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Comprehensive Evaluation of Endobronchial Lesions: Correlating Clinical, Radiological, Bronchoscopic, and Histopathological Findings in Patients Undergoing Fibreoptic Bronchoscopy

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ABSTRACT

Background: Endobronchial lesions are abnormal tumors or alterations of the bronchial tree with varied etiologies, including malignant, infectious, inflammatory, and benign conditions. Fibreoptic bronchoscopy continues to be a critical diagnostic modality for the direct visualization and tissue sampling.

Objective: To evaluate the clinical, radiological, bronchoscopic, and histopathological features of endobronchial lesions identified via fibreoptic bronchoscopy.

Methodology: A cross-sectional descriptive study was carried out at a tertiary care center (LRH) from January to December 2024. Sixty-four patients with endobronchial lesions visible on bronchoscopy were enrolled in the study. Clinical evaluations, imaging, bronchoscopic findings, and biopsies were examined and categorized.

Results: The findings revealed that the majority of patients were older males (mean age group: 56–65 years; 73.4% male). Dyspnea (64%) was the most frequent symptom, and mass lesions (54.6%) were the most frequent radiologic finding. Exophytic growths were noted in 46.8% on bronchoscopy. Squamous cell carcinoma (23.4%) was the most frequent diagnosis by histopathology, followed by small cell carcinoma (17.1%) and chronic inflammation (20.3%). The right upper lobe was the most frequently involved site (29.6%).

Conclusion: In summary, endobronchial lesions primarily occur in elderly men and often present as malignant masses. Fibreoptic bronchoscopy with histopathological analysis remains crucial for early and accurate diagnosis, particularly in areas endemic for both infectious and malignant conditions.

Keywords: Endobronchial Lesions; Fibreoptic Bronchoscopy; Squamous Cell Carcinoma; Histopathology; Radiology

Introduction

Endobronchial lesions are pathological abnormalities within the bronchial tree. Endobronchial lesions can develop from multiple causes, including neoplastic, infectious, inflammatory, congenital, or traumatic conditions.[1] Malignant etiologies involve primary lung cancers such as squamous cell carcinoma and small cell carcinoma, whereas benign tumors like hamartomas and papillomas can also be present. Infectious causes, such as tuberculosis and fungal infections, are prevalent in endemic regions, and inflammatory diseases, including sarcoidosis and Wegener's granulomatosis, may also lead to endobronchial lesions.[2] Further, foreign body aspiration, postintubation trauma, and congenital abnormalities can also cause lesions. Their early detection and correct characterization are of great importance for the prompt initiation of the right treatment and enhancing patient prognosis. The advent and ready availability of fibreoptic bronchoscopy have revolutionized clinicians' ability to directly view and take samples of these lesions, and it is now an essential tool in respiratory medicine.[3,4]

The clinical presentations of endobronchial lesions are variable based on their size, anatomical location, nature, and growth rate. Chronic cough is a common symptom, often accompanied by hemoptysis, wheezing, stridor, dyspnea, and chest pain. Systemic symptoms, such as fever, weight loss, and anemia, may also occur in some instances. Most lesions, however, are clinically silent during the initial stages, leading to a delayed diagnosis. Obstructive lesions may cause complications, including lung collapse, post-obstructive pneumonia, and bronchiectasis, complicating clinical assessment.

The causes of endobronchial lesions depend on age, sex, environment, location, and immune status. Primary lung cancers, such as bronchogenic carcinoma, are the most common malignant lesions in high-income nations and often relate to smoking.[5] In contrast, infectious diseases like endobronchial tuberculosis are more frequent in young adults and immunocompromised individuals in developing countries. Benign lesions such as papillomas and hamartomas, though rare, can cause local obstruction and mimic malignancy.

Initial evaluation utilizes imaging techniques such as chest X-rays and high-resolution CT scans. X-rays may reveal collapse or consolidation, while CT scans provide detailed localization and sizing. However, imaging alone cannot reliably distinguish malignancies, so further diagnostic workup is needed.

Fibreoptic bronchoscopy offers a minimally invasive technique for directly visualizing the tracheobronchial tree and identifying lesions. It also enables the collection of tissue for diagnostic analysis, such as endobronchial biopsies, brushings, washings, and transbronchial needle aspirations. Besides serving as a diagnostic tool, bronchoscopy also has therapeutic purposes, including debulking tumors, stenting, removing foreign bodies, and controlling hemoptysis.[6]

Histopathological analysis of tissue obtained through bronchoscopy remains the gold standard for diagnosis. Malignant conditions include primary lung cancers of different histological types, like squamous cell carcinoma, adenocarcinoma, and small cell carcinoma, and also metastases from extrapulmonary locations. Infectious conditions, especially those caused by Mycobacterium tuberculosis or fungi, exhibit typical features such as granulomas or necrosis, and special stains may be required for accurate diagnosis. Benign lesions typically exhibit well-differentiated histological patterns, characterized by the absence of atypia or invasive features.[7,8]

In low-resource settings, diagnosis relies on clinical evaluation, imaging, bronchoscopy, and histopathology. A multidisciplinary approach is vital, especially when early diagnosis can significantly impact outcomes. disease or cause permanent lung damage.

There is little local data on clinical, radiological, and histopathological profiles of endobronchial lesions, particularly in countries like Pakistan, where cancer and infection are both common. Understanding prevalence and diagnostic challenges locally can help improve clinical algorithms and diagnosis.

Objective

To evaluate the clinical, radiological, bronchoscopic, and histopathological features of endobronchial lesions identified via fibreoptic bronchoscopy.

Methodology

This cross-sectional descriptive study was conducted at the Department of Pulmonology, Lady Reading Hospital (LRH), Peshawar from January to December 2024. A total of 64 patients were enrolled in the study through a non-probability consecutive sampling method. Patients 18 years and older, of either sex, who had undergone fibreoptic bronchoscopy and were identified as having visible endobronchial lesions, were enrolled with informed consent. Patients with bleeding pathology, unstable cardiovascular status, severe respiratory distress, active pregnancy, recent myocardial infarction, or who refused consent were excluded from the study.

All patients underwent a comprehensive clinical evaluation, during which clinicians took a detailed history, performed a physical examination, and assessed respiratory symptoms, including cough, hemoptysis, dyspnea, and chest pain. The team performed standard blood tests and conducted imaging studies, including a chest X-ray and high-resolution computed tomography scans, as necessary.

Clinicians performed fibreoptic bronchoscopy with local

anaesthesia and conscious sedation through routine methods. They noted the bronchoscopic appearance of each lesion, whether polypoid, ulcerative, or infiltrative and obtained endobronchial biopsy samples, bronchial brushings, and washings for cytological and histopathological examination.

Expert pathologists at the pathology department analyzed all samples. They classified histopathological features into malignant, benign, infectious, and inflammatory lesions according to conventional diagnostic criteria. The data team tabulated, entered, and processed the information using SPSS version 25, computing frequencies and percentages for categorical variables and means and standard deviations for continuous variables.

Results

Among the study cases, the most common age group was 56–65 years, with 37.5% of cases, followed by 25% in patients above the age of 65, which clearly indicates that endobronchial lesions are more common in older individuals. There is an evident male preponderance clearly indicated by 73.4% males (Table 1).

The most common symptom reported was dyspnea, occurring in 64% of cases, followed by cough (53.1%) and chest pain (45.3%). Hemoptysis was observed in 34.3% of the patients and is considered a valuable symptom for indicating the need for bronchoscopy. Systemic manifestations like weight loss (17.1%) and loss of appetite (14%) were also seen and indicate possible malignancy or chronic illness. Hoarseness of voice was less frequent (9.3%) and can be secondary to recurrent laryngeal nerve involvement or compression of the upper airway (Table 2).

The most frequent imaging abnormality was a mass lesion in 54.6% of cases, typically a sign of neoplastic process and necessitating further investigation with bronchoscopy. Mediastinal lymphadenopathy was the second most common finding (20.3%), suggestive of either malignancy or chronic infection such as tuberculosis. The other radiological signs, including lung collapse and cavitary lesions, each appeared in 6.2% of the patients, whereas pleural effusion and consolidation were each noted in 4.6%. Ground-glass opacities were least frequent (3.1%) (Table 3).

The most common presentation was an exophytic lesion, occurring in 46.8% of cases, frequently appearing as a globular or protruding mass, which is suggestive of malignancy. Nodular lesions occurred in 18.7%, and ulcerative lesions in 9.3%, which may reflect infection, malignancy, or inflammation. Mucosal abnormality, such as thickening or irregularity, occurred in 17.1%, and plaque-like lesions in 7.8% (Table 4).

The graph shows the histopathological diagnosis of endobronchial lesions in the study population. Squamous cell carcinoma was the most common lesion observed in 23.4% of cases, followed by small cell carcinoma in 17.1% and poorly differentiated carcinoma in 10.9%, indicating the prevalence of malignant lesions. Chronic inflammation was the commonest non-malignant condition found in 20.3% of the patients. Other etiologies included adenocarcinoma (9.3%), tuberculosis (4.6%), and aspergillosis (6.2%). A lesser number of cases revealed benign tumors or normal histology. This figure illustrates the broad spectrum of pathological endobronchial lesions and highlights the importance of tissue diagnosis through bronchoscopy (Figure 1).

The most frequent site of involvement was the right upper lobe, occurring in 29.6% of patients, followed by the left

Table 1. Age and gender distribution (n = 64)

Age Group (years)	No. of Patients	Percentage (%)
<35	5	7.8
36–45	7	10.9
46–55	12	18.7
56–65	24	37.5
>65	16	25
Gender		
Male	47	73.4
Female	17	26.5

Table 2. Clinical presentation of study cases (n = 64)

Symptom	No. of Patients	Percentage (%)
Shortness of breath	41	64.0
Cough	34	53.1
Chest pain	29	45.3
Hemoptysis	22	34.3
Weight loss	11	17.1
Loss of appetite	9	14.0
Hoarseness of voice	6	9.3

upper lobe (23.4%) and the right middle lobe (17.1%). Involvement of the lower lobes occurred less often, with 10.9% of patients showing left lower lobe involvement and 12.5% right lower lobe involvement. The lesions in the trachea or main bronchi were the least frequent, occurring in 6.2% of cases (Table 5).

Discussion

Fibreoptic bronchoscopy is a minimally invasive diagnostic test that provides direct visualization of the tracheobronchial tree using a flexible tube with an incorporated light source and camera.[9] It is a vital tool in the assessment of respiratory disease, notably in identifying endobronchial lesions, obtaining tissue samples by biopsy, and performing therapeutic interventions. Generally performed under conscious sedation with local anesthesia, it is considered safe, effective, and crucial in modern pulmonary medicine for diagnosing airway abnormalities, malignancies, and infections. This study investigated the clinical, radiological, bronchoscopic, and histopathological features of

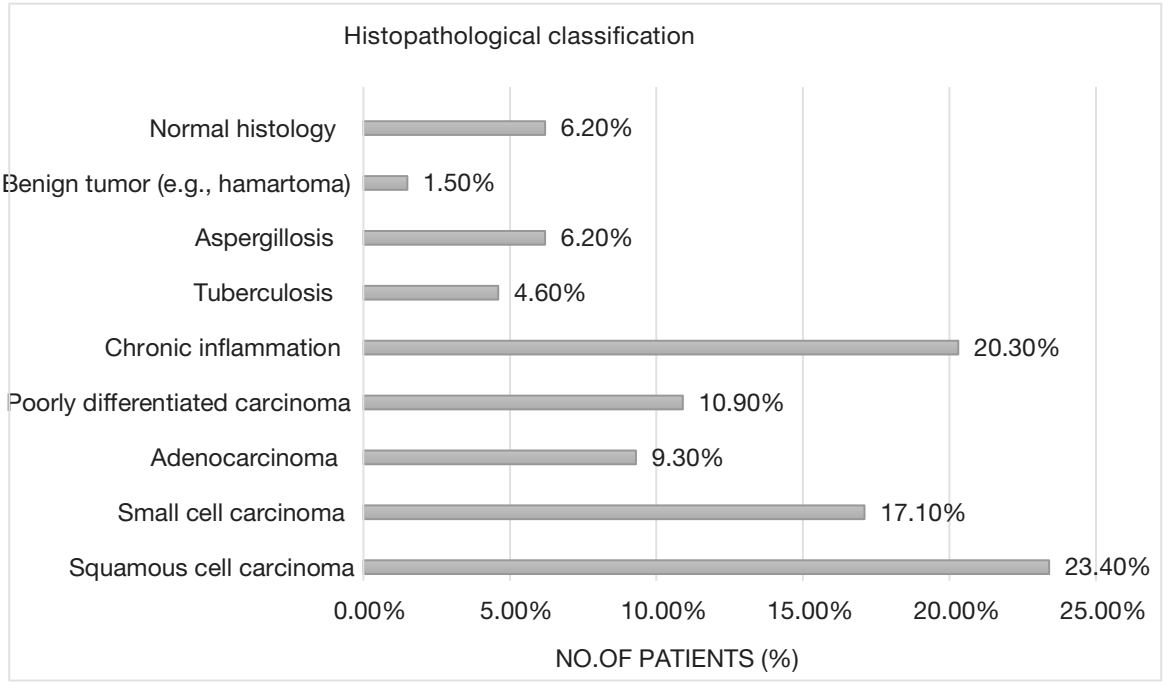

Figure 1. Histopathological Classification

Table 3. Imaging findings of study cases (n = 64)

Imaging Feature	No. of Patients	Percentage (%)
Mass lesion	35	54.6
Mediastinal lymph nodes	13	20.3
Collapse	4	6.2
Cavity	4	6.2
Pleural effusion	3	4.6
Consolidation	3	4.6
Ground glass opacity	2	3.1

endobronchial lesions diagnosed by fibreoptic bronchoscopy, emphasizing its pivotal role, especially where infectious and malignant conditions are prevalent. Endobronchial lesions occurred most frequently in patients aged 56–65 years (37.5%). This aligns with prior observations that lung cancers predominantly affect older adults, confirming the age-related prevalence seen worldwide.[10]

There was an evident male predominance of 73.4% in our study. This has been reportedly observed by an earlier study by Mathew et al. (2022), wherein they documented that the majority of suspected lung cancer patients were elderly male smokers with symptoms such as cough, weight loss, and loss of appetite. CT scans tended to reveal mass lesions, and bronchoscopy identified intraluminal growths, with the most frequent type of cancer being squamous cell carcinoma.[11] This could be accounted for by increased tobacco use and occupational exposure to respiratory irritants among men in most developing nations, such as Pakistan and India.

Another study of 38 Romanian patients with lung cancer by Biciuşcă et al. (2022) also highlighted that most elderly patients were men (84.2%) with a mean age of approximately 65 years. Squamous cell carcinoma was the most frequent type of cancer, particularly in men, and infiltrative lesions were the most common bronchoscopic finding.[12]

Clinically, shortness of breath (64%), cough (53.1%), and chest pain (45.3%) were the most common symptoms among our patients, which are in agreement with other studies in the literature. By comparison, Alsurayhi et al. (2024) similarly reported that shortness of breath is the most characteristic symptom of COPD, followed by chronic cough and sputum production, all of which significantly affect daily life and influence disease evaluation.[13] Hemoptysis was present in 34.3% of our cases, a notable finding because it often requires bronchoscopy to rule out malignancy, particularly in chronic smokers.

Radiological results in our study revealed mass lesions in

Table 4. Bronchoscopic appearance of study cases (n = 64)

Appearance Type	No. of Patients	Percentage (%)
Exophytic lesion	30	46.8
Nodular lesion	12	18.7
Ulcerative lesion	6	9.3
Mucosal abnormality	11	17.1
Plaque-like lesion	5	7.8

Table 5. Anatomical site of lesion among study cases (n = 64)

Lung Segment Involved	Number of Patients	Percentage (%)
Right upper lobe	19	29.6
Left upper lobe	15	23.4
Right middle lobe	11	17.1
Left lower lobe	7	10.9
Right lower lobe	8	12.5
Trachea/main bronchi	4	6.2

more than half the patients (54.6%), followed by mediastinal lymphadenopathy (20.3%). This finding aligns with Sharma et al.'s (2023) observation that mass lesions were the most frequent finding on chest CT scans among patients who underwent bronchoscopy.[14] Equally, in a study conducted by Finkelstein et al. (2003), 35 abnormal lesions were detected through bronchoscopy, which included endoluminal growth, obstructive masses, and mucosal abnormalities.[15]

Bronchoscopic findings aligned with radiological impressions. Exophytic lesions, suggestive of endobronchial tumors, were the most frequent (46.8%), a finding that parallels those of Rana et al. (2018), who also identified exophytic growths and lung carcinoma as the most common bronchoscopic and histopathological findings.[16] Nodular, ulcerative, and mucosal abnormalities in our patients correlated with infectious and inflammatory etiologies, reinforcing the need to supplement visual appearance with histopathology for accurate diagnosis.

Histopathological examination showed squamous cell carcinoma (23.4%) as the leading diagnosis, followed by small cell carcinoma (17.1%) and poorly differentiated carcinoma (10.9%). In contrast, an East Chinese study by Wang et al. (2017) indicated that adenocarcinoma (ADC) was the most frequent lung cancer subtype (60%), with greater frequency in females, whereas squamous cell carcinoma (SCC) was more common in males.[17] Notably, in our study, chronic inflammation (20.3%) was the most common non-malignant diagnosis, and this might suggest long infections or irritant exposure. Aspergillosis (6.2%) and tuberculosis (4.6%) cases in our study again demonstrate the endemic status of infectious lung diseases in South Asia.

Anatomically, the right upper lobe was the most common site affected (29.6%), followed by the left upper lobe (23.4%) and right middle lobe (17.1%). A retrospective analysis by Hung et al. (2024) evaluated the efficacy of LAGA-assisted lung percutaneous thermal ablation (LPTA) methods, including RFA and MWA, in treating lung tumors, with the majority of interventions targeting the right upper lobe.[18] The greater contribution of the right side could be attributed to the more vertical and broader pointing of the right bronchus, making it easier for inhaled carcinogens and pathogens.

The comparison of these data with foreign research highlights general global trends and regional specificities. Although cancers predominate in the histological context worldwide, bacterial infections such as tuberculosis and aspergillosis continue to be important endobronchial disease contributors in developing countries. This highlights the need to always have a wide differential diagnosis when interpreting radiologic and bronchoscopic results.

The research validates the diagnostic value of fibreoptic bronchoscopy in assessing endobronchial lesions. The addition of clinical evaluation, imaging, and histopathology provides a secure and minimally invasive method for arriving at a specific diagnosis. These results justify requiring more awareness and instruction in bronchoscopy, especially where both malignant and infectious diseases account for the majority of pulmonary morbidity.

Conclusion

This study highlights the clinical significance of endobronchial lesions, which are more prevalent in older men and often accompanied by respiratory symptoms, including dyspnea and cough. Malignant lesions, particularly squamous cell carcinoma, were the most common observations, and infectious and inflammatory conditions also contributed to the disease burden. Fibreoptic bronchoscopy was a safe and mandatory diagnostic tool for lesion visualization and obtaining histopathological evidence. In a resource-constrained environment where both infections, such as tuberculosis and malignancy, coexist, an integrated strategy combining clinical evaluation, imaging, bronchoscopy, and histopathology is necessary for accurate diagnosis

and treatment planning.

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