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Spiral CT Evaluation Of Pulmonary Mass Lesions

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Abstract

Introduction: A pulmonary mass lesion is any pulmonary, pleural or mediastinal lesion detected on chest radiographs as an area of opacity more than 3cm in diameter. One of the standard techniques for diagnostic evaluation that assist detection uses spiral CT which makes a wide range measurement of the lung in a short time.

Aims And Objectives: To study the diagnostic accuracy of spiral CT in the differentiation of benign and malignant pulmonary mass lesions, pattern of pulmonary mass lesions, accuracy of spiral CT in the characterization of pulmonary mass lesions. To correlate the spiral CT findings with a histopathological diagnosis where possible.

Materials and Methods: This cross-sectional study was carried out at Mamata Medical College, Khammam, a tertiary care centre in South India. 50 patients with pulmonary mass lesions (clinically suspected or incidentally detected on other imaging studies) referred for CT evaluation were studied. Patients with mass lesions larger than 3cm and only those cases with a definite final diagnosis were included in the study.

Results: Malignant lung masses are more common in the right lung. The right upper lobe is one of the most common locations of lung cancer. Enhancement of less than 15 HU indicates benignity on contrast-enhanced CT. Invasion of the surrounding structures and distant metastases with multiorgan involvement increases the likelihood of a lung mass to be malignant.

Conclusion: Spiral CT is very useful in deciding whether FOB with TBNA or a TTNA should be done preferentially in the diagnostic approach of a lung mass

Keywords: Spiral CT, Pulmonary mass lesion

Introduction

Any pulmonary, pleural, or mediastinal lesion found on chest radiographs as an area of opacity more than 3cm in diameter is referred to as a pulmonary mass lesion.[1] Bronchogenic carcinoma, lung metastasis, mycobacterial or fungal pneumonia, lung abscess, pulmonary pseudotumor, round atelectasis, and other less common entities such as pulmonary arteriovenous malformation, hamartomas, bronchogenic cyst, pulmonary sequestration, and hydatid cyst, among others, are all possibilities for the lung mass.

Bronchogenic carcinoma is the most prevalent lung mass diagnosis. Non-small cell lung carcinoma and small cell lung carcinoma are the two primary histologic categories. Squamous cell carcinoma, adenocarcinoma, and large cell carcinoma are the different histologic forms of non-small cell lung cancer.[2]

The most common imaging modality used to examine the pulmonary mass is computed tomography (CT). The purpose of radiographic examination of lung mass lesions is to distinguish as precisely as possible between benign and malignant lesions[3].

One of the standard techniques for diagnostic evaluation that assist detection uses spiral CT which makes a wide range measurement of the lung in a short time.

Because of its greater sensitivity in detecting lung nodules, spiral CT was first employed for thoracic imaging[4]. Spiral CT permits volumetric data to be acquired while holding one breath, providing section-to-section continuity. More lung lesions are consistently diagnosed by removing the respiratory discrepancies associated with traditional CT. Furthermore, the data volume may be evaluated at short reconstruction intervals, making multiplanar and three-dimensional imaging of thoracic anomalies possible.

The present study is aimed at evaluating the pattern of pulmonary mass lesions by Spiral CT and distinguishing benign and malignant pulmonary mass lesions and correlate the Spiral CT findings with the final clinical and histopathological diagnosis.

Materials and Methods:

This cross sectional study was carried out at Mamata Medical College, Khammam, a tertiary care centre in South India, for a period of 24 months i.e, from October 2018 to September 2020.

50 patients with pulmonary mass lesions (clinically suspected or incidentally detected on other imaging studies) referred for CT evaluation were studied. Patients with mass lesions larger than 3cm and only those cases with a definite final diagnosis were included in the study. The final diagnosis was made based on findings of fibre optic bronchoscopy(FOB), transbronchial needle aspiration(TBNA), transthoracic needle aspiration(TTNA), the therapeutic response in the case of inflammatory lesions and radiological follow-up.

CT was performed on a Siemens SOMATOM Scope CT scanner. A topogram was acquired in a state of suspended respiration with the patient supine. The scan was done from the level of lung apices to the diaphragm and routinely including the adrenals, to determine the location of the mass and pertinent vascular structures. Initial plain scans are obtained with 10mm collimation sections and table speed of 15 mm per second, i.e., a pitch of 1.5, tube voltage 120kv, tube current 50ma and scan duration 15 sec. Additional 5mm collimation sections are obtained through the lesion, if a mass or nodule was identified.

Images were reconstructed at 10mm. increments by using a 180 linear interpolation algorithm and a matrix size of 512X512. pixels, i.e., with 20% overlap. Wherever indicated the thinner images were reconstructed at 4 mm.

Intravenous contrast was given to each patient (except in patients who previously had contrast reactions or in renal failure). 60ml-80ml of non-ionic water contrast (K-Scan 370 manufactured by Genetek, Wardha, India.) was injected manually as a single bolus through an 18-gauge catheter. The above mentioned CT protocol was repeated post-contrast and in addition 5mm. Sections at hila were obtained. Axial CT images so obtained were studied in detail on lung, mediastinal and bone window.

The CT findings were interpreted based as the following: mass lesion based on tumor site - right/left, central/peripheral/apical; size, tumor margins - spiculated, lobulated, smooth; calcification, air bronchograms within the lesion, presence of any cavitation, satellite lesions.

Interpretation of chest wall invasion was based on the following criteria: greater than 3cms of degree of contact with the pleura, pleural thickening, adjacent bone destruction, soft tissue mass.

The histopathology reports of FNACs, bronchial brushings, bronchoscopic biopsies were reviewed. The CT findings were compared with the histopathological data or the therapeutic response in the case of inflammatory lesions. The results were analyzed separately on a patient-by-patient basis.

Result and Observation:

An analysis of the clinical data, spiral CT and histopathological data of fifty patients with pulmonary mass lesions yielded the following results.

Of the fifty patients with pulmonary masses for whom spiral CT evaluation was done during the study period, 37 patients (74%) were male and 13 (26%) were females.

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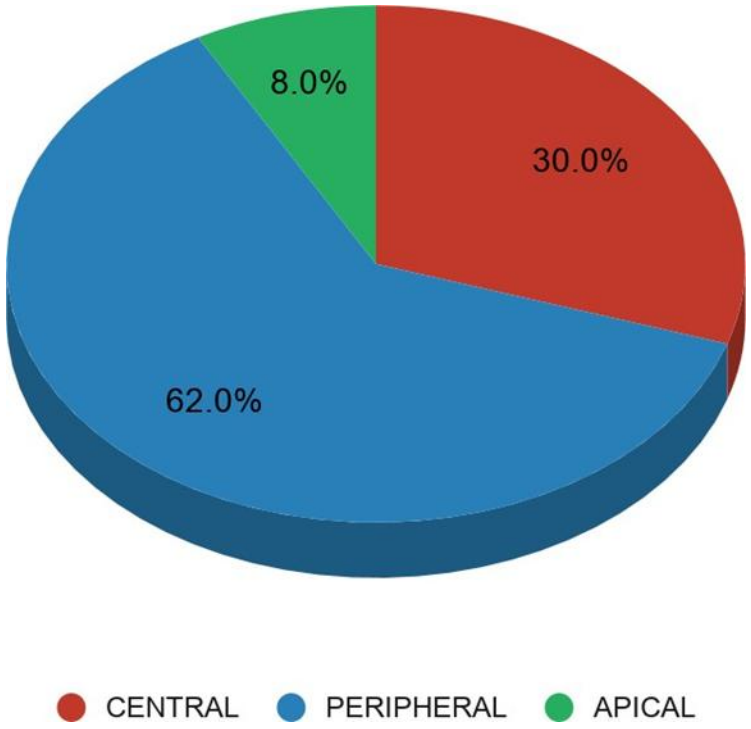
The age of the patients ranged from 22 years to 84 years with a mean age of 51.86 years. The incidence of pulmonary mass lesions was found to be more common in the fourth decade with 16 patients in this age group (32%). The next most common age group was found to be the fifth decade with 9 patients in this age group (18%).

The most common associated risk factor present was smoking which was present in 32 patients i.e. 64 percent, of which 30 were males and 2 were females. Out of the 50 patients with pulmonary masses, the right lung was involved in 54%, left in 42%, both lungs in 4% of cases.

The most common pulmonary symptom was cough with expectoration (52.5%), followed by dyspnea (45.2%), hemoptysis (35.8%), and chest pain (33%). The most common extrapulmonary symptoms were weight loss in 58%, hoarseness of voice in (8%), bone pain in (6%), Pancoast's syndrome in (2%). Clubbing was seen in 26%.

The central location of a mass lesion, that is before the subsegmental bronchus was seen in 15 patients out of a total of 50 patients with pulmonary mass lesions of which 13 were malignant and 2 were benign. Apical mass lesions were seen in 04 patients, with malignant mass lesions in 02 patients and benign lesions in 2 patients. The peripheral location of mass lesions was seen in a total of 31 patients of which 25 were malignant and 6 were benign.



Twelve patients had smooth margins of which 7 were malignant. Lobulated margins were seen in 12 patients with malignant lesions. Spiculated margins were seen in 16 patients with malignant pulmonary mass lesions. Irregular margins were seen in 5 patients with malignant mass lesions and 5 patients with benign mass lesions

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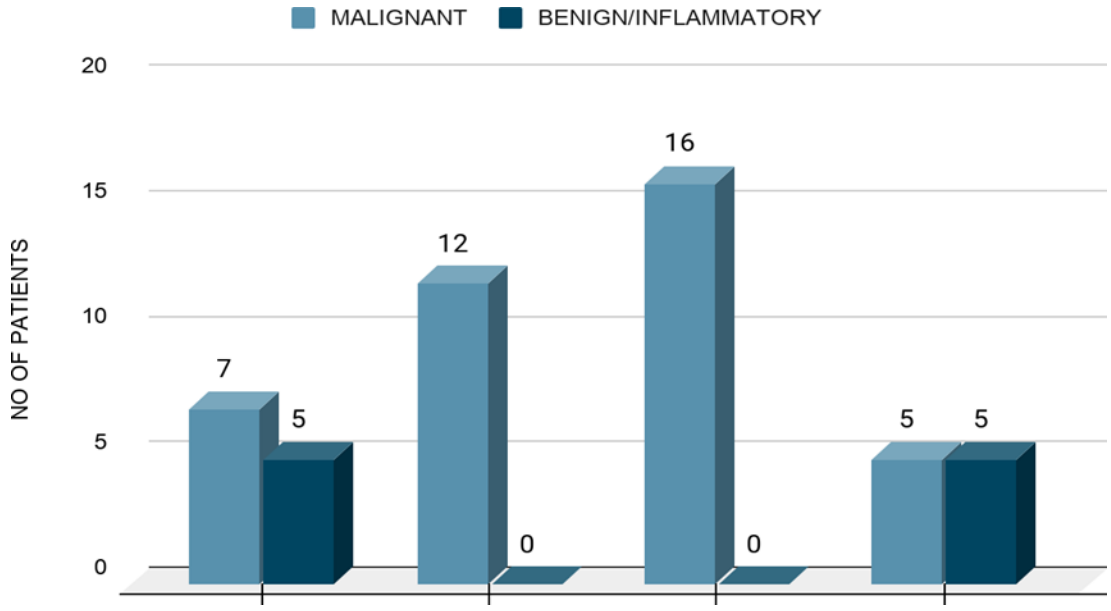

Calcification was seen in a total of 8 patients of which 02 had a benign or inflammatory mass lesion. Only 06 patients out of 40 patients with malignant mass lesions had calcifications on spiral CT scans.

Cavitation was seen in 15 patients of which 7 had malignant mass lesions and 8 had benign/inflammatory mass lesions. Other observation made was that the cavitation in malignant mass lesions had irregular inner margins while those in benign/inflammatory lesions had relatively smooth inner margins.

Satellite lesions were seen in 01 patients with inflammatory mass lesions and in 02 of patients with malignant mass lesions. Satellite lesions were not seen in the 09 patients with benign mass lesions and 38 patients with malignant mass lesions.

SATELLITE LESIONS	TYPE OF LESION	NO.OF PATIENTS	TOTAL
PRESENT	BENIGN/INFLAMMATORY	01	03
	MALIGNANT	02	
ABSENT	BENIGN/INFLAMMATORY	09	47
	MALIGNANT	38	

Contrast enhancement was noted on post-contrast CT scans in 50 patients. Of these, homogenous enhancement was seen in 10 patients and heterogeneous enhancement in 31 patients. Peripheral rim like enhancement was noted in 9 patients.

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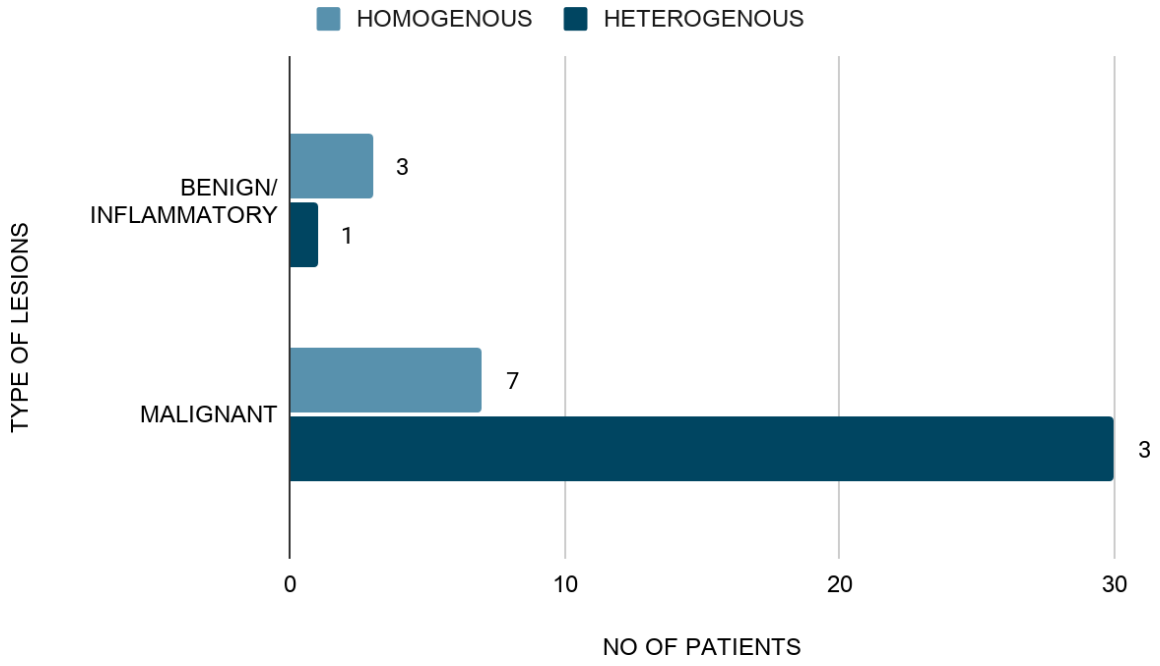

Of the 50 patients with lung masses, pleural involvement was seen in 28 patients. Pleural thickening was the most common form of involvement of pleura among 5 patients with inflammatory mass lesions. In those patients with malignant mass lesions, pleural effusion was the most common form of involvement of pleura which was seen in 15 patients. Pleural effusion was seen in 03 patients with benign/inflammatory mass lesions and 15 patients with malignant lesions. Pleural nodules were seen in 01 patients with malignant mass lesions.

Invasion of surrounding structures is seen in 5 cases. Chest wall invasion is seen in 2 cases. The mediastinal invasion was noted in 1 case and vascular invasion was observed in 2 of the malignant mass lesions.

Lymph node enlargement was noted in a total of 20 patients. Of these nodal involvement was seen in 02 patients with benign/inflammatory mass lesions and in 18 patients with malignant mass lesions.

Extrathoracic metastases were observed in 5 cases. Few of them had multi- organ involvement. The most common organ to be involved with is bone (60%) followed by liver (40%) and adrenals (40%).

HISTOLOGICAL TYPE	NO.OF PATIENTS	PERCENTAGE
ADENOCARCINOMA	18	50
SQUAMOUS CELL CARCINOMA	15	41.6
SMALL CELL CARCINOMA	02	5.55
LARGE CELL CARCINOMA	01	2.77

Of the 40 patients with malignant lung mass lesions, 36 were primary pulmonary lesions and 4 were metastases. In the primary lung malignant tumors, the most common histological type was found to be adenocarcinoma, which was seen in 18 patients. The next most common type was squamous cell carcinoma seen in 15 patients.

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Spiral CT was a useful tool in the characterization of pulmonary mass lesions into inflammatory, benign, malignant, metastatic lesions and the findings were correlated with histopathological data which showed a hundred percent sensitivity for spiral CT for characterization of mass lesions

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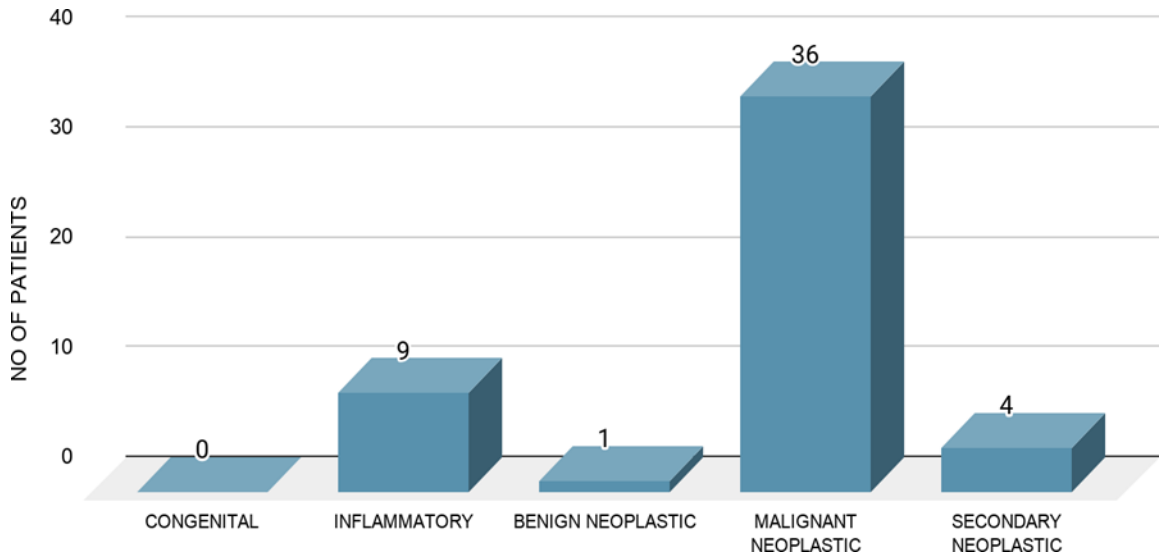
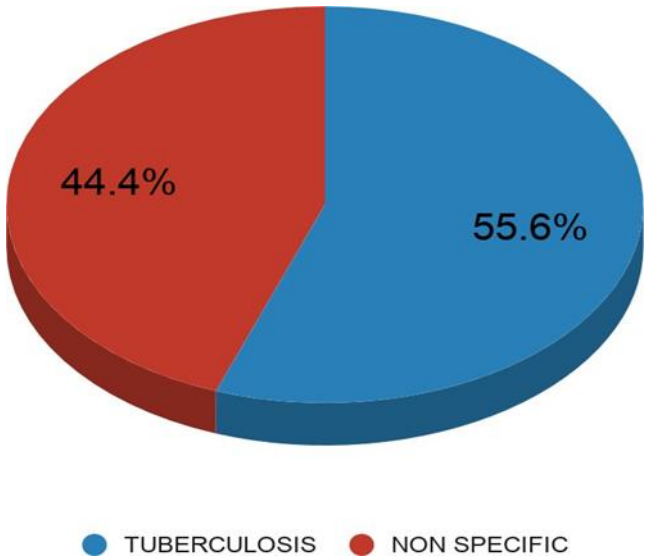


Of the 50 patients with pulmonary mass lesions studied, the most common cause of pulmonary mass lesion was found to be due to neoplasm Which was seen in 41 patients (82%) of the 50 patients. The remaining 9 patients(18%) had inflammatory pathology.

The most common cause of mass lesion was found to be due to primary malignant neoplasm which was seen in 36 patients (72%) followed by the inflammatory cause which was seen in 9 patients (18%)



Of the nine patients with inflammatory mass lesions, tuberculous etiology was found in 5 patients (55.55%). The remaining 4 patients had non-specific bacterial infections. Of the 5 patients with tuberculous etiology, 3 patients had fungal balls associated with the tuberculous mass lesion.

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NEOPLASTIC LESION	NO.OF PATIENTS	PERCENTAGE
BENIGN	01	2.43
PRIMARY PULMONARY	36	87.8
SECONDARY PULMONARY	04	9.75
TOTAL	41	100

Of the 41 patients with neoplastic mass lesions, 36 patients (87.8%) had primary pulmonary neoplasm. The next common mass lesion was found to be due to secondary deposits in the lung which was seen in 04 patients (9.75%). One had a benign mass lesion which included hamartoma(2.43%).

Discussion:

In this study, we found that lung mass was significantly more common in males than females as there were 74% males and 26% females. **Biswas et al**[5] found an almost similar sex proportion in their study, where there were 82.2% males and 17.8% females.

Most of the patients of this present study were from 40 to 70 years comprising 66% of the total study population. The age of the cases with pulmonary mass lesions seen in various other studies ranged from 40 to 80 years[6,7].

Smoking is found to be associated with 64% of patients with pulmonary mass lesions in this study. This finding is similar to the observation by **Biswas et al**[5] where smoking is associated with 81.1% of patients with lung masses.

In the present study, most of the mass lesions were detected in the upper zones of the right lung(46%) followed by the upper zones of the left lung (34%). Both lungs were involved in 4%.

These findings are comparable to the study by Biswas et al[5], where maximum numbers of masses were detected in upper zones of the right lung (36.7%), followed by upper zones of the left lung (23.3%) and both lungs (4.4%).

In the present study, the majority of the masses were seen to be located peripherally as seen in 62% of cases, while in 30% of cases masses were central. Findings are consistent with the study by **Biswas et al**[5], peripheral masses were seen in 51.1% of cases and 48.9% of cases were central. **Rawat et al**[7], peripheral masses in 51.23% and central masses 48.77%.

In our study, we found that out of the patients with 36 primary malignant lung lesions, 26 were men, and 10 were women.

In a study done by Furuya et al[8] with thin-section CT, all nodules with a halo margin - 97% with densely spiculated margins, 93% with ragged margins, and 82% with lobulated margins were malignant. In the study done by Biswas et al[5], 78.1% with spiculated margins were malignant lesions. A similar observation (in 80%) was made in their study by Ningappa et al[9].

In our study, 100% with spiculated margins,100% with lobulated margins and 50% with irregular margins are malignant.

Zwirewich et al[10] found that the presence of spiculation has a predictive value for malignancy of approximately 90% and should prompt an aggressive workup. While an irregular margin is an indication of malignancy, it can be seen in lipoid pneumonia, organizing pneumonia, progressive massive fibrosis, and granulomatous disease.

In our study, 7(58.3%) out of 12 smooth margin lesions were malignant of which 3 were metastatic tumors.

A lobulated margin indicates that the nodule has uneven rates of growth, In a series by Siegelman et al[11], approximately 40% of smooth-edged lobulated nodules were malignant.

In our study 100% of smooth-edged lobulated masses were malignant.

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Woodring et al[12] found that whereas only 5% of all cavitated nodules with thin walls (<5mm) were malignant, the probability of malignancy was >85% when maximum wall thickness was >15mm.

In our study, all benign mass lesions with cavitations had a wall thickness of <5mm. Out of the 7 malignant mass lesions with cavitation, 7 cases had a wall thickness of more than 15mm. However, because there is much overlap, cavity wall characteristics cannot be used to confidently differentiate benign and malignant nodules.

Heitzman et al[13] found that the presence of satellite nodules does not allow a confident diagnosis of benignity, as 10% of dominant nodules with satellite nodules will be malignant.

In our study, 2 out of 3 cases with satellite lesions were malignant. When cancerous, satellite nodules are usually the result of peripheral foci of tumor or skip metastatic lesions.

Shetty et al[14] found that pleural effusion was seen in 34.5% of patients with lung masses. In our study, pleural effusion was seen in 38% of patients.

In the study done by Madan and Bannur[15], adenocarcinoma was the commonest cell type seen in 30% cases, followed by squamous cell carcinoma in 22.5% cases.

In the present study, adenocarcinoma was observed to be the most common cell type of malignancy (36%), followed by squamous cell carcinoma (30%). Small cell carcinoma was noted in 4% in the present study. Similar results were also seen in a study by Singh et al[16], where it was found to be 4%.

Conclusion:

Spiral CT is a modality of choice for evaluating pulmonary mass lesions because of its better spatial resolution.

Lung masses can be considered benign if they exhibit the pattern of benign calcification. If the lesion represents a malignant tumour, CT serves as a part of the staging process to access the extent of the disease. When the imaging features indicate that the malignancy probability is high, tissue samples should be obtained for diagnosis. Also, spiral CT is very useful in deciding whether FOB with TBNA or a TTNA should be done preferentially in the diagnostic approach of a lung mass.

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