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Original Article

Pathology Section

Correlation of CT Findings of Thoracic Mass Lesions with CT Guided Aspiration Cytology

ADYA KINKAR PANDA, SARITA PRADHAN, SATYA SUNDAR MOHAPATRA, RUPANITA BISWAL, S NISHA

ABSTRACT

Introduction: Thoracic masses have always remained an enigma in clinical practice. Computed Tomography (CT) is a useful investigation in further characterisation of suspicious thoracic masses and guided Fine Needle Aspiration Cytology (FNAC) is regarded as a quick diagnostic tool to differentiate malignant from benign thoracic mass lesions.

Aim: To evaluate the CT findings of thoracic mass lesions and assess the role of CT-guided FNAC, to comparatively analyse the radiological and cytopathological results.

Materials and Methods: Sixty patients with strong clinical suspicion and chest radiographic diagnosis of thoracic mass were included in the study. Their characteristic imaging findings were studied and the radiologically benign or malignant Features were correlated with cytological diagnosis.

Results: Out of all the sixty cases of thoracic masses, 40 (66.67%) were localized to the lung followed by mediastinal mass in 14 cases (23.33%). Pleural effusion (malignant vs benign-57.1% vs 14.3%), collapse of adjacent lung (51.4% vs. 11.4%), mediastinal lymphadenopathy (28.6% vs. 5.7%) and chest wall invasion (25.7% vs. 0%) are more commonly seen in malignant than in benign lesions. The radiological and pathological correlation of thoracic mass in the present study was 88% which is statistically significant (p = 0.01) with a specificity of 85.7% and sensitivity of 90%.

Conclusion: CT-guided FNAC of thoracic mass lesions is a safe and a rapid diagnostic procedure with less complication. Specific diagnosis can also be derived from cytomorphology alone.

Keywords: Cytomorphology, Radiological-pathological correlation,Transthoracic FNAC

INTRODUCTION

Percutaneous, transthoracic FNAC is a diagnostic procedure carried out to evaluate thoracic masses [1]. Clinical data and radiological findings with CT plays an important role in determining the nature of pulmonary nodule (benign versus malignant). Radiological features like lesion size, location, contour and edge, density (including the presence or absence of calcifications or fat) and contrast enhancement are evaluated. However, these features alone cannot always distinguish benignity from malignancy, and significant overlapping features exist among different lesions. CT allows the performance of FNAC in situations in which conventional X-rays or ultrasound do not correctly visualise the lesion or the needle tract, as enclosed within the thoracic cage. Most of the pulmonary opacities puzzle the clinicians and are justified through evaluation [1,2].

The present work was undertaken with the view to classify the various thoracic masses into appropriate categories radiologically and to evaluate the possible etiology and correlate the radiological findings with the pathological findings.

MATERIALS AND METHODS

This prospective study was conducted in the Department of Radiodiagnosis and Pathology in a Tertiary Care Hospital over a period of three years starting from June 2012 to May 2015. A total of 60 patients with strong clinical suspicion and chest radiographic diagnosis of thoracic mass were included in the study. Written consent was taken from each patient. Extremely small nodular centrally placed lesions, small hilar/middle mediastinal masses which have better accessibility with Trans Bronchial Needle Aspiration (TBNA) cytology and lesions with typical features of consolidation, either by their lobar distribution or from their clinical presentations were excluded from the study.

In cases where strong suspicion of an intrathoracic mass on plain chest radiographs, CT was performed with a multislice (16 slice, Siemens CT scanner) to further characterize the lesion radiologically and to locate the lesion at a particular axial plane in cases where FNAC is deemed feasible or inevitable. Intravenous contrast agents were administered in patients with normal renal function tests (Serum blood urea nitrogen values) and in addition to other imaging findings, the contrast enhancement patterns of the lesion were taken into account while radiologically classifying the lesion as possibly benign or malignant. The extent and nature of the lesion (whether solid or necrotic) was delineated and the site for entry was determined with a particular aim to strike

the solid parts. Care was taken for risk free access with minimal aerated lung, vital organs, muscle, nerve trunks, heart, major fissures and blood vessels in the path and also to avoid necrotic areas. Skin was cleaned with isopropyl alcohol or betadine and local anesthesia was given up to the pleura."Skinny" or thin caliber (22 to 23 gauge) Lumbar Puncture (LP) needles were used to obtain specimens for cytological evaluation. The distance from the skin surface up to the core of the lesion was measured and a needle guard was placed in position if a vital organ was next to the lesion or the lesion was too small. The angulation with the skin surface was also noted and the trajectory was directed to avoid aorta, heart, pulmonary vessels, main or segmental bronchus and in cases of cavitary lesions, aiming for their walls. The CT table was withdrawn and the LP needle with the stylet was introduced into the thorax. Care was to be taken to traverse the visceral and parietal pleura in single stab as repeated puncture of the pleura increases the risk of pneumothorax further. During insertion and withdrawal of the needle the patient was asked to hold his breath and the needle was permitted to swing free after the needle is in place, which helps in reducing the lacerating injury to the lung. The CT table was repositioned to previously recorded table positions and cross-sectional images were taken to confirm the position of the needle and adjustment if needed was estimated. The CT table was again withdrawn and aspiration process was completed. Aspirate smears were done, wet fixed or air dried and stained by Papanicolaou (Pap) and Hematoxylin & Eosin. Cell blocks were prepared wherever possible. Immediately after the procedure, the patient's whole thorax was further scanned to detect any procedure induced pneumothorax or alveolar hemorrhage along the track of the needle. Minimal pneumothoraces, if detected were aspirated using the same needle kept within the pleural space, whereas in cases with larger pneumothoraces covering almost whole of the lung surface, pulmonary medicine or cardiothoracic surgery consultations were taken and managed as advised. Even if there is no pneumothorax in the immediate post procedure imaging, the patient was advised for a plain chest radiograph after an interval four hours to detect cases with delayed onset of complications.

RESULTS

Among the 60 cases, in whom CT guided FNAC was done, the specimen was adequate in 56 (93.3%) cases. Patient's age varied from 16-84 years (mean age-50 years) with the predominant age group 45-54 years. The male is to female ratio was 2.16:1.

In all 40 (66.67%) cases were localized to the lung followed by mediastinal mass in 14 cases (23.33%), pleural masses in 4 cases (6.67%) and chest wall mass in 2 cases (3.33%). CT findings of 35 Lung masses were compiled and compared with cytologically reported malignant and benign lesions [Table/Fig-1]. Pleural effusion (malignant vs. benign- 57.1% vs. 14.3%), collapse of adjacent lung (51.4% vs. 11.4%), mediastinal lymphadenopathy (28.6% vs. 5.7 %) and chest wall invasion (25.7% vs 0%) were more commonly seen in malignant than in benign lesions. Moreover, calcification and air bronchogram (48.6%) were also more commonly seen in malignant lesions. This contradictory finding of air bronchogram being more commonly seen in malignant lesions is most likely due to exclusion of non mass like typical air space consolidation from the study.

CT-Findings	Malignant	Benign	Not seen
Collapse	18(51.4%)	4(11.4%)	13(37.2%)
Calcification	3 (8.6%)	0(0%)	32(91.4%)
Lymphnode	10(28.6%)	2(5.7%)	23(65.7%)
Effusion	20(57.1%)	5(14.3%)	10(28.6%)
Air Bronchogram	17(48.6%)	4(11.4%)	14(40%)
Chest Wall iInvasion	9(25.7%)	0(0%)	26(74.3%)
SVC Obstruction	4(11.4%)	0 (0%)	31(88.6%)

[Table/Fig-1]: Prevalence of different CT findings in lung masses in cytologically malignant and benign lesions (n=35 cases, as 5 cases out of 40 were inconclusive on FNA).

Pathological spectrum of all thoracic lesions showed adenocarcinoma to be the most common lung mass [Table/Fig-2]. Among the 14 mediastinal masses, germ cell tumour was the most common lesion followed by lymphoma [Table/Fig-3]. Out of 4 cases of pleural mass in which CT-guided FNAC was done, two were tubercular granulomas and two were metastatic adenocarcinomas. The two cases with chest wall masses revealed spindle cell tumour and metastatic follicular carcinoma of thyroid which was correlated by FNAC and biopsy from the thyroid nodule.

The most frequent age group for benign lesion was 25-34 years with 7.4% of cases and for malignant lesions it was 45-54 and 55-64 years with 24.1% of cases. 82% of malignant cases were above the age of 45 years. Most common carcinoma variant was adenocarcinoma in both males and females.

The needle size used was 22-23G with a reproducibility percentage of 93.3%. Minimal complications were recorded

Pathological Diagnosis	Male	Female	Total
Adenocarcinoma	10	8	18
Squamous Cell Carcinoma	4	2	6
Small Cell Carcinoma	1	0	1
Large Cell Carcinoma	1	0	1
Metastatic Osteosarcoma	1	0	1
Poorly differentiated Carcinoma	1	0	1
Tuberculoma	3	1	4
Inflammatory	2	1	3
Total	23	12	35

[Table/Fig-2]: Pathological diagnosis of lung mass (n=35 cases).

Pathological Diagnosis	Male (10)	Female (3)	Total (13)
Germ Cell Tumour	5	0	5(38.4%)
Lymphoma	3	1	4(30.8%)
Thymoma	1	0	1(7.7%)
Metastatic Squamous Cell Carcinoma	1	0	1(7.7%)
Esophageal Duplication Cyst	0	1	1(7.7%)
Round Cell Tumour	0	1	1(7.7%)

[Table/Fig-3]: Pathological diagnosis of mediastinal mass (n=13).

in 6 cases (10%). Chest pain occurred in 6 cases, hemoptysis in 2 cases, vasovagal reaction in 2 cases and pneumothorax in 1 case. All complications resolved on conservative management.

Total 54 out of 60 cases of CT-guided FNAC revealed conclusive cytopathologic report, 48 cases had a complete correlation between radiological evaluation by CT and cytopathological evaluation by CT guided FNAC. In 6 cases there was no correlation between these two. The radiological and pathological correlation of thoracic mass in the present study was 88% which is statistically significant (p = 0.01) with a specificity of 85.7% and sensitivity of 90%.

DISCUSSION

In today's era of evidence based treatment, CT evaluation of the thoracic masses provides the optimum benefit to the patient in reaching a correct diagnosis. CT guided FNAC being a simple, safe, and quick procedure for pathological diagnosis of thoracic masses, has been recommended for obtaining bacteriological material, staging patients with neoplastic conditions and diagnosing mediastinal masses for specific management [3,4]. Bhatia et al., [5] , Tan et al., [6] and Gouliamos et al., [7] have described FNAC as the final frontier with a high degree of sensitivity and accuracy.

In the present study the adequacy of sampling was 93.3%. Adequacy of sample in more than 90% cases was also reported in studies made by Holings et al., [8] . In the present study mostly peripheral lesions were attempted for a second pass and deep central lesions were left after one pass.

The cytology specimen evaluated in the present study showed definite malignancy in 66.66%, inflammatory lesions and of tubercular etiology in 15%, and benign neoplasms in 8.33%. Similar observation was found by Bandyopadhyay et al., [9], Tan et al.,[6] and Gouliamos et al.,[7] . A higher value was reported by Ahmad et al.,[3] with malignancy in 78% cases and TB in 12% cases.

Thomas et al., [10] laid the importance of determining the cell type before the course of treatment is planned. It was particularly important with small cell carcinomas for which surgery is not the primary choice, and also in cases when surgery is contraindicated for reasons like poor pulmonary functions, extensive emphysema and metastatic lesions.

So an attempt was made for the cellular typing of malignant lesion obtained. Incidence of adenocarcinoma was 64.28%, followed by squamous cell carcinoma in 21.43%, small cell carcinoma, large cell carcinoma, poorly differentiated carcinoma and metastatic in 3.57% cases each. Tan et al., [6] also reported a high incidence of adenocarcinoma in 49.4% of cases, where the most of the lesion were peripheral in distribution. They reported squamous cell carcinoma in 12%, small cell carcinoma in 9.4% and metastatic lesion in 8% cases. Overall, the non small cell carcinoma was in 89.29% cases. Distinction of NSCLC (Non Small Cell Lung Carcinoma) from SCC (Small Cell Carcinoma) was important as most of the therapeutic decision needed this degree of differentiation as was highlighted by Bhatia et al., [5].

Various CT findings were seen in cases of lung mass which helped in differentiating a suspected benign neoplasm/lesion from that of a malignant one. Out of 35 cases for which the cytopathological report by CT guided FNAC was available, pleural effusion was seen in 57.1%, collapse of adjacent lung in 51.4%, air bronchogram in 48.6%, enlarged mediastinal lymph node in 28.6%, chest wall invasion in 25.7% and calcification in 8.6% of malignant cases. The detection of calcification in 8.6% of malignant tumours is close to the findings of Zerhouni et al., [11], who found 7% prevalence of calcium in malignant nodules with a diameter of 6cm or less. Air bronchogram was seen in 48.6% of malignant cases which varies significantly from Kuriyama et al., [12], who found that 72% of the adenocarcinomas demonstrated air bronchograms. Mediastinal lymphadenopathy was seen in 28.6% of malignant lung masses in this study, which again varied significantly from the findings of Webb et al., [13] has stated that mediastinal lymph node metastases are seen in about 50% of patients with bronchogenic carcinoma.

Jain et al., [14] described that the most common mediastinal lesions were lymphoma, thymoma, germ cell tumours, neuroendocrine tumours and inflammatory lesions beside metastatic lesions. Similarly, Sherwani et al., [15] and Bandyopadhyay et al., [9], described lymphoma, thymoma, germ cell tumour and neural tumours being common in the mediastinum.In the present study, germ cell tumours (38.4%) was more common, other being lymphoma (30.8%).

In the present study out of 4 cases of pleural mass where CT guided FNAC was done, two cases turned out to be tuberculosis and the other two were of metastatic adenocarcinomas. The two chest wall masses where CT guided FNAC was done, one case came out to be metastasis from follicular carcinoma of thyroid which was correlated by FNAC and biopsy from the thyroid nodule and the other was reported as spindle cell tumour.

Detection of 37.05% of malignancy in less than 55 years of age in the present study is close to the finding of Behera et al., [16] who reviewed the data from national research registry programme of Indian Council of Medical Research (ICMR), which showed 40% of lung cancer in less than 50

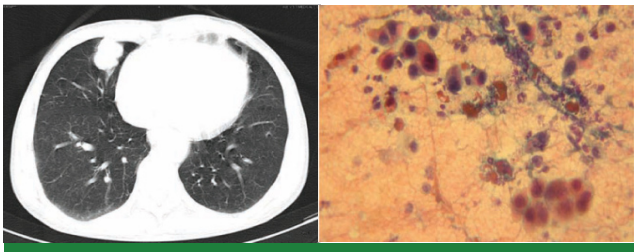
years of age. The malignant tumours common in younger age groups were lymphomas and germ cell tumours.

Needles of 22-23G were used for most aspirates in the present study with a reproducibility percentage of 93.3%. Sonnenberg et al., [17] found that by using 25G needle for emphysematous lung, COPD and coagulopathy, the sample was adequate in 88.5%. Nearly, similar complication rate of 11.8% was noted by Singh et al., [18].

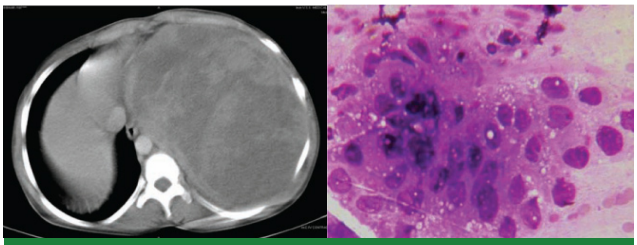
To reduce pneumothorax, there should be swiftness in action decreasing the time of the aspiration procedure. The patient should be advised to hold respiration while the needle is traversed through the lung. Using 100% oxygen inhalation and keeping the site of entry in the dependent position after the procedure was also helpful.

To reduce tumour seedling Mondal et al., [19] opined the use of 23G needle instead of 18G needle. Thomas et al., [10] describing hemorrhage stated that, amount of blood in cough as a teaspoon full or as tablespoon full is considered normal. They also described air embolism as one of the rarest complication that has to be managed more stringently.

The radiological diagnosis by CT evaluation was compared with the cytopathological diagnosis in 54 cases as in 6 cases there was in-conclusive report/in-adequate sample. In 48 cases the radiological diagnosis from CT evaluation was well correlated with the cytopathological diagnosis [Table/Fig-4-7]. Two cases suspected to be malignant radiologically as per their CT findings came out to be benign pathologically. Similarly four cases suspected to be benign radiologically came out to be malignant pathologically. The correlation between CT evaluation and cytopathological diagnosis by CT guided fine needle aspiration results of thoracic mass in our study is 88.88% which is statistically significant (p=0.01) with a sensitivity of 90% and specificity of 85.7% . So to increase the percentage of accuracy and reduce the false positive and false negative rates, the Pulmonologist, Radiologist, and Pathologist should work in close proximity.



[Table/Fig-4]: CT Thorax showing nearly homogenously enhancing lobulated lung mass with calcification and another solid nodule in the opposite lung. **[Table/Fig-5]:** Cytopathological diagnosis-squamous cell carcinoma (H&E,400X).



[Table/Fig-6]: CT thorax showing well defined heterogeneously enhancing mass lesion occupying the whole of the left hemithorax. **[Table/Fig-7]:** Cytopathological diagnosis-germ cell tumour (H&E, 400X).

LIMITATION

This study also had few limitations ,like biopsy correlation was not available in all cases as CT guided biopsy was more expensive considering the cost of the biopsy gun, and to avoid unnecessary biopsies in radiologically suspected and cytopathologically proven benign cases. However, biopsy, either CT guided or Video assisted thoracoscopic biopsies were advised in cases where cytologically proven malignant cases, keeping in view of possible further management course according to the Immunohistochemical analysis and classification of lung masses into small cell and non small cell variants. Follow up of all such patients also could not be done as they were referred to higher centre for treatment.

CONCLUSION

The higher success rate in CT guided transthoracic FNAC is because of its high diagnostic accuracy, low complication and minimal trauma. It is helpful in radiologically indeterminate cases and especially important in peripheral lesions, metastatic lesions and mediastinal lesions where sputum cytology is usually negative. In central and mediastinal lesions FNAC diagnosis may avoid exploratory procedure for biopsy. Although, video assisted thoracotomy and biopsy is the most accurate method of diagnosis, CT guided FNAC is safe, less expensive and less invasive with high rate of accuracy.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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AUTHOR(S):
1. Dr. Adya Kinkar Panda
2. Dr. Sarita Pradhan
3. Dr. Satya Sundar Mohapatra
4. Dr. Rupanita Biswal
5. Dr. S Nisha

PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Radiology, IMS and SUM Hospital, Bhubaneswar, Odissa, India.
2. Assistant Professor, Department of Pathology, IMS and SUM Hospital, Bhubaneswar, Odissa, India.
3. Professor, Department of Radiology, IMS and SUM Hospital, Bhubaneswar, Odissa, India.
4. Postgraduate Student, Department of Pathology, IMS and SUM Hospital, Bhubaneswar, Odissa, India.
5. Professor, Department of Radiology, V.S.S Medical College, Burla, Odissa, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Sarita Pradhan,
Assistant Professor, Department of Pathology,
IMS and Sum Hospital,
Bhubaneswar-751003, Odissa, India.
E-mail: dr.sarita26@gmail.com

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