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**Original Research Article**

# A prospective study of number of attempts required in conventional image guided transthoracic fine needle aspiration for pulmonary lesions

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## ABSTRACT

**Background:** With the established role of computed tomography (CT) screening for lung cancer, and the broad application of high-resolution CT, the solitary pulmonary nodule (SPN) are increasingly detected. The discovery rate of pulmonary lesions is evidently elevated these days: most of them are benign, but some of them are lung cancer. Lung cancer remains the leading cause of cancer deaths worldwide. The diagnosis of this pulmonary lesion is difficult and obtaining tissue samples to conduct pathology examination is the key point. Image guided transthoracic fine needle aspiration (TTFNA) of lung lesions is a well established, safe, and rapid method for achieving a definitive diagnosis for most lung lesions.
**Methods:** TTFNA were performed in 160 patients attended the OPD and admitted due to pulmonary lesions between September 2016 and May 2017. After detailed characterization by computed tomography and compared with chest x-ray, TTFNA was done. Number of attempts, reasons for multiple attempts, and final FNAC diagnosis were recorded.
**Results:** When CT guidance was used sufficient material was obtained in 91.03% of patients, but with USG guidance insufficient material was reason for repeated attempts in nearly 25.25% of cases. Bloody aspirate was reason in total 13.54% patients and there was no significant difference between CT guidance and USG guidance (14.29% v/s 13.13% respectively). Again only inflammatory cells was reason for repeated attempts, in CT guidance 8.93% and in USG guidance 20.20%, attributed to localization of needle in both techniques.
**Conclusions:** CT guided FNAC should be considered in diagnosis of lung lesions if computerized tomography is not contraindicated. Further, routine need for advanced imaging techniques like 3D computerized tomographic study for localizing lesions in lung to reduce the number of attempts should be considered.

**Keywords:** Computerized tomography, Fine needle aspiration cytology, Pneumothorax, Ultrasonography

## INTRODUCTION

Image guided transthoracic fine needle aspiration (TTFNA) of lung lesions has been a valuable diagnostic tool since it was first described in 1965.[1] Image-guided transthoracic fine needle aspiration (TTFNA) is a well established, safe, and rapid method for achieving a definitive diagnosis for most lung lesions.

With the established role of computed tomography (CT) screening for lung cancer, and the broad application of high-resolution CT, the solitary pulmonary nodule (SPN) are increasingly detected. Therefore, the discovery rate of pulmonary lesions is evidently elevated: most of them are benign, but some of them are lung cancer. Lung cancer remains the leading cause of cancer deaths worldwide. The diagnosis of this pulmonary lesion is difficult and obtaining tissue samples to conduct pathology examination is the key point. Accurate assessment,

proper treatment and timely surgical resection of malignant pulmonary lesions will be highly beneficial to the survival of patients with lung cancer.[2] The main ways to obtain a specimen for pathology diagnosis include exfoliative cell examination of sputum, bronchoscopy, transthoracic fine needle aspiration (TTFNA), video-assisted thoracic surgery (VATS) and open-lung biopsy. The exfoliative cell examination of sputum is easy and non-invasive, but its positive rate is low. VATS and open-lung biopsy must be conducted under general anaesthesia, with risk, surgical trauma and high cost; nevertheless, some patients cannot undergo general anaesthesia. Bronchoscopy has a great diagnostic value in central type lung nodules, but the determination value in peripheral lesions is limited. TTFNA, as a minimally invasive diagnostic method, has been widely used in the diagnosis of small nodules.

Modalities commonly employed for imaging-guided percutaneous needle biopsy include moving x-ray technique (fluoroscopy), ultrasound, conventional CT, and helical CT, which has become more widely used.

Ultrasound is useful only where the tissue mass is in contact with the chest wall since the ultrasound beam does not pass through air and, hence, the aerated lung. Magnetic resonance imaging (MRI) currently has a limited use because of expense, difficulty accessing the patient within the magnet, the relatively poor visualization of lung lesions, and difficulties with ferromagnetic instruments within the magnetic field[3]. CT fluoroscopy is technical advancement which enables real-time visualization of a lesion during needle manipulation. It is reported to be more accurate than conventional CT in diagnosing pulmonary lesions, with a significant reduction in complication rates.[4] This technique is especially useful for targeting small lung lesions, juxtraphrenic lesions, and patients with poor breath holding capacity. It was developed most recently and is not universally available, and it has simplified the process and decreased the time requirements of CT-guided needle biopsies.[5-7] It offers promising advantages and may permit accurate and rapid procedures, particularly in benign lesions. The decision as to which method to use should be tailored to each patient, and is preferably reached by a team consisting of pulmonary physicians, chest surgeons, oncologists, cytologists, and radiologists.[8]

This study aimed to determine average number of attempts required in the diagnosis of pulmonary lesions and to compare the results using CT and USG as two modalities used for imaging. Secondary objective was to reestablish role of TTFNA in diagnosis of pulmonary lesions.

## METHODS

This is a monoinstitutional prospective study.TTFNA were performed in 160 patients attended the opd and admitted due to pulmonary lesions between September 2016 and May 2017. Laboratory blood tests, including platelet count, prothrombin time, and international normalized ratio, were done before the procedure. Initially after clinical suspicion a routine chest x-ray-postero anterior view done, and characteristics of lesion in chest x-ray documented. Detailed characterization was defined by computed tomography and compared with chest x-ray.

### *TTFNA*

Transthoracic needle lung biopsy is performed with the aid of equipment that creates a computer-generated image and allows radiologists to see an area inside the body from various angles. This "stereotactic" equipment helps them pinpoint the exact location of the abnormal tissue.

### *Biopsy technique*

After appropriate patient positioning, a radiopaque marker or grid is placed on the patient's skin over the area of interest to focus the optimal access point. A short spiral CT scan of the region of interest is obtained, and from these images, an appropriate table position and needle trajectory are chosen. The shortest straight pathway from the skin to the lesion is preferred over a longer oblique pathway. The depth from the skin entry site to the lesion is then measured (Figure 1).[9]

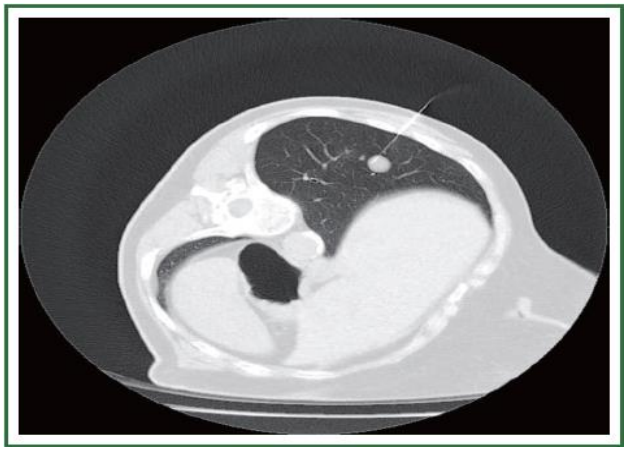

**Figure 1: A CT scan of a needle inserted into the lung to obtain a sample for biopsy.**

During the procedure, patients must be able to follow breathing instructions. Needle choice depends mostly upon lesion characteristics and location. There are techniques of needle tip repositioning that can be quite helpful for obtaining diagnostic material from lung lesions, particularly small nodules.[10,11]

Variables to consider are: the difficulty of the procedure, complications arising from each biopsy, the quality of the specimen obtained, the characteristics of the lesion

biopsied, and the need for specimens for cytological, histological and microbiological examination.[12,13]

For USG guided procedure after positioning lesions identified, marked and patient should follow same breathing instructions. During procedure needle localization was done by either USG or CT. No premedication was administered to the patients before the procedure. Needle aspiration was performed using 23-24-gauge needles. Aspiration materials were fixed in alcohol and sent for pathologic examination. Demographic characteristics, history, physical examination findings, laboratory values, radiologic findings, procedure performed, depth of lesion during procedure, number of attempts, reasons for multiple attempts, final FNAC diagnosis were recorded. All data submitted to MS-Excel and subjected for statistical analysis.

## RESULTS

One hundred and fifty five patients, consisting of 60 females and 95 males, were included in the study (Table 1). Their mean age was 55.97 (range 25–87) years. Median age was 56 years. The radiologic characteristics in each groups were observed as masses, nodules on Chest radiography and computed tomography. The most frequent radiologic lesion was a mass (124 patients, 80%). Significantly more TTFNBs were performed in patients presenting with a mass. Mass lesions were diagnosed as malignant in all of patients.

**Table 1: Clinical and demographic characteristics of the patients.**

| Age (years) | No of patients |
|---|---|
| 20-30 | 3 |
| 31-40 | 20 |
| 41-50 | 29 |
| 51-60 | 32 |
| 61-70 | 56 |
| 71-80 | 9 |
| >80 | 6 |
| Total | 155 |

### *Chest x-ray*

Lesion localizations on chest radiography were as follows: in right lung 79 (50.96%) in the left lung; 76 (49.03%). pleural effusion was present in 45 (29.03%) and was absent in 110(70.96%). Mediastinal widening was present in 60 (30.78%) and absent in 95 (61.29%) (Figure 2).

Lesions involved apex in 38 (25%) cases and mid lobe in 76 (49%) patients, lower lobe in 28 (18%) and hemithorax in 13 (8%) cases (Figure 3). Lesions were central in location in 75 (48.38%) and peripheral in location in 80 (51.61%). Lesions reached chest wall in 62 (40%) cases (Figure 4).

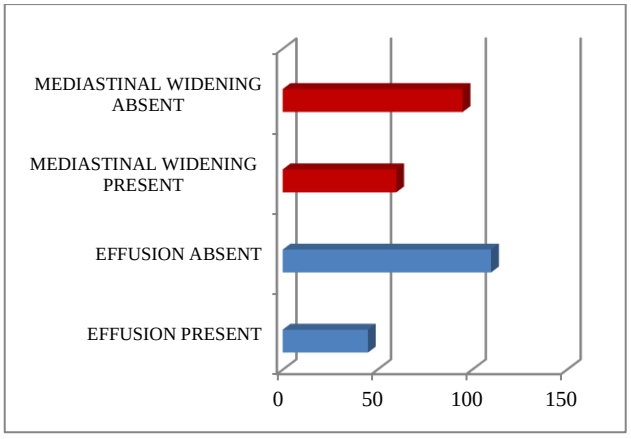


**Figure 2: Radiologic characteristics by chest x-ray.**

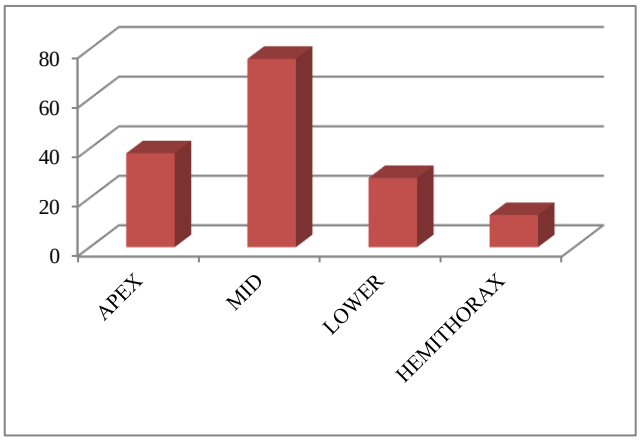


**Figure 3: Radiologic characteristics by chest x-ray.**

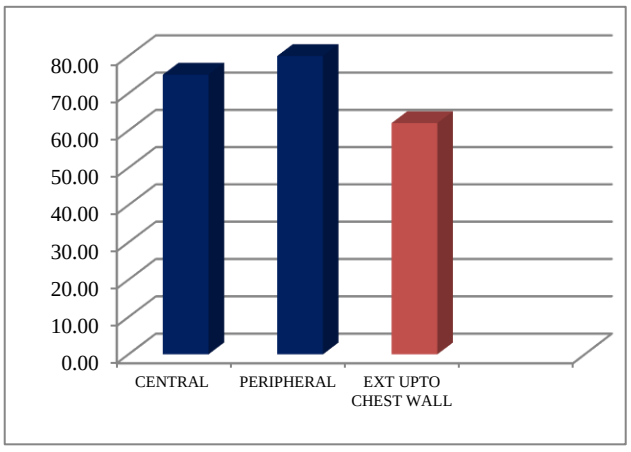


**Figure 4: Radiologic characteristics by chest x-ray.**

Maximum size of lesion was 13cms and minimum was 3.5cms, and average size being 6.75cms.

### *Computerised tomography*

On computerized tomography radiological characters like side of lesion and central and peripheral distribution were same as in chest x-ray (Figure 3,4). Unlike in chest x-ray

lesions were extending to chest wall in 98 (63.22%) cases as compared to 62 (40%) in chest x-ray.

Chest x-ray as predicted overestimated the size of lesion in many patients, in CT scan average size 5X5 cm. small lesion was 2X2 and largest was 11X9. As even minimum pleural effusion considered in CT scanning, number of patients with pleural effusion were more by this imaging compared to chest x-ray (Table 2).

**Table 2: Radiological characteristics by CT scan and chest x-ray.**

| | Average size | Minimum size | Maximum size | Pleural effusion | Extending to chest wall |
|---|---|---|---|---|---|
| CXR | 6.75 | 3.5 | 13 | 45 | 62 |
| CT | 5X5 | 2X2 | 11X9 | 75 | 98 |

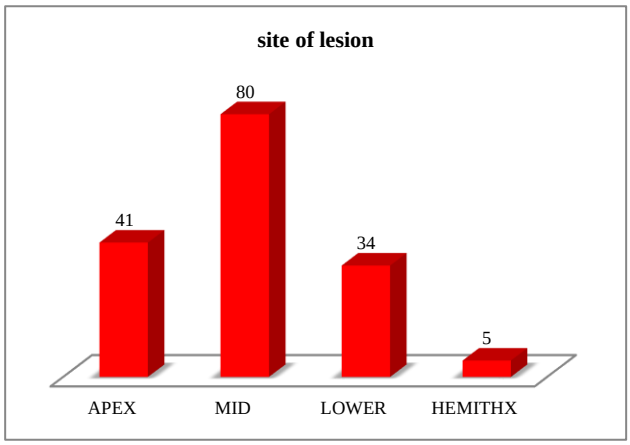


**Figure 5: Radiologic characteristics by CT scanning.**

Mediasinal nodes were involved in 93 (60%) cases by CT evaluation and lobar distribution according to CT scan depicted in figure 5.41% involved apex, 80%mid thorax and 34% lower thorax. Only 5% were extending to hemithorax.

Ultrasonography guide TTFNA done in 99 cases and CT guided TTFNA was done in 56 cases. In 22 patients as mediastinal lymphnodes more easily accessible than primary lesion, mediastinal lymphnode FNA done.

***Depth of lesion***

Average depth required was 6.11 cms. Minimum was 2.3 cms and max needed was 12.4 cms.

FNA was successful in first attempt in 102 patients but second attempt and third attempt were required in 31 and 22 patients respectively. The reasons for repeated attempts were insufficient material in 30(39.47%) cases and only haemmoragic in 21(27.63%) cases and only epithelial cells in 25(32.89%) cases (Table 3). Cytologically The malignant lesions diagnosed by TTFNB were non-small cell lung carcinoma in 116 (77.66%) patients, small cell lung carcinoma in 24 (16%) patients,, lymphoma in 4 (2.6%) patients, thymoma in two (1.3%) patients, plasmacytoma in one (0.65%) patient, rhabdomyosarcoma in one patient (0.65%), and metastasis in 2 (1.3%) patient (Table 4).

**Table 3: Total number of attempts required and reasons for repeated attempts.**

| Attempts | Insufficient material | Only haemmoragic | Only epithelial cells | Total repeated attempts |
|---|---|---|---|---|
| 2 (=31) and 3 (n=22) | 30 | 21 | 25 | 76 |
| (%) | 39.47 | 27.63 | 32.89 | 100 |

**Table 4: Final diagnosis by cytology performed and percentage.**

| Cytology | Number of patients | Percentage (%) |
|---|---|---|
| Non small cell carcinoma SCC/adeno | 116 | 77.66 |
| Small cell carcinoma | 24 | 16 |
| Lymphoma | 4 | 2.6 |
| Thymoma | 2 | 1.3 |
| Plasmacytoma | 1 | O.65 |
| Metastasis | 2 | 1.3 |
| Rhabdomyosarcoma | 1 | 0.65 |

**Table 5: Comparison between USG and CT scan regarding number of attempts.**

| Success rate | Single attempt | Two attempts | Three Attempts | Total |
|---|---|---|---|---|
| Total patients | 102 | 31 | 22 | 155 |
| USG | 61 | 19 | 19 | 99 |
| CT | 41 | 12 | 3 | 56 |
| USG Success% | 62 | 19 | 19 | |
| CT Success% | 73 | 21 | 5 | |

***Number of attempts***

When USG guidance was used it was successful at first attempt in 62% cases compared to 73% cases when CT guidance was used. Rest of patients required more than one attempt (Table 5).

**Table 6: Reasons for repeated attempts and percentage.**

| | Number of patients | Percentage (%) |
|---|---|---|
| **Insufficient material** | | |
| Total | 30 | 19.35 |
| CT (n=56) | 5 | 8.93 |
| USG (n=99) | 25 | 25.25 |
| **Only Blood** | | |
| Total | 21 | 13.54 |
| CT (n=56) | 8 | 14.29 |
| USG (n=99) | 13 | 13.13 |
| **Only inflammatory cells** | | |
| Total | 25 | 16.12 |
| CT (n=56) | 5 | 8.93 |
| USG (n=99) | 20 | 20.20 |

When CT guidance was used sufficient material was obtained in 91.03% of patients, but with USG guidance insufficient material was reason for repeated attempts in nearly 25.25% of cases. Bloody aspirate was reason in total 13.54% patients and there was no significant difference between CT guidance and USG guidance (14.29% v/s 13.13% respectively) Again only inflammatory cells was reason for repeated attempts, in CT guidance 8.93% and in USG guidance 20.20%, attributed to localization of needle in both techniques (Table 6).

## DISCUSSION

TTFNA using CT and US guided imaging, after analysis of 155 patients, this study showed that similar diagnostic yield compared to previous studies. However, as this is a, single center study, with primary aim regarding attempts, USG guidance required more than one attempt in significant number of cases compared to CT guidance. Insufficient material and only inflammatory cells aspirate obtained more in USG arm and are the most common reasons for inconclusive diagnosis. In 1976, Haaga and Alfidi. reported the first case of CT-guided pulmonary puncture biopsy, and after that, this technology has been continuously developing and updating.[14] As imaging technology has advanced, so has the type of guidance used: plain radiograph and fluoroscopy giving way to computed tomography (CT), ultrasound (US) guided procedures.[15,16] The direct purpose of TTFNA is to improve the diagnosis accuracy. Before the procedure, patients' clinical and imaging materials should be fully understood. If it is an enhanced scanning, sites with evident enhancement should be chosen for puncture. CT characteristics of the focal localization scanning should be analyzed seriously. If there is any larger lesion, sites with evident enlargement should be chosen as the puncture targets and liquefactive necrosis tissue should be avoided. The operator's experience is paramount. Hiraki et al reported that the acquisition of a larger number of samples significantly increases diagnostic accuracy because the sampling error decreases.[17] While simultaneously considering the risks and benefits, it is important to decide first the number of specimens and to choose the right method. Regarding the methods, the diagnostic accuracies of aspiration, core biopsy, and the combination of techniques were respectively 93.4%, 95.2%, and 100.0%.[18] It is not obvious whether the consistency of the nodule is a significant factor associated with diagnostic accuracy. TTNA is a successful method that is performed in the diagnosis of malignant disease and the presence of a pathologist during the procedure increases the diagnostic value.

## CONCLUSION

Image guided TTFNA remains an important modality in the diagnosis of lung diseases, particularly malignancies. CT guided FNAC should be considered in diagnosis of lung lesions if computerized tomography is not contraindicated. further, routine need for advanced imaging techniques like 3D computerized tomographic study for localizing lesions in lung to reduce the number of attempts should be considered.

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