**Original Research Article**

# Computerized tomography guided percutaneous transthoracic fine needle aspiration of lung lesions

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## Abstract

**Introduction:** Computed tomogram guided fine needle aspiration cytology (FNAC) is an important and useful investigation to differentiate between benign and malignant lesions of lungs. With computed tomography (CT) it is possible to perform a biopsy on almost any portion of lung with high degree of safety and minimal morbidity avoiding more invasive techniques.

**Aim:** The present study was designed to assess the efficacy of CT guided fine needle aspiration of lung lesions and to assess the incidence of complications.

**Materials and methods:** 65 cases of both sex and varying age groups referred to radiology department for CT guided lung FNAC from October 2012 to January 2013 were included in this study. Relevant clinical history and investigations were obtained from the patient. Informed and written consent was taken from the patient. The lesions were localized by CT scan and after the needle tip was confirmed to be in the desired location, aspirations were performed.

**Results:** A total 65 cases, 53 cases were male and 12 cases were female with mean age 49.23 years. The most common diagnosis observed following biopsy was malignancy (non small cell carcinoma) in 41 cases (63%), benign lesion in 6 cases (9%) and 3% showed mixed lesions. Among 65 cases, 49 cases (75%) showed adequate material in the aspirate specimen, where as 12 cases (18.4%) showed inadequate tissue for diagnosis. However 4 cases were lost on follow up. Complications observed during procedure include pneumothorax in 11 cases (16.9%) and hemoptysis/pulmonary hemorrhage in 2 cases (3%).

**Conclusion:** CT guided FNAC is well recognized procedure with good efficacy for evaluation of pulmonary lesions with minimal complications, most common being pneumothorax followed by hemoptysis.

**Key words**

Percutaneous transthoracic fine needle aspiration, CT, Lung mass, Pneumothorax.

## Introduction

Lung biopsy is a procedure to get sample of cells from any solid or cystic lesion between chest wall and mediastinum which is not visible at bronchoscopy using highly sophisticated radiological imaging techniques to visualize and localize the lesion in the lung.

Lung biopsy is a relatively frequently performed procedure with considerable benefit for patient management.

Lung biopsy classified according to method of access as Percutaneous transthoracic lung biopsy or percutaneous transthoracic fine needle aspiration, Bronchoscopic lung biopsy or transbronchial fine needle aspiration and Open surgery.

Computed tomography (CT) guided fine needle aspiration cytology (FNAC) is a well known modality for characterization of lung masses with a reported diagnostic accuracy rate of 93% and a sensitivity rate of 95% [1, 2]. It has been used to differentiate lung masses into benign, malignant and inflammatory types. However, its diagnostic sensitivity rate in benign lung diseases is reported to be 50% in most series [3]. Furthermore its use has been extended in differentiating lung malignancy into different cytopathological types which aids in proper management of the malignant lesion. CT guided FNAC is widely recognized technique in indeterminate mass. It is a simple diagnostic method of relatively low cost, with negligible mortality and limited morbidity [4]. The accuracy of CT guided FNAC for discriminating benign from malignant lesion has been recorded to vary from 64% to 97% [5]. Several post procedural complications have been reported for CT guided FNAC such as pulmonary hemorrhage, hemoptysis and pneumothorax. The risk for developing pneumothorax has been observed to be 22% - 45% due to high sensitivity of CT in detecting pneumothorax [6].

Relative contraindications to image guided FNAC are severe chronic obstructive airway disease, bleeding diathesis, contralateral pneumonectomy and pulmonary arterial hypertension [7].

The present study is designed to assess the efficacy of CT guided fine needle aspiration of lung lesions and to assess the incidence of complications.

## Materials and methods

This was a prospective study conducted in Osmania General Hospital, Hyderabad from October 2012 to January 2013. The study included 65 cases of both sex and of various age groups.

The study was carried out in 65 patients who presented with intrathoracic and mediastinal mass that attended the outpatient/inpatient department of Medicine in the respective hospitals and were sent for chest CT in the department of Radiology. Relevant clinical history and investigations were obtained from the patient to narrow down the differential diagnosis and to see if patient was eligible for FNAC. Patient should not have any history of bleeding disorder, thrombocytopenia, dysponea, uncontrolled cough, chronic obstructive airway diseases, pulmonary arterial hypertension etc. Cooperative patients who can hold breath for short while with peripheral indeterminate lung mass or mass who were to undergo chemo or radio-therapy and not approachable by USG were taken for CT guided FNAC.

All the CT guided needle aspiration biopsies of parenchymal lung masses were performed by the incharge consultant radiologist or by residents under their supervision.

The Scanner used in this study is SEIMENS SOMATOM PLUS.

**Pre-procedural evaluation and preparation**

- Informed and written consent was taken from the patient explaining the risk and benefits of the procedure.
- **Preprocedural investigations:** Coagulation indices- PT. APTT (activated partial thromboplastin time), platelet count, Platelet count APPT ratio and Oral coagulants stopped 4 days before biopsy is performed, recent chest radiographs, Recent CT scans of chest were taken. Repeat CT scan was performed if there had been significant change in the patients clinical condition or if there has been significant delay before the biopsies was performed or if the localizing CT scan at the time of biopsy showed significant changes.
- **Setting to deal with complications:** ECG monitor, Blood pressure instrument, Pulse oximeter, Working IV line- for administration of emergency medication, $O_2$, Suction equipment, Oral and nasal airways, Ambu bag, Instruments for aspiration of pneumothorax, Chest tube connectors and tubings and Resuscitation cart were arranged.

**FNAC procedure**

**Patient positioning and instructions:** As patient comfort is crucial for maintaining a designated position which is crucial for accurate needle placement supine/ prone with arms at their sides is chosen generally, Decubitus position was chosen only if absolutely needed because the patients drift out of position easily. Posterior approach was favoured if no fissure was violated because it is associated with decrease pneumothorax rate (due to bucket handle motion of ribs).Post procedure patient is placed with puncture site in down position therefore it is easier for the patient in supine position. The breathing technique were explained to the patient and practiced beforehand. Deep breaths and coughing should be avoided during procedure.

**Imaging technique**

Thin sections of CT scans were obtained to identify and target the lesion. The lesion was further evaluated for feasibility and nonfeasibility of the lesion.

**Feasibility of lesion**

Small lesion in favourable location was preferable to a larger lesion in less desirable location. For small peripheral lesion as direct puncture is unwise, a near tangential approach was used-in this way the needle enters the lung at some distance from target and plenty of room is there for adjustment.

Favourable locations are a) pleural based lesions-as aerated lung is not violated, b) upper lung zone lesion-as they move little with respiration, c) relatively peripheral lesion d)perpendicular puncture directed at center( lung at the puncture site is ventilated as lesion itself and may obstructed direct bronchial supply to portion of lung immediately peripheral to nodule).

**Non-feasibility of lesion**

They includes Small lesions abutting the heart-cardiac motion, Nodules in superior portion of RML just under dome shaped minor fissure, Small lesions deep in CP angles where respiratory movement is more therefore increases chances of misregistration.

Areas to be avoided are areas of necrosis or adjacent post obstructive pnuemontis, crossing of fissures-as transgression results in three rather than one, visceral pleural puncture, Belbs and bulla as it increases risk of pneumothorax and large vessels.

As far as possible aerated lungs is avoided to prevent pneumothorax by direct puncture of pleural based lesion, passage through collapsed or consolidated portion of lung should be avoided.

Course needle over ribs and not on ribs (causes periosteal irritation-vasovagal stimulation and also difficult to manipulate needle later) or under ribs (as neurovascular bundle travels just below it).

In post thoracotomy patients the side on which surgery was performed is selected for biopsy as pleurae are adhered due to scarring.

**FNAC technique**

The patient was kept in supine/prone position according to the site of lesion on previous chest radiograph or CT scans on the CT table. Scout images were used to identify the lesion. Using the imaging technique described above the CT slice was chosen. On the chosen slice entry site was marked with metallic marker placed on the skin. The distance from midline to entry site, the depth from skin and angle of insertion of needle was assessed on the CT monitor console.

After the skin entry site was chosen it was sterilized with standardized antiseptic solution. Cutaneous and subcutaneous tissue was infiltrated with lignocaine up to a maximum dose of 20ml of 2% solution. Pleura was avoided to avoid the risk of pneumothorax.

Stepwise advancement of the needle was done within plane of gantry, to a position, just outside the parietal pleura, directed at the lesion and the slice is rescanned to assess the position of needle. When the needle is advanced or withdrawn into the patient the patient was asked to suspend respiration for 10-15 seconds, the ideal respiratory volume being small inspiration within range of normal quite breathing. The patient was allowed to breath gently with needle in place. All corrective manipulations of the needle were performed withdrawing the needle (but not through pleura) and readvancing.

With needle within the target the central stylet was then removed and 10cc syringe was attached. Suction was applied while rotating and moving the needle to and fro during suspended respiration. Procedure was terminated on acquisition of an adequate specimen, development of symptomatic pneumothorax, or development of parenchymal hemorrhage with severe coughing or hemoptysis.

The cellular material was seen to be within the barrel of the needle and not in the barrel of syringe. To ensure this the needle was disconnected from syringe, syringe refilled with air and syringe and needle reconnected to expel the contents onto the slides to spread the material.

An on-site evaluation of the aspirated specimen was performed by pathologist experienced in lung cytology. Post procedure the patient was rolled off the procedure table onto a stretcher with the puncture site dependent. Coughing, talking and all forms of activities were restricted as these could induce complications.

**Post biopsy observation**

No specific monitoring is required following an uncomplicated biopsy procedure.

Most complications are known to occur within one hour of the procedure, therefore patient was kept in the hospital for at least one hour or longer if pneumothorax occurred. Chest radiographs are reviewed by radiologist.

Patient kept in supervised area so that staff could be alerted if they develop shortness of breath, chest pain or other symptoms within first hour.

If complications had developed, the clinical condition of the patient and their home circumstances were considered before deciding on further management.

## Results

65 patients of both sex and varying age group referred for CT guided lung FNACs to Radiology were included. The patient's age ranged from 23 to 77 years with a mean of 49 years. The maximum number of patients was in fifth and sixth decades. Among 65 patients 53 were male

patients and 12 were female patients (**Table - 1**). The most common diagnosis observed following biopsy was malignancy (non small cell carcinoma) in 41 cases (63 %), benign lesion in 6 cases (9%) and 3% showed mixed lesions.

**Table - 1:** Age and Sex distribution.

| AGE (YEARS) | MALE | FEMALE |
|---|---|---|
| 21- 30 | 05 | -- |
| 31- 40 | 07 | 03 |
| 41- 50 | 12 | 05 |
| 51- 60 | 14 | 03 |
| 61- 70 | 10 | 01 |
| 71- 80 | 05 | -- |

However 12 (18%) cases were inconclusive out of which no opinion was possible in 2 cases, no evidence of malignancy or granuloma was seen in 5 cases and the material obtained was insufficient in 5 cases (**Table - 2**).

**Table - 2:** Etiological break up of cases following pathological diagnosis of aspirate.

| BIOPSY RESULT | NO. OF CASES | % |
|---|---|---|
| Malignant | 41 | 63% |
| Benign | 6 | 9% |
| Inconclusive | 12 | 18% |
| Lost | 4 | |

Among 65 cases, 49 cases (75%) showed adequate material in the aspirate specimen, where as 12 cases (18.4%) showed inadequate tissue for diagnosis. However 4 cases were lost on follow up (**Table - 3**).

**Table - 3:** Diagnostic yield of cases following pathological examination.

| PATHOLOGICAL RESULT | NO. OF CASES | % |
|---|---|---|
| Diagnostic yeild | 49 | 75% |
| Inadequate yeild | 12 | 18.4% |

Complications observed during procedure include pneumothorax in 11 cases (16.9%) and hemoptysis/pulmonary hemorrhage in 2 cases (3%) as per **Table - 4**.

**Table - 4:** Complications encountered due to procedure.

| COMPLICATIONS | NO. OF CASES | % |
|---|---|---|
| Pneumothorax | 11 | 16.9% |
| Hemoptysis/pulmonary hemorrhage | 2 | 3% |
| Hemothorax | Nil | - |
| Other | Nil | - |
| Death | Nil | - |

## Discussion

65 patients presenting to Osmania General Hospital, Hyderabad for CT guided transthoracic fine-needle aspiration cytology of lung lesions referred to radiology department during the period October 2012 to January 2013 were studied. Detailed clinical examination with a provisional diagnosis was noted in each case. The patients were investigated with chest radiographs/CT chest and evaluated carefully before FNAC was performed.

The efficacy of CT guided transthoracic fine-needle aspiration cytology of lung lesions was evaluated.

In the present study the cytological and bacteriological examination of biopsy material from lung FNACs yielded clinically useful information in 75% (49 cases) and the material obtained was inadequate for a proper diagnosis in 18%(12 cases) in studies done by Allison, et al. [8] (87%), Bibbo, et al. [9] (94%), Swischuk JL, et al. [10] (94%) and Larscheid RC [11] (74%)9). In a study done by Miller et al[12] using core needle for biopsy the diagnostic yield was 84%.

The value of our study although close to the one done by Larscheid RC [11] is relatively less compared to the rest of the studies.

This can be due to Small study group comprising 65 patients, Irregular presence of onsite

cytopathologist for supervision [11, 12], 4 patients were lost on follow up.

Therefore the presence of cytopathologist produces good diagnostic yield.

Incidence of complication due to the procedure of CT guided transthoracic fine-needle aspiration cytology of lung lesions.

The literature states the most common complication to be pneumothorax. In our study the incidence of pneumothorax is16% (11 cases) none of which required placement of chest drainage tubes. The incidence of pneumothorax in studies performed by Lee and Sagel [13] is 23-43%, Dennie, et al. [14] is 22.9%, Simpson RW, et al. [15] is 32%, Poe RH, et al. [16] is 27%, Allison DJ [6] is 24%, Swischuk JL, et al. [10] is 26.9%, Miller JA, et al. [12] is 7% and Counes DJ [17] is 18%.

The incidence of hemoptysis is 3% in our study which also correlates with Lee and Sagel [13] and Simpson RW, et al. [15] studies where the incidence was < 5%.

## Conclusion

CT guided FNAC is well recognized procedure with good efficacy for evaluation of pulmonary lesions with minimal risks of complications, most common being pneumothorax followed by hemoptysis.

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