Journal of Cardiovascular Disease Research
ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 10, 2024

"Diagnostic Accuracy Of Multidetector Computed Tomography (MDCT) In Evaluation Of Suspected Cases Of Carcinoma Lung In Comparison With Histopathology".

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Abstract:
Introduction: Multidetector CT (MDCT), is the newest technological development that have revolutionized the diagnostic approach to diseases of the chest including lung cancer. MDCT will allow improved detection of pleural dissemination and hilar lymph node adenopathy because of the continuous and narrow scan collimation. It has considerable advantage over single-detector helical CT in the form of shorter acquisition time, greater coverage, and superior image resolution. Besides, it also has a role in characterizing them as benign or malignant. Hence the present study is aimed at evaluating the imaging characteristics and diagnostic accuracy of Carcinoma lung by 128-slice MDCT scanner, in comparison with histopathology.
Methodology: A prospective observational study was conducted over a period of 22 months in all 46 patients referred to the Department of Radiodiagnosis for CT scan of chest during February 2022 to April 2023, with clinical/radiological suspicion of Carcinoma Lung after obtaining ethical committee clearance and written informed consent from patients. Purposive sampling method was used. Scanning was performed by a 128-slice CT scanner (Ingenuity CT; Philips Medical Systems, Best, the Netherlands). The Pre and Post contrast images were viewed and analysed by a single radiologist. Radiological diagnosis was compared histologically. Diagnostic accuracy of MDCT in diagnosis of bronchogenic carcinoma was calculated with pathological diagnosis as Gold standard $P<0.05$ was considered as statistically significant.
Results: Study population included 28 males and 18 females. Mean age of study population was 61.61 years ± 11.7 years in the range of 38-82 years. Provisional CT diagnosis of Bronchogenic carcinoma was given in 46 patients of which 37 were positive on pathology. Of the 9 false positive cases, 8 cases are diagnosed as inflammatory infiltrate where as one case is diagnosed as metastasis from another site. Of the cases confirmed as bronchogenic carcinoma on pathology, 78.4 % had nodal involvement and 54% had metastasis at time of presentation. Diagnostic accuracy and Positive predictive value of MDCT in diagnosing bronchogenic carcinoma in our study is 80.4%.
Conclusions: Multi Detector Computed Tomography has a high positive predictive value in diagnosis of bronchogenic carcinoma. MDCT is a useful tool in the staging of Bronchogenic Carcinoma. Staging is important in treatment planning and predicting outcome.

Keywords: Multidetector Computed tomography (MDCT), carcinoma lung, Histopathology, Diagnostic accuracy.

Introduction:
In India, lung cancer accounts for 5.9% of all cancers and 8.1% of all cancer-related deaths.[1] Imaging is essential in the screening, diagnosis, staging, response assessment, and surveillance of patients with lung cancer. Subtypes of lung cancer can have distinguishing imaging appearances.[2] Computed tomography (CT), is one of the most frequently used imaging modalities.[3] CT assists in finding abnormalities, highlights signs of disease, monitor the response to treatment and as a support to plan the radiation therapy program. CT plays a role of primary importance in the definition of local invasiveness (sensitivity: 62-93% vs. CXR: 1-2,7%; [4-6]), while it has limits in the evaluation of mediastinal and thoracic pleural invasion [7].
Multidetector CT (MDCT) is the newest technological development that have revolutionized the diagnostic approach to diseases of the chest including lung cancer.[8] The advantages of MDCT include both improved nodule detection and nodule characterization on lung cancer screening programs, because the entire lung can be scanned with thin slice in a single breath-hold without an intersection gap. In the evaluation of lung cancer, MDCT will allow improved detection of pleural dissemination and hilar lymph node adenopathy because of the continuous and narrow scan collimation.[8] It has considerable advantage over single-detector helical CT in the form of shorter acquisition time, greater coverage, and superior image resolution. It identifies small nodules not visible by radiography. Besides, it also has a role in characterizing them as benign or malignant. [9]
Hence the present study is aimed at evaluating the imaging characteristics and diagnostic accuracy of Carcinoma lung by 128-slice MDCT scanner, in comparison with histopathology, and for staging of carcinoma lung in suspected cases of carcinoma lung.

OBJECTIVES
1. To assess the accuracy of multi detector computed tomography in diagnosis of carcinoma lung in comparison with histopathology.
2. To document the various CT appearances of carcinoma.
3. To assess the stage of carcinoma lung.

MATERIAL AND METHODS: A prospective observational study was conducted on all patients referred to the Department of Radiodiagnosis for CT scan of chest (in a tertiary care hospital) during February 2022 to April 2023, with clinical/radiological suspicion of Carcinoma Lung. Informed written consent taken from participating individual and institutional ethical committee clearance was obtained.

Inclusion criteria:
1. Patients with clinically or radiologically suspected carcinoma lung.
2. Patients in whom histopathological findings were available.

Exclusion criteria:
1. Previously diagnosed cases of carcinoma lung.
2. Patients in whom IV contrast is contraindicated
3. Those who are not willing to participate in the study

Sample size was calculated based on formula for finite population**.**
As per previous past 6-month data obtained from department of radiodiagnosis prevalence of patients diagnosed radiologically as having carcinoma lung among suspected cases attending radiodiagnosis department was 89.2% using 128 slice MDCT.
Hence P = Prevalence is 89.2%.
e = allowable error was 5%

N = study population (Patients suspected with carcinoma lung attending our department in the past 6 months was) = 55

$$Sample\ size(n) = \frac{\frac{z^2 X\ p(100-p)}{e^2}}{1 + \frac{z^2 X\ p(100-p)}{e^2 N}}$$

$$Sample\ size(n) = \frac{\frac{(1.96)^2 X\ 89.2(100-89.2)}{(5)^2}}{1 + \frac{(1.96)^2 X\ 89.2(100-89.2)}{(5)^2\ 55}}$$

$$Sample\ size(n) required\ is = 40$$

Sample size with 10% as non-response rate was found to be 44. Purposive sampling method was used and written informed consent was taken from participants.

Technique: A detailed history, previous imaging findings was obtained and recorded in semi structured questionnaire.

Scanning was performed by a 128-slice CT scanner (Ingenuity CT; Philips Medical Systems, Best, the Netherlands). Patients were kept nil orally 4 hours prior to the CT scan and normal serum creatinine levels were ensured to avoid complications while administrating contrast medium. Risks of contrast administration were explained to the patient and consent was obtained prior to the contrast study.

Patient was scanned in supine position with arms above head. Patients were instructed to hold his/her breath at end of inspiration. Routine anteroposterior topogram of the chest was initially taken in all patients in the supine position with the breath held. Axial sections of 1 mm thickness were taken from the level of lung apices to the diaphragm routinely, including the liver and adrenals. In all cases after plain scan, Contrast enhanced images were obtained after intravenous injection of 1ml/kg of iodinated contrast agent, Iomeron 400 at rate of 4ml/sec using bolus tracking. The following parameters will be set while taking the scan

- Slice thickness: 1mm
- Collimation: 0.6mm
- Increment: 0.5mm
- Pitch: 1.015
- Matrix: 512

Post study reconstructions were done. Sagittal and coronal reconstructions were made wherever necessary. The scans were reviewed on a direct display console at multiple window settings. The Pre and Post contrast images were viewed and analysed by a single radiologist. Radiological diagnosis was compared histologically.

Statistical analysis: Data entered in to MS - Excel and analysed using SPSS 22. Continuous variables are expressed in mean and SD and categorical variables as percentages. Diagnostic accuracy of MDCT in diagnosis of bronchogenic carcinoma was calculated with pathological diagnosis as Gold standard $P<0.05$ was considered as statistically significant.

Definitions

- ***Sensitivity*:** probability that a test result will be positive when the disease is present (true positive rate).

= ***a / (a+b)***

- ***Specificity*:** probability that a test result will be negative when the disease is not present (true negative rate).

= ***d / (c+d)***

- ***Positive predictive value*:** probability that the disease is present when the test is positive.

$$PPV = \frac{sensitivity \times prevalence}{sensitivity \times prevalence + (1 - specificity) \times (1 - prevalence)}$$

- ***Negative predictive value*:** probability that the disease is not present when the test is negative.

$$NPV = \frac{specificity \times (1 - prevalence)}{(1 - sensitivity) \times prevalence + specificity \times (1 - prevalence)}$$

- ***Accuracy*:** overall probability that a patient is correctly classified.

= ***Sensitivity* × *Prevalence* + *Specificity* × *(1 − Prevalence)***

Sensitivity, specificity, disease prevalence, positive and negative predictive value as well as accuracy are expressed as percentages.[10]

Results:

Forty-six patients included as per the inclusion criteria - were evaluated with MDCT scan and later followed up with pathology. Pathological diagnosis was considered as the final diagnosis

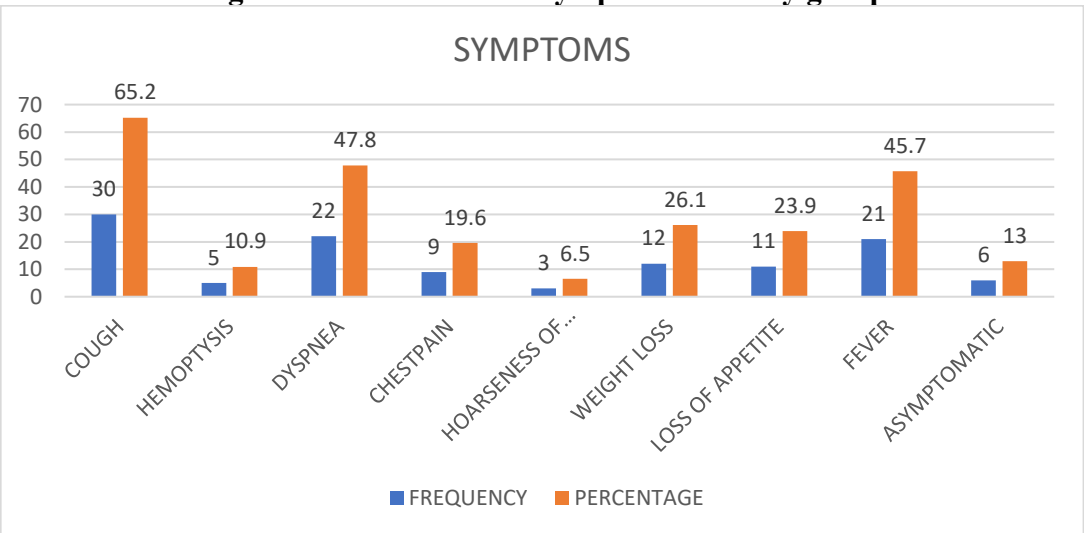
Study population included 28 males and 18 females. Mean age of study population is 61.61 years ± 11.7 years in the range of 38-82 years. (shown in table 1)

Table 1: Distribution by Patient's characteristics

Patient characteristic	Group	Frequency
Age	30-50 Years	10 (21.7%)
	50-70 Years	27 (58.7%)
	>70 years	9 (19.6%)
Mean ±SD of age (in years)		61.61±11.7 years
Sex	Male	28 (60.9%)
	Female	18 (39.1%)

Among the study population, 87% were symptomatic at the time of presentation. 65.2% of patients had cough (n = 30), 10.9% patients had haemoptysis (n =5), 47.8% patients had dyspnoea (n = 22), 19.6% patients had chest pain (n = 9), 6.5 % patients had Hoarseness of voice (n = 3), 26.1 % patients had weight loss (n = 12), 23.9% patients had loss of appetite (n = 11), 45.7% patients had Fever (n = 21) and 13% of patients were asymptomatic (n=6). (shown in figure 1)

Figure 1: Distribution of symptoms in study group



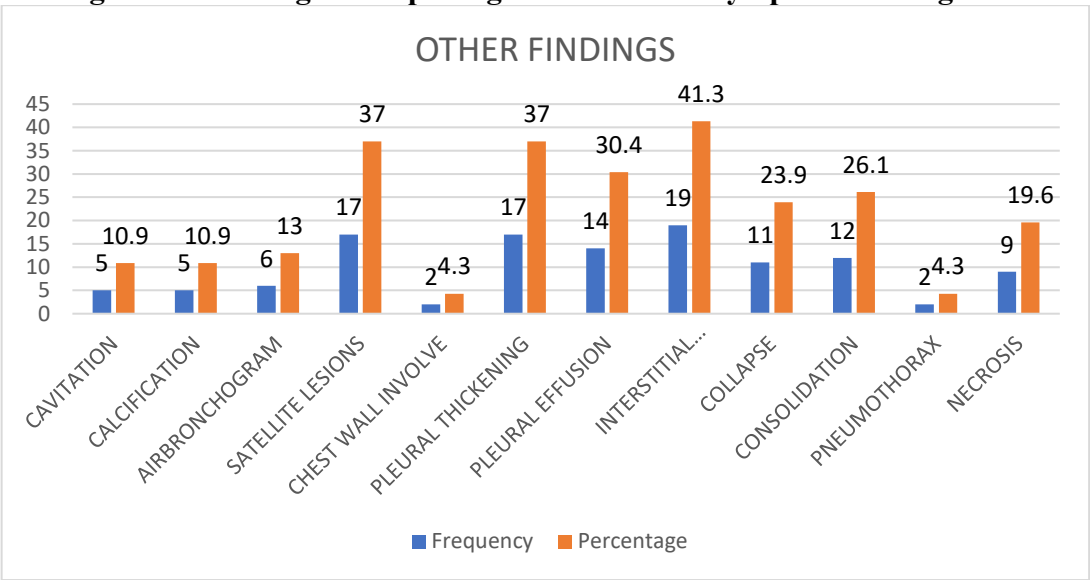
Out of 46 patients, 41.3% cases had lesions which were central in location(n=19) and 58.7% cases had lesions in peripheral location (n = 27). In our study, 47.8% lesions had spiculated margins (n=22), 32.6% lesions had lobulated margins (n=15), 10.9% lesions had smooth margins (n=5) and 8.7% lesions were ill defined (n=4). Of the 46 patients evaluated in our study, none of the patients had lesions less than 2cms (n = 0), 10.9% patients had lesion between 2 -3cms (n = 5), 34.8 % patients had lesion between 3 – 5cms (n = 16), 34.8% patients had lesion between 5 -7cms (n = 16) and 19.6% patients had lesions greater than 7cms (n = 9). On contrast administration, an enhancement of 15HU or more is considered significant. Of 46 cases involved in our study, 95.7% showed significant enhancement. (n=44). Mean enhancement of lesions in our study group is 40.67HU. 55.8% of patients had radiological evidence of metastasis, with most common site being contralateral lung(19.2%), followed by liver (11.5%). (shown in table 2)

Table 2: Distribution by lesion characteristics on MDCT

Lesion characteristic		Number	Percent
Location of Lesion	Central	19	41.3
	Peripheral	27	58.7
Margin	Spiculated	22	47.8
	Lobulated	15	32.6
	Smooth	5	10.9
	Ill Defined	4	8.7
SIZE	2-3cm	5	10.9
	3-5cm	16	34.8
	5-7cm	16	34.8
	>7cm	9	19.6
Enhancement pattern	<15HU	2	4.3
	>15 HU	44	95.7
SITE OF METASTASIS	Adrenal	2	3.8
	Bone	5	9.6
	Liver	6	11.5
	Brain	2	3.8
	Contralateral lung	10	19.2
	Malignant Pleural Effusion	4	7.7
	No Mets	23	44.2

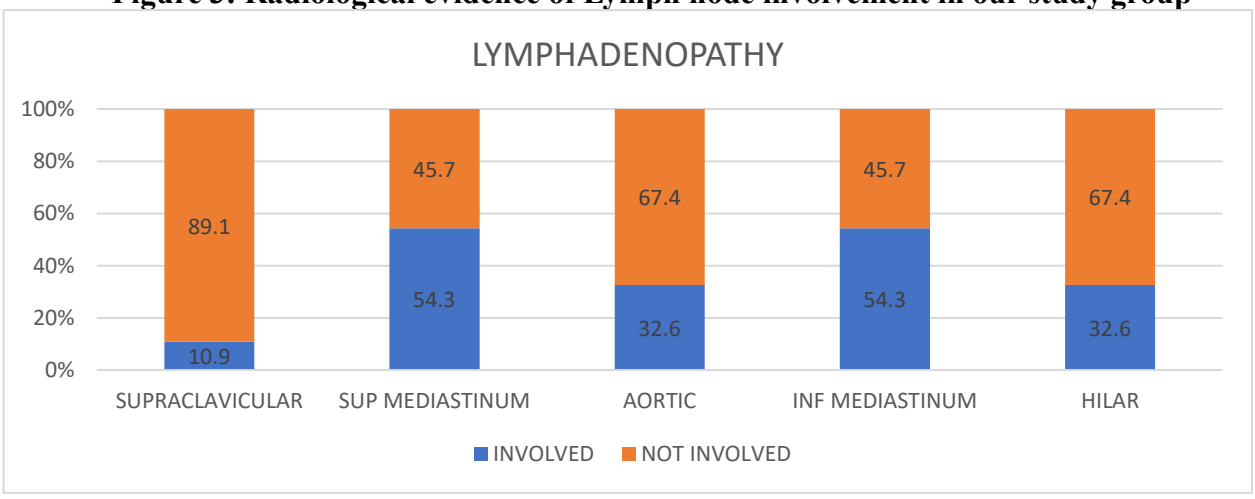
Other MDCT findings were shown in figure 2.

Figure 2: Bar diagram depicting distribution of symptoms among cases



supraclavicular nodes were involved in 10.9% cases(n=5), superior mediastinal nodes were involved in 54.3% cases(n=25), Aortic nodes were involved in 32.6% cases(n=15), inferior mediastinal nodes were involved in 54.3% cases(n=25) and hilar nodes were involved in 32.6% patients(n=15) on MDCT. (shown in figure 3)

Figure 3: Radiological evidence of Lymph node involvement in our study group



Provisional CT diagnosis of Bronchogenic carcinoma was given in 46 patients of which 37 were positive on pathology (80.4%). Of the 37 cases confirmed as bronchogenic carcinoma on pathology, adenocarcinoma is most common histological subtype (n=21) followed by squamous cell carcinoma (n=10), undifferentiated (n=4) and small cell carcinoma (n=2). (shown in table 3)

Table 3: Histopathological / cytological diagnosis of cases in our study group.

HISTOPATHOLOGY	Number of Cases	Percent
Adenocarcinoma	21	45.7
Squamous cell	10	21.7
Small Cell	2	4.3

Undifferentiated	4	8.7
Inflammatory Infiltrate	8	17.4
Metastasis	1	2.2

Of the cases confirmed as bronchogenic carcinoma on pathology, 78.4 % had nodal involvement and 51.4% had metastasis at time of presentation. (shown in table 4)

Table 4: TNM staging of carcinoma lung in study participants

Tumor staging		Nodal Involvement		Metastasis	
T1a	4 (10.8%)	N0	8(21.6%)	M0	18(48.6%)
T2a	8 (21.6%)	N1	2(5.4%)	M1a	7(18.9%)
T2b	4(10.8%)	N2	22(59.5%)	M1b	12(32.4%)
T3	10(27%)	N3	5(13.5%)		
T4	11(29.7%)				

Diagnosis of bronchogenic carcinoma was confirmed in 37 patients (80.4%). Of the 9 false positive cases, 8 cases were diagnosed as inflammatory infiltrate where as one case is diagnosed as metastasis from other site. Hence, true positive cases are 37(80.4%); False positive cases are 9(19.6%) in number. (shown in table 5)

Table 5: MDCT finding versus Histopathological Finding

MDCT Finding	Histopathological Finding		Total
	Malignant	Benign	
Positive	37 True Positive	9 False positive	46
Negative	0 False Negative	0 True Negative	0
Total	37	9	46

The positive predictive value and diagnostic accuracy of MDCT in diagnosing bronchogenic carcinoma in our study is 80.4% with 100% sensitivity and 0% specificity. (shown in table 6)

Table 6: Diagnostic accuracy of MDCT in comparison with Histopathology

Statistic	Value	95% CI
Sensitivity	100.00%	90.51% to 100.00%
Specificity	0.00%	0.00% to 33.63%
Disease prevalence (*)	80.43%	66.09% to 90.64%
Positive Predictive Value (*)	80.43%	80.43% to 80.43%
Negative Predictive Value (*)		
Accuracy (*)	80.43%	66.09% to 90.64%

Discussion: The incidence of lung cancer has seen a steady rise in incidence over the past few years especially in developing countries like India. [11] In our study an attempt has been made to ascertain the demographic characteristics, clinical presentation, MDCT characteristics and histological types of bronchogenic carcinoma.

In our study, Bronchogenic carcinoma is seen to be more common in the age group 51 – 70 years. This is in concordance with studies done by Rawat et al [12], Karuna RK et al [13] and Krishnamurthy et al [14]. The mean age in our study is 61 years which is similar to that found in a study done by Krishnamurthy et al. [14]

In our study, Male to female ratio is 1.5:1 which is similar to the study of Rawat et al [12] and Dey et al and Hassan et al[15,16]. Cough is the most common presenting complaint among patients in our study

(65.2 %) followed by dyspnoea (47.8%) and fever (45.7%). This is in agreement with study by Shetty et al[11] and Vigg A et al.[17]

MDCT EVALUATION

SIZE: In our study majority of the lesions were between 3-5cms and 5-7cm in size which is similar to study done by Shetty CM[11] where most of the lesions were above 3cms in size.

LOCATION:

Bronchogenic carcinoma presented as peripheral lesion in 51.4% cases and as central lesion in 48.6 % cases. This is in concordance with the study done by Vigg A[17] where peripheral lesions are found to be more common than central lesions. 52.4% of adenocarcinomas and 60% of squamous cell carcinomas in our study were peripheral in location. All the small cell carcinomas in our study were central in location. Undifferentiated carcinoma had equal incidence in central and peripheral location. Hence according to our study Adenocarcinoma and squamous cell carcinoma were predominantly peripheral lesions where as small cell carcinoma is predominantly a central lesion. This is in concordance to Joan M[18] who observed that adenocarcinoma is more commonly peripheral lesion. Shetty CM[11] concluded that adenocarcinoma is commonly a central lesion which is contrary to our study.

MARGINS: In our study, bronchogenic carcinoma presented with spiculated margins in 45.9% (n=17) cases and with lobulated margins in 27% (n=10) cases on CT. Hence it can be inferred that bronchogenic carcinoma presents most commonly with spiculated or lobulated margins. This correlates to the study by Shetty CM et al[11] wherein most of the lesions had spiculated margins. 57.1% Adenocarcinomas, 50% of squamous cell carcinomas and 100% of small cell carcinomas had spiculated margins. This might be due to overall higher incidence of spiculated margins in bronchogenic carcinoma. Large cell carcinoma predominantly had smooth margins (50%). Of the cases diagnosed as inflammatory infiltrate on pathology, 25% cases showed spiculated, 37.5% showed lobulated margins and 37.5% showed ill-defined margins.

ENHANCEMENT: In our study, 97.3% cases of bronchogenic carcinoma showed significant contrast enhancement of greater than 15HU. Hence it could be inferred that significant contrast enhancement could be noted in bronchogenic carcinoma. This is concordant to the findings in the study by Shetty CM[11]. However no significant difference in enhancement is noted among the subtypes of bronchogenic carcinoma in our study.

METASTASES: 51.4% cases of bronchogenic carcinoma had radiological evidence of metastases at the time of presentation. This is in concordance with the study by Sukesh et al[19]. The most common site of metastasis in our study were contralateral lung(n=10) followed by liver(n=6). 57% cases of adenocarcinoma showed radiological evidence of metastases at time of presentation with contralateral lung being the most common site. 50% cases of squamous cell carcinoma showed metastases at time of presentation with adrenals being the most common site. All the cases of small cell carcinoma in our study showed metastasis at time of presentation. 25% cases of undifferentiated carcinoma showed metastases at time of presentation. No histopathological correlation was done for metastatic lesions noted on imaging.

LYMPHNODE INVOLVEMENT: Radiological evidence of lymph nodal involvement was seen in 78.4% of cases with bronchogenic carcinoma in our study. At time of presentation, 59.5% cases of bronchogenic carcinoma were at N2 stage of nodal involvement. Similar findings were seen in studies by Yousif[20] and Shetty CM[11]. 50% of cases with small cell carcinoma showed N3 stage of lymph nodal

involvement at the time of presentation. Of the cases which were diagnosed as inflammatory infiltrate, 50% cases did not show any evidence of lymph node involvement. No histopathological correlation was done for lymph node involvement.

HISTOLOGICAL SUBTYPE: In our study adenocarcinoma was the most common histological subtype accounting for 56.8% of cases with bronchogenic carcinoma. This is in concordance with the study by Devesa et al[21] which showed an increasing trend in the incidence of adenocarcinoma. However, our findings are contrary to the studies done by Rawat et al[12], and Prasad R et al [22] which revealed that squamous cell carcinoma was the most common histological subtype followed by adenocarcinoma.

Of the 46 cases identified as carcinoma on MDCT confirmed with final histopathological/ cytological diagnosis in 37 patients (80.4%). Of the 9 false positive cases, 8 cases are diagnosed as inflammatory infiltrate where as one case is diagnosed as metastasis from other site. The positive predictive value of CT in diagnosing bronchogenic carcinoma in our study is 80.4%. This is in concordance with study done by Yadav D[23]. It is lower than in studies done previously. This might be due to atypical presentation of infectious diseases in 8 cases of our study.

CONCLUSION:

The following conclusions can be drawn from the study:

- Bronchogenic carcinoma is more commonly seen in males
- Multi Detector Computed Tomography has a high diagnostic accuracy positive predictive value of 80.4% in diagnosis of bronchogenic carcinoma.
- MDCT is a useful tool in the staging of Bronchogenic Carcinoma. Staging is important in treatment planning and predicting outcome.

LIMITATIONS

- MDCT cannot precisely distinguish between reactive hyperplasia and metastatic mediastinal lymphadenopathy.

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