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Correlations of CT scan Findings of Lung Masses with Histopathology and Demographic Variables in a Developing Country

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Abstract

Background: To evaluate and correlate CT findings in various lung masses with their histopathological diagnosis and demographic variables. Also, the diagnostic accuracy and limitations of CT and USG guided transthoracic biopsy was highlighted.

Methods: 65 patients with lung masses, who were referred to the Department of Radiodiagnosis, SMS Medical College & Attached Group of Hospitals, Jaipur, were CT evaluated and FNAC under CT guidance with an aim to ascertain the role of CT in evaluation of such masses and to asses the diagnostic accuracy and safety of Usg and CT guided biopsy.

Results: In this study CT has sensitivity of 98.27%, specificity of 28.57%, positive predictive value of 91.93%, negative predictive value of 66.67%. In our study, overall diagnostic accuracy of CT in malignancy of lung in reference to cytopathology is 90.77%.

Conclusion: CT has very high sensitivity, specificity and diagnostic accuracy in evaluation of lung masses.

Keywords: CT scan, Lung, Biopsy.

Introduction

Lung cancer is the leading cause of morbidity and mortality with estimated new cases to be 224,390 in year 2016 and estimated deaths 158, 080 according to SEER study [1]. The average incidence rate of lung cancer varies from 0.06 to 31.5 per 100,000 cases [2].

Computed tomography (CT) is well suited for making a definitive diagnosis of some disease processes [3]. CT helps to determine the location and features of the lesions and depicts associated findings to help document the extent of diseases.[3] Although unusual primary lung masses are difficult to diagnose on the basis of imaging findings alone because such findings are nonspecific in the majority of cases, cross-sectional imaging can play an important role in the diagnostic work-up of these unusual tumors by delineating their

extent and directing the radiologist to the appropriate biopsy site.[3]

Chest radiograph is the first investigation done but gives only probable diagnosis. Lung Cancer is the only visceral malignancy which gives an early roentgen clue of its existence and it is not infrequent for physician to encounter patients referred for the evaluation of a spot or abnormality having been discovered as an incidental finding on a chest roentgenogram. However, it might be the only case where such a discovery instead of comforting the physician adds to the diagnostic dilemma where he has to summon all his clinical skills and years of experience to come to any conclusion. Fortunate are those patients who leave the clinic with a definite diagnosis as for the majority; a period of immense anxiety has just began.

Computed tomography (CT) scan is the standard imaging modality used for the evaluation of lung masses.[4] The merits of CT in intrathoracic scanning are innumerable. But the most important amongst them which is also the area of interest of present work is the ability to evaluate lung masses on its own and to differentiate them in terms of benign and malignant with reasonably high degree of accuracy. Moreover, it is a modality which does not have a dead end. It has more to offer for lesions which are indeterminate on CT evaluation, transthoracic Biopsy and FNAC can be performed on such lesions using CT guidance.

Gold standard for diagnosis remains histopathological examination.[3-4] The most valid argument favoring the performance of an invasive procedure like transthoracic FNAC is that short of thoracotomy, it is the only well established procedure which tells about the histological nature of all types of lung masses. Such histological diagnosis is not only required for small operable cases but also for inoperable cases in which palliative treatment is imperative. Bronchoscopy, Bronchoalveolar lavage, bronchoscopic biopsy should be reserved for cases in which involvement of major airway, vocal cords and carina is suspected or in cases were CT evaluation detects fourth to sixth order CT bronchus sign.

Accordingly, this study was carried out with an aim to evaluate and correlate CT findings in various lung masses with their histopathological diagnosis and demographic variables. Also, the diagnostic accuracy and limitations of CT and USG guided transthoracic biopsy was highlighted.

Material and Methods

Study Area:- Department of Radiodiagnosis and Department of Pulmonary Medicine, Department of Medicine, Department of Surgery, Department of Oncology, SMS Medical college and attached group of Hospitals, Jaipur, Rajasthan

Study Design: Observational study.

Study Type: Hospital based Cross-sectional and prospective (quantitative) study

Study Period: Data collection for study started after approval from the institutional research and review board, up to June 2019. Then it took another 2 months to process the data and write the thesis.

Sample Size: Sample size was calculated at 95% confidence level assuming 75% positive predictive value of CT scan among lung mass cases as found in seed article. At the precision (absolute allowable error), 65 cases of lung mass were taken in this study.

Sampling Technique:-Every eligible patient coming to radio diagnosis department was taken for data collection.

Study Population

- All patients with radiographic evidence of lung mass.

- All patients with CT scan evidence of lung mass.
- Patients eligible for biopsy

Inclusion Criteria

- Patients with lung mass > 20 mm on CT imaging which can be biopsied by transthoracic approach
- Those who give written and informed consent

Exclusion Criteria

- Contraindication to contrast enhanced CT i.e. pregnancy, allergy to i.v contrast, renal failure, hemodynamic instability, instability for sufficient breath holds.
- Patients with H/O of Primary malignancy will not be included.
- Non compliant patient
- Patients unfit for biopsy (raised INR, low platelet count <50,000).
- Previous unilateral pneumonectomy
- Patient on mechanical ventilation

Results

Table 1: Intrathoracic masses; Age and Sex Distribution.

Range (years)	Male		Female		Total	
	No.	%	No.	%	No.	%
<40	2	3.63	1	10	3	04.61
41-50	12	21.81	1	10	13	20.00
51-60	19	34.54	2	20	21	32.31
61-70	12	21.81	5	50	17	26.15
>70	10	18.18	1	10	11	16.92
Total	55		10		65	

The study of 65 patients, including a total of 55 males (84.61%) and 10 females (15.38%), who presented with lung masses were evaluated by CT scan and underwent transthoracic biopsty. The male-female ratio was 5:1. The age range in either sex was 30 to 80 years. The age sex distribution of patient revealed that maximum number of males belonged to the age range was 51-60 years(34.54%) and maximum of females presented in the age range 61-70 years (50%) incidentally.

Table 2: CT Morphological and Histopathological diagnosis

	Malignant on FNAC (Histology)	Benign on FNAC (Histology)	
Malignant on CT	57	05	62
Benign on CT	01	02	03
Total	58	07	65

All 65 patients presenting clinically with suspicion of lung masses, underwent plain chest skiagram and CT was done in all 65 patients. Biopsy was performed. The results were categorized as benign or malignant.

Out of 62 CT morphological malignant cases 57 proved malignant (True Positive) and 5 were benign on histopathology (false Positive), and out of 3 benign tumors 2 proved to be benign (True Negative) and 1 was Malignant on histopathology (False Negative)

Sensitivity =	98.27 %
Specificity =	28.57 %
Positive Likelihood Ratio =	1.37
Negative Likelihood Ratio =	0.06
Positive Predictive Value =	91.93 %
Negative Predictive Value =	66.67 %
Diagnostic accuracy =	90.77%

Table 3: Morphological Characteristics (CT)

(A) Size (Cm) (n=65)	Malignant		Benign		Total	
	No.	%	No.	%	No.	%
2-4	18	31.03	2	28.57	20	30.77
4-6	31	53.45	3	42.86	34	52.30
6-8	5	8.62	1	14.29	06	9.23
>8	4	6.89	1	14.29	05	14.09
Total	58	100	7	100	65	100

The size was variable from 2 to 14 cms in CT scan. Lung lesions were categorized based on the maximum length in any one of the perpendicular dimensions, into 4 groups. According the size the malignant lesions were larger than benign lesions, the maximum number 3 (42.86%) of benign lesions were found in 4-6 cm group and while maximum number 31 (53.45%) of malignant lesions were found in 4-6 cm group.

Table 4: Edges of lesion Characteristics (CT**)**

Contour (n=65)	Malignant		Benign		Total	
	No.	%	No.	%	No.	%
Smooth	2	3.48	1	14.28	3	4.61
Irregular	20	34.82	4	57.14	24	36.92
Spiculated	36	62	2	28.57	38	58.46

Edges of the lesion was grouped into smooth in which the edges were well defined; irregular where the edges showed undulations and spiculated when spiculations or fraying were present in any part of the lesions. A significant association was observed between spiculated margin and malignant mass.

Table 5: Contrast enhancement of lung masses (N=65)

Patten of Enhancement	Malignant		Benign		Total	
	No.	%	No.	%	No.	%
Homogenous	0	0	1	14.3	1	1.34
Heterogenous	58	100	6	85.7	64	98.46
No Enhancement	0	0	0	0	0	0
Total	58	100	7	100	65	100

There was heterogeneity of contrast enhancement as homogenous, heterogeneous or no enhancement was observed in benign and malignant masses, all malignant and benign masses showed enhancement. All the malignant masses showed heterogeneous contrast enhancement.

Table 6: Other associated findings (N=65)

Finding	No. of patients	%
GGO	52	80
Pleural effusion	34	52.3
Collapse consolidation	15	23.07
Mediastinal invasion	5	7.69
Pleural invasion	34	52.3
Rib destruction	6	9.23

A note was also made of the other findings associated with the lung mass.Most of the lung masses, both malignant and benign, showed surrounding GGO in 52 patients (80%), followed by pleural effusion in 34 (52.4%) and collapse consolidation in 15 (23.07%).

The malignant masses at the periphery, most of which turned out to be Squamous cell carcinoma on histopathology showed pleural invasion in 34 (52.3%) out of which the most aggressive ones presented with rib destruction in 6 (9.23%). The aggressive malignant masses in the center showed mediastinal invasion in 5 (7.69%) patients in the form of involvement or encasing of the bronchus and major vessels.

Discussion

Lung masses whether asymptomatic or presenting with ominous symptoms have always been challenging entities for both surgeons and radiologists alike. Many diagnostic modalities and various techniques and approaches have been put forward from time to time. CT has opened new avenues for evaluation of intrathoracic masses. The present study was undertaken

to establish the role of CT and CT and USG guided biopsy in lung masses, especially in our setting.

In this study out of 62 CT morphological malignant cases 57 proved malignant (True Positive) and 5 were benign on histopathology (false Positive), and out of 3 benign tumors, 2 proved to be benign (True Negative) and 1 was Malignant on cytopathology (False Negative). On the basis of these findings, in this study CT has sensitivity of 98.27%, specificity of 28.57%, positive predictive value of 91.93%, and negative predictive value of 66.67%. In our study, overall diagnostic accuracy of CT in malignancy of lung in reference to histopathology is 90.77%. These results were approximately similar to Seemann MD et al (2000)107 and Imaad-ur-Rehman, et al (2011) study.[5]

Most malignant masses in the present study were between 4-6cm size, as stated above, with a range of 2-14 cm. Of the total 65 lesions in which measurements were made 58 were malignant (89.23%) and 7 were benign (10.77%). The reason for the observed difference was probably due to the fact that for lesion larger than 2 cm in diameter, the frequency of benignancy falls sharply as does the percentage of benign lesions assessed as benign (Zerhouni et al, (1986)[6]. Moreover, size alone is unreliable in differentiating malignant form benign nodules as nodules as small as 1cm can be malignant (Seiglman SS et al, 1984)[7].

The 65 lesion assessed by CT were classified as smooth, irregular or spiculated, based on the contour or edge characteristics. The basis of such a classification was earlier studied by Yamasthita et al., (1995)[8]. Another aspect of contour characteristics of a lesion in that they have sharp and smooth to moderately smooth edges. In formulating a proper approach regarding contour characteristics of a lesion, agreement was found with the observation of Siegelman et al (1984)[7]. That pulmonary mass with irregular or spiculated margins should be assessed as indeterminate, even though they fulfill other criteria for benignancy. Of malignant masses 36 had spiculated, 20 lobulated and 2 smooth margins. In benign masses 1 had smooth, 2 spiculated and 4 irregular margins.

Characteristics studied under this heading were the degree of homogeneity of the lesions, calcification, cavitation and groung glass opacity.

The presence and the pattern of calcification in lung masses has generated immense interest among radiologists, for long. Various techniques have been elaborately described to detect unsuspected calcification on CT. Quantitative CT using thin sections was originally described by Seigelman, SS (1984)[7]. He also described the edge effect wherein high density voxels were clustered at the margins of malignant lesions as compared to benign lesions which had a predominantly central or diffuse pattern of calcification. Zerhouni et al, (1986)[6]in addition suggested that at least 10% of the cross sectional area of the nodule needed to appear calcified for a lesion to be considered benign. But they also conceded that CT densitometry is not of equal usefulness in all types of nodules and is most effective in 3 cm or smaller, smooth or lobulated nodules.

In the subgroup of patients with calcification, 10 were malignant and 7 benign. Though the number of case in the present study in small, it is to be believed that visualization of lesion does not alone exclude the diagnosis of bronchogenic carcinoma.

The presence fat has been described in hamartomas of the lung. One case showed fat and calcification and subsequently diagnosed as hamartoma.

Cavitations with irregular inner margin as well as goround glass opacity were almost always associated with malignant nature of the lesions.

The pattern of contrast enhancement was studied in lung masses and the findings were correlated with the histological diagnosis. A total of 65 lesions were studied. The majority of malignant lesions showed heterogenous pattern of contrast enhancement and a few showed homoghenous enhancement. No malignant lesion showed capsular pattern of enhancement. Of the benign lesions, majority showed homogenous enhancement pattern. Such evaluation of pulmonary lesions was carried out by Yamashita et al., (1995)[8] In their study all but one lung cancer showed homogenous enhancement, however no lesion in their study was more than 3 cm in size. They themselves stressed the need for further study, where no lesion were less than 2 cm in size, showed predominantly inhomogenous pattern for both malignant and benign nodules. Yamashita et al., (1995)[8] suggested that peripheral and capsular enhancement pattern, both suggested tuberculomas (or granulomas) or hamartomas. Whereas it is to agree with them on the latter in that capsular enhancement is suggestive of granulomas with central necrosis, it is to be differed on the former aspect as larger lesions are more likely to have central necrosis regardless of etiology.

Apart from morphology and contrast enhancement, CT helped in evaluation of lung masses by detecting number additional findings which in many cases changed the further course of management.

CT could detect additional metastatic lesions in a suspected bronchogenic carcinoma in many cases. A proper assessment of mediastinal lymphnodes was done in the same examination. Moreover direct evidence in the form of chest wall invasion, rib and vertebral erosion was seen in some cases. Similarly signs of extrathoracic metastatic disease in the form of deposits in the liver, adrenals were also seen in a few cases.

The greater contrast resolution of CT permitted separate identification of pulmonary masses from the adjacent area of collapse, consolidation or pleural effusion. Such lesions were obscured in the plain radiographs and were only detected on CT. Thus accurate localization of the mass was done and guided procedures could be performed to obtain histopathological diagnosis.

A total of 65 biopsy were performed in all 65 patients. Three samples were taken after engaging the lesions and appropriate placement of the needle as demonstrated on the CT scan. The final diagnosis of all the patients was determined by clinical follow up and histopathology.

The average lesions size was 4-8 cm (range 2-14cm). The diagnostic value of the specimen was recorded on the basis of the information conveyed by the pathologist after examining the specimen.

Conclusion

CT has very high sensitivity, specificity and diagnostic accuracy in evaluation of lung masses.

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