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TO ASSESS MULTIDETECTOR COMPUTED TOMOGRAPHY IN EVALUATION OF MALIGNANT LUNG LESIONS

Radio-Diagnosis

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ABSTRACT

Background: Lung cancer remains one of the leading causes of cancer-related mortality worldwide. Accurate characterization and staging of malignant lung lesions are essential for appropriate treatment planning. Multidetector computed tomography (MDCT) provides detailed anatomical information and plays a crucial role in the evaluation of pulmonary malignancies. **Methods:** This cross-sectional study was conducted in the Department of Radiodiagnosis, Sri Aurobindo Medical College and Postgraduate Institute, Indore, from June 2024 to November 2025. Fifty patients with histopathologically confirmed malignant lung lesions who underwent MDCT chest examination were included. Lesions were evaluated for location, size, contour, enhancement pattern, internal characteristics, local invasion, lymph node involvement, and associated thoracic findings. MDCT findings were correlated with histopathological diagnosis. Diagnostic performance parameters including sensitivity, specificity, positive predictive value, negative predictive value, diagnostic accuracy, and Cohen's kappa coefficient were calculated. **Results:** The mean age of patients was 61.8 ± 10.7 years, with a male predominance (76.0%). Peripheral lesions (58.0%) were more common than central lesions (42.0%). Lobulated/irregular margins (44.0%) and heterogeneous enhancement (70.0%) were the predominant imaging features. Pleural involvement (36.0%), hilar lymphadenopathy (52.0%), and mediastinal lymphadenopathy (48.0%) were frequently observed. Histopathology revealed adenocarcinoma as the most common subtype (40.0%), followed by squamous cell carcinoma (30.0%). MDCT showed an overall concordance of 88.0% with histopathology and demonstrated a sensitivity of 92.0%, specificity of 85.7%, positive predictive value of 95.8%, negative predictive value of 75.0%, and diagnostic accuracy of 90.0%. Cohen's kappa coefficient was 0.84, indicating almost perfect agreement. **Conclusion:** MDCT is a highly accurate imaging modality for characterization, staging, and pre-treatment evaluation of malignant lung lesions, showing excellent correlation with histopathological diagnosis.

KEYWORDS

Multidetector Computed Tomography, Lung Cancer, Malignant Lung Lesions, Histopathology, Diagnostic Accuracy

INTRODUCTION

Lung malignancies constitute one of the most significant causes of cancer-related morbidity and mortality worldwide. [1] Although the term neoplastic lung disease encompasses both benign and malignant tumors, the majority of clinically important pulmonary neoplasms are malignant in nature. [2]

Benign pulmonary tumors such as hamartomas and adenomas are relatively uncommon, whereas malignant lesions may arise primarily within the lung or occur secondary to metastatic spread from extrapulmonary malignancies. [3]

Lung cancer is the most common cause of cancer-related death in men and the second most common cause of cancer-related death in women worldwide. It remains a major public health concern because of its high incidence and poor survival rates. The strongest prognostic factor influencing survival in patients with lung cancer is the resectability of the tumor at the time of diagnosis. Bronchogenic carcinoma accounts for the majority of primary lung malignancies and is often used synonymously with lung cancer. Other less common malignant pulmonary neoplasms include pulmonary lymphoma and sarcoma. [3,4]

Based on anatomical location, bronchogenic carcinomas are broadly classified into central and peripheral tumors. Central lung cancers are predominantly represented by squamous cell carcinoma and small cell lung carcinoma, whereas peripheral lung cancers are most commonly adenocarcinoma and large cell carcinoma. Histopathologically, lung cancers are categorized into small cell lung carcinoma (SCLC) and non-small cell lung carcinoma (NSCLC), the latter including squamous cell carcinoma, adenocarcinoma, and large cell carcinoma. [5]

Accurate imaging plays a crucial role in the detection, characterization staging, and management of malignant lung lesions. Multidetector computed tomography (MDCT) has emerged as a highly valuable imaging modality owing to its excellent spatial resolution and ability to provide detailed anatomical information. MDCT can identify several imaging features suggestive of malignancy, including irregular or spiculated margins, pleural tags, bronchial cut-off sign, feeding vessel sign, associated collapse or consolidation, cavitation, and mediastinal or hilar lymphadenopathy. These imaging characteristics aid in differentiating malignant lesions from benign pulmonary abnormalities. [6]

In addition to lesion detection, MDCT accurately delineates tumor extent, invasion of adjacent structures, lymph node involvement, and distant spread, thereby contributing significantly to disease staging and treatment planning. Furthermore, CT-guided biopsy procedures facilitate histopathological confirmation, which remains the gold standard for diagnosis. [7]

Therefore, the present study was undertaken to evaluate the role of MDCT in the characterization of malignant lung lesions, assessment of their extent and local invasion, and correlation of imaging findings with histopathological diagnosis.

MATERIALAND METHODS

This hospital-based cross-sectional observational study was conducted in the Department of Radiodiagnosis, Sri Aurobindo Medical College and Postgraduate Institute, Indore, Madhya Pradesh, India, over a period of 18 months from June 2024 to November 2025. Institutional Ethics Committee approval was obtained prior to commencement of the study.

A total of 50 patients referred to the Department of Radiodiagnosis for multidetector computed tomography (MDCT) of the chest with clinical or radiological suspicion of malignant lung lesions were enrolled consecutively during the study period. Histopathological diagnosis was considered the reference standard for confirmation of malignancy.

The sample size was determined based on the average institutional case load of patients undergoing MDCT evaluation for suspected malignant lung lesions.

Inclusion Criteria

- Patients of any age group with clinically suspected malignant lung lesions who underwent both MDCT chest examination and histopathological evaluation during the study period were included.
- Patients with incidentally detected malignant lung lesions on MDCT were also included.

Exclusion Criteria

- Patients with a history of hypersensitivity to intravenous contrast agents, deranged renal function precluding contrast administration, pregnant women, and patients unwilling to provide informed consent were excluded from the study.

METHODOLOGY

MDCT Protocol: All examinations were performed using a 128-slice

multidetector CT scanner. Following acquisition of a scout topogram, axial images were obtained from the thoracic inlet to the suprarenal region with the patient in the supine position during breath-hold. Non-contrast scans were acquired initially, followed by contrast-enhanced scans using low-osmolar non-ionic iodinated contrast material administered intravenously.

Images were reconstructed with a slice thickness of 5 mm and reconstruction interval of 0.6 mm. Multiplanar reformations including sagittal and coronal images, along with three-dimensional reconstructions, were generated whenever required. Images were reviewed using standard mediastinal, lung, and bone window settings.

Image Analysis: All CT examinations were interpreted by experienced radiologists. The lesions were evaluated for location (central or peri-pheral), size, morphology, margins, attenuation characteristics, enhancement pattern, cavitation, calcification, necrosis, airway involvement, pleural invasion, chest wall infiltration, mediastinal extension, associated collapse or consolidation, lymphadenopathy, and distant metastases. The extent of disease and adjacent structure involvement were documented.

Histopathological Correlation: Histopathological examination of biopsy or surgical specimens served as the gold standard. MDCT findings were correlated with histopathological diagnosis to assess the accuracy of imaging in characterization of malignant lung lesions.

Outcome Measures

The primary outcomes included assessment of the imaging characteristics of malignant lung lesions on MDCT, evaluation of lesion extent and local invasion, and correlation of MDCT findings with histopathological diagnosis.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. The Chi-square test was used to determine associations between categorical variables. A p-value of less than 0.05 was considered statistically significant. Diagnostic performance of MDCT was assessed by calculating sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy using histopathological findings as the reference standard.

RESULTS

A total of 50 patients with histopathologically confirmed malignant lung lesions were included in the study. The mean age of the study population was 61.8 ± 10.7 years, with the majority of patients (34.0%) belonging to the 61–70 years age group. Males constituted 38 (76.0%) cases, while females accounted for 12 (24.0%), resulting in a male-to-female ratio of 3.2:1. Smoking history was present in 34 (68.0%) patients. The most common presenting symptom was cough (84.0%), followed by dyspnea (58.0%), chest pain (52.0%), and weight loss (46.0%) (Table 1, Figure 1).

Table 1. Baseline demographic and clinical characteristics of the study participants

Variable	Category	n	%
Age (years)	≤40	4	8.0
	41–50	9	18.0
	51–60	14	28.0
	61–70	17	34.0
	>70	6	12.0
Gender	Male	38	76.0
	Female	12	24.0
Smoking Status	Smoker	34	68.0
	Non-smoker	16	32.0
Clinical Presentation*	Cough	42	84.0
	Dyspnea	29	58.0
	Chest pain	26	52.0
	Weight loss	23	46.0
	Hemoptysis	16	32.0
	Fever	11	22.0

***Multiple responses possible.**

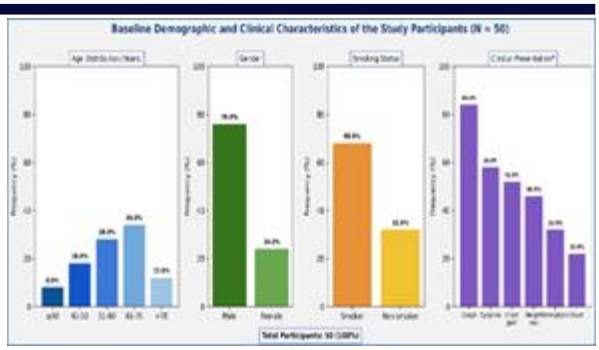

Figure 1. Baseline demographic and clinical characteristics of the study participants

MDCT evaluation showed that peripheral lesions (58.0%) were more common than central lesions (42.0%). Lobulated/irregular (44.0%) and spiculated margins (34.0%) were the predominant contour patterns. Most lesions were large at presentation, with 52.0% measuring >5 cm and 28.0% exceeding 7 cm. Among internal characteristics, heterogeneous enhancement (70.0%) was the most frequent finding, followed by necrosis (44.0%). Cavitation was observed in 20.0% of lesions, while calcification was present in only 8.0%. (Table 2, Figure 2).

Table 2. MDCT Characteristics of Malignant Lung Lesions (n = 50)

Variable	Frequency (n=50)	Percentage (%)
Location		
Central	21	42.0
Peripheral	29	58.0
Contour		
Lobulated/Irregular	22	44.0
Spiculated	17	34.0
Irregular Thick-Walled Cavity	5	10.0
Smooth	3	6.0
Ill-defined	3	6.0
Size of Lesion		
1–2 cm	2	4.0
2–3 cm	4	8.0
3–4 cm	8	16.0
4–5 cm	10	20.0
5–7 cm	12	24.0
>7 cm	14	28.0
Internal Characteristics		
Heterogeneous Enhancement	35	70.0
Necrosis	22	44.0
Cavitation	10	20.0
Calcification	4	8.0

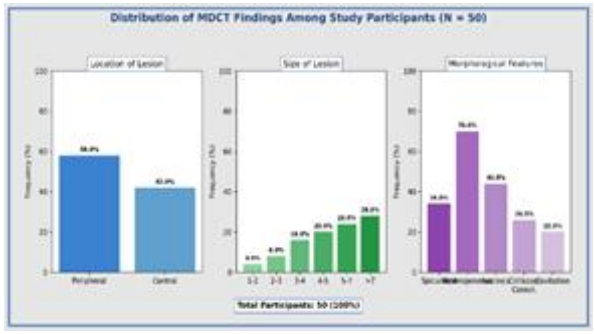

Figure 2: MDCT Characteristics of Malignant Lung Lesions (n = 50)

Associated thoracic findings on MDCT included pleural thickening/involvement (36.0%), bronchial cut-off sign (30.0%), and pleural effusion (30.0%). Collapse, interstitial thickening, and consolidation were observed in 26.0%, 22.0%, and 16.0% of patients, respectively. Local tumor extension was evident as mediastinal infiltration (24.0%) and chest wall infiltration (16.0%). Lymph node involvement was common, with hilar lymphadenopathy (52.0%), mediastinal lymphadenopathy (48.0%), and subcarinal lymphadenopathy (40.0%) being the most frequent nodal findings. These findings highlight the role of MDCT in assessing local invasion and regional nodal spread of malignant lung lesions (Table 5, Figure 3).

Table 3. Associated Findings, Local Invasion and Nodal Disease on MDCT (n = 50)

Variable	Frequency (n=50)	Percentage (%)
Bronchial Cut-off Sign	15	30.0
Satellite Lesions	8	16.0
Collapse	13	26.0
Consolidation	8	16.0
Interstitial Thickening	11	22.0
Pleural Thickening/Involvement	18	36.0
Pleural Effusion	15	30.0
Chest Wall Infiltration	8	16.0
Mediastinal Infiltration	12	24.0
Hilar Lymphadenopathy	26	52.0
Mediastinal Lymphadenopathy	24	48.0
Peribronchial Nodes	12	24.0
Subcarinal Nodes	20	40.0
Contralateral Mediastinal Nodes	8	16.0
Supraclavicular Nodes	6	12.0

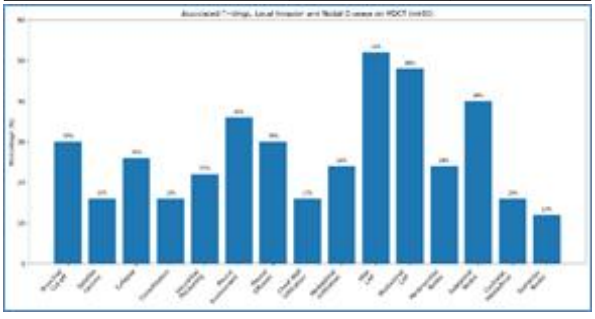

Figure 3. Distribution of MDCT findings among study participants

Histopathological examination revealed that adenocarcinoma was the most common malignant lung lesion, accounting for 20 (40.0%) cases, followed by squamous cell carcinoma in 15 (30.0%) patients. Small cell lung carcinoma was identified in 8 (16.0%) cases, while metastatic malignancies and large cell carcinoma constituted 8.0% and 6.0% of cases, respectively. Overall, non-small cell lung carcinoma (NSCLC) represented the majority of malignant lung lesions in the study population (Table 4, Figure 4).

Table 4. Histopathological Distribution of Malignant Lung Lesions (n = 50)

Histopathological Diagnosis	Frequency (n=50)	Percentage (%)
Adenocarcinoma	20	40.0
Squamous Cell Carcinoma	15	30.0
Small Cell Lung Carcinoma	8	16.0
Metastatic Malignancy	4	8.0
Large Cell Carcinoma	3	6.0
Total	50	100.0

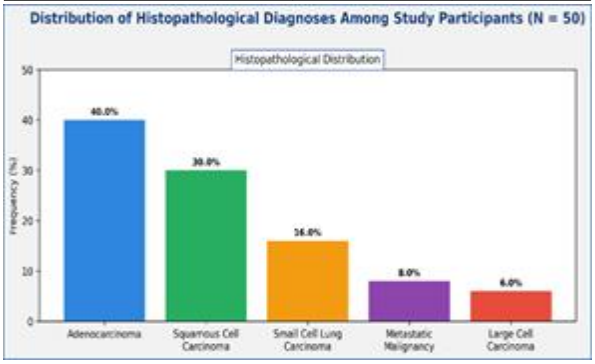

Figure 4. Histopathological distribution of malignant lung lesions

MDCT showed a high degree of agreement with histopathological diagnosis, with an overall concordance of 88.0%. The highest concordance was observed for metastatic lesions (100.0%) and adenocarcinoma (90.0%), while the lowest was seen in large cell carcinoma (66.7%). These findings indicate that MDCT is highly reliable for the characterization and preoperative evaluation of malignant lung lesions, demonstrating excellent correlation with histopathology. (Table 5).

Table 5. Correlation of MDCT Diagnosis with Histopathological Diagnosis (n = 50)

Histopathological Diagnosis	MDCT Diagnosis (n)	Histopathology (n)	Concordance (%)
Adenocarcinoma	18	20	90.0
Squamous Cell Carcinoma	13	15	86.7
Small Cell Lung Carcinoma	7	8	87.5
Large Cell Carcinoma	2	3	66.7
Metastatic Lesions	4	4	100.0
Overall Agreement	44	50	88.0

MDCT demonstrated a high degree of agreement with histopathological diagnosis, with an overall concordance of 88.0%. The highest concordance was observed for metastatic lesions (100.0%) and adenocarcinoma (90.0%), while the lowest concordance was seen in large cell carcinoma (66.7%). Cohen's Kappa analysis demonstrated almost perfect agreement (κ = 0.84) between MDCT and histopathological diagnosis, indicating excellent reliability of MDCT in predicting the histological nature of malignant lung lesions. These findings indicate excellent diagnostic correlation between MDCT and histopathology, supporting the utility of MDCT as a reliable modality for characterization and pre-treatment evaluation of malignant lung lesions.

Table 6. Diagnostic Performance and Agreement of MDCT with Histopathological Diagnosis (n = 50)

Parameter	Value
Overall Concordance (%)	88.0
Cohen's Kappa Coefficient (κ)	0.84
Strength of Agreement	Almost Perfect
Sensitivity (%)	92.0
Specificity (%)	85.7
Positive Predictive Value (%)	95.8
Negative Predictive Value (%)	75.0
Diagnostic Accuracy (%)	90.0

DISCUSSION

The present study was conducted to assess the role of multidetector computed tomography (MDCT) in the evaluation of malignant lung lesions and to correlate MDCT findings with histopathological diagnosis. A total of 50 histopathologically confirmed cases of malignant lung lesions were evaluated. The mean age of the study population was 61.8 ± 10.7 years, with the majority of patients belonging to the 61–70 years age group (34.0%). Males constituted 76.0% of the study population, with a male-to-female ratio of 3.2:1, and 68.0% of patients had a history of smoking. These findings are comparable to those reported by Nadaraj et al., who observed that 77.5% of patients were males, with the highest proportion belonging to the 61–70 years age group (47.5%), reflecting the established association between lung cancer, male gender, advancing age, and smoking exposure. [1] Similarly, Khanduri et al. reported a predominance of male patients and smokers among individuals with suspected lung malignancies. Cough (84.0%), dyspnea (58.0%), chest pain (52.0%), and weight loss (46.0%) were the most common presenting symptoms in our study, findings that are consistent with previous reports describing respiratory symptoms as the predominant clinical manifestations of lung cancer.[8]

MDCT evaluation demonstrated that peripheral lesions (58.0%) were more common than central lesions (42.0%). The most frequent contour patterns were lobulated or irregular margins (44.0%) and spiculated margins (34.0%), both of which are classical imaging features suggestive of malignancy. More than half of the lesions measured greater than 5 cm in diameter, indicating advanced disease at presentation. Among the internal characteristics, heterogeneous enhancement (70.0%) was the most common finding, followed by necrosis (44.0%), cavitation (20.0%), and calcification (8.0%). Similar observations were reported by Ananthasayanam et al. [9], who found malignant lesions to be characterized by irregular contours, heterogeneous attenuation, and significant contrast enhancement. Nadaraj et al. [1] also documented necrosis in 31 cases, cavitation in 13 cases, and multiple irregular morphological features in malignant lung lesions. These findings support the ability of MDCT to accurately characterize lesion morphology and identify features strongly suggestive of malignancy.

The present study also demonstrated several important associated thoracic findings. Pleural thickening or pleural involvement (36.0%), bronchial cut-off sign (30.0%), and pleural effusion (30.0%) were among the most frequently observed features. Collapse, interstitial thickening, and consolidation were identified in 26.0%, 22.0%, and

16.0% of patients, respectively. Comparable findings were reported by Nadaraj et al. [1], who documented pleural thickening in 35 cases, bronchial cut-off sign in 37 cases, collapse in 37 cases, consolidation in 17 cases, and interstitial thickening in 30 cases. Such findings indicate the significant impact of malignant lesions on adjacent lung parenchyma and airways and highlight the utility of MDCT in assessing disease extent beyond the primary tumor.

Assessment of local invasion revealed mediastinal infiltration in 24.0% and chest wall infiltration in 16.0% of patients. These findings are clinically significant because they directly influence tumor staging, resectability, and treatment planning. Similar observations were reported by Khanduri et al. [8] and Nadaraj et al. [1], both of whom emphasized the role of MDCT in accurately identifying local extension of bronchogenic carcinoma. The ability of MDCT to delineate mediastinal and chest wall involvement provides valuable information for determining operability and selecting appropriate therapeutic strategies.

Lymph node involvement was common in the present study, with hilar lymphadenopathy (52.0%), mediastinal lymphadenopathy (48.0%), and subcarinal lymphadenopathy (40.0%) being the most frequent nodal findings. Peribronchial, contralateral mediastinal, and supraclavicular lymph node involvement were also observed. These findings are in agreement with the observations of Pandey et al. [10], who demonstrated high diagnostic accuracy of MDCT in evaluating thoracic masses and nodal disease. Accurate assessment of lymph node involvement is essential for TNM staging, prognostication, and treatment planning, and MDCT remains one of the most effective imaging modalities for this purpose.

Histopathological examination revealed that adenocarcinoma (40.0%) was the most common malignant lung lesion, followed by squamous cell carcinoma (30.0%), small cell lung carcinoma (16.0%), metastatic malignancy (8.0%), and large cell carcinoma (6.0%). These findings are similar to those reported by Kumar et al. [2], who also identified adenocarcinoma as the predominant histological subtype. Similar observations have been reported by Lu et al. [11], who highlighted the predominance and heterogeneity of lung adenocarcinoma among patients with lung malignancies. In contrast, Nadaraj et al. [1] and Khanduri et al. [8] reported squamous cell carcinoma as the most common subtype. The increasing predominance of adenocarcinoma observed in recent studies may be attributable to changing smoking habits, environmental exposures, and improved detection of peripheral lung lesions by advanced imaging techniques.

Correlation between MDCT diagnosis and histopathological findings demonstrated a high degree of agreement in the present study, with an overall concordance of 88.0%. Concordance was highest for metastatic lesions (100.0%) and adenocarcinoma (90.0%). Similar findings were reported by Nadaraj et al. [1], who demonstrated substantial agreement between CT diagnosis and histopathological diagnosis with a Kappa value of 0.746. Likewise, Ananthasayanam et al. [9] reported excellent correlation between MDCT findings and histopathological diagnosis, emphasizing the value of MDCT in lesion characterization and pre-procedural planning.

The diagnostic performance of MDCT in the present study was excellent, with a sensitivity of 92.0%, specificity of 85.7%, positive predictive value of 95.8%, negative predictive value of 75.0%, and an overall diagnostic accuracy of 90.0%. These findings are comparable with those reported by Khanduri et al. [8], who documented a sensitivity of 97.3%, specificity of 76.9%, and diagnostic accuracy of 92.0%. Nadaraj et al. [1] reported a positive predictive value of approximately 97%, while Ananthasayanam et al. [9] demonstrated sensitivity of 100%, specificity of 77.8%, and excellent diagnostic performance of MDCT. Similarly, Pandey et al. [10] reported sensitivity, specificity, and diagnostic accuracy of 94%, 90%, and 93%, respectively. The comparable results observed across studies further validate the reliability and effectiveness of MDCT in the diagnosis and evaluation of malignant thoracic lesions.

Agreement analysis using Cohen's Kappa statistic demonstrated a κ value of 0.84, indicating almost perfect agreement between MDCT diagnosis and histopathological diagnosis. Similar findings have been reported by Nadaraj et al. [1], who observed a Kappa value of 0.746, indicating substantial agreement between CT diagnosis and histopathological findings in patients with bronchogenic carcinoma. These findings were comparable to those reported by Mohammed et al. [12]. The slightly higher agreement observed in the present study may be attributed to advances in multidetector CT technology and improved image reconstruction techniques, allowing better lesion characterization and assessment of tumor morphology.

Overall, the present study demonstrates that MDCT plays a pivotal role in the evaluation of malignant lung lesions by providing detailed information regarding lesion morphology, extent of disease, local invasion, lymph node involvement, and distant metastases. The strong concordance observed between MDCT and histopathological findings highlights its reliability in lesion characterization and pre-treatment assessment.

Despite these strengths, certain limitations should be acknowledged. The study was conducted at a single tertiary care center with a relatively limited sample size, which may affect the broader applicability of the findings. In addition, PET-CT was not routinely available for comparative assessment of staging accuracy, and the absence of long-term follow-up precluded evaluation of treatment response, survival outcomes, and prognostic implications.

CONCLUSION

MDCT is a highly effective and reliable imaging modality for the evaluation of malignant lung lesions. It provides comprehensive information regarding lesion location, morphology, enhancement characteristics, local invasion, lymph node involvement, and disease extent, thereby facilitating accurate diagnosis and staging. In the present study, MDCT demonstrated high diagnostic performance with excellent agreement with histopathological findings, highlighting its value in characterizing various histological subtypes of lung malignancies. The ability of MDCT to accurately assess tumor spread and correlate with pathological diagnosis makes it an indispensable tool for treatment planning, prognostication, and overall management of patients with malignant lung lesions.

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