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Research Article

Retrospective Study and Radio-Pathological Correlation of Spectrum of Pulmonary Lesions in Tertiary Care Centre

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Introduction: Lung cancer remains the leading cause of cancer-related mortality globally, with varying clinical presentations and radiological patterns. Early detection is critical for improving patient outcomes. This study aims to evaluate the clinical, radiological, and histopathological characteristics of lung lesions in a rural atertiary care hospital.

Methods: A retrospective analysis of 41 patients diagnosed with lung lesions between January 2022 and October 2024 at B.K.L Walawalkar Rural Medical College and Hospital was conducted. Demographic data, clinical complaints, CT scan findings, and histopathological results were reviewed and correlated.

Results: The study population consisted of 18 males and 23 females, with the majority aged above 60 years. Cough was the most common symptom, followed by chest pain and hoarseness. Radiologically, peripheral masses were the predominant pattern (58.53%), with adenocarcinoma being the most frequent histopathological diagnosis (70.73%). Lesions typically ranged from 1.1 to 2.0 cm in size. The right lung upper lobe was the most common site of involvement.

Conclusion: The findings from this study are consistent with global trends in lung cancer presentation, with adenocarcinoma being the predominant type and peripheral masses being the most common radiological feature. This highlights the importance of early detection and imaging techniques for diagnosing lung cancer, particularly in rural settings where clinical presentation may be delayed.

Keywords: Lung Cancer, Clinical Presentation, Radiological Features, Histopathology, Adenocarcinoma.

INTRODUCTION

Pulmonary diseases continue to represent a significant cause of morbidity and mortality globally. These diseases can manifest in a variety of forms, ranging from benign to malignant lesions, and are often difficult to diagnose without advanced imaging and pathological correlation. As a result, combining radiological imaging with pathological findings

through retrospective studies has become an essential tool in understanding the spectrum of pulmonary lesions and refining diagnostic accuracy. Radiological imaging, particularly high-resolution computed tomography (HRCT), plays a crucial role in identifying and characterizing pulmonary lesions. Imaging techniques allow for non-invasive evaluation of the lung structure and tissue, providing valuable information regarding lesion size, location, and morphology. Studies have shown that radiological features, such as consolidation, nodule patterns, and bronchial wall thickening, can provide initial clues about the nature of the lesions, which can then be further investigated through histopathological analysis [1].

Despite the advancements in imaging techniques, however, the differentiation between benign and malignant lesions remains challenging. The complexity of interpreting CT scans is exacerbated by the overlapping features of various pulmonary conditions. For example, both infectious and non-infectious lesions can present similarly on CT scans, making it difficult for radiologists to confidently determine the underlying pathology without the support of pathological confirmation [2].

While radiological imaging provides the initial clues, pathological examination of pulmonary lesions is critical for an accurate diagnosis. Histopathological analysis allows for the identification of the lesion's cellular characteristics, enabling the differentiation between malignant and benign entities. The pathological spectrum of pulmonary lesions is broad, encompassing a variety of diseases such as infections, tumors, interstitial lung diseases, and vascular conditions (Xie et al., 2020). For instance, in pulmonary cryptococcosis, radiographic findings often correlate with the severity of the disease, yet the definitive diagnosis is confirmed through histopathological examination of tissue biopsies or autopsy specimens [3].

The integration of pathological findings with radiological data enhances the diagnostic process, leading to more accurate clinical management. A retrospective analysis by Cozzi et al. (2022) demonstrated that radiomics, an advanced imaging technique that extracts quantitative features from radiographic images, can be employed to assess tumor aggressiveness and predict prognosis in lung cancer cases. This approach, when paired with pathological results, can significantly improve diagnostic accuracy and provide a more comprehensive understanding of pulmonary lesions [4].

Retrospective studies are indispensable in pulmonary research as they allow for the analysis of pre-existing data and the correlation of radiological findings with pathological outcomes. These studies are particularly useful in understanding the distribution and nature of pulmonary lesions across diverse populations. They can also reveal the diagnostic challenges associated with these lesions, providing insights into improving clinical practices. A retrospective study on pulmonary tuberculosis sequelae by Kumar Rai et al. (2020) highlighted that a large percentage of tuberculosis patients exhibit residual radiological lesions post-treatment, underscoring the importance of accurate imaging and follow-up [5].

Similarly, studies examining pulmonary lesions in lung cancer have shown that integrating radiological and pathological data can facilitate better tumor staging and treatment decisions. The development of nomograms based on radiological features, combined with pathological findings, has been shown to predict disease outcomes and help in formulating individualized treatment strategies [6].

One of the main challenges in radio-pathological correlation is the variability in lesion appearance on imaging and the difficulty in achieving definitive histopathological diagnosis, particularly in cases where tissue samples are not easily accessible. Advances in non-invasive techniques, such as positron emission tomography (PET) and 68Ga-FAPI PET/CT imaging, offer promising alternatives for improving diagnostic precision in pulmonary diseases. Xie et al. (2024) demonstrated the utility of 68Ga-FAPI PET/CT in distinguishing between benign and malignant pulmonary lesions, showing the growing potential of imaging to provide insights typically reserved for pathological assessments [7].

Moreover, the application of deep learning and machine learning techniques in the analysis of radiological images is transforming the landscape of pulmonary lesion diagnostics. By incorporating large datasets, these technologies can reduce diagnostic ambiguity and provide automated, accurate predictions of lesion nature, thereby aiding clinicians in making timely and informed decisions [8]. The aim of this study is to investigate the radiological and pathological correlation of

pulmonary lesions, focusing on how imaging findings from CT scans align with the histopathological characteristics of the lesions. By examining various lung lesions through both imaging and tissue analysis, the study aims to enhance our understanding of the nature and progression of these lesions. The first objective is to analyze the various patterns of radiological features of lung lesions, utilizing CT scans as a primary tool for identifying and categorizing abnormalities such as nodules, consolidations, and ground-glass opacities. The second objective is to explore the spectrum of pulmonary lesions from a pathological perspective, examining tissue samples in the pathology department to distinguish between malignant, benign, infectious, and inflammatory lesions. Finally, the study seeks to correlate the findings from radiological imaging with the histopathological diagnoses of these lesions, ultimately aiming to improve diagnostic accuracy by understanding the relationship between imaging results and tissue pathology. This correlation will not only aid in refining clinical diagnoses but also assist in determining the appropriate therapeutic approaches based on a comprehensive understanding of each lesion's characteristics.

MATERIAL AND METHODS

1. **Study Design:** The study was a retrospective observational design, analyzing medical records of 41 patients diagnosed with lung lesions between January 2022 and October 2024. The study aimed to correlate CT imaging features with histopathological diagnoses, using existing patient data for comprehensive analysis.
2. **Study Setting:** Conducted at B.K.L. Walawalkar Rural Medical College and Hospital, KasarwadiSawarde, Chiplun, a tertiary care facility offering advanced diagnostic services including CT imaging and pathology departments capable of conducting detailed lesion analyses.
3. **Study Duration:** The study spanned from January 2022 to October 2024, allowing ample time to gather sufficient data from patients diagnosed with lung lesions during this period, ensuring a diverse sample for analysis.
4. **Participants – Inclusion and Exclusion Criteria**
   Inclusion Criteria:
   Patients aged 20-80 years
   Available histopathological and radiological reports
   Exclusion Criteria:
   Incomplete medical records
   Non-diagnostic biopsy samples
5. **Study Sampling:** Purposive sampling was employed to select patients with both CT scans and histopathological reports, ensuring data for accurate radiological-pathological correlations.
6. **Study Sample Size:** The study included 41 patients, providing enough data to analyze correlations between imaging and pathological findings while ensuring statistical significance.
7. **Study Groups:** Patients were grouped based on lesion type:
   Malignant
   Benign
   Infectious
   Inflammatory
8. **Study Parameters Radiological:** Lesion size, type, and morphology **Pathological:** Histological diagnosis, tissue features, and cell type
9. **Study Procedure:** Data were collected from medical records, including CT scans and histopathology reports. Radiologists and pathologists independently reviewed and analyzed the data, followed by a correlation of the findings.
10. **Study Data Collection:** Clinical, radiological, and histopathological data were extracted from patient records, anonymized for confidentiality, and entered into a secure database for analysis.
11. **Data Analysis:** Descriptive statistics and Pearson's correlation were used to assess relationships between radiological and pathological findings, calculating sensitivity, specificity, and diagnostic accuracy.
12. **Ethical Considerations:** Ethical approval was obtained from the institutional ethics committee. Patient data were anonymized to ensure confidentiality, and the study adhered to the Declaration of Helsinki standards for ethical medical research.

OBSERVATION AND RESULT

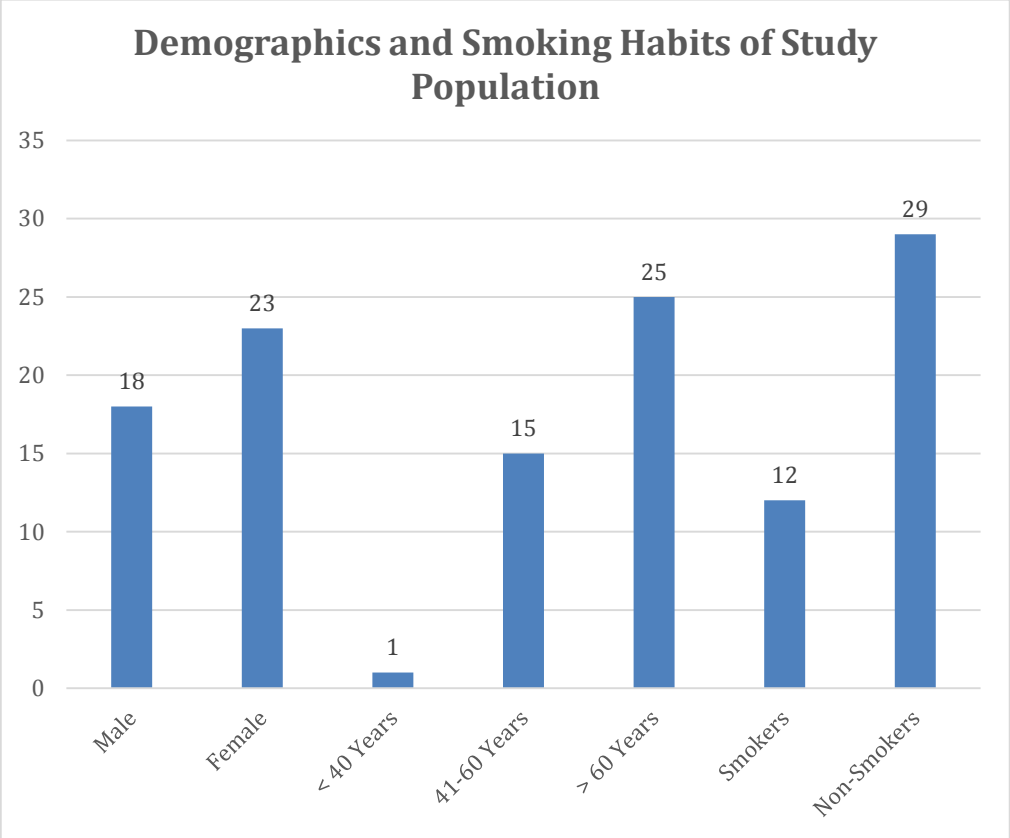
The study included 41 patients, with a slightly higher number of females (23) compared to males (18). The majority of patients were over the age of 60 (25 patients), followed by those in the 41-60 years age group (15 patients). Only 1 patient was under the age of 40. In

terms of smoking habits, 12 patients (29%) were smokers, while the remaining 29 patients (71%) were non-smokers (Table 1).

Table 1: Demographics and Smoking Habits of Study Population

Sr No	Demographic Parameter	Number of cases n=41	Percentage 100 %
1	**Age (Years)**		
	1. <40	1	2 %
	2. 41 to 60	15	37 %
	3. >60	25	61 %
2	**Gender**		
	1. Male	18	43 %
	2. Female	23	57 %
3	**Smoking Habits**		
	1. Smokers	12	29 %
	2. Non smokers	29	71 %

Graph 1: Demographics and Smoking Habits of Study Population



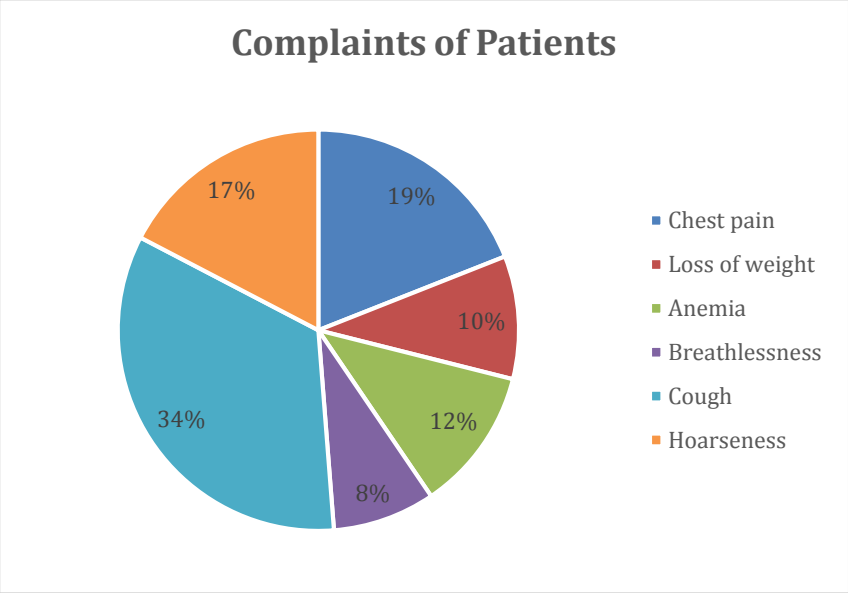
The most common complaint among patients was cough, which was reported by all 41 patients. Chest pain was the second most frequent complaint, observed in 23 patients. Other common symptoms included anemia (14 patients), hoarseness (21 patients), loss of weight (12 patients), and breathlessness (10 patients). These symptoms reflect the varied clinical presentation of lung lesions, with cough being the most pervasive (Table 2).

Table 2: Complaints of Patients

Sr No	Complaints	Number of cases n=41	Percentage 100 %
1	Chest pain	23	56 %
2	Loss of weight	12	29 %
3	Anemia	14	34 %

4	Breathlessness	10	24 %
5	Cough	41	100 %
6	Hoarseness	21	51 %

Graph 2: Complaints of Patients

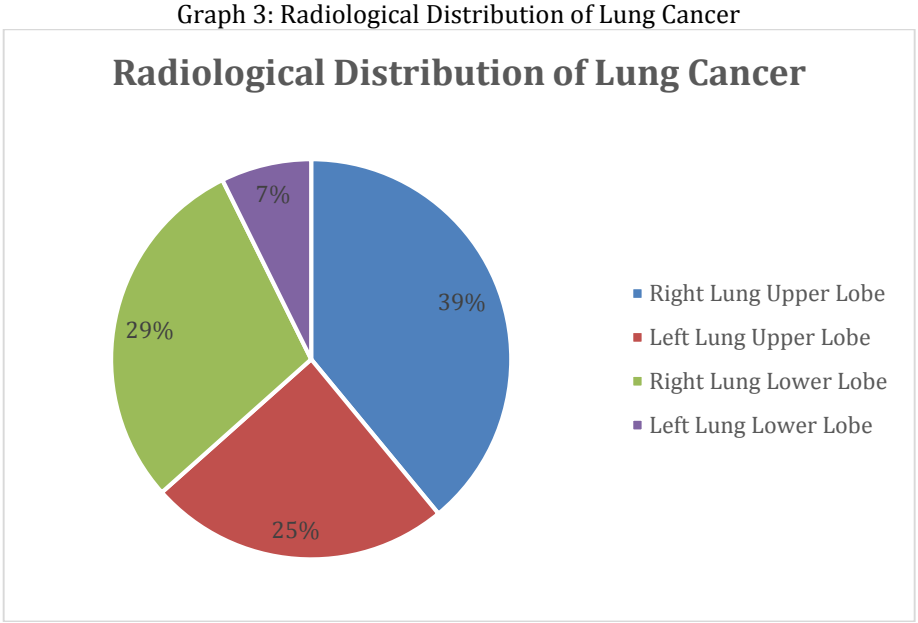


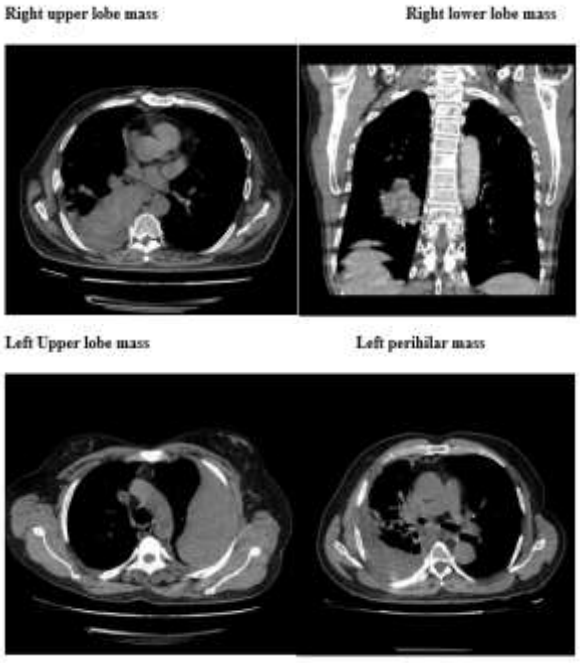
The distribution of lung cancer lesions based on their location revealed that the right lung upper lobe was the most commonly affected site, with 16 patients (39.02%) showing lesions in this region. The left lung upper lobe was involved in 10 patients (24.39%), while the right lung lower lobe accounted for 12 patients (29.26%). The left lung lower lobe was the least affected, with only 3 patients (7.31%) having lesions in this area (Table 3).

Table 3: Radiological Distribution of Lung Cancer

Sr No	Location	Number of cases n=41	Percentage 100 %
1	Right Lung Upper Lobe	16	39 %
2	Left Lung Upper Lobe	10	24 %
3	Right Lung Lower Lobe	12	29 %
4	Left Lung Lower Lobe	3	7 %

Graph 3: Radiological Distribution of Lung Cancer



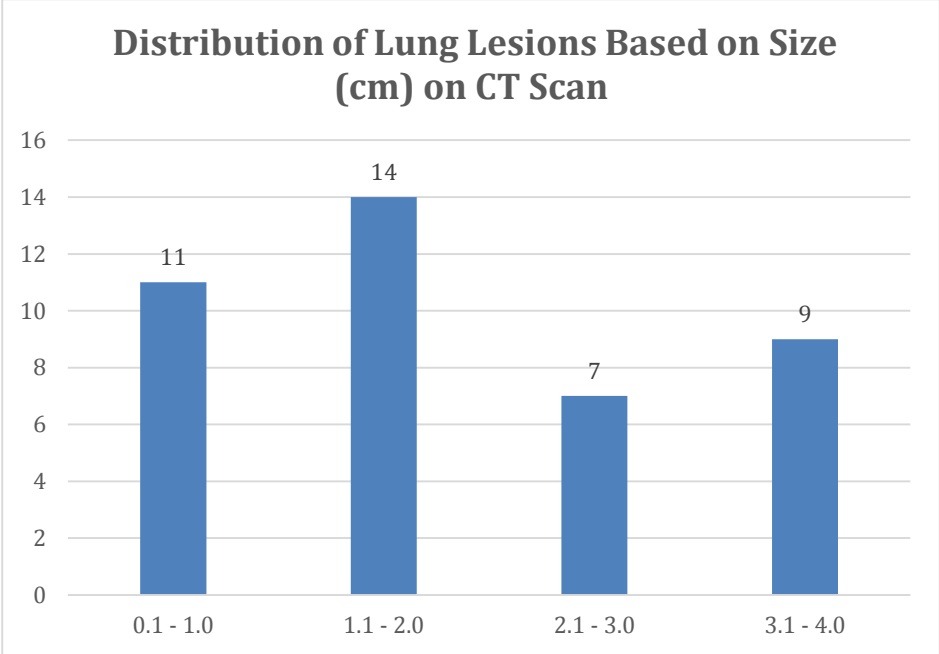


The size of lung lesions varied significantly across the study population. The majority of lesions were between 1.1 and 2.0 cm in size, with 14 patients (34.15%) presenting with lesions in this range. Smaller lesions (0.1 - 1.0 cm) were found in 11 patients (26.83%). Lesions sized between 2.1 and 3.0 cm were present in 7 patients (17.07%), while 9 patients (21.95%) had lesions between 3.1 and 4.0 cm (Table 4).

Table 4: Distribution of Lung Lesions Based on Size (cm) on CT Scan

Sr No	Size (cm)	Number of cases n=41	Percentage 100 %
1	0.1 - 1.0	11	27 %
2	1.1 - 2.0	14	34 %
3	2.1 - 3.0	7	17 %
4	3.1 - 4.0	9	21 %

Graph 4: Distribution of Lung Lesions Based on Size (cm) on CT Scan

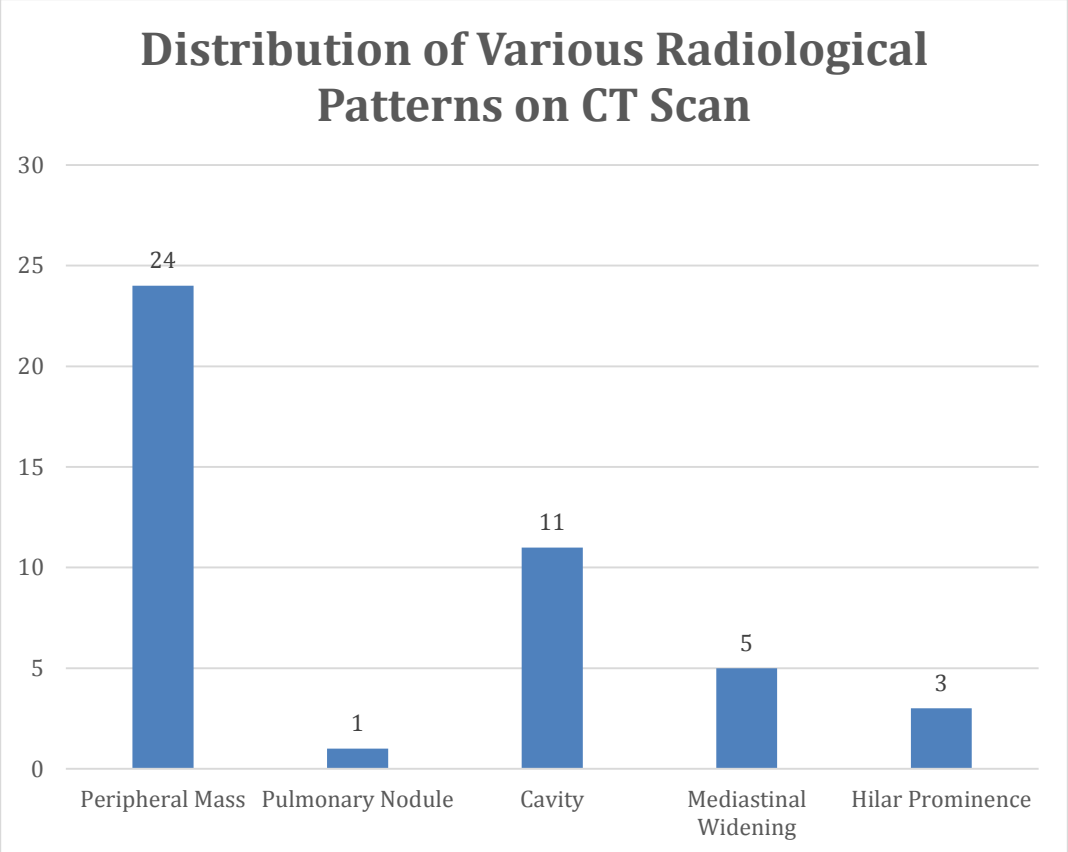


The most common radiological pattern observed on CT scans was peripheral mass, seen in 24 patients (58.53%). Cavitary lesions were the second most frequent, found in 11 patients (26.80%). Mediastinal widening was noted in 5 patients (12.19%), and hilar prominence was seen in 3 patients (4.86%). Pulmonary nodules were the least common, present in only 1 patient (2.43%) (Table 5).

Table 5: Distribution of Various Radiological Patterns on CT Scan

Sr No	Radiological Pattern	Number of cases n=41	Percentage 100 %
1	Peripheral Mass	24	59 %
2	Pulmonary Nodule	1	2 %
3	Cavity	11	27 %
4	Mediastinal Widening	5	12 %
	Hilar Prominence	3	7 %

Graph 5: Distribution of Various Radiological Patterns on CT Scan

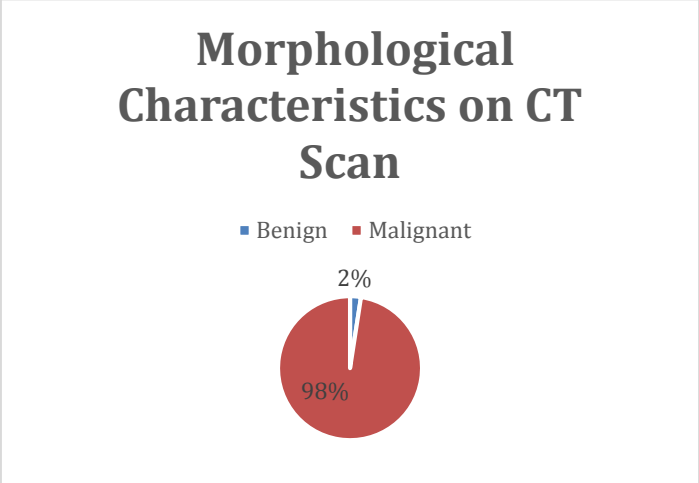


Regarding the morphological characteristics of lung lesions, the vast majority of patients had malignant lesions, with 40 patients (97.56%) diagnosed as malignant on CT imaging. Only 1 patient (2.43%) had a benign lesion (Table 6).

Table 6: Morphological Characteristics on CT Scan

Sr No	Radiological Features	Number of cases n=41	Percentage 100 %
1	Benign	1	2 %
2	Malignant	40	98 %

Graph 6: Morphological Characteristics on CT Scan

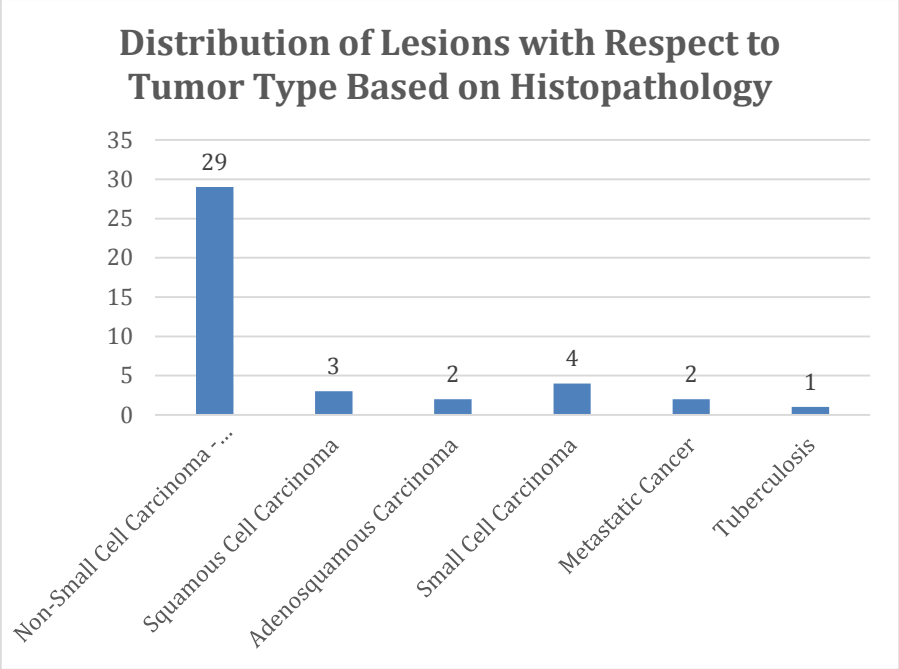


Histopathological analysis revealed that the most common tumor type was Non-Small Cell Carcinoma (NSCLC) - Adenocarcinoma, observed in 29 patients (70.73%). Squamous Cell Carcinoma was found in 3 patients (7.31%), while Adenosquamous Carcinoma was seen in 2 patients (4.87%). Small Cell Carcinoma was identified in 4 patients (9.75%), and metastatic cancer was found in 2 patients (4.87%). One patient (2.43%) was diagnosed with tuberculosis, which was an important differential diagnosis in the study population (Table 7).

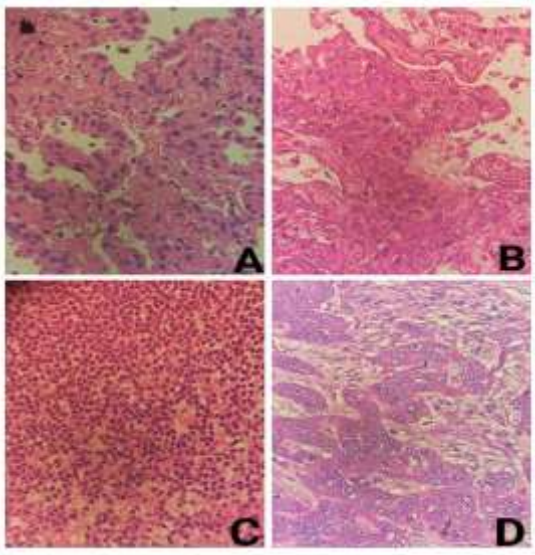
Table 7: Distribution of Lesions with Respect to Tumor Type Based on Histopathology

Sr No	Tumor Type	Number of cases n=41	Percentage 100 %
1	Non-Small Cell Carcinoma - Adenocarcinoma	29	71 %
2	Squamous Cell Carcinoma	3	7 %
3	Adenosquamous Carcinoma	2	5 %
4	Small Cell Carcinoma	4	10 %
5	Metastatic Cancer	2	5 %
6	Tuberculosis	1	2 %

Graph 7: Distribution of Lesions with Respect to Tumor Type Based on Histopathology



Adenocarcinoma



A) Metastatic carcinoma
B) Small cell carcinoma
C) Squamouscell carcinoma

DISCUSSION

The results of this study provided insights into the clinical, radiological, and histopathological characteristics of lung lesions in patients from B.K.L Walawalkar Rural Medical College and Hospital. Comparing our findings with similar studies in the literature, several trends and variations are observed, highlighting the similarities and differences in disease presentation, diagnostic approaches, and treatment outcomes.

Our study observed a female predominance, with 18 males and 23 females. Studies such as those by Mohiuddin et al. (2024) [9] and Papiris& Roussos (2006) [10] have reported that males are more frequently affected by lung cancer, particularly due to higher smoking rates. However, the high proportion of non-smokers in our cohort (71%) is in contrast to the findings of Sarfraz et al. (2018), where 80.2% of the patients were male smokers [11].

Our study identified cough as the most frequent complaint, followed by chest pain and hoarseness, consistent with findings from Iyen-Omofoman et al. (2013), who also reported cough as the leading symptom [12]. Our study found that other systemic

symptoms such as weight loss (29%) and breathlessness (24%) were less common, reflecting early-stage disease, which is consistent with findings by Hamdani et al. (2022), where these symptoms were often seen in advanced cases [13].

In terms of radiological findings, our study demonstrated a predominance of lesions in the upper lobes, particularly the right lung, which corresponds with the findings of Hamdani et al. (2022) [13] and Mohiuddin et al. (2024) [9], where upper lobe lesions were most frequent. These studies suggest that the upper lobes are more prone to malignant lesions, likely due to increased exposure to carcinogens in the upper airway. The left lower lobe involvement was minimal in our study (7%), consistent with reports by Raj et al. (2023), where lower lobe lesions were less frequently associated with lung cancer [14].

Peripheral masses (58.53%) were the most common radiological pattern in our study, followed by cavitary lesions (26.8%). Raj et al. (2023) similarly identified peripheral masses as the predominant radiological pattern. Cavitary lesions, observed in 26.8% of our patients, are typically seen in advanced stages of cancer.

The vast majority of lesions in our study were classified as malignant on CT scan (97.56%), a finding that aligns with the study by Mohiuddin et al. (2024) [9], where malignant lesions predominated in the cohort of lung cancer patients. This is not surprising, given that patients with symptoms suggestive of malignancy are more likely to be referred for advanced imaging.

In our study, adenocarcinoma was the most common tumor type (70.73%), consistent with the findings of Mohiuddin et al. (2024) [9], where adenocarcinoma was the predominant histopathological subtype. This aligns with global trends, as adenocarcinoma has been increasingly recognized as the most common lung cancer subtype, especially in non-smoker.

CONCLUSION

In conclusion, the findings from this study largely align with the results of previous studies in terms of the clinical presentation, radiological features, and histopathological patterns of lung cancer. The female predominance, the high frequency of peripheral masses, and the predominance of adenocarcinoma are consistent with global trends. However, some regional variations were observed, particularly with respect to smoking habits and lesion size. These differences highlight the importance of considering regional characteristics when diagnosing and managing lung cancer. Further studies involving larger sample sizes and diverse populations are needed to better understand the variations in lung cancer presentation and improve diagnostic accuracy across different demographics.

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