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RADIO-PATHOLOGICAL CORRELATION OF LUNG MASSES :A PROSPECTIVE STUDY OF 100 CASES

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ABSTRACT:

Objective: The present study was undertaken to establish the role of CT in comprehensive evaluation of lung masses, especially in our set-up and to study the efficacy and safety of CT guided fine needle aspiration cytology. **Materials and Methods:** In this study, 45 patients of lung mass of varying ages and both sexes were referred to the Department of Radio-diagnosis, Mahatma Gandhi Medical College, Hospital, Jaipur from various department of this institution, were were further evaluated with CT scan and guided biopsy of lung mass lesions.**Results:** Based on CT evaluation and guided biopsy of lung mass lesions, there were 38(84.44%) malignant and 7 (15.55%) benign. In the malignant group, majority 17 (37.78%) were squamous cell carcinomas, followed by poorly differentiated carcinoma 10 (22.22%) and small cell carcinomas 6 (13.33%).In the benign group, the majority 4 (8.88%) were tubercular infections. **Conclusion:** In addition to morphological evaluation, CT provides additional information regarding staging of the disease which increases the specificity and sensitivity of the CT diagnosis. On its own, CT showed high sensitivity (97.36%), specificity (100%) and diagnostic accuracy (97.6%) in evaluation of lung masses in our study. CT guided FNAC is of utmost use in cases where pre-biopsy evaluation and imaging suggests that a high probability of malignancy is present and where facility of on-site cytopathologist is available with high sensitivity, specificity and diagnostic accuracy.

Keywords: CT scan, CT guided FNAC, Lung carcinoma.

INTRODUCTION:

Lung mass lesion includes lung carcinoma, fibroma, hamartoma, leiomyoma, aneurysm, mycetoma, infarct, lymph node enlargement, tubercular lymphadenopathy and tuberculoma. Carcinoma bronchus is by far the commonest and most important primary tumor of lung. **(1)**

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. **(2)**

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 begun.

CT serves as a dual role in the patient suspected to have a lung carcinoma based on the plain chest radiograph. Initially, it may substantially facilitate the diagnostic evaluation, by providing more precise characterization of the size, contour, extent and tissue composition of suspicious lesion.**(3)**

How difficult is the question posed by indeterminate pulmonary mass/nodule? In fact, it is very simple. Is it cancer, or is it not cancer? Depending on the series in the medical literature approximately 40% of all resected pulmonary nodules are malignant. CT scanning for lung cancer in five year prospective experience allows detection of early stage lung cancers. Benign nodule detection rate is also high.

The merits of CT in thoracic 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.**(4)** It has more to offer for lesions which are indeterminate on CT evaluation, transthoracic fine needle biopsy can be performed on such lesions using CT guidance. The most valid argument favoring the performance of an invasive procedure like transthoracic fine needle biopsy is, the short of thoracotomy. It is the only well established procedure which tells about the histological nature of all types of lung masses.**(5,6)** Such histological diagnosis is not only required for small operable cases but also for inoperable cases in which palliative treatment is imperative. Bronchoscopy, BAL, 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.

With this background the present study was undertaken to establish the role of CT in comprehensive evaluation of lung masses, especially in our set-up and to study the efficacy and safety of CT guided fine needle aspiration cytology.

MATERIAL AND METHODS

Study Design: With the aim of CT evaluation and guided biopsy of lung mass lesions, the present study from October 2009 to February 2011 has gathered relevant data on 45 patients. These subjects of varying ages and both sexes were referred to the Department of Radio-diagnosis, Mahatma Gandhi Medical College, Hospital, Jaipur from various department of this institution. The patients who were diagnosed having lung masses on chest skiagram were further evaluated with CT. Each subject was worked up and investigated according to the set protocol, broadly categorized as follows:

(a) Detailed clinical history, examination and relevant investigations including chest radiography.

(b) CT evaluation.

(c) CT guided FNAC

The present study employs the computerized software inbuilt in Seimens Somatom plus spiral CT scanner for CT evaluation of lung masses and needle guidance for transthoracic needle biopsy. The scanner has the capability to perform HRCT scanning and provides software for needle localization. Standardisation of the scanner was done from time to time.

CT evaluation

Scanning technique: The patients diagnosed having pulmonary radiodense lesion on plain skiagram chest was scanned on an outpatient basis, after 3-4 hours fasting. An assessment of the patient's underlying pulmonary disease was made before scanning. Scans were conducted on Siemens Somatoma +4 spiral CT machine using exposure factors of 120kV and 90mAs.

For CT evaluation, the standard protocol involved scanning the entire thorax from the lung apices to the costophrenic angles in supine position. In cases of suspected lung cancers, sections were extended caudally to include the adrenals.Both non-contrast and contrast enhanced scans were performed in most cases. Contrast used was non-ionic, water, soluble, the dose of contrast administered was 1-2m1/kg body weight administered by rapid intravenous bolus injection. Scanning began immediately after completion of the contrast injection.

Measurement of variable and parameters: The location of the lesion was analyzed and mass were grouped as parenchymal when they were confined to the lung parenchyma in either hemithorax. The lesions involving the hilar structures especially the bronchi were classified as hilar and lesions contained in any of the mediastinal compartment was specified.

The maximum dimensions in all 3 axis were recorded. Attempt was made to separate the masses from the surrounding collapse and consolidation wherever indicated and feasible. The morphology of the masses was studied with respect to their contour and texture. Masses were categorized as having smooth, lobulated or irregular contour and were distinguished as solid homogenous, solid inhomogenous, cystic, solid with calcifications, fat or air containing in terms of air loculi, air bronchograms or air cavities. An attempt was made to categorize the pattern of calcification.

Densitometric measurements were carried out wherever possible. Areas of differential densities were identified. The amount and pattern of contrast enhancement was also categorized. The lesions were categorized as mild, moderate and highly enhancing based on a post contrast change in attenuation values in the range of 40-60 HU, 60-80HU, >80HU respectively. Those showing no change were categorized as non-enhancing. The pattern of enhancement was categorized as homogenous, inhomogenous and peripheral..

Finally, an attempt was made to provide a CT diagnosis and lesions were categorized as benign, malignant or indeterminate.

CT guided FNAC

Preprocedural Measures: A written informed consent was taken from the patient, after

explaining the entire procedure to the patient including the possible complications. The importance of the successful completion of the procedure was emphasised to the patient and the benefits were explained. This helped immensely to get the patient's full cooperation.The patient was explained the importance of breath holding and multiple practice command of the same were carried out to ensure adequate and uniform breath holding.Another important measure was to obtain a preintervention coagulation profile of the patient including the platelet count, PT and PTT.

Percutaneous Site Localization Using CT:The accessibility of the lesions was studied by performing the routine CT scan of the thorax. An access route was decided which would traverse the least amount of aerated lung; The most representative CT image was selected in terms of accessibility and computer software in the form of grid was superimposed on the CT image.

RESULTS

CT evaluation of lung masses were carried out in 45 patient referred to the department of Radio-diagnosis, Mahatma Gandhi Medical College Hospital, Jaipur, with the primary objective to define the nature of abnormality and to provide a possible diagnosis in terms of malignant or benign. Another objective was to assess the suitability of the lesions regarding CT guided FNAC. Biopsy was performed under CT guidance in 45 masses. The observation regarding demography, clinical and other diagnostic procedures, CT evaluation and FNAC are compiled below.

Most cases with lung masses belonged to age group of 41-80 years (75.5%) with the mean age being 60 yrs. An overall male-female ratio was 5.4:1 in the present study.

Table-1 Lung masses: Site and Localization

Distance from pleura (Cm)	Mediastinal	Hilar	Parenchymal	Total
0-1	2	1	29	32(71%)
1.1-2	0	1	5	6(13.33%)
2.1-3	0	2	1	3(6.66%)
3.1-4	1	2	0	3(6.66%)
4.1-5	0	0	0	0(0%)
5.1-6	0	1	0	1(2.22%)
Total	3(6.66%)	7(15.55%)	35(77.78%)	45(100%)

Table-2 Diagnostic methods and test results

Parameters (Cases)	Malignant (%)	Benign (%)
Chest findings (45) (X-ray chest)	34(75.5%)	11(24.4%)
CT Findings (45)	37(82.22%)	8(17.7%)
CT Evaluation + FNAC (45)	38(84.44%)	7(15.5%)

Table-3 Histopathological findings

Histopathology	*No. of patients (N= 45)*
SQCC	**17**
SMCC	**6**
ADENO	**1**
PDC	**10**
LYMPHOMA	**1**
METS	**3**
TUBM	**4**
PNEUMONITIS	**2**
TBLN	**1**

Table -4 (a) Morphological Characteristics

(A)Size (Cm)(n=45)	Malignant		Benign		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**
2.1-4	7	15.56	2	4.44	9	20
4.1-6	15	33.33	5	11.11	20	44
6.1-8	9	20	0	0	9	20
8.1-10	3	6.67	0	0	3	6.67
>10	4	8.89	0	0	4	8.89
Total	**38**	**84.44**	**7**	**15.56**	**45**	**100**

Table -4(b) Morphological Characteristics

(B)Contour (n=45)	Malignant		Benign		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**
Smooth	8	17.78	4	8.89	12	26.67
Lobulated	2	4.44	1	2.22	3	6.67
Irregular	28	62.22	2	4.44	30	66.67
Total	38	84.44	7	15.56	45	100

Table -4 (c) Morphological Characteristics

Texture (n=45)	Malignant		Benign		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**
Solid						
Homogenous	11	24.44	4	8.89	15	33.33
In homogenous	27	60	3	6.67	30	66.67
Calcifications						
Central	1	2.22	2	4.44	3	6.66
Peripheral	1	2.22	1	2.22	2	4.44
Air Bronchograms	0	0	2	4.44	2	4.44

Table -5 Contrast enhancement of lung masses (N45)

Patten of enhancement	Malignant		Benign		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**
Homogenous	12	26.67	5	11.11	17	37.78
Inhomogeneous	25	55.56	2	4.44	27	60
Peripheral	1	2.22	0	0	1	2.22
Total	38	84.44	7	15.55	45	100

Most malignant lesions ranged between 4-8 cm in maximum size (53.33%) and all benign lesions were 2-6 cm in size (15.55%) and none above 6cm reflecting that the frequency of benignancy falls sharply with size, however size alone cannot differentiate between benign and malignant lesion.

38(84.44%) masses were within 2cm from the most accessible pleural surface and majority (77.78%) were of parenchymal origin. Based on CT evaluation and guided biopsy of lung mass lesions, there were 38(84.44%) malignant and 7 (15.55%) benign. In the malignant group, majority 17 (37.78%) were squamous cell carcinomas, followed by poorly differentiated carcinoma 10 (22.22%) and small cell carcinomas 6 (13.33%).In the benign group, the majority 4 (8.88%) were tubercular infections.

CT Evaluation

Most of the malignant lesions had irregular contour (62.22%) whereas most benign lesions had smooth margins (8.89%). Contour alone, has poor specificity and predictive value for malignancy, however it is quite sensitive and pulmonary masses with irregular margins should be assessed as malignant even though they fulfil other criteria for benignancy.

In large lesions, there are almost equal chances of both benign and malignant lesions to be inhomogenous (60% malignant and 6.67% benign). Thus heterogeneity of lesions is of little diagnostic value in itself for any prediction.

4.44% of malignant lesion and 6.66% of benign lesion showed calcification thus visualization of calcification on CT scans within lung lesions does not exclude the diagnosis of bronchogenic carcinoma.

CT Guided FNAC

CT is the preferred modality for guiding biopsy needles for sampling lung masses as it is the only modality which provides the easiest and the most safest approach to lesions of all types situated anywhere in the thorax with low incidence of complications as pneumothorax (11.11%) and hemoptysis (2.22%).

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 lung masses. The present study was undertaken to establish the role of CT and CT guided fine needle aspiration cytology in lung masses, especially in our setting.

A total of 38 males (84.44%) and 7 females (15.55%) who presented with lung masses on plain skiagram were evaluated by CT scan and underwent CT guided FNAC. The male-female ratio was 5.4:1. The age range in either sex was 0 to >80 years. The age and sex distribution of patient revealed that maximum number of males belonged to the age range 41-60 years (40%) with a second peak age incideifce in 60-80 years (28.9%) whereas females had peak incidence in 21-40 years(6.67%) followed by 41-60 years (4.44%) . 75.5% of total cases were in age range of 40-80 yrs with the mean age being 60 yrs in our study compatible with the study of J P et al .(7)

The lesions were grouped into mediastinal, hilar or parenchymal depending on their respective position on the CT scans. Further classification based on the distance from the nearest pleural surface to the edge of the lesion was made. The majority of the lesion were parenchymal (77.77%) most of which were within 1cm from the pleura, hilar lesions constituted 15.55% and most were >2 cm away from pleura

Out of the lung malignancies detected in the present study majority were squamous cell carcinomas (37.77%) followed by poorly differentiated carcinoma(22. 22%) and small cell carcinomas (13.33%), which reflects the general prevalence of the disease (8) Incidence of adenocarcinoma in our study was only 2.22% not compatible with the previous studies of Singh et al (2004) and Prashant Ramachandra (2007) Out of the benign group, majority were tubercular infections (8.88%), a reflection of the increased prevalence of tuberculosis in this part of the world.**(7,8)**

Most malignant lesions ranged between 4-8 cm in maximum size (53.33%) and all benign lesions were 2-6 cm in size (15.55%) and none above 6cm reflecting that the frequency of benignancy falls sharply with size, however size alone cannot differentiate between benign andmalignant lesion. (9). Moreover, size is unreliable in differentiating malignant form benign nodules as nodules as small as 1 cm can be malignant. (10).

The 45 lesion assessed by CT were classified as smooth, lobulated or irregular , based on the contour or edge characteristics . The basis of such a classification was earlier studied by Siegelman et al., and more recently by Yamasthita et al.(10,11)There were 28 malignant (62.22%) and 4(8.89%) benign lesion (Table No. 4b) in the present study based on contour alone. Though the observed difference is statistically significant ($p<0.l$), contour in itself has poor specificity and predictive value for malignancy as many smooth marginated carcinomas do occur(17.78% cases in our study) and have been reported from time to time. Informulating a proper approach regarding contour characteristics of a lesion, agreement was found with the observation of Siegelman et al, that pulmonary masses with irregular margins should be assessed as malignant, even though they fulfill other criteria for benignancy.**(10)**

Characteristics studied under this heading were the degree of homogeneity of the lesions, presence and pattern of calcification, air bronchograrns or air loculi. Though most of the lesion studied were inhomogenous (66.67%), but more malignant lesions showed in homogenous texture than benign ones (60% and 6.67% respectively). The preponderance of in homogenous lesions (66.67%) could be explained by the fact that firstly, most of the lesions were large and secondly, a large proportion of them were malignant, especially squamous cell carcinomas which are known to cavitate **(12)** and small cell carcinomas which are known to be very aggressive in -nature.

The presence and the pattern of calcification in lung masses has generated immense interest among radiologists, for long. In the subgroup of patients with overt calcification, (5 cases; table No. 4c) 3 were benign and 2 malignant. Out of the benign lesion 2 had central and 1 had peripheral pattern of calcification. Though the number of case in the present study in small, it is to be believed that visualization of calcification in lesion does not alone exclude the diagnosis of bronchogenic carcinoma.

The presence of air bronchograms in pulmonary lesions was seen in only 2 lesions; both of which proved to be benign. However both the lesions were of large size and the significance of this finding in small peripheral lung cancer could not be evaluated due to the nature of the subjects (Table 4c).

The pattern of contrast enhancement was studied in lung masses and the findings were correlated with the histological diagnosis (Table No. 5). A total of 45 lesions were studied. The majority of malignant lesions showed in homogenous pattern of contrast enhancement 25(55.56%), 12(26.67%) showed homogenous and 1(2.22%) peripheral pattern of enhancement. Of the benign lesions, majority 5(11.11%) showed homogenous enhancement. Such evaluation of pulmonary lesions was out by Yamashita et al. (1995) 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.(11) Among the homogenously enhancing lesions, 12(26.67%) were malignant and 5(11.11%) were benign.

Apart from morphology and contrast enhancement, CT helped in evaluation of lung masses by detecting number of 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 lymph nodes and nodal staging 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 extra thoracic 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 histological diagnosis.

A total of 45 aspiration biopsy were performed in all 45 patients. In most of the cases a single pass was made after engaging the lesions and appropriate placement of the needle as demonstrated on the CT scan.

Out of 45 cases in which CT evaluation and CT guided fine needle aspiration biopsy were performed, 38 (84.44%) were diagnosed as malignant and 7 (15.55%) as benign.

The complications associated with the procedure were noted and check scan were taken immediately after the procedure to detect the presence of pneumothorax. Both generic complications like ecchymosis, local bleeding , syndrome, syncope etc. and specific complications like pneumothorax, hemoptysis, hemorrhage etc were noted. In the present study pneumothorax occurred in 7 (11.11%) cases and hemoptysis occurred in 1(2.22%) case as in the study of JP Singh et al (2004).**(7)**

Out of 45 patient who had been X-rayed 34(75.5%) shows malignant features & 11(24.4%) shows benign nature of the lesion with sensitivity of 85%, specificity 73.33%, positive predictive value of 89.47% and negative predictive value of 64.70% for malignancy.

The CT scan shows that 37(82.2%) patient had malignant features & 8(17.7%) had benign nature. Sensitivity of CT in diagnosing malignancy is 97.36%, specificity 100%, positive predictive value 100% and negative predictive value 88.89%. The final diagnosis with FNAC shows 38(84.4%) malignant & 7(15.5%) benign - lesions with sensitivity and specificity of 100%. So in total 38 patients of malignancy lung, CT alone can diagnose the lesions in 37 patients with diagnostic accuracy of 97.4% in our study comparable to 96.6% of Stanley et al (1987) and 91% of Mohammad et al (2001)

CONCLUSION

In addition to morphological evaluation, CT provides additional information regarding staging of the disease which increases the specificity and sensitivity of the CT diagnosis. On its own, CT showed high sensitivity (97.36%), specificity (100%) and diagnostic accuracy (97.6%) in evaluation of lung masses in our study. CT guided FNAC is of utmost use in cases where pre-biopsy evaluation and imaging

suggests that a high probability of malignancy is present and where facility of on-site cytopathologist is available with high sensitivity, specificity and diagnostic accuracy.

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