy, unable to undergo bronchoscopy due to medical contraindications, not ready to provide written informed consent.

Procedure

After obtaining written informed consent, detailed demographic and clinical data, including presenting symptoms, duration of illness, smoking history, and relevant medical history, were recorded using a standardized case record form.

Available radiological investigations, including chest radiography, computed tomography (CT) of the thorax, and positron emission tomography (PET) scans, were reviewed prior to bronchoscopy. Bronchoscopic examination was performed as part of the routine diagnostic workup using flexible or rigid bronchoscopy, as clinically indicated. The procedure was conducted under standard aseptic precautions and institutional protocols, with continuous monitoring of vital parameters. Sedation was administered when required.

A systematic evaluation of the tracheobronchial tree was undertaken to identify abnormalities such as endobronchial growths, mucosal irregularities, and extrinsic compressions. Based on bronchoscopic findings, appropriate diagnostic specimens were obtained through endobronchial biopsy, transbronchial biopsy, bronchoalveolar lavage, and/or needle aspiration. All specimens were submitted for histopathological and cytological examination.

Patients were monitored during and after the procedure for immediate complications, which were documented when present. Bronchoscopic findings, pathological results, and diagnostic outcomes were recorded and analyzed to evaluate the diagnostic utility and accuracy of bronchoscopy in suspected lung malignancy.

Data was systematically collected using a standardized case record form and entered into Microsoft excel for further analysis. Statistical analysis was conducted using the SPSS 25.0 version.

3. Result

Table 1: Age distribution of study participants (n = 88)

Age group (years)	Frequency (n)	Percentage (%)
18–30	15	17
31–40	14	15.9
41–50	16	18.2
51–60	16	18.2
61–70	17	19.3
71–80	10	11.4
Total	88	100
Mean age: 48.98 ± 17.10 years		

In the present study, the 61–70 year's age group constituted the highest proportion of participants (19.3%, n=17), followed by 41–50 years and 51–60 years (18.2%, n=16 each), with a mean age of 48.98 ± 17.10 years.

Table 2: Smoking status of study participants (n=88)

Smoking status	Frequency (n)	Percentage (%)
18–30	46	52.3
61–70	22	25.0
71–80	20	22.7
Total	88	100

Over half of the study participants, or 52.3% of the overall population, were found to be current smokers. It was observed that 22.7% of subjects had never smoked, while 25.0% had previously smoked. Compared to past smokers (n = 22) and never smokers (n = 20), the number of current smokers (n = 46) was significantly greater. Overall, the distribution shows that active smoking is more common in the study population.

Table 3: Clinical features distribution of study participants (n=88)

Clinical Feature	Frequency (n)	Percentage (%)
Cough	64	72.7
Dyspnea	45	51.1
Hemoptysis	30	34.1
Chest pain	35	39.8
Weight loss	38	43.2
Fever	19	21.6

Cough was found to be the most prevalent clinical characteristic, occurring in 72.7% of individuals (n = 64). Dyspnea was recorded in 51.1% of instances, whereas 43.2% and 39.8% of individuals reported experiencing weight loss and chest pain, respectively. A moderate prevalence of hemoptysis was seen in 34.1% of the study population. The least frequent symptom, which affected 21.6% of participants, was fever.

Table 4: CT thorax findings distribution of study participant

CT thorax finding	Frequency (n)	Percentage (%)
Central mass	28	31.8
Peripheral lesion	27	30.7
Endobronchial lesion	14	15.9
Segmental collapse	10	11.4
Hilar lymphadenopathy	6	6.8
Non resolving consolidation	3	3.4
Total	88	100.0

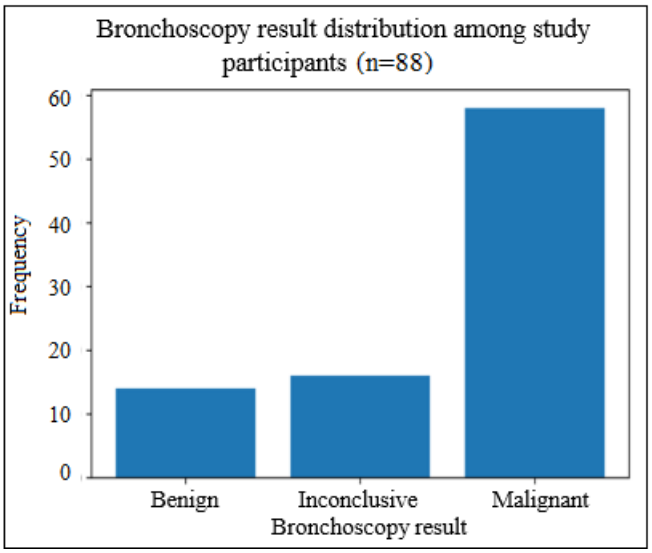
Central mass was shown to be the most prevalent CT thorax finding, occurring in 31.8% of participants (n = 28). Peripheral lesions were found to be almost as common, making up 30.7% of cases (n = 27). 15.9% of subjects had endobronchial lesions, while 11.4% had segmental collapse. Non-resolving consolidation and hilar lymphadenopathy were less frequent findings, occurring in 3.4% and 6.8% of patients.

Table 5: Bronchoscopy result distribution among study participants

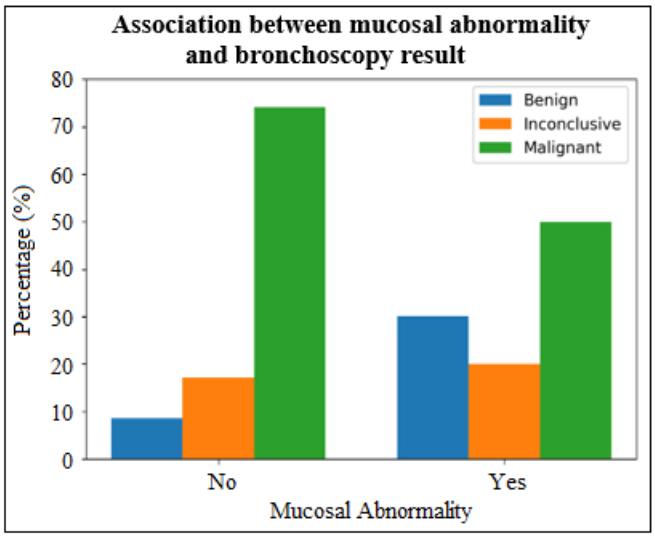
Bronchoscopy result	Frequency (n)	Percentage (%)
Benign	14	15.9
Inconclusive	16	18.2
Malignant	58	65.9
Total	88	100.0

65.9% of the bronchoscopy results (n = 58) were found to be malignant. It was shown that 15.9% of instances had benign findings, while 18.2% of participants had inconclusive outcomes.

Compared to benign and indeterminate categories, there were significantly more malignant instances. Overall, bronchoscopy demonstrated a high diagnostic yield for malignancy in the study population.



Graph 1: Bronchoscopy Result distribution among study participants



Graph 2: Association between mucosal abnormality and bronchoscopy result

Table 6: Association between mucosal abnormality and bronchoscopy result

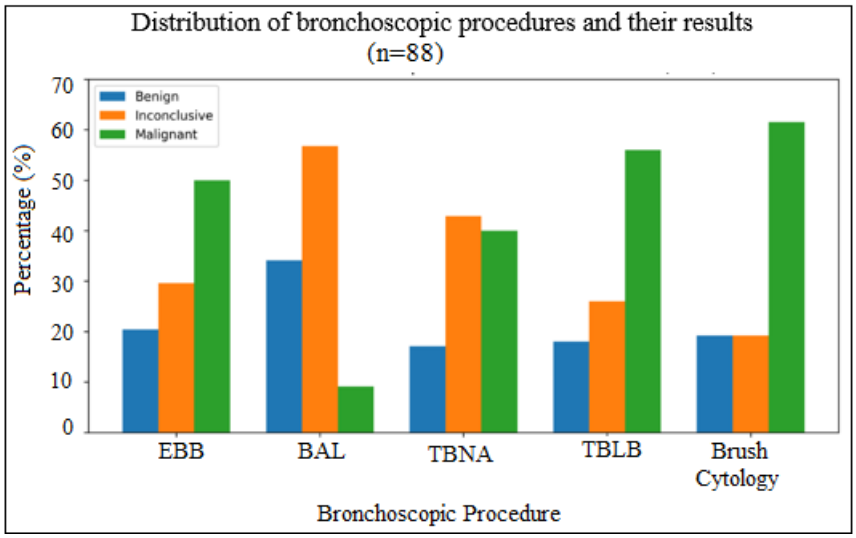
Mucosal abnormality	Benign n (%)	Inconclusive n (%)	Malignant n (%)	Total
No	5 (8.6)	10 (17.2)	43 (74.1)	58
Yes	9 (30.0)	6 (20.0)	15 (50.0)	30
Total	14 (15.9)	16 (18.2)	58 (65.9)	88
$\chi^2 = 7.511$, df = 2, p = 0.023***(significant)				

Malignant bronchoscopy results were found in 74.1% of participants without mucosal abnormality and 50.0% of those with mucosal abnormality. Benign findings were found to be more common in patients with mucosal abnormalities (30.0%) than in those without (8.6%). The percentage of inconclusive results was 20.0% in the group with abnormality and 17.2% in the group without abnormality. Mucosal abnormalities and bronchoscopy results were found to be statistically significantly correlated (**$\chi^2 = 7.511$, df = 2, p = 0.023).**

Table 7: Distribution of bronchoscopic procedures and their results among performed cases (n= 88)

Procedure	Performed (n)	Benign n (%)	Inconclusive n (%)	Malignant n (%)
Endobronchial biopsy	54	11 (20.4)	16 (29.6)	27 (50.0)
Bronchoalveolar lavage	88	30 (34.1)	50 (56.8)	8 (9.1)
TBNA	35	6 (17.1)	15 (42.9)	14 (40.0)
TBLB	50	9 (18.0)	13 (26.0)	28 (56.0)
Brush cytology	52	10 (19.2)	10 (19.2)	32 (61.5)

All participants (100.0%) had bronchoalveolar lavage, whereas endobronchial biopsy and brush cytology were carried out in 61.4% and 59.1% of cases, respectively. Brush cytology yielded the highest percentage of malignant outcomes (61.5%), followed by transbronchial lung biopsy (56.0%) and endobronchial biopsy (50.0%). While bronchoalveolar lavage showed the lowest malignant yield (9.1%) with a high inconclusive rate (56.8%), TBNA exhibited malignant yield in 40.0% of conducted cases.

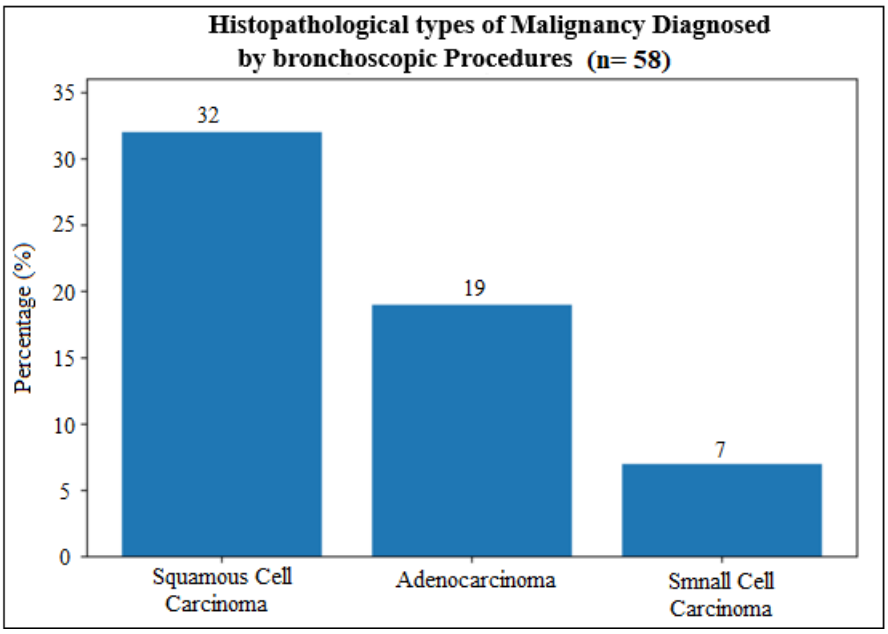


Graph 3: Distribution of bronchoscopic procedures and their results among performed cases

Table 8: Histopathological types of Malignancy Diagnosed by bronchoscopic Procedures (n = 58)

Histopathological Type	Frequency (n)	Percentage (%)
Sq Cell Carcinoma	32	55.2
Adenocarcinoma	19	32.8
Small Cell Carcinoma	7	12.1
Total	58	100

Among the 58 malignant cases diagnosed by bronchoscopic procedures, squamous cell carcinoma was the most common histopathological subtype, accounting for 32 cases (55.2%). Adenocarcinoma was diagnosed in 19 cases (32.8%), while small cell carcinoma was identified in 7 cases (12.1%). Thus, squamous cell carcinoma constituted the predominant histopathological diagnosis in the study population.

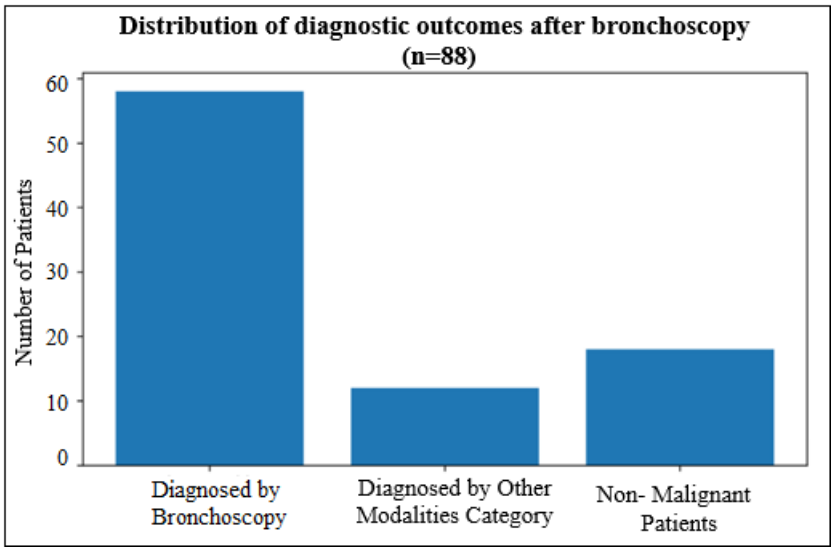


Graph 4: Histopathological types of Malignancy Diagnosed by bronchoscopic Procedures

Table 9: Distribution of diagnostic outcomes after bronchoscopy and subsequent investigations (n = 88)

Category	Number of patients (n)	Percentage (%)
Total patients	88	100
Patients diagnosed by bronchoscopy (individual or combined procedures)	58	65.9
Non-diagnostic by bronchoscopy but diagnosed by other modalities	12	13.6
Total non-malignant patients	18	20.5
Total	88	100

A bronchoscopy revealed that 65.9% of patients (n = 58) had a malignant diagnosis. It was shown that 13.6% of cases (n = 12) were later determined to be malignant by other diagnostic methods despite not being diagnosed by bronchoscopy. Of the study population, 20.5% (n = 18) were non-malignant patients. Overall, the majority of diagnosis were made using bronchoscopy, and a lesser percentage of missed cancers were found using other modalities.



Graph 5: Distribution of diagnostic outcomes after bronchoscopy and subsequent investigations

4. Discussion

The present study evaluated the role of bronchoscopy in the diagnosis of suspected lung malignancy at a tertiary care center.

The mean age of the study population was 48.98 ± 17.10 years, with the highest proportion of patients belonging to the 61–70-year age group. Similar findings were reported by Devi et al. [7], who observed a mean age of 53.2 years, and Kumar and Gupta [8], who reported a mean age of 52.4 years among patients undergoing bronchoscopy for suspected lung cancer. Biciușcă et al. [9] reported a slightly higher mean age of 56.1 years. The predominance of middle-aged and elderly patients observed in the present study is consistent with the known epidemiology of lung cancer, where cumulative exposure to tobacco smoke and environmental carcinogens contributes to malignant transformation.

Smoking exposure was highly prevalent in the study population, with 52.3% of patients being current smokers and 25.0% former smokers. Similar observations were reported by Devi et al. Elhidsi et al. [10], and Kumar and Gupta [8], all of whom documented smoking histories in the majority of patients with pulmonary malignancy. The high prevalence of tobacco exposure in the present study likely contributed to the substantial proportion of malignant bronchoscopic diagnoses and the predominance of smoking-related histological subtypes.

Cough was the most common presenting symptom (72.7%), followed by dyspnea (51.1%), weight loss (43.2%), chest pain (39.8%), and hemoptysis (34.1%). Comparable findings were reported by Arooj et al. [11], who identified cough as the predominant symptom among patients with suspected lung cancer. Similar symptom profiles have also been described by Devi et al. [7] and Kumar and Gupta [8]. These findings reflect the typical clinical manifestations of lung malignancy and emphasize the importance of early bronchoscopic evaluation in symptomatic patients.

CT thorax revealed central masses in 31.8% of patients and peripheral lesions in 30.7%, making them the most common radiological findings. Devi et al. [7] similarly reported central masses in approximately one-third of patients, while Liam et al. [12] demonstrated higher bronchoscopic diagnostic yields in centrally located lesions. The nearly equal distribution of central and peripheral lesions in the present study may explain the observed diagnostic yield and highlights the importance of complementary diagnostic modalities for peripheral pulmonary lesions.

Bronchoscopy established a malignant diagnosis in 65.9% of patients, while 15.9% had benign findings and 18.2% remained inconclusive. This diagnostic yield is comparable to those reported by Kumar and Gupta [8], who observed a diagnostic yield of approximately 65%, and Biciușcă et al. [9], who reported a yield of 68%. These findings confirm that bronchoscopy remains a highly effective diagnostic modality in patients with suspected lung malignancy.

A statistically significant association was observed between mucosal abnormalities and bronchoscopic outcomes (χ^2=7.511, p=0.023). Jang et al. [13] demonstrated that enhanced bronchoscopic imaging improves the detection of malignant mucosal lesions, while Zaric et al. [14] reported increased diagnostic accuracy through targeted evaluation of abnormal mucosal areas. The present findings emphasize the importance of meticulous mucosal inspection during bronchoscopy and support targeted biopsy of suspicious mucosal abnormalities.

Among the bronchoscopic procedures, brush cytology demonstrated the highest malignant yield (61.5%), followed by transbronchial lung biopsy (56.0%) and endobronchial biopsy (50.0%). Bronchoalveolar lavage showed the lowest malignant yield (9.1%). Similar observations were reported by Tomar et al. [15], who demonstrated superior diagnostic performance of bronchial brushing compared with BAL. Roth et al. [16] further showed that combining cytological and histopathological sampling techniques significantly improves overall diagnostic yield. Devi et al. [78] also highlighted the value of direct tissue acquisition procedures in achieving definitive diagnosis. These findings support the routine use of multiple complementary bronchoscopic sampling techniques.

Histopathological examination revealed squamous cell carcinoma as the most common subtype (55.2%), followed by adenocarcinoma (32.8%) and small cell carcinoma (12.1%). Similar findings were reported by Elhidsi et al. [10] and Biciușcă et al. [9], who observed squamous cell carcinoma as the predominant histological subtype among bronchoscopically diagnosed lung cancers. Devi et al. [7] reported a comparable distribution, although adenocarcinoma slightly predominated in their cohort. The predominance of squamous cell carcinoma in the present study is likely related to the high prevalence of smoking and the greater accessibility of centrally located squamous lesions to bronchoscopic biopsy.

Bronchoscopy established a diagnosis in 58 patients (65.9%), while subsequent investigations identified an additional 12 malignant cases. Ultimately, 70 patients (79.5%) were confirmed to have malignancy. Thus, bronchoscopy alone accounted for approximately 82.9% of all confirmed malignant diagnoses. Similar conclusions were drawn by Kumar and Gupta [8], and Herth [17], who emphasized the pivotal role of bronchoscopy in establishing tissue diagnosis and guiding therapeutic decision-making. The additional diagnoses obtained through CT-guided biopsy and other investigations highlight the complementary role of alternative diagnostic modalities in patients with non-diagnostic bronchoscopic findings.

The strengths of the present study include comprehensive evaluation of patients with suspected lung malignancy through demographic profiling, smoking status assessment, clinical presentation, CT thorax findings, bronchoscopic findings, procedure-specific diagnostic yields, histopathological diagnosis, and final diagnostic outcomes. The study demonstrated a substantial diagnostic yield of bronchoscopy, identified factors associated with diagnostic success such as mucosal abnormalities, compared the performance of various bronchoscopic sampling techniques, and provided histopathological characterization of diagnosed malignancies. Furthermore, the inclusion of subsequent investigations in

non-diagnostic cases enabled assessment of the overall contribution of bronchoscopy to the final diagnosis. However, the study was limited by its single-center design, relatively small sample size, and cross-sectional nature. Advanced bronchoscopic modalities were not utilized, which may have reduced diagnostic yield in peripheral lesions. Additionally, procedure outcomes may have been influenced by lesion location, sampling adequacy, and operator expertise, and long-term clinical outcomes were not evaluated.

5. Conclusion

The present study demonstrates that bronchoscopy is a highly valuable diagnostic tool in the evaluation of suspected lung malignancy. Most patients were middle-aged to elderly and had a significant history of smoking, highlighting the strong association between tobacco exposure and lung cancer. CT thorax commonly revealed central masses and peripheral lesions, aiding lesion localization and bronchoscopic planning. Bronchoscopy established a malignant diagnosis in 65.9% of cases, confirming its substantial diagnostic yield. Mucosal abnormalities showed a significant association with bronchoscopic diagnostic outcomes, emphasizing the importance of meticulous airway inspection. Among the bronchoscopic techniques, brush cytology, transbronchial lung biopsy, and endobronchial biopsy demonstrated the highest diagnostic yields. Squamous cell carcinoma was the predominant histopathological subtype diagnosed. Furthermore, bronchoscopy contributed to the diagnosis of the majority of ultimately confirmed malignancies, while complementary investigations improved diagnostic accuracy in non-diagnostic cases. Overall, bronchoscopy remains an effective, safe, and indispensable first-line investigation for suspected lung malignancies in tertiary care practice.

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