

Computed Tomography Guided Fine Needle Aspiration Cytology of Lung and Mediastinal Lesions

Khushabu Gadodiya¹, Rekha Narendra Patil², Dinkar Kumbhalkar³, Waman K Raut⁴

ABSTRACT

Introduction: Computed tomography guided fine needle aspiration cytology is a safe and well established technique for the diagnosis of lung and mediastinal lesions. This study was carried out in the department of pathology in the tertiary health care and teaching institute where radiology department is well established. The aim was to study the cytomorphology of the spectrum of the lung and mediastinal lesions and to correlate the cytological diagnosis with the radiological diagnosis.

Material and methods: Computed tomography guided fine needle aspiration cytology was done in 90 patients after taking written consent of the patient. Patients were explained the benefits and risks of the procedure. The results were analysed.

Results: A total of 90 patients were included in the study. There were 81 patients of lung lesions and nine patients of mediastinal lesions. There were 63(70%) males and 27(30%) females. Adequate aspirate was obtained in 77 patients giving the adequacy rate of 85.55%. Adenocarcinoma was the most common type of lung malignancy and Non Hodgkins Lymphoma was the most common malignancy in the mediastinum. Inflammatory lesions were seen in 13 cases. Granulomatous lesions were found in six patients. One interesting case of hydatid with aspergillosis was diagnosed on cytology smears, which on radiology was diagnosed as neoplastic. Pneumothorax was seen in three patients. No patient required chest tube insertion.

Conclusion: Computed tomography guided fine needle aspiration cytology is a safe and reliable method for the diagnosis of lung and mediastinal lesions. It can help in early diagnosis and initiation of the treatment avoiding major surgical procedures.

Keywords: Computed Tomography, Fine Needle Aspiration Cytology, Lung Mass, Mediastinum, Chest Mass, Thoracic Mass, Pulmonary Mass.

INTRODUCTION

A variety of benign and malignant lesions can occur in the lung and mediastinum.¹ Pulmonary tissue records the highest incidence of invasive cancer in both males and females as per WHO.² Percutaneous transthoracic Fine needle aspiration cytology (FNAC) done under the computed tomography (CT) guidance is a relatively safe and reliable diagnostic technique for the lung and mediastinal lesions. In diffuse parenchymal lung disease the role of FNAC is limited. FNAC plays an important part in the diagnosis of localized lung lesion.³ FNAC of these lesions can differentiate between benign and malignant lesions and also the small cell carcinoma of the lung from non small cell carcinoma of the lung which helps in early initiation of the treatment and avoid more invasive

surgeries in maximum number of cases specially in patients with inoperable lesions due to patient's general condition and local factors.¹⁻¹³

Radiologic imaging can very well document the size, shape, contour, edge, density and presence or absence of calcification in the lesion. These features are not of much help in categorizing the lesions as benign or malignant as there is a lot of overlap.^{5,6,8,12}

CT guided Percutaneous transthoracic FNAC is a safe, effective and relatively simple procedure with high diagnostic accuracy for lung and mediastinal lesions.¹⁻⁸

Regardless of the size of the lung and mediastinal lesion CT guidance allows the needle placement in the lesion safely avoiding the vital structures in the vicinity.^{2,4-7,11}

CT Guided FNAC of lung lesions has achieved widespread recognition as a diagnostic tool in lung pathology. The most common complication is pneumothorax and is easily treated and few cases require active management.^{1,3,5,10,11-13}

The present study was carried out in the department of pathology with the aim of studying the cytomorphological spectrum of CT guided FNAC of the lung and mediastinal lesions and to correlate the cytological diagnosis with the radiological diagnosis.

MATERIAL AND METHODS

This study was carried out in the Pathology department of a teaching institute of Central India where Radiology Department is well established.

A total of 90 patients were included in the study. The study period was from 1st of July 2014 to 30th June 2016. Permission of institutional Ethical committee was taken.

Detailed clinical history and pre-procedural workup of the patient was done. Pre-procedural investigations like

¹Ex Assistant Professor, Department of Pathology, Government Medical College, Akola, ²Assistant Professor, Department of Pathology, Government Medical College, Nagpur, ³Professor, Department of Pathology, Government Medical College, Nagpur, ⁴Professor and Head of the Department, Department of Pathology, Government Medical college, Nagpur, India

Corresponding author: Dr. Rekha Narendra Patil, Poonam Apartment (402), Dandigy Layout, Shankar Nagar, Nagpur. 440010, India

How to cite this article: Khushabu Gadodiya, Rekha Narendra Patil, Dinkar Kumbhalkar, Waman K Raut. Computed tomography guided fine needle aspiration cytology of lung and mediastinal lesions. International Journal of Contemporary Medical Research 2019;6(2):B7-B12.

DOI: <http://dx.doi.org/10.21276/ijcmr.2019.6.2.17>

complete blood count (CBC), prothrombin time, International normalized ration (INR) and virology were done. Written consent of the patient was taken after explaining the benefits and risks of the procedure in the language which the patient could understand.

Selection criteria of the patient population were radiologically detected lung or mediastinal lesion in patient of any age and sex. Patients not diagnosed on sputum and bronchoalveolar lavage (BAL) examination. Exclusion criteria were patients whose general condition was very poor, highly vascular lesion, poor pulmonary function, suspected hydatid cyst, bleeding diathesis, patients needing assisted ventilation, severe pulmonary hypertension, chronic obstructive pulmonary diseases (COPD) with documented bullous lesion. A complete examination of the patient was done to rule out primary malignancy elsewhere.

The exact position of the lesion was established by the computed tomography (CT) scan study. FNAC was done following all aseptic precautions. The skin was cleaned with betadin and 23 gauge 89 mm long spinal needle was introduced through the percutaneous transthoracic approach. A needle path which could avoid the injury to the vital structures was selected. The patient was positioned on the CT table in prone or supine position. Each needle path was

chosen so as the needle could be at the most perpendicular angle to the pleura and shortest possible depth could be chosen. The skin site of entry was marked using a laser grid system. The site was cleaned and prepared in the usual sterile manner. Local anaesthesia administered using 2% lidocaine. The 89 mm long spinal needle was advanced under the CT guidance to the edge of the lesion. Breath holding technique was employed. The aspirate was obtained by to and fro movement of the needle within the lesion. The negative pressure was released and the needle was removed. The aspirate was noted and the both alcohol fixed and air dried smears were prepared. Alcohol fixed smears were stained with Haematoxylin and Eosin and Papanicolaou stain. Air dried smears were stained with May- Grunwald Geimsa and special stains like Periodic acid-Schiff (PAS) and acid fast bacilli (AFB) stain were done when needed. Patient was kept under observation for a minimum of 2 hours. Post procedural x- ray was done in all patients to rule out any complications. Pneumothorax was seen in 3 patients and was managed conservatively.

RESULTS

A total of 90 patients in whom Computed tomography (CT) guided fine needle aspiration cytology (FNAC) was done

Age range (years)	Males	Females	Total
Upto 40	6	9	15(16.67%)
41-50	9	2	11(12.23%)
51-60	14	7	21(23.33%)
61-70	27	8	35(38.89%)
71-80	7	1	8(8.88%)
Total (%)	63(70%)	27(30%)	90(100%)
Subject	Sub heading	Number	Percentage
Site of lesion	Lung	81	90%
	Mediastinum	09	10%
Size of the lesion	Less than 2 cm	16	17.77%
	More than 2 cm	74	82.23%
Sample adequacy	Adequate	77	85.55%
	Inadequate	13	14.44%
Radiological diagnosis	Malignant neoplastic	79	87.77%
	Non neoplastic	11	12.22%
Cytological diagnosis	Malignant neoplastic	61	79%
	Non neoplastic	16	20.77%

Table-1: Showing the general demography of the study

Site	Primary malignancy	Metastasis	Infections	Suspicious of malignancy	Total
Lung	48	07	12	02	69(89.61%)
Mediastinum	05	01	01	01	08(10.38%)
Total (%)	53(68.83)	08(10.38)	13(16.89%)	03(3.90%)	77(100%)

Table-2: Showing the distribution of lesions as per the cytological diagnosis

Type of malignancy	Number /48	Percentage/48(100%)
Adenocarcinoma	29	60.42%
Squamous cell carcinoma	12	25%
Large cell carcinoma	04	8.33%
Small cell carcinoma	03	6.25%

Table-3: Primary neoplastic lesions in lung

Method	Malignant	Inflammatory/non neoplastic	Inadequate	Suspicious of malignacy	Total
Radiology	79	11	-	-	90
Cytology	61	13	13	3	90

Table-4: Showing the radiological and cytological diagnosis

Radiology / Cytology>	Neoplastic	Non Neoplastic
Neoplastic	60	05
Non neoplastic	01	08

Table-5: Showing the comparison of radiological and cytological diagnosis

Cytology / Histopathology >	Neoplastic	Non neoplastic
Neoplastic	12	0
Non neoplastic	1	1

Table-6: Showing cytology and histopathology correlation of 14 cases.

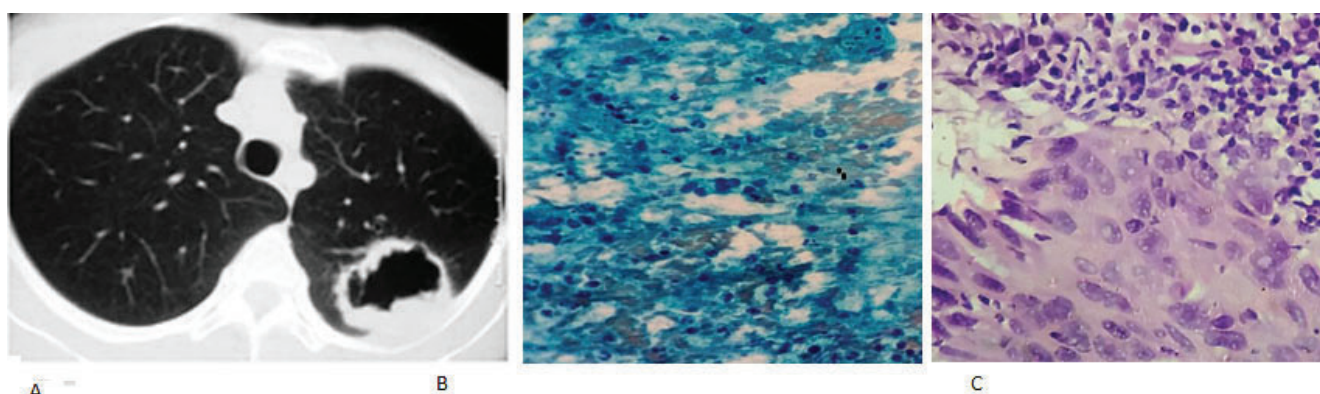


Figure-1: (A) CT showing cavitary lesion with irregular thick wall. B-FNAC smears showing marked inflammation obscuring the cellular details. C-biopsy showing histological features of squamous cell carcinoma.

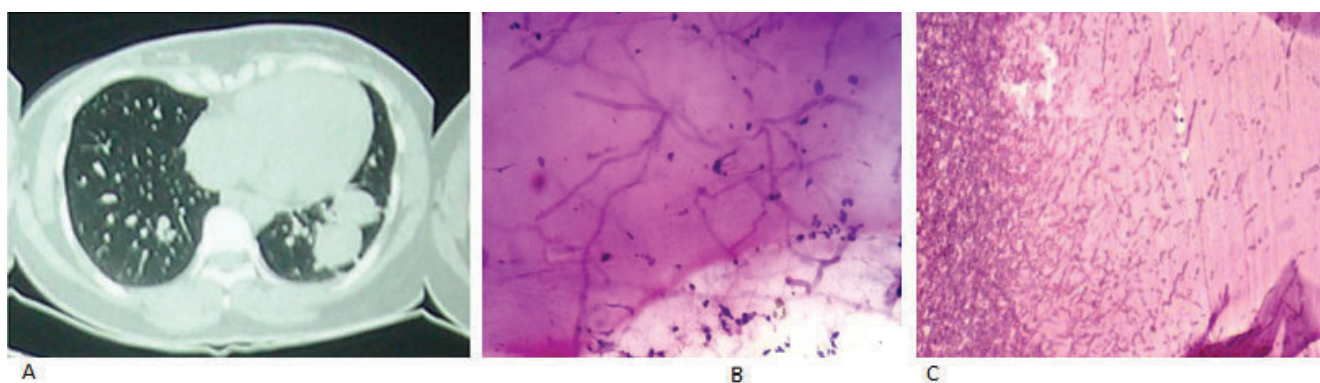


Figure-2: (A) CT showing Hydatid cyst with associated Aspergillosis which elicited inflammatory reaction; misdiagnosed as malignant neoplasm. B- cytology smears showing acute angle branching along with hydatid membrane. C- Histopathology sections showing laminated membrane and acute angle branching fungal hyphae.

were included in the present study. There were 63 males (70%) and 27 (30%) females. The youngest patient was 3 years old male child and the eldest patient was 80 years old male. The general demographic findings are as shown in the table number 1. We had 81 patients of lung lesions and 9 patients of mediastinal lesions. Right lung was involved in 56 patients. There were 6 patients with anterior mediastinal lesion, two patients with having superior mediastinal lesion and one case of posterior mediastinal lesion.

The maximum number of patients i.e. 67 (74.44%) patients were in the age group of 41 to 70 years. The size of the lesion was in the range of 1.5 cm to 8 cm. The size of the lesion was

less than 2 cm in 16 patients out of the total 90 patients. The aspirate was mostly haemorrhagic. In 14 patients the aspirate was blood mixed purulent.

Adequate aspirate was obtained in a total of 77 patients. The overall adequacy rate was 85.55%. There were 13 patients with inadequate aspirate which included 12 patients of lung lesions and one case of mediastinal lesion. These patients were excluded from study for further calculations.

The most common clinical presentation was breathlessness (60%) and weight loss (54%) followed by cough (49%) and fever (48%).

Table number 2 shows the distribution of lesions as per

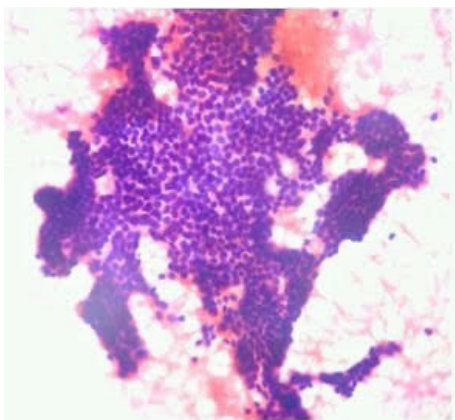


Figure-3: Cytology smears showing sheets of cells with glandular arrangement.

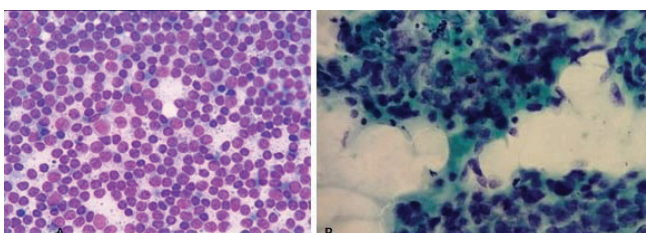


Figure-4: Mediastinal lesions (A): Cytology smears showing monotonous population of cells Non Hodgkins lymphoma. (B): cytology smears showing features of germ cell tumor.

the cytological diagnosis. The table number 2 shows that malignancy was seen in 79.21% cases. There were 53 patients (68.83%) having primary malignancy, eight patients (10.38%) had metastasis. Out of these seven patients of metastasis in lung three were known cases of gastrointestinal adenocarcinoma, and other patients were diagnosed cases of squamous cell carcinoma of larynx, Non Hodgkins Lymphoma, malignant round cell tumor and pleomorphic sarcoma. One patient of metastasis in mediastinum was a case of epithelial malignancy from unknown primary

Non neoplastic lesions /Inflammatory lesions

There were 13 cases of inflammatory lesions diagnosed on cytology. Out of these 13 cases there were six cases of non specific inflammation. Smears of these cases showed plenty of polymorphs with macrophages and necrotic background. The special stains like Acid fast bacilli and Periodic-Acid Schiff (PAS) were negative. One of these cases due to high suspicion of malignancy underwent biopsy which showed histopathological features of squamous cell carcinoma. (figure 1)

The smears of other six cases showed well formed epitheloid granulomas with caseous necrosis and giant cell formation. AFB was positive in five cases. These cases were reported as tuberculous granulomatous lesions. This included five cases with lung lesions and one patient with mediastinal lesion.

There was an interesting case of hydatid with associated aspergillosis. The smears of this patient showed laminated membrane with acute angle branching hyphae.(figure 2) PAS stain done on cytology smears, showed PAS positive hyphae. This case was a rare case of coexistence of hydatid

with aspergillosis in an immunocompetent person a rare combination. The radiological diagnosis of the patient was of a neoplastic lesion. This may be due to the absences of the classical radiological features of hydatid. The coexistence of hydatid with aspergillosis masked the clinical and radiological picture. We received pneumectomy specimen of this patient which confirmed the cytological diagnosis of coexistence of hydatid with aspergillosis. This case has already been published.¹⁴

Neoplastic lesions of lung

Table-3 shows the primary neoplastic lesions in lung. The most common primary lung malignant neoplasm was adenocarcinoma.(figure 3) The smears showed malignant cells in clusters, acinar and at places glandular pattern. Cells were of moderate to large size having moderate to abundant amount of cytoplasm, round eccentric nuclei with prominent nucleoli.¹⁵

Squamous cell carcinoma was the second common type of primary lung carcinoma in this study. The smears showed cells in irregular solid cohesive fragments and sheets. The cells showed hyperchromatic nuclei and moderate amount of cytoplasm.

Large cell carcinoma was seen in four patients. Smears showed predominantly dispersed large pleomorphic cells having high nuclear cytoplasmic ratio. Giant cells were also seen. Small cell carcinoma in three patients. Smears of these patients showed small to medium-sized cells in clusters. Cells had little or no cytoplasm. Nuclear molding was noticed. Nuclei showed uniform finely or coarsely granular nuclear chromatin and a small nucleoli. Streaks of nuclear material and numerous mitotic figures were noted.

There were seven cases of metastasis from known primary. Out of the seven cases, three cases of adenocarcinoma of the gastrointestinal tract. One case each of Non Hodgkin's lymphoma(NHL), pleomorphic sarcoma, malignant round cell tumor and squamous cell carcinoma of larynx.

There were three cases diagnosed as suspicious of malignancy on cytology smears. The smears showed scanty cellularity, but there were few cells which showed atypical features in the form of dispersed cell population and high nuclear cytoplasmic ratio.

Malignant lesions of mediastinum

There were two cases of Non Hodgkin's lymphoma(NHL), one case each of Hodgkin's disease, germ cell tumor, (figure 4) round cell tumor, and metastasis of epithelial malignancy from unknown primary.

The most common location was the anterior mediastinum and NHL was the most common. Cytology smears showed monotonous population of lymphoid cells. Nuclei showed speckled chromatin and inconspicuous nucleoli.

Table No 4 shows that there were 79 cases diagnosed as malignant neoplastic on radiology and 11 cases diagnosed as inflammatory lesions. On cytology there were 61 cases diagnosed as malignant, 13 cases as inflammatory 13 cases showed inadequate material and three cases were suspicious of malignancy.

Table 5 shows that radiological and cytological diagnosis correlated in 68 cases. The cytoradiological correlation was 91.89%. The sensitivity was 92.31%, and specificity was 100%. In one patient who was diagnosed as non-neoplastic on radiology, the smears showed cytological features of adenocarcinoma with granulomatous reaction.

The rare and interesting case of coexistence of hydatid with aspergillosis was diagnosed as neoplastic on radiology. The classical radiological features of hydatid were masked by the presence of aspergillosis.

Three patients were diagnosed as neoplastic on radiology. The cytology smears of these patients showed tuberculous granulomatous lesions and were AFB positive. One case which was diagnosed as inflammatory on cytology on biopsy showed features of squamous cell carcinoma.

Biopsy was done in 18 patients. Cytology and histopathology correlation was available in 14 cases. There were two cases in which both the cytology and histopathology was inadequate for interpretation. One case was inadequate on cytology and biopsy showed features of squamous cell carcinoma. The other patient was reported as suspicious of malignancy on cytology and biopsy showed features of squamous cell carcinoma. This gives sensitivity of 92.31%, specificity of 100%. Pneumothorax occurred in 3(3.33%) case out of 90 patients. No patient needed chest tube insertion.

DISCUSSION

The present study was carried out to study the cytomorphology of lung and mediastinal lesions. There were 90 patients and adequate aspirate was obtained in 77 cases giving an adequacy rate of 85.55%. It was comparable with other studies.^{1,3-5,7-11} The size and depth of the lesion affects the adequacy of the aspirate. The high diagnostic accuracy is best achieved in large nodules.^{2,8} In our study there were 16 cases having size less than 2 cm. In the present study the range of the lesion size was from 1.4 to 8 cm, similar to other studies.^{2,6,10}

A major diagnostic problem for the clinician is a non-resolving opacity on the chest imaging study.⁸ Evolution of the extremely sophisticated radiologic imaging techniques and the reestablishment of sampling technique of the well visualised lesions lead to revolutionising the cytology of respiratory track. Computed Tomography (CT) is the most prominent imaging modality used in the study of lung lesions.^{3,10}

Diagnostic lung puncture technique was introduced by Leyden in 1883 and Menbriel in 1986 which has long been used for the identification of infections and malignancy.⁴ FNAC can differentiate between small cell carcinoma, lymphoma very appropriately. This is a major advantage of FNAC making the early treatment possible. These conditions are treated by chemotherapy rather than surgery.¹⁻¹⁰

Lung was the most commonly aspirated site similar to other studies.^{1,9,13} The number of male patients were more in the study and the male to female ratio was 2.3:1. Other studies also showed predominance of male patients.^{3,4,5,9,10,11}

The clinical presentation of the patients with lung and

mediastinal lesions is variable. These patients presents with cough, chest pain, shortness of breath, loss of weight, haemoptysis, fever and sometimes with hoarseness of voice.^{1,3,4,6,8,11} The most common clinical presentation was shortness of breath and weight loss followed by cough, chest pain and fever in our study.

Non neoplastic lesions

There were 13 non-neoplastic lesions, 12 in lungs and one in mediastinum. In six cases the cytological diagnosis was tuberculous granulomatous lesions with AFB positive bacilli. Granulomatous lesions were confidently diagnosed on cytology. The AFB positive bacilli can be seen in 38% cases of granulomatous lesions.⁸ The present study showed AFB positivity in 4(66.66%) out of the 6 granulomatous lesions.

Non specific inflammatory lesions were seen in six cases which showed plenty of polymorphs and necrotic fibrinous background. These are non specific findings. Due to high clinical suspicion of malignancy in one of the case diagnosed as non specific inflammatory lesion on cytology, biopsy was done and it showed histological features of squamous cell carcinoma. This was similar to the finding in the study by S. K. Mondal et al in which one patient was diagnosed as non specific inflammation on cytology smears. Biopsy was done in this patient and it showed squamous cell carcinoma.⁴ Similar to the case in the present study.

Moumita Sengupta has reported a case of histoplasmosis in the lung.¹⁰ S. K. Mondal et al had one case each of hydatid and aspergillosis.⁴ Rangaswamy et al also had a case of aspergilloma.¹ In the study of Ramaswamy et al cell block was helpful in the diagnosis of aspergillosis.¹ In this study there was a very rare single case of a combination of hydatid with aspergillosis in an immunocompetent patient. This case was diagnosed on cytology smears. Hydatid cyst is very common in lungs. Hydatid cyst has classical radiological signs which are described in the literature but in complicated hydatid cyst the radiological picture is altered.¹⁶ In the present case the atypical radiological picture of hydatid was present and it was reported as neoplastic.¹⁴

Malignant lesions were the most common accounting for 79.22%. This is similar to the other studies.^{1,3,4,5,6,7,8} Benign spindle cell lesions are difficult to aspirate and the diagnostic accuracy for benign lesions ranges from 10-50% and for malignant lesions is high upto 95%.^{1,2,4,5,13}

Adenocarcinoma was the most the common malignancy in our study similar to the other studies.^{3,4,5,9,13} In some studies squamous cell carcinoma the most frequent type of carcinoma.^{1,7,8,11}

In the mediastinum the majority of the lesions were seen in the anterior mediastinum similar to other studies.^{16,17} In the present study haematolymphoid malignancy was the most type of malignancy in the mediastinal region. We did not have a single case of thymoma which was the most common mediastinal lesion in the other studies.^{13,16,17} This could be due to the less number of mediastinal cases in the present study.

We had a case of germ cell tumor in a 3 year old male child with anterior mediastinal lesion. In the present study there was the sensitivity and specificity was 92.31% and 100% respectively compared to other studies.^{3,4,5,6,7,8,13}

Various complications like pain, pneumothorax, haemorrhage and haemoptysis can occur during the procedure. Other rare complications are haemothorax, pulmonary embolism and very rarely needle tract implantation.^{1-6,11,13} We encountered pain as the most common complication followed by pneumothorax in 3 patients. No patient required chest tube insertion in our study.

CONCLUSION

CT guided FNAC of lung and mediastinal lesions is a safe, less invasive procedure with a high diagnostic accuracy. This can help in early initiation of the specific therapy avoiding the major surgical procedure like thoracotomy. Most common complication being pneumothorax which can be treated. The pit falls in the diagnosis can be prevented by proper clinical and radiological correlation.

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Source of Support: Nil; **Conflict of Interest:** None

Submitted: 09-12-2018; **Accepted:** 11-02-2019; **Published:** 20-02-2019