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Original Article

Successful Diagnostic and Complication Rate in CT Guided Lung Biopsy: Comparison of Core Needle Biopsy and Fine Needle Aspiration Biopsy in Different Size Pulmonary lesions

Tanapong Panpikoon, MD., Jesada Suvikrom, MD., Prathana Mitrakul, MD., Tharintorn Treesit, MD.

Division of Interventional Radiology, Department of Diagnostic Radiology, Faculty of Medicine, Ramathibodi Hospital, Bangkok

Abstract

Objective: The aim of the study was to compare successful diagnostic and complication rate of core needle biopsy (CNB) with those of fine needle aspiration biopsy (FNAB) performed on pulmonary lesions of different sizes.

Materials and Methods: We retrospectively reviewed results and complications of 156 consecutive percutaneous CT guided biopsy of pulmonary lesions obtaining in January 2007 to July 2009, performed with either CNB (Semiautomatic cutting biopsy device 18 G) or FNAB (Spinal needle 20 G). The patients who performed with both CNB and FNAB were excluded. Fifty-four Core needle biopsies and 102 Fine needle aspiration biopsies were recorded. The successful diagnostic and complication rates of each method were compared in lesion less than 1 cm, equal 1 cm to less than 3 cm and greater than 3 cm in AP diameter.

Results: The overall successful diagnostic rate of our procedure was 76.3%. There was no statistically significant difference ($p<.05$) between successful diagnostic rate of CNB and FNAB in every size of pulmonary lesion (40.0% Vs 54.5% in lesion less than 1 cm, 78.6% Vs 69.7% in lesion equal 1 cm to less than 3 cm, 90.5% Vs 88.0% in lesion greater than 3 cm) as well as complication rate of CNB and FNAB in every size of pulmonary lesion (40% vs 36.4% in lesion less than 1 cm, 35.7%Vs28.8% in lesion equal 1 cm to less than 3 cm, 24.0% Vs 39.1% in lesion greater than 3 cm). But, there was statistically significant difference ($p<.05$) between successful diagnostic rate of lesion less than 1 cm (54.5%) and lesion greater than 3 cm (88.0%) when biopsy was performed by FNAB.

between successful diagnostic rate of lesion less than 1 cm (40.0%), lesion equal to 1 cm to less than 3 cm (78.6%) and lesion greater than 3 cm (90.5%) when biopsy was performed by CNB. There was no statistically significant difference ($p<.05$) between complication rate in every size of lesion when biopsy was performed by either CNB or FNAB.

Summary: CT guide lung biopsy is significantly less accurate for small pulmonary lesion (less than 1 cm in AP diameter) than for larger pulmonary lesion. There was no significant difference of successful diagnostic and complication rate when CT guide lung biopsy was performed by either CNB or FNAB.

Introduction

Percutaneous transthoracic needle biopsy (TTNB) using image guidance is a relatively safe and accurate method of establishing the diagnosis of pulmonary nodules, reported diagnostic accuracy for TTNB for pulmonary nodules range from 64-97%[1-5]. Computed tomography (CT) is the preferred image guidance modality for TTNB. The advantage of CT-guided lung biopsy is that the lung parenchyma and not inflated areas at the puncture site is visualized and can be used as an access path to the lesion, substantially reducing risk of pneumothorax. Such core needle biopsy (CNB) or fine needle aspiration biopsy (FNAB) is well-established method for TTNB.

FNAB is method to obtain an aspirate with a thin needle (20G or greater) which usually provides enough material to confirm or rule out malignancy by cytological analysis. In most cases, a histological diagnosis is not possible owing to an insufficient amount of material. CNB using large gauge semi-automated needle biopsy (14-19G) is a traditionally performed in patients without a known primary tumor, in cases of potential lymphoma and after inconclusive FNAB. Comparing FNAB and CNB, the latter led to a significant higher rate of specific diagnosis with same complication rate[6-7].

At our institution CT guide lung biopsy is routinely performed in most of many different lung lesions. However, we have no standard practical guideline for appropriate technique for different lung lesions. Therefore, we are interested in studying our CT guide lung biopsy experiences by compare successful diagnostic and complication rate of CNB with those of FNAB performed on different sizes of pulmonary lesions. From the result, we expected information that such CNB or FNAB is appropriate technique for either sizes of pulmonary lesion.

Materials and Methods

We retrospectively reviewed results and complications of 156 consecutive percutaneous CT guided biopsy of pulmonary lesions obtaining in January 2007 to July 2009, performed by either CNB or FNAB. The patients who performed with both CNB and FNAB were excluded. Fifty-four Core needle biopsies and 102 Fine needle aspiration biopsies were recorded.

All procedures were performed on a 16 slices multidetector CT scan. We measure long axis of pulmonary lesions on lung window settings. The lesion less than or equal 3 cm in diameter were performed on image obtained with a slice thickness of 2 mm. The lesion greater than 3 cm in diameter were performed on image obtained with a slice thickness of 2 or 5 mm. Biopsies were performed by body intervention fellowships under supervision of experience body intervention staff. Before each procedure, informed consent was obtained. Patients were placed in a supine, prone or lateral decubitus position depending on the location of the lesion. Localization was performed by CT imaging with laser light and grid system. Local anesthesia with 1% lidocaine was administered subcutaneously. Before tissue cutting or aspiration was obtained, a CT image was obtained to document successful placement of needle within the lesion.

CNBs were performed by semiautomatic cutting biopsy device 18 G with a spring activated Tru-Cut system. The tru-Cut biopsy needle is characterized by a trough at the distal end. First the biopsy gun fires inner needle into the lesion, where a core of tissue falls into the trough. Then the outer needle cuts the sample lying in the trough out of the surrounding tissue and captures the sample, which can be safely removed through the outer needle or with the whole system. Usually at least two samples were taken for histological evaluation and were instantly put into 10% formalin. FNABs were performed by spinal needle 20 G. The aspirated volume ranged between 3 and 5 ml for most aspiration biopsies, the needle was moved back and forth within the lesion for 10-15 seconds or until the hub of the syringe become filled with blood. Before the needle was removed from the lesion, the suction was stopped to avoid aspiration of further tissue potentially confusing cystologic evaluation. The specimens obtained were placed on sterile glass slides and immediately smeared. No cytopathologist or cytotechnologist was present at all biopsies.

After removal of the biopsy needle, whole CT scans of chest was performed for recognized presence of pneumothorax and then patients were immediately placed in a puncture side down position and transferred to observation ward. Talking and coughing were discouraged. We obtained chest radiographs 1 and 4 hr after biopsy. Patients with pneumothorax were administered oxygen nasal canula to speed resorption of pneumothorax. Patients with enlarging pneumothorax on serial chest radiographs and those with symptomatic pneumothorax were treated with placement of chest drainage tube.

Cytopathological results of every biopsy were recorded and classified in conclusive (positive for malignancy, suspicious for malignancy and diagnostic of specific benign entity) and non-conclusive (inadequate specimen or normal lung tissue) group. The successful diagnostic and complication rates of each biopsy were calculated and compared between 3 groups of lesion. We divided pulmonary lesion into 3 groups according to their sizes, less than 1 cm, equal 1 cm to less than 3 cm and greater than 3 cm in AP diameter, respectively. The chi-square test was used to assess the statistical significance of our results.

Results

One hundred and fifty-six CT guide lung biopsies were included in our study. 119 conclusive cytopathological results from all 156 biopsies were noted. The overall successful diagnostic rate of our

procedure was 76.3%. We have got 43 conclusive results from 54 core needle biopsies and 76 conclusive results from 102 Fine needle aspiration biopsies. The successful diagnostic rates of CNB and FNAB are about 79.6% and 77.5 %, respectively (table 1).

In group of lesion less than 1 cm, there are 16 patients in this group. We have got 2 conclusive results from 5 core needle biopsies and 6 conclusive results from 11 fine needle aspiration biopsies. The successful diagnostic rates of CNB and FNAB are about 40.0% and 54.5 %, respectively.

In group of lesion equal 1 cm to less than 3 cm, there are 94 patients in this group. We have got 22 conclusive results from 28 core needle biopsies and 46 conclusive results from 66 fine needle aspiration biopsies. The successful diagnostic rates of CNB and FNAB are about 78.6% and 69.7%, respectively.

And in group of lesion greater than 3 cm, there are 46 patients in this group. We have got 19 conclusive results from 21 core needle biopsies and 22 conclusive results from 25 fine needle aspiration biopsies. The successful diagnostic rates of CNB and FNAB are about 90.5% and 88.0%, respectively.

FNAB shows slightly higher successful diagnostic rate in lesion less than 1 cm where as CNB shows slightly higher successful diagnostic rate in lesion equal to greater than 1 cm. However, there is no statistically significant difference ($p<.05$) between successful diagnostic rate of CNB and FNAB in any size of pulmonary lesion (table 2).

When we compared the successful diagnostic rate between the groups of different in size of lesion, there are statistically significant difference ($p<.05$) between successful diagnostic rate of lesion less than 1 cm (54.5%) and lesion greater than 3 cm (88.0%) when biopsy was performed by FNAB, between diagnostic accuracy of lesion less than 1 cm (40.0%), lesion equal to 1 cm to less than 3 cm (78.6%) and lesion greater than 3 cm (90.5%) when biopsy was performed by CNB.

The major complication we concerned after CT guide lung biopsy is pneumothorax. 50 patients (32.0%) develop pneumothorax after procedure, 21 patients from CNB group and 29 patients from the FNAB group. Only 2 patients from CNB group (1.3%) have enlarging pneumothorax on serial chest radiographs and symptomatic pneumothorax after CNB. They were treated with placement of chest drainage tube.

Table 1 Conclusive cytopathological result, successful rate and complication(pneumothorax) rate of CNB and FNAB from CT guide lung biopsy

	CNB	FNAB	CNB+FNAB
Conclusive cytopathological result	43	76	119
Inconclusive cytopathological result	11	26	37
Pneumothorax	21	29	50
Total	54	102	156
Successful diagnostic rate	*79.6%*	*74.5%*	*76.3%*
Complication rate (pneumothorax)	*38.9%*	*28.4%*	*32.0%*

In group of lesion less than 1 cm, there are 16 patients in this group. Two of 5 patients from CNB groups and 4 of 11 patients from FNAB group have pneumothorax. The complication rates of CNB and FNAB are about 40.0% and 36.4%, respectively.

In group of lesion equal 1 cm to less than 3 cm, there are 94 patients in this group. Ten of 28 patients from CNB groups and 19 of 66 patients from FNAB group have pneumothorax. The complication rates of CNB and FNAB are about 35.7% and 28.8%, respectively.

And in group of lesion greater than 3 cm, there are 46 patients in this group. Six of 21 patients from CNB groups and 9 of 25 patients from FNAB group have pneumothorax. The complication rates of CNB and FNAB are about 28.5% and 36.0%, respectively. Using Chi-square test, there was no statistically significant difference ($p<.05$) between complication rate in every size of lesion when biopsy was performed by either CNB or FNAB. (Table 3).

Discussion

Percutaneous transthoracic needle biopsy (TTNB) using CT guidance is a relatively safe and accurate method of establishing the diagnosis of benign and malignant pulmonary lesion. With the recommended co-axial technique, reported diagnostic accuracy for TTNB for pulmonary nodules range from 64-97% and major complications are rare[1-5]. Pneumothorax is the most common complication after procedure with reported rate of 19-44%[8], the range of reported rates of ICD insertion is 1.6-4.3%.

Due to our retrospective comparative study

Table 2 Comparison of successful diagnostic rate between CNB and FNAB in different size of lesion

Size of lesion	CNB		FNAB		Statistical difference by Chi-square test ($p<0.05$)
	Conclusive result /All	Successful diagnostic rate	Conclusive result/All	Successful diagnostic rate	
less than 1 cm	2/5	*40.0%*	6/11	*54.5%*	No
equal 1 cm to less than 3 cm	22/18	*78.6%*	46/66	*69.7%*	No
greater than 3 cm	19/21	*90.5%*	22/25	*88.0%*	No

Table 3 Comparison of complication rate between CNB and FNAB in different size of lesion

Size of lesion	CNB		FNAB		Statistical difference by Chi-square test ($p<0.05$)
	Pneumothorax	Complication rate	Pneumo-thorax	Complication rate	
less than 1 cm	2/5	40.0%	4/11	36.4%	No
equal 1 cm to less than 3 cm	10/28	35.7%	19/66	28.8%	No
greater than 3 cm	6/21	28.6%	9/25	36.0%	No

design, we have some important limitation. First, we cannot compare diagnostic accuracy rate of both technique. So, we use the term "successful diagnostic rate" instead of diagnostic accuracy rate. Many influencing factor for pneumothorax or other complication risk were not recorded. However, we got many interesting information from our study.

Our results show that 76.3 % of successful diagnostic, 32.0% complication rate and 1.3% of ICD insertion rate from our experience are in the average range from worldwide reports. Even through, we not routinely use recommended co-axial technique. No statistical significant difference of successful diagnostic and complication rate between CNB and FNAB were founded on every different size of pulmonary lesions. From this information, we do not worried about different efficacy of both technique and should routinely done TTNB by CNB or FNAB technique according to standard recommended guideline. FNAB is suitable for tissue sampling of pulmonary lesion given a known primary tumor in combination with suspected metastases. It is generally considered insufficient if the primary tumor is unknown. CNB or large-gauge

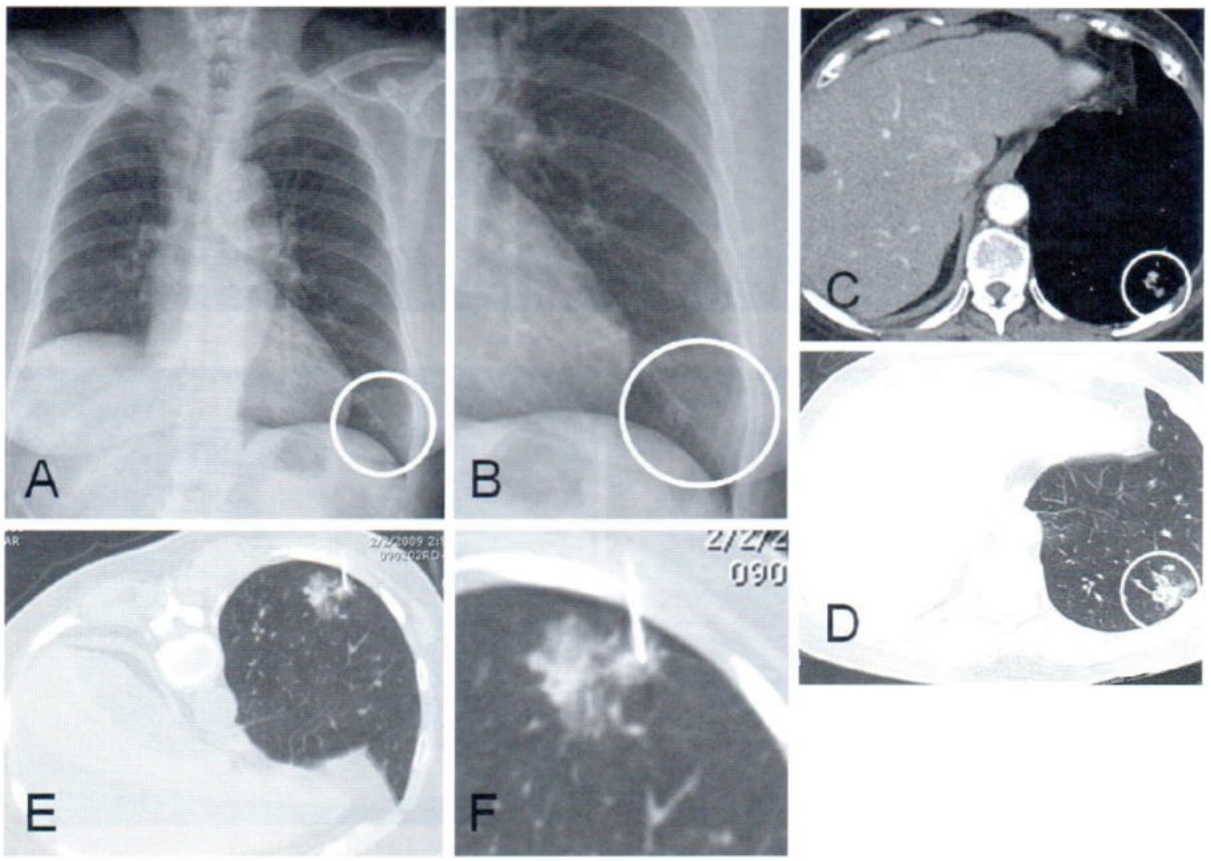

Fig.1 A 73 years old woman presented with abnormal chest film. Her chest film showed nodular opacities at left lower lung field (A, B). After that CT scans of chest was done and showed group of nodular opacities with surrounding ground glass opacity (C, D). Percutaneous transthoracic FNA biopsy was performed by using spinal needle No.20G (E, F) and cytological report showed positive for malignant cells. Then, she undergone pneumonectomy and pathological result shows adrenocarcinoma.

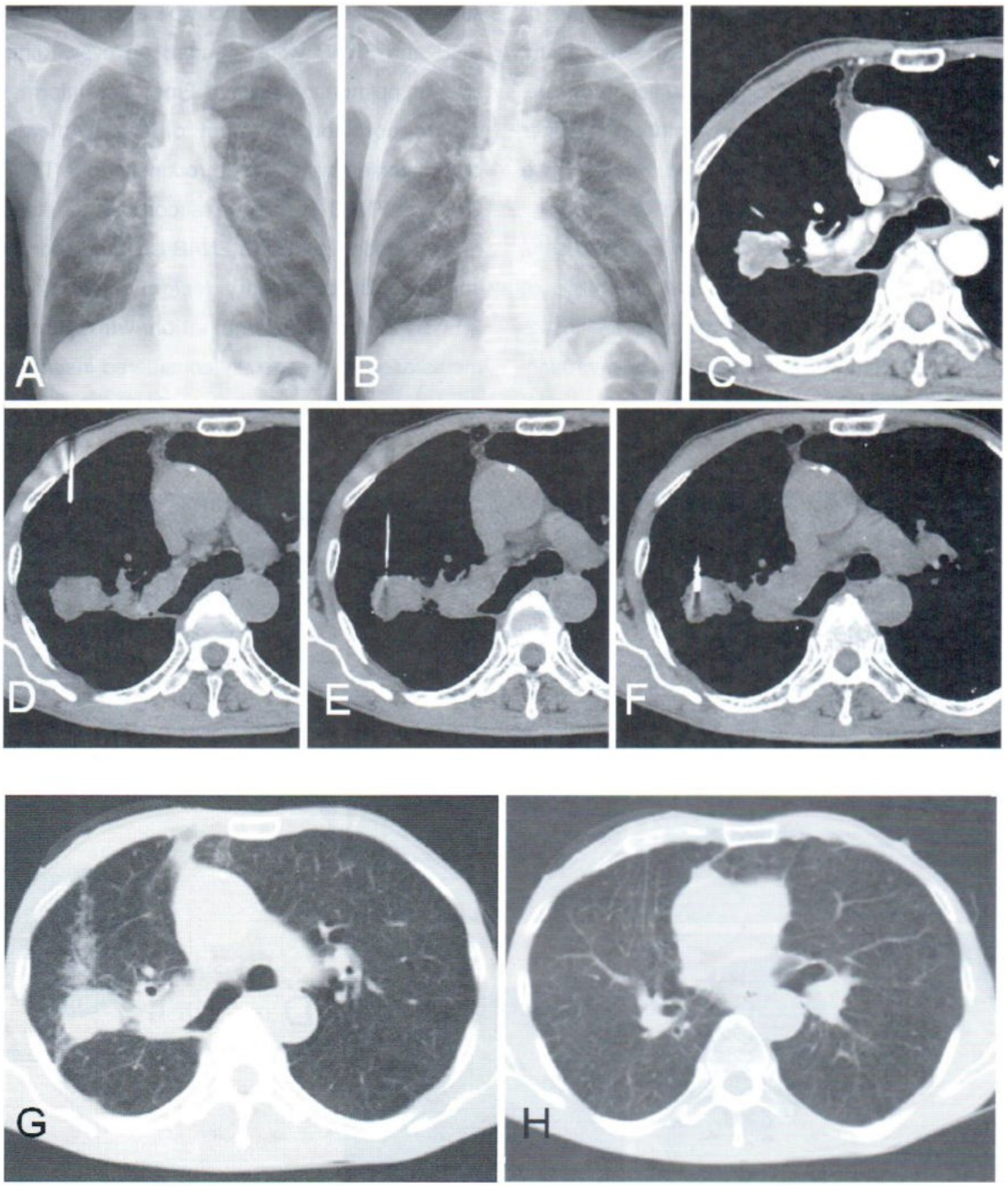

Fig.2 A 70 years old man presented with developing of RUL mass from May 2008 (A) to February 2009 (B). CT scans of chest was done and showed enhancing mass at RUL. Percutaneous transthoracic Core needle biopsy was performed by using Semi automatic cutting devices No.18 G X I attempt (D, E, F) and pathological report showed brochoalveolar carcinoma (BAC). CT scans of chest after TTNB (G, H) showed pulmonary hemorrhage along the needle tract. No pneumothorax was observed.

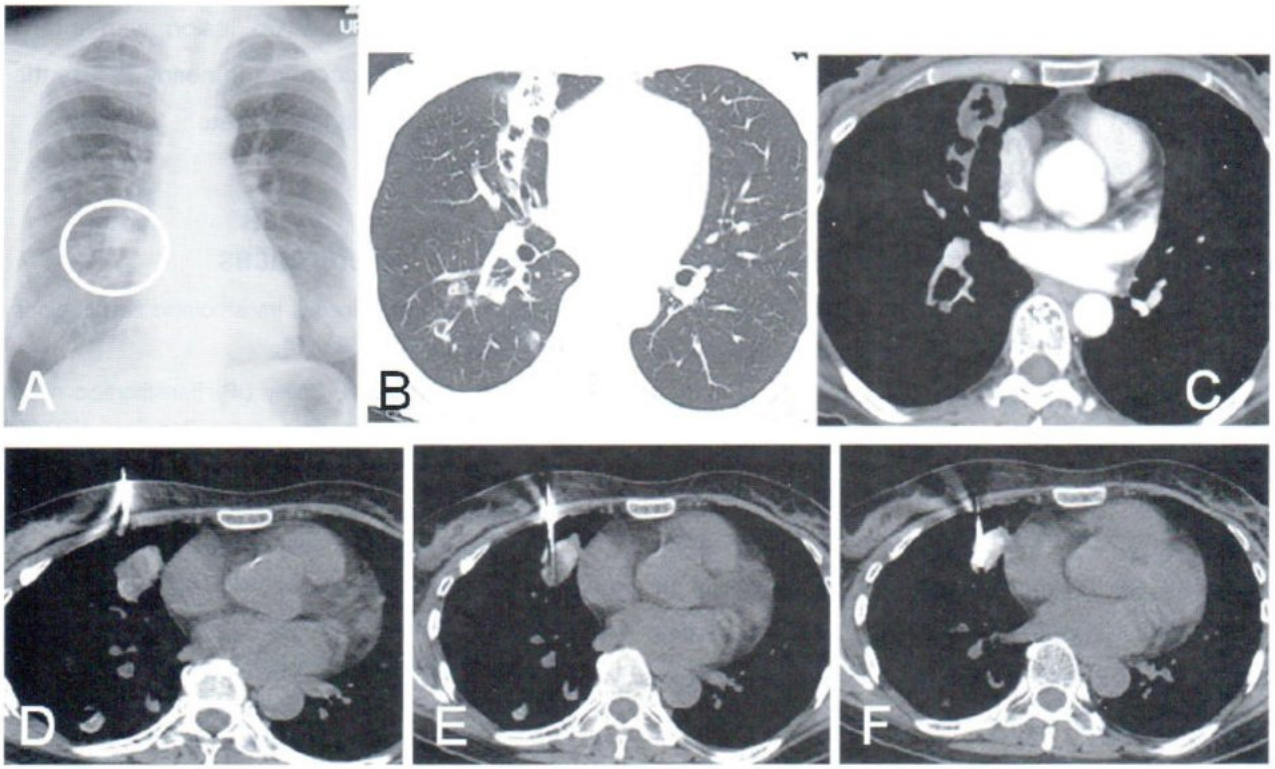

Fig.3 A 48 years old woman known case of Rheumatoid arthritis presented with multiple pulmonary masses (A). CT scans of chest was done and showed multiple pulmonary nodules and some of them have cavitary formation (B, C). Percutaneous transthoracic Core needle biopsy was performed by using Semi automatic cutting devices No.18 G X I attempt (D, E, F) at the RML mass and pathological report showed Cryptococcosis.

automated needle biopsy is traditionally performed in patients without a known primary tumor, in cases of potential lymphoma and after inconclusive FNAB. Owing to the varying availability of a cytopathologist and results that are comparable to those of FNAB (or even better), CNB has meanwhile been established as the primary technique of choice.

Previous studies have reported accuracies for TTNB of small and large size of pulmonary lesion that conflict with on another[9,10,11]. Although the criteria for small nodules are arbitrary, we defined such nodules as being less than 1 cm in diameter. Our rationale for this size criterion is that in our experience, on the basis of size alone, lesion greater than 1 cm in diameter usually do not pose technical difficulty, where as small nodules often are technically challenging. From our study, there are statistically significant difference ($p<.05$) between successful diagnostic rate of lesion less than 1 cm (54.5%) and lesion greater than 3 cm (88.0%) when biopsy was performed by FNAB, between successful diagnostic rate of lesion less than 1 cm (40.0%), lesion equal to 1 cm to less than 3 cm (78.6%) and lesion greater than 3 cm (90.5%) when biopsy was performed by CNB. This information confirmed that pulmonary lesions less than 1 cm in diameter pose technical difficulty and cause less successful diagnostic rate with either CNB or FNAB. We may

ask pulmonologist for close follow up lesion with interval imaging than TTNB according to nearly or less than 50% of successful diagnostic rate.

Varying complication rate of different size pulmonary lesions in both CNB and FNAB are shown in our study. The small lesions (less than 1 cm) show slightly higher complication (pneumothorax) rate than the large lesion (larger than 3 cm), likely to be from more technical difficulty and more number of pleural pass. However, other many factor that may effect risk of pneumothorax such as number of pleural pass, distance of pleural surface, location of pulmonary lesion, presence of emphysema/degree of emphysema and training level of fellow who done TTNB were not included in this study. With this information, we interested and have planning for our next study with purpose of study for examine multiple variable factor that effect risk of pneumothorax after TTNB.

Conclusion

Percutaneous transthoracic needle biopsy (TTNB) using CT guidance is a relatively safe and accurate method of establishing the diagnosis of benign and malignant pulmonary lesion. There is no difference between successful diagnostic and complication rate of CNB and FNAB. FNAB is suitable for tissue sampling of pulmonary lesion given a known primary tumor in combination with suspected metastases. CNB or large-gauge automated needle biopsy is traditionally performed in patients without a known primary tumor, in cases of potential lymphoma and after inconclusive FNAB.

The pulmonary lesions less than 1 cm in diameter pose technical difficulty, cause less successful diagnostic rate and more complication rate with either CNB or FNAB. We may ask pulmonologist for close follow up lesion with interval imaging than TTNB according to nearly or less than 50% of successful diagnostic rate.

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