e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(8); 1674-1680

Original Research Article

An Observational Study of Histopathological Spectrum of Lung Lesions in Core Needle Biopsies at SMS Medical College & Attached Hospitals, Jaipur

Kalpana Shekhawat[1], Garima Sharma[2], Prachis Ashdhir[3], Govind Singh Jodha[4]

[1]Senior Resident, Department of Pathology, JLN Medical College, Ajmer, Rajasthan, India
[2]Professor, Department of Pathology, SMS Medical College, Jaipur, Rajasthan, India
[3]Professor, Department of Gastroenterology, SMS Medical College & Hospital, Jaipur, Rajasthan, India
[4]Medical Officer, District Hospital Nuh, Haryana, India

Received: 01-05-2026 / Revised: 15-06-2026 / Accepted: 21-07-2026
Corresponding author: Dr. Kalpana Shekhawat
Conflict of interest: Nil

Abstract

Background: Lung lesions encompass a wide spectrum of non-neoplastic, benign, and malignant conditions, and their accurate diagnosis is critical for guiding therapy. Core needle biopsy (CNB), particularly under radiological guidance, has become a reliable, minimally invasive diagnostic tool. However, data on the histopathological spectrum of lung lesions in Indian populations remain limited.

Materials and Methods: This cross-sectional observational study was conducted in the Department of Pathology, SMS Medical College, Jaipur, over nine months, enrolling 100 patients who underwent CNB for lung lesions. Inclusion criteria were all adequately preserved guided core biopsies, both neoplastic and non-neoplastic. Inadequate or poorly fixed specimens were excluded. Clinical history, radiological features, and histopathological findings were systematically recorded. Immunohistochemistry (IHC) was applied where routine histology was inconclusive, using a panel of markers (TTF-1, CK7, Napsin A, p40, etc.) to subtype tumors. Data were analyzed using standard statistical methods, with a p-value <0.05 considered significant.

Results: The mean age of participants was 58.4 years, with most cases between 41–60 years. Males predominated (68%; ratio 2.1:1). Common symptoms included cough (78%) and breathlessness (58%), with smoking history in 60%. Of the 100 biopsies, 58% were malignant, 4% benign neoplasms, and 38% non-neoplastic. Adenocarcinoma (41.4%) was the most frequent malignancy, followed by squamous cell carcinoma (24.1%) and small cell carcinoma (6.9%). CNB achieved a 94% diagnostic success rate, with minimal complications (3% pneumothorax, 2% hemoptysis).

Conclusion: Core needle biopsy is a safe, effective, and high-yield diagnostic technique for lung lesions. It provides accurate histopathological classification, with IHC enhancing diagnostic precision, thereby facilitating appropriate clinical management.

Keywords: Lung lesions, Core needle biopsy, Histopathology, Adenocarcinoma, Squamous cell carcinoma, Immunohistochemistry.

DOI: 10.25258/ijcpr.18.8.249

Introduction

The lungs are essential organs responsible for gaseous exchange and are vulnerable to a wide spectrum of pathological conditions ranging from inflammatory and infectious diseases to benign and malignant neoplasms. Chronic respiratory diseases contribute substantially to global morbidity and mortality, with millions of cases being preventable [1]. The burden and pattern of lung diseases vary widely depending on geographic, environmental, occupational, and genetic factors.

Lung parenchymal lesions may manifest as inflammation, fibrosis, granulomatous reactions, or neoplastic growths, often presenting diagnostic challenges due to overlapping clinical and radiological features [2]. Histopathological examination remains the cornerstone for definitive diagnosis, particularly in differentiating benign from malignant lesions and in subclassifying neoplasms. Lung cancer, one of the leading causes of cancer-related mortality worldwide, highlights the importance of early and accurate tissue diagnosis.

The lung is also a frequent site of metastatic involvement from extrapulmonary malignancies,

necessitating distinction between primary lung cancer and secondary deposits for appropriate staging and management. Core needle biopsy (CNB) has emerged as a crucial diagnostic modality, providing adequate tissue for histopathological evaluation as well as ancillary investigations such as immunohistochemistry (IHC) and molecular studies [3].

In India, the diagnostic landscape of lung lesions is further complicated by the high prevalence of tuberculosis, which often mimics malignancy both clinically and radiologically. Non-specific symptoms, coexistence of chronic illnesses like chronic obstructive pulmonary disease, and delayed presentation frequently result in diagnostic dilemmas and late-stage detection [4].

Lung cancers are broadly classified into non-small cell lung cancer (NSCLC) and small cell lung cancer (SCLC), accounting for approximately 82% and 14% of cases respectively [3]. Cigarette smoking remains the most significant risk factor, implicated in 80–90% of cases, while occupational exposure to carcinogens such as asbestos and radon contributes to nearly 10% of lung cancers. Despite advances in imaging, targeted therapy, and immunotherapy, prognosis remains poor in advanced disease, emphasizing the need for early diagnosis and accurate histological classification [4].

Image-guided lung biopsies are often the first diagnostic step when radiological abnormalities are detected. CT-guided fine-needle aspiration (FNA) and CNB are widely used techniques, particularly for peripheral lung lesions. While FNA provides cytological material, CNB offers larger tissue cores that allow for architectural assessment, IHC, and molecular testing, making it superior for comprehensive diagnosis [5].

CT-guided CNB has demonstrated a higher diagnostic yield compared to FNA, especially in peripheral lesions. The availability of sufficient tissue reduces diagnostic errors and enables detection of actionable genetic alterations such as EGFR mutations and ALK rearrangements, which are critical for targeted therapies [6–7].

Histopathological evaluation is equally important in inflammatory and infectious lung diseases. Granulomatous inflammation, commonly seen in tuberculosis and fungal infections, can closely mimic malignancy, necessitating tissue confirmation for accurate diagnosis and management [8].

In oncology, precise histological and molecular classification of lung tumors is essential. NSCLC subtypes require detailed characterization, while SCLC is identified by its aggressive neuroendocrine features and distinct therapeutic approach. CNB ensures adequate tissue for such evaluations, which are now integral to standard lung cancer care [9]. The lung is a common site for metastases from breast, colorectal, renal, and melanoma primaries. Differentiation from primary lung cancer relies on histopathology supported by IHC markers such as TTF-1, Napsin A, CK7, and CK20, all of which require preserved tissue architecture obtained through CNB [10].

Although CNB is associated with complications such as pneumothorax and bleeding, advances in imaging guidance have significantly improved its safety profile. Furthermore, CNB facilitates evaluation of prognostic and predictive markers, supporting personalized treatment strategies in modern oncology.

This study aimed to evaluate the histopathological spectrum of lung lesions diagnosed on core needle biopsy and to correlate morphological findings with clinico-radiological features at SMS Medical College and Attached Hospitals, Jaipur.

Materials and Methods

This observational cross-sectional study was conducted in the Department of Pathology, S.M.S. Medical College and Attached Hospitals, Jaipur, Rajasthan. The study duration was nine months or until the required sample size was achieved, followed by two months for data analysis. The study population included all formalin-fixed, guided core needle biopsy specimens of lung lesions received for histopathological examination during the study period. Biopsy specimens that were well preserved, adequately fixed, and properly labeled, including both neoplastic and non-neoplastic lesions, were included after obtaining informed consent, while inadequate or improperly fixed samples were excluded.

The sample size was calculated at a 95% confidence level assuming a 67.5% prevalence of malignant lung lesions with a 10% allowable error, yielding a minimum of 88 cases, which was rounded off to 100. After approval from the Institutional Ethics Committee, demographic and clinical details including age, sex, presenting symptoms, and relevant clinical history were recorded using a structured proforma. Radiological findings, primarily computed tomography scan impressions, were reviewed and correlated with histopathological diagnoses.

All specimens underwent detailed gross examination followed by routine hematoxylin and eosin staining. Histomorphological evaluation was performed to classify lesions as benign, malignant, or metastatic and to identify specific subtypes wherever feasible. Immunohistochemistry was applied in selected cases where morphological features were inconclusive. Statistical analysis was

performed using standard software, with qualitative variables expressed as proportions and quantitative variables as mean ± standard deviation. A p-value of <0.05 was considered statistically significant.

Results

The study population comprised 100 patients with a mean age of 58.4 ± 12.6 years, with a predominance of middle-aged individuals (52% aged 41-60 years). Males outnumbered females with a ratio of 2.1:1. Sixty percent of patients had a smoking history, with most smokers (46.7%) having 10-20 pack years exposure. Hypertension (24%) and COPD (22%) were the most prevalent comorbidities. (Table 1)

Cough was the most common presenting symptom (78%), followed by dyspnea (58%) and weight loss with anorexia (46%). The majority of patients (82%) presented with multiple overlapping symptoms, while 6% were asymptomatic with incidental radiological findings. Lesions were predominantly located in the upper lobes, with left upper lobe (32%) and right upper lobe (28%) being most frequently involved. Solitary lesions (78%) with heterogeneous enhancement pattern (64%) were the predominant radiological characteristics. (Table 2)

Core needle biopsy was predominantly CT-guided (82%) using 14-gauge needles (64%). Most procedures yielded 4-5 tissue cores (48%), achieving adequate sample in 96% of cases with a diagnostic success rate of 94%. Complications were minimal, with pneumothorax (3%) and hemoptysis (2%) being the only adverse events observed. Clinico-radiological concordance was high, with 87.5% of radiologically suspected malignant lesions confirmed histopathologically. (Table 3) Histopathological analysis revealed that 62% of lesions were neoplastic and 38% were non-neoplastic. Among non-neoplastic lesions, inflammatory pathology (18%) and granulomatous lesions (12%) were predominant. Malignant neoplasms constituted 58% of all cases, with primary lung carcinomas (46%) outnumbering metastatic tumors (12%). Adenocarcinoma was the most common malignancy (24%), followed by squamous cell carcinoma (14%). Benign neoplasms were rare (4%), with pulmonary hamartoma being the most frequent. (Table 4)

Among 58 malignant cases, the majority occurred in the 41-60 years age group (58.6%) with a male predominance (male to female ratio 2.6:1). Squamous cell carcinoma and small cell carcinoma showed strong association with smoking, with 100% of small cell carcinoma cases occurring in current smokers. In contrast, adenocarcinoma demonstrated a relatively higher proportion among non-smokers (41.7%), consistent with established epidemiological patterns. (Table 5) Immunohistochemistry facilitated accurate subtyping of primary lung carcinomas. Adenocarcinoma characteristically expressed TTF1 (91.7%), CK7 (100%), and Napsin A (75%), while squamous cell carcinoma showed consistent p40 positivity (100%). Small cell carcinoma demonstrated universal synaptophysin expression (100%) with partial TTF1 positivity (50%). These immunoprofiles were instrumental in distinguishing histological subtypes and confirming primary versus metastatic origin. (Table 6)

Table 1: Demographic Profile and Risk Factors (n=100)

Parameter	Category	Frequency (n)	Percentage (%)
Age Distribution	21-40 years	18	18.0
	41-60 years	52	52.0
	61-80 years	28	28.0
	>80 years	2	2.0
	Mean Age ± SD	**58.4 ± 12.6 years**	
Gender	Male	68	68.0
	Female	32	32.0
	Male to Female Ratio	**2.1:1**	
Smoking Status	Current smoker	42	42.0
	Ex-smoker	18	18.0
	Non-smoker	40	40.0
Pack Years (n=60)	<10 pack years	15	25.0
	10-20 pack years	28	46.7
	>20 pack years	17	28.3
Comorbidities	Hypertension	24	24.0
	COPD	22	22.0
	Diabetes mellitus	16	16.0
	Previous malignancy	8	8.0

Table 2: Clinical Presentation and Radiological Characteristics (n=100)

Parameter	Category	Frequency (n)	Percentage (%)
Clinical Symptoms	Cough	78	78.0
	Difficulty in breathing	58	58.0
	Weight loss & anorexia	46	46.0
	Chest pain	42	42.0
	Fever	34	34.0
	Hemoptysis	12	12.0
	Multiple symptoms	82	82.0
	Asymptomatic (incidental)	6	6.0
Lesion Location	Left upper lobe	32	32.0
	Right upper lobe	28	28.0
	Right lower lobe	16	16.0
	Left lower lobe	12	12.0
	Right middle lobe	8	8.0
	Bilateral	4	4.0
Lesion Pattern	Solitary	78	78.0
	Multiple	22	22.0
Enhancement Pattern	Heterogeneous	64	64.0
	Homogeneous	18	18.0
	No enhancement	18	18.0

Table 3: Procedural Details and Diagnostic Outcomes (n=100)

Parameter	Category	Frequency (n)	Percentage (%)
Guidance Method	CT-guided	82	82.0
	USG-guided	18	18.0
Needle Gauge	14G	64	64.0
	16G	28	28.0
	18G	8	8.0
Number of Cores	2-3 cores	42	42.0
	4-5 cores	48	48.0
	>5 cores	10	10.0
Sample Adequacy	Adequate	96	96.0
	Inadequate	4	4.0
Diagnostic Outcome	Successful diagnosis	94	94.0
	Inconclusive results	6	6.0
Complications	No complications	95	95.0
	Pneumothorax	3	3.0
	Hemoptysis	2	2.0
Clinico-Radiological Concordance			
Suspected malignant (n=64)	Malignant confirmed	56	87.5
Suspected benign (n=28)	Non-neoplastic confirmed	24	85.7

Table 4: Histopathological Spectrum of Lung Lesions (n=100)

Category	Diagnosis	Frequency (n)	Percentage (%)
Non-neoplastic Lesions		**38**	**38.0**
Inflammatory	Acute inflammatory lesion	8	8.0
	Chronic inflammatory lesion	6	6.0
	Non-specific inflammatory	4	4.0
Granulomatous	Necrotizing granulomatous	8	8.0
	Non-necrotizing granulomatous	4	4.0
Infectious	Fungal lesions	3	3.0
	Pneumonia	3	3.0
Others		2	2.0
Benign Neoplasms		**4**	**4.0**
	Pulmonary hamartoma	2	2.0
	Granular cell tumor	1	1.0
	Schwannoma	1	1.0

Malignant Neoplasms		**58**	**58.0**
Primary NSCLC	Adenocarcinoma	24	24.0
	Squamous cell carcinoma	14	14.0
	Large cell carcinoma	2	2.0
	Poorly differentiated NSCC	2	2.0
Primary SCLC	Small cell carcinoma	4	4.0
Metastatic	Metastatic adenocarcinoma	8	8.0
	Metastatic squamous cell carcinoma	2	2.0
	Metastatic sarcoma	1	1.0
	Unknown primary	1	1.0

NSCLC: Non-small cell lung carcinoma; NSCC: Non-small cell carcinoma; SCLC: Small cell lung carcinoma

Table 5: Clinicopathological Profile of Malignant Lesions (n=58)

Parameter	**Adenocarcinoma (n=24)**	**Squamous Cell Carcinoma (n=14)**	**Small Cell Carcinoma (n=4)**	**Metastatic (n=12)**
Age Distribution				
21-40 years	4 (16.7%)	2 (14.3%)	0 (0%)	0 (0%)
41-60 years	14 (58.3%)	10 (71.4%)	2 (50.0%)	8 (66.7%)
61-80 years	6 (25.0%)	2 (14.3%)	2 (50.0%)	4 (33.3%)
Gender				
Male	16 (66.7%)	12 (85.7%)	4 (100%)	10 (83.3%)
Female	8 (33.3%)	2 (14.3%)	0 (0%)	2 (16.7%)
Smoking Status				
Current smoker	8 (33.3%)	12 (85.7%)	4 (100%)	-
Ex-smoker	6 (25.0%)	2 (14.3%)	0 (0%)	-
Non-smoker	10 (41.7%)	0 (0%)	0 (0%)	-

Table 6: Immunohistochemistry Profile of Primary Lung Carcinomas (n=44)

Tumor Type	**TTF1**	**p40**	**CK7**	**CK20**	**Napsin A**	**Synaptophysin**
Adenocarcinoma (n=24)	22 (91.7%)	0 (0%)	24 (100%)	2 (8.3%)	18 (75.0%)	0 (0%)
Squamous cell carcinoma (n=14)	0 (0%)	14 (100%)	4 (28.6%)	0 (0%)	0 (0%)	0 (0%)
Small cell carcinoma (n=4)	2 (50.0%)	0 (0%)	1 (25.0%)	0 (0%)	0 (0%)	4 (100%)
Large cell carcinoma (n=2)	1 (50.0%)	0 (0%)	2 (100%)	0 (0%)	0 (0%)	0 (0%)

TTF1: Thyroid transcription factor-1; CK: Cytokeratin

Discussion

The present study analyzed the histopathological spectrum of lung lesions diagnosed by core needle biopsy in 100 patients and provides important insights into demographic patterns, clinical presentation, radiological features, diagnostic accuracy, and pathological outcomes. The findings highlight the utility of core needle biopsy as a reliable diagnostic modality in the evaluation of pulmonary lesions.

The mean age of patients in this study was 58.4 ± 12.6 years, with the majority (52%) belonging to the 41–60-year age group. Nearly 80% of patients were older than 40 years, reflecting the cumulative effect of aging, prolonged exposure to environmental carcinogens, and lifestyle-related risk factors in lung disease pathogenesis. A marked male predominance was observed with a male-to-female ratio of 2.1:1, consistent with previous studies. Dey et al. (2020) [11] reported a male predominance of 81.3%, while Kamath M observed a male-to-female ratio of 3.3:1. This disparity is likely attributable to higher rates of smoking, occupational exposure, and environmental risk factors among men.

Malignant lesions were most frequently observed in the 41–60-year age group (58.6%), with no malignant cases detected above 80 years of age. This differs slightly from Dey et al. (2020) [11], who reported peak incidence in the 71–80-year age group. Such variation may reflect regional differences in life expectancy, healthcare access, and diagnostic practices.

Respiratory symptoms dominated the clinical presentation, with cough (78%) and dyspnea (58%) being the most common complaints. Constitutional symptoms such as weight loss and anorexia were present in 46% of patients, suggesting a significant proportion of advanced disease. The majority of patients (82%) presented with multiple symptoms,

underscoring the systemic impact of lung pathology. Hemoptysis was relatively uncommon (12%), possibly indicating earlier detection in some cases. Incidental radiological detection in 6% of asymptomatic patients highlights the increasing role of imaging in identifying early-stage lesions.

Smoking history was documented in 60% of patients, including 42% current smokers and 18% ex-smokers, reaffirming tobacco use as a major risk factor. Dey et al. (2020) [11] reported an even higher prevalence of smokers (83.2%). Among malignant cases, current smokers constituted 41.4%, with strong associations noted for squamous cell carcinoma and small cell carcinoma. In contrast, adenocarcinoma showed a higher proportion of non-smokers (41.7%), consistent with global trends indicating a rising incidence of adenocarcinoma among non-smokers. Common comorbidities included hypertension, COPD, and diabetes mellitus, reflecting shared risk factors and the multimorbid nature of the study population.[12-13]

Radiologically, lesions were predominantly located in the upper lobes, particularly the left upper lobe (32%) and right upper lobe (28%), consistent with smoking-related malignancies and certain infectious processes. Most lesions were solitary (78%), favoring primary lung tumors over metastatic disease. Heterogeneous enhancement was observed in 64% of cases, correlating with malignant pathology characterized by necrosis and variable tumor vascularity.

Core needle biopsy demonstrated excellent performance, with sample adequacy in 96% and overall diagnostic accuracy of 94%. CT-guided procedures accounted for 82% of biopsies, with 14G needles used most commonly. These results compare favorably with Manas et al. (2018) [12], who reported 95% diagnostic accuracy, and Balbi M et al. (2024) [12], who reported 94% accuracy in cystic airspace lesions. Zhu et al. (2021) [14] reported a lower accuracy of 83.3% in metastatic lesions. The low complication rate in the present study (pneumothorax 3%, hemoptysis 2%) further supports the safety of this procedure.

Neoplastic lesions constituted 62% of cases, with malignant lesions accounting for 58%. This high malignancy rate reflects referral bias and biopsy selection criteria. Similar findings were reported by Manas et al. (2018) [12] and Itha MB et al. (2021) [15]. Among non-neoplastic lesions, inflammatory pathology was most common (47.4%), followed by granulomatous lesions (31.6%), reflecting the high prevalence of tuberculosis and chronic infections in the region.

Primary lung malignancies accounted for 79.3% of malignant cases, with metastases comprising 20.7%. NSCLC was the predominant subtype (72.4%), with adenocarcinoma being most frequent (41.4%), followed by squamous cell carcinoma (24.1%). This contrasts with studies by Shabnam Sarfraz et al. (2018) [16] and Dey et al. (2020) [11], who reported squamous cell carcinoma as the most common subtype. The higher adenocarcinoma prevalence in this study aligns with evolving epidemiological trends.

Immunohistochemistry played a crucial role in tumor classification. Adenocarcinomas showed high TTF1 and CK7 positivity with frequent Napsin A expression, while squamous cell carcinomas demonstrated uniform p40 positivity. Small cell carcinomas showed synaptophysin positivity with variable TTF1 expression, consistent with neuroendocrine differentiation. Metastatic lesions were effectively differentiated using appropriate IHC panels.[17]

Benign neoplasms constituted a small proportion (4%), predominantly pulmonary hamartomas, reflecting biopsy selection bias. Radiological-histopathological correlation showed good concordance, with 87.5% of radiologically suspected malignant lesions confirmed histologically. However, 7.1% of radiologically benign lesions were malignant, emphasizing the importance of tissue diagnosis.

Overall, the findings align well with existing literature [17,18] and reinforce the diagnostic value of core needle biopsy in evaluating lung lesions, particularly in the era of precision oncology.

Conclusion

The study demonstrates that core needle biopsy is a highly reliable and safe diagnostic tool for evaluating lung lesions. The majority of lesions were malignant, particularly non-small cell carcinomas like adenocarcinoma and squamous cell carcinoma. Smoking was strongly associated with malignancy, especially squamous cell and small cell carcinoma. The high diagnostic yield, supported by IHC subtyping, reinforces the value of core needle biopsy in the histological classification and management of lung lesions.

Reference

1. Zhu J, Wang X, Qu Y, Wen Z. CT-guided core needle biopsy of the lung in patients with primary malignancy suspected of lung metastasis: 5-year experience from a single institution. Diagn Interv Radiol. 2021;27(4):534-41.
2. Travis WD, Brambilla E, Noguchi M, Nicholson AG, Geisinger K, Yatabe Y et al. Diagnosis of lung cancer in small biopsies and cytology: implications of the 2011 International Association for the Study of

Lung Cancer/American Thoracic Society/Eur opean Respiratory Society classification. Arch Pathol Lab Med. 2013;137(5):668-84.
3. Kakria N, Garg Y. Pathological variation of lung masses. Indian J Pathol Oncol. 2018;3:435-40.
4. Sarfraz S, Gupta R, Bhardwaj S. Histopathological patterns of endobronchial lung biopsy specimen in lung cancer along with clinico-radiological correlation. Int J Med Clin Res. 2018;5(11):K1-K5.
5. National Cancer Registry Programme. Report of National Cancer Registry Programme 2012–2016. Bengaluru: ICMR/NCDIR; 2020.
6. Memtsoudis SG, Besculides MC, Zellos L, Patil N, Rogers SO. Trends in lung surgery: United States 1988 to 2002. Chest. 2006;130(5):1462-70.
7. Grogan EL, Weinstein JJ, Deppen SA, Putnam JB Jr, Nesbitt JC, Lambright ES, et al. Thoracic operations for pulmonary nodules are frequently not futile in patients with benign disease. J Thorac Oncol. 2011;6(10):1720-5.
8. Smith MA, Battafarano RJ, Meyers BF, Zoole JB, Cooper JD, Patterson GA. Prevalence of benign disease in patients undergoing resection for suspected lung cancer. Ann Thorac Surg. 2006;81(5):1824-8.
9. Malik PS, Sharma MC, Mohanti BK, Shukla NK, Deo SV, Mohan A, et al. Clinicopathological profile of lung cancer at AIIMS: a changing paradigm in India. Asian Pac J Cancer Prev. 2013;14:489-94.
10. Li L, Jing L, Buryanek J, Zhang S. CT-guided core needle biopsy of peripheral lung lesions with onsite adequate evaluation: Review of 215 cases. J Cytol Histol. 2014;4:1-5.
11. Dey A, Sharma A. Computed topographic-guided core needle biopsy of lung masses: our experience at a diagnostic center in Western India. J Med Sci Health. 2020;6(1):5-11.
12. Manas R, Yadav R, Jain A, Nigam JS, Yadav D. Cytomorphological spectrum of lung lesions and its correlation with clinico-radiological findings: A study of 40 cases. J Cytol. 2018;35(3):164–169.
13. Balbi M, Capelli S, Caroli A, Culasso NC, Barba M, Senkeev R, et al. CT-guided core needle biopsy of pulmonary lesions associated with cystic airspaces: a case-control study. AJR Am J Roentgenol. 2024;223:e2431042.
14. Zhu J, Wang X, Qu Y, Wen Z. CT-guided core needle biopsy of the lung in patients with primary malignancy suspected of lung metastasis: 5-year experience from a single institution. Diagn Interv Radiol. 2021 Jul;27(4):534-541.
15. Itha MB, Veeragandham S. Histopathological spectrum of lung lesions in patients undergoing lung resection – an institutional study. Int J Health Clin Res. 2021;4(13):47-53.
16. Sarfraz S, Gupta R, Bhardwaj S. Histopathological patterns of endobronchial lung biopsy specimen in lung cancer along with clinico-radiological correlation. Int J Contemp Med Res. 2018;5(11):K1-K5.
17. Baratella E, Cernic S, Casagrande F, De Pellegrin A, Borsatti E, Girometti R, et al. CT-guided core needle biopsy of the chest: A valuable tool for histological diagnosis of lung cancer and molecular analysis in the era of targeted therapy. Radiol Med. 2022;127(5):505–514.
18. Khaparde SH, Patrikel SB, Deshmukh SD, Shinde BB. Role of needle biopsy in early diagnosis of lung lesions in tertiary care hospital. IP J Diagn Pathol Oncol. 2021;6(3):170-174.