

Performance of Radiological Diagnosis of Malignant Lesions of Lung

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Abstract:

Background:

Lung cancer is the leading cause of death in Bangladesh especially in the northern zone. CT guided core biopsy of lung helps in confirming histopathological diagnosis of lung tumor. Radiological performance for diagnosing lung malignancies relies on methods like CT, though sensitivity, specificity, and accuracy can vary based on lesion size and radiologist experience.

Methods:

This cross-sectional study was conducted at Department of Respiratory Medicine, Rangpur Medical College, Rangpur, Bangladesh from January 2023 to December 2023 on 102 patients with suspected bronchial carcinoma. CT scan of chest was performed for all the patients followed by CT guided core biopsy of lung for histopathology. Sensitivity, specificity, Positive predictive value (PPV), Negative predictive value (NPV), and accuracy of radiological diagnosis were calculated.

Results:

Most patients (63%) were aged 51-70, with a male-to-female ratio of 2.6:1. CT scans showed 79% with bronchial neoplasm and 21% with inflammation. Histopathology revealed 77% had bronchial carcinoma, with various types identified, Adenocarcinoma (29%), Squamous cell carcinoma (43%), Small cell carcinoma (16%), neuroendocrine carcinoma (6%), metastatic leiomyosarcoma (1.2%), metastatic GIST (1.2%) and undifferentiated carcinoma (1.2%). Sensitivity, specificity, Positive predictive value (PPV), Negative predictive value (NPV), and accuracy of radiological diagnosis of bronchial carcinoma were respectively 100%, 91.3%, 97.5%, 100% and 98.0%.

Conclusion:

CT scan can differentiate malignant lesions from inflammatory lung lesions with high performance, though histological confirmation of malignant lesions are mandatory.

Key words: Bronchial carcinoma, CT scan, CT guided core biopsy, Sensitivity, Specificity, PPV, NPV, Accuracy

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Introduction:

Lung cancer is the neoplasm with the highest prevalence and mortality rates in the world (1.35 million new cases and 1.8 million deaths per year). Although most patients present at an advanced stage, those with early-stage lung cancer may be treated with potentially curative intent. Therefore, the importance of early diagnosis and an appropriate radiological staging cannot be underestimated. Most patients with lung cancer that are symptomatic have hemoptysis, coughing,

shortness of breath, chest pain and persistent infections. Less than 10% of patients are asymptomatic when the tumor is detected as an incidental finding.¹

Chest x-ray (CXR) is the first investigation performed during the workup of suspected lung cancer. It has found extensive use in the past for widespread availability, technical feasibility, low risk and low cost. Once a suspicious lesion is detected, more detailed morphological information is required. Lung tumors may present as central or peripheral masses, even those of the

in-situ adenocarcinoma that may present as an area of chronic air space disease. The central neoplasm may have hilar lymph node enlargement, mediastinal invasion or bronchial obstruction, with partial or total lung collapse; a parenchymal consolidation or superinfection may exist, which may mask or be the first sign of a possible underlying neoplasm.¹

Computed tomography-guided percutaneous transthoracic needle biopsy (PTNB) has become a widely accepted technique for establishing a diagnosis in patients with pulmonary lesions due to its high accuracy, ranging from 83–97%. This procedure is minimally invasive, safe, and has a short recovery time and a low complication rate.² The overall diagnostic accuracy of CT-guided biopsy (FNAB plus CNB) was 92.1% with a sensitivity of 92.1% and a specificity of around 100% for the diagnosis of malignancy. CNB has a slightly higher sensitivity, specificity and accuracy for detecting a malignancy in comparison with FNAB.³ However, the accuracy decreases (60%-80%) in nodules that are smaller than 2cm in diameter.⁴ Whereas FNAB provides only cytology specimens for smears and/or cell blocks, CNB yields a tissue specimen. Although FNAB is a useful technique for the diagnosis of lung cancer, CNB provides the advantage of facilitating a histology with preservation of the architectural context of lesional cells and their microenvironment. But due to lack of facilities, CNB is not feasible everywhere. Many a times CT scan is used to distinguish malignant to inflammatory lesions.

Sensitivity, specificity, Positive predictive value (PPV), Negative predictive value (NPV), and accuracy of CT scan on detecting malignant and inflammatory lesions differed from study to study as it based on quality of CT scan, lesion size and radiologist experience. There is inadequate data in Bangladesh specially in this northern part on this issue. So, we aimed to detect the radiological performance of CT scan for diagnosing lung malignancies.

Methods:

The cross-sectional study was carried out in the Department of Respiratory Medicine, Rangpur Medical College, Rangpur, Bangladesh during the period from January, 2023 to December, 2023. A total of 102 patients were enrolled for study. All patients were clinically assessed. CT-scan of chest

was performed and reported by an experienced radiologist. Density of the chest lesion were measured. Density above 40 Hounsfield unit (HU) is considered as soft tissue growth and density below 40 HU is considered as inflammatory lesion.⁵ In this study 50-100 HU lesion is considered as neoplastic growth. Radiologically growth with irregular margin is considered as neoplastic and growth with smooth margin as benign lesion. For the biopsy processes depending on the lesion location, patients were placed in prone, supine, or lateral positions. Appropriate puncture pathway was determined by performing CT scan and marked with a skin marker. Repeating CT scan was used to ensure the right localization of the skin marker. After local anesthesia, a localization needle was inserted into the chest wall without puncturing the pleura, to indicate the needle entry route. Then, the needle was directly advanced into the lung and fired to obtain a specimen (typically 2-3 specimens and 2 cm in length of each one). The biopsy specimens were fixed in 10% formalin immediately and were sent for histopathology. After biopsy, the outpatients were asked to stay in the waiting room for at least 1 hour with observation of the nurses and the inpatients were sent back to the ward to remain under physicians' observation. Post biopsy CT scan was used to identify procedure-related complications.³

Results:

In this study majority (63%) of the participants belonged to the age group of 51 to 70 years of age, and male: female ratio=2.6:1 (Table-I).

Table-I: Age and sex of patients (N=102)

Variables	no. (%)
Age Group (Years)	
1-20	3(2.94)
20-30	3(2.94)
31-40	4(3.92)
41-50	12(11.65)
51-60	33(32.35)
61-70	32(31.37)
71-80	11(10.78)
81-90	4(3.92)
Sex	
Male	73(72)
female	29(28)

All patients were assessed by CT scan of chest and density of lesion were measured. Density above 40 HU is considered as soft tissue growth. Radiologically 79.41% of patients were diagnosed with bronchial neoplasm and 20.51% of patients had Inflammation (Table-II).

Table-II: Radiological and histopathological diagnosis of lung lesion (N=102)

Diagnosis Type	CT Scan (Radiology)	Histopathology (Gold Standard)
Bronchial carcinoma (malignant)	81(79.41%)	79(77.45%)
Inflammatory lesion (benign)	21(20.59%)	23(22.55%)

On histology, 77.45% of patients were diagnosed with bronchial carcinoma and 20.59% of patients were diagnosed as inflammatory lesion. Among inflammatory lesions, 2.94% as pulmonary tuberculosis, 1.96% of patients have a diffuse parenchymal lung disease like cryptogenic organising pneumonia, 17.64% of patients as inflammatory lesion like pneumonia (Figure-1).

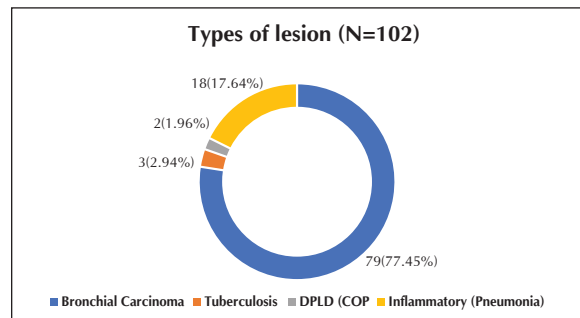


Figure-1: Histopathological diagnosis of lung lesion (=102)

Adenocarcinoma (30.37%) and squamous cell carcinoma (43.03%) were common bronchial neoplasms (Figure-2).

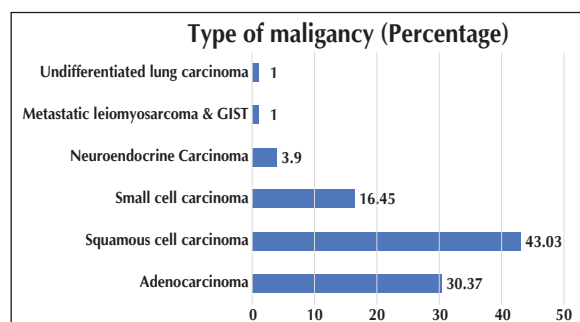


Figure-2: Types of bronchial carcinoma on histology (n=79)

CT scan is highly sensitive (100%) for detecting malignant lung lesions, excellent for ruling out malignancy. Specificity (91.3%) is moderate, meaning a few benign inflammatory lesions are overcalled as malignant. PPV (Positive Predictive Value) and NPV (Negative Predictive Value) were respectively 97.5% and 100%. Overall, accuracy of 98.0% shows CT is a reliable screening and diagnostic tool, though histopathology remains the gold standard (Table-III).

Table-III: Performance of radiological diagnosis for bronchial carcinoma

	Histopathology Malignant	Histopathology Inflammatory	Total
CT Malignant	77 (TP)	4 (FP)	81
CT Inflammatory	2 (FN)	19 (TN)	21
Total	79	23	102

Sensitivity: $TP / (TP + FN) = 100\%$

Specificity: $TN / (TN + FP) = 91.3\%$

PPV: $TP / (TP + FP) = 97.5\%$

NPV: $TN / (TN + FN) = 100\%$

Accuracy: $(TP + TN) / \text{Total} = 98.0\%$

CT scan shows highly specificity (100%) for inflammatory lesions. Sensitivity (91.3%) is somewhat lower, indicating a few inflammatory lesions were misdiagnosed as malignant. PPV (Positive Predictive Value), and NPV (Negative Predictive Value) were respectively 100% and 97.5%. The overall accuracy (98%) remains strong, supporting CT as a dependable diagnostic tool, though histopathology remains essential for confirmation (Table-IV).

Table-IV: Performance of radiological diagnosis for Inflammatory Lesion

	Histopathology: Inflammatory (+)	Histopathology: Malignant (-)	Total (CT)
CT: Inflammatory (+)	TP=19	FP=2	21
CT: Malignant (-)	FN=4	TN=77	81
Total (Histopathology)	23	79	102

Sensitivity: $TP / (TP + FN) = 91.3\%$

Specificity: $TN / (TN + FP) = 100\%$

PPV: $TP / (TP + FP) = 100\%$

NPV: $TN / (TN + FN) = 97.5\%$

Accuracy: $(TP + TN) / \text{Total} = 98.0\%$

Discussion:

The age of patients belonged to 5-90 years. Out of 102 patients, sixty five patients (63%) were 51-70 years age group where maximum prevalence of bronchogenic carcinoma was seen in between 60 and 69 years of age (50.76%) with distribution from 30 years to 80 years.⁵ Incidence of lung cancer was 27% higher among males compared to female.⁵ We found in this study males were 72% and females are 28% which is 44% higher than female and compatible with study of National Institutes of Health. Out of 79 cases histopathologically diagnosed lung cancer male was 66 (83%) and female was 13 (17%) in this study. Before taking biopsy sample all patients were evaluated by CT scan of chest. Density of lung lesion were measured and expressed as Hounsfield unit (HU). Radio logically HU more than 40 is noted as soft tissue lesion and less than 40 is inflammation or fluid. In this study 50-100 HU lesion is considered as neoplastic growth. Radio-logically 81 (79.41%) patients were diagnosed as neoplasm and 21 (20.59%) patients as inflammatory lesion. After taking core biopsy sample, all specimens were evaluated by a single experienced histopathologist. On histopathology eighty-one (79.41%) cases of neoplasm seventy nine (77.45%) cases were diagnosed as carcinoma of lung and twenty three (22.59%) cases as inflammation. Among inflammation two (1.96%) cases were diagnosed as cryptogenic organizing pneumonia (COP), three (2.94%) cases were diagnosed as pulmonary tuberculosis and eighteen (17.64%) cases were diagnosed as pneumonia. Histopathologically twenty-four (24) cases (30%) were diagnosed as adenocarcinoma of lung, thirty four (34) cases (43%) as Squamous cell carcinoma of lung, thirteen (13) cases (16%) as small cell carcinoma of lung which are compatible with classification of lung tumour. Rest nine cases were diagnosed as neuroendocrine carcinoma 4(5%), metastatic leiomyosarcoma 1(1%), metastatic Gastro-intestinal stromal tumour (GIST) 1(1%), undifferentiated lung carcinoma 1(1%).

Importance of Computed Tomography (CT-scan) for the diagnosis of bronchial carcinoma by core tissue which was confirmed by histopathological examination were assessed where sensitivity, specificity, Positive predictive value (PPV), Negative predictive value (NPV), and accuracy of radiological diagnosis of bronchial carcinoma

were respectively 100%, 91.3%, 97.5%, 100% and 98.0%.

Hoque et al⁶ stated that Role of CT-scan in the evaluation of lung tumor by FNAC examination where sensitivity 97.4%, specificity 76.9%, positive predictive value 92.5%, negative predictive value 90.9%, accuracy 92.2%.⁶ Colic et al showed sensitivity 63-85% and specificity 61-77% as role of CT scan for evaluation of lung carcinoma.⁷ Similarly, Finkelstein et al described sensitivity-59% and specificity 85% about CT-scan in the diagnosis of lung cancer.⁸ Patel D et al showed sensitivity -92.4%, specificity - 88.3%, positive predictive value -90.1%, negative predictive value -90.8% for evaluation of low dose CT accuracy in detecting pulmonary nodules in smokers.⁹ The mean sensitivity, specificity, accuracy, PPV, NPV, and AUC (95%CI) of Plain CT only were 0.79, 0.78, 0.79, 0.67, 0.87, and 0.88 (95%CI, 0.82–0.93), Plain+Contrast CT were 0.88, 0.91, 0.90, 0.84, 0.93, 0.93 (95%CI, 0.88–0.98) in external validation cohort, respectively.¹⁰ With a cut-off TTP of 18.10 s to distinguish inflammatory pseudotumors (IPNs) from malignant solitary pulmonary nodules (SPNs), the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were 92.0%, 97.3%, 97.3%, 96.0%, and 96.9%, respectively. The sensitivity, specificity, and accuracy of CT plain scan combined with DI-CTP in diagnosing pulmonary nodules were 100%, 96.83%, and 98.97%, respectively.¹¹ CT is the imaging modality of choice for evaluating suspected inflammatory lung disease. However, its role is to detect the pattern and extent of disease, not to provide a specific pathological diagnosis. In this study, performance of CT scan in detecting inflammatory lesions was high. Sensitivity, specificity, Positive predictive value (PPV), Negative predictive value (NPV), and accuracy of radiological diagnosis of inflammatory lesions were respectively 91.3%, 100%, 100%, 97.5%, and 98.0%.

CT is exquisitely sensitive for detecting parenchymal abnormalities, with sensitivity for detecting any abnormality in diffuse lung disease often cited as >95%.¹² For idiopathic pulmonary fibrosis (IPF), the specific pattern of "usual interstitial pneumonia (UIP)" on HRCT has a high specificity of approximately 90% for the histopathologic UIP pattern.¹² PPV and NPV: These are highly variable and depend entirely on the

specific CT pattern and the clinical pre-test probability. For example, in a pandemic setting with a high pre-test probability, the PPV of a classic COVID-19 CT pattern is high.¹³

Conclusion:

CT scanning is an indispensable, highly sensitive tool for detecting both malignant and inflammatory lung lesions. The anatomical changes seen at CT often do not have a one-to-one correlation with a specific histopathological diagnosis. Therefore, while CT scan strongly suggests malignancy or characterize the pattern of inflammation, histopathology remains the definitive gold standard for diagnosing lung cancer and specifying the type of interstitial lung disease or pneumonia.

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