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Cross-sectional Study

Conformity of Fine Needle Aspiration Biopsy (FNAB) and Core Needle Biopsy (CNB) in peripheral lung tumor patients: A cross-sectional study

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ABSTRACT

Background: The problem of establishing lung tumor diagnostics is a challenge for clinicians, especially pulmonologists, in determining a definitive diagnosis of a lung tumor.
Objective: Analyzing the conformity of anatomical pathology results between fine-needle aspiration biopsy (FNAB) and core needle biopsy (CNB) materials in peripheral lung tumors.
Methods: A cross-sectional study was conducted from July 2019 to December 2020 with 66 participants. Participants were examined for CNB and FNAB, in which the results of these examinations were compared for conformity. Statistical analysis used the Kappa test with $p < 0.05$.
Result: Most participants' tumor size was >70 mm, with FNAB results showing malignant category (39.5%), non-malignant (40.0%), and undiagnosed (38.9%; $p = 0.757$). Meanwhile, CNB examination showed a tumor size of >70 mm that was categorized into malignant (40.4%) and non-malignant (33.3%; $p = 0.510$). Most tumors were located in the right superior lobe that had FNAB results in the malignant (39.5%), non-malignant (30.0%) and undiagnosed (27.8%; $p = 0.306$) categories. The CNB examination also showed that most tumors were located in the right superior lobe, which had resulted in the category of malignant (34.4%), non-malignant (26.7%), and undiagnosed (75.0%; $p = 0.240$). Conformity of anatomical pathology results from FNAB and CNB subject such as malignancy category of 35 participants (74.5%), non-malignancy of 7 participants (53.8%) and undiagnosed of 4 participants (16.7%) with an accuracy of 69.69% ($K = 0.43$; $p = 0.001$).
Conclusion: There is a conformity between the anatomical pathology results from FNAB and CNB materials for the diagnosis of lung tumors. CNB showed better results in the detection of anatomical malignancy and specimen adequacy.

1. Introduction

The problem of establishing lung tumor diagnostics is a challenge for clinicians, especially pulmonologists, in determining the diagnosis of lung tumors. Generally, patients are admitted to hospitals with advanced stage and physical limitations to carry out invasive diagnostic procedures. Even though the patient is willing to undergo a diagnostic procedure, there are limited diagnostic specimens for lung tumor material. Diagnostic modalities of peripheral lung lesions include traditional and advanced techniques. Traditional diagnostic techniques consist of percutaneous biopsy with transthoracic needle aspiration (TTNA) known as fine-needle aspiration biopsy (FNAB) and bronchoscopy, while advanced techniques include endobronchial ultrasound (EBUS) and electromagnetic navigation bronchoscopy (ENB) [1].

Fine needle aspiration biopsy is recognized as an initial diagnostic tool for all body lesions, whether suspected to be benign or malignant. In some cases, there are limitations and shortcomings where the cytological sample of FNAB material is not sufficient to determine lung tumor diagnosis. Therefore, the patient must undergo other diagnostic procedures by performing a repeat biopsy procedure using a larger needle (core needle biopsy/CNB) or an open biopsy [2]. This procedure does not rule out the possibility of causing the patient to become uncomfortable, prolonging the treatment period that leads to a higher cost of treatment [3,4].

In several hospitals, concurrent FNAB and CNB procedures have been applied and show several advantages when these biopsies are combined

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at one time, which includes: (a) time efficiency since patients come in one visit and receive both procedures; (b) the specimens obtained by both procedures are more adequate, representative and complementary to enable the anatomical pathologist to obtain an accurate diagnosis; (c) cost-effective since it is expected to eliminate second diagnostic procedure that is potentially more invasive [4,5].

A thoracic ultrasonography (USG)-guided biopsy facilitates the process of determining the area of peripheral thoracic lesions, thereby increasing the success of sampling required for diagnosis [6]. Based on the description above, we are interested in analyzing the comparison between CNB and FNAB results with the help of thoracic ultrasound in peripheral lung tumors.

2. Methods and materials

2.1. Participants

Participants in this study were lung tumor patients who met the inclusion and exclusion criteria. Participants included in this study were patients with peripheral lung tumors based on chest X-ray, ultrasound, and CT scan [7–9] and those who could perform a percutaneous biopsy using thoracic ultrasound guidance. Meanwhile, exclusion criteria were patients with a performance score of <50 or hemodynamically unstable, massive untreated pleural effusion, mediastinal tumor, central lung tumor, coexisting lung disease conditions, impaired hemostatic function, and anatomical pathology results from either biopsy or FNAB or CNB that didn't come out.

2.2. Ethical approval

This study has been submitted for ethical approval with registration research based on the Declaration of Helsinki at the Health Research Ethics Committee in the Hospital. All participants first filled out the informed consent form before the study was carried out.

2.3. Study design

A cross-sectional study was carried out at Hospital, from September 2019 to December 2020. The number of participants in this study was 66 participants with consecutive sampling. This study compared the results of sampling using FNAB and CNB techniques assisted by ultrasound. This study report used Strengthening the Reporting of Cohort Studies in Surgery (STROCSS) 2021 guidelines [10].

2.4. Fine needle aspiration biopsy procedure

Fine needle aspiration biopsy is a diagnostic procedure in the form of a percutaneous biopsy of the thoracic region using a 25-gauge fine needle. The FNAB sampling technique is to lay the patient on the operating table, determine the biopsy site, disinfect the skin in the biopsy area with 10% povidone-iodine followed by 70% alcohol, install a sterile drape, perform 2% lidocaine infiltration (1–2 cc) at the biopsy site, intracutaneously, subcutaneously until it reaches the parietal pleura, perform a vertical spinal needle puncture until it reaches the lesion. The stylet is taken, the needle is connected to a 20 cc syringe, the suction is pulled firmly, the needle is moved up and down along 0.5–1 cm several times. The suction is slowly returned to its original position, the needle is removed. The aspirated biopsy material is removed onto a slide, a flat smear is made immediately, fixed, and then dried. If necessary, this procedure can be repeated a second or third time according to the initial assessment by an anatomical pathologist in assessing the adequacy of the specimen [8,9,11].

2.5. Core needle biopsy procedure

Core needle biopsy is a diagnostic procedure in the form of a percutaneous biopsy of the thoracic region using a 14-gauge core needle with the tip of the needle functioning as a cutter. The CNB sampling technique is carried out by inserting the core needle at the same location at the previous FNAB needlepoint until it reaches the lesion according to the depth of the thoracic ultrasound. Biopsy material that has been cut through the core is removed onto a slide, immediately a flat smear is made, fixed, and then dried. If necessary, this procedure can be repeated a second or third time according to the initial assessment by the anatomical pathologist in assessing the adequacy of the specimen. Post-biopsy observations are conducted for inpatients while in the room. For outpatients, observation is carried out for 2 h in the operating room, if there are no complications, the participant is allowed to go home with advice to return immediately if symptoms of shortness of breath or coughing up blood are found [12,13].

2.6. Statistical analysis

The measured data were analyzed by univariate and bivariate analysis, in which univariate data was displayed in the form of a frequency distribution or mean ± standard deviation (SD). Measurement data were analyzed using IBM SPSS Statistics software version 21.0 (IBM Corp., Armonk, NY, USA). Statistical analysis in this study used the Kruskal Wallis, Fisher Exact, and Kappa test with $p < 0.05$ was considered significant.

3. Results

3.1. Characteristics of participants

Most participants were male (81.8%), aged >50 years (77.3%), with most respiratory symptoms being chronic cough (63.6%). Most tumors were located in the right lung (62.1%) and most were in the right superior lobe (34.8%). Most participants had a needle inserted in the anterior (66.7%). Most tumors sized >70 mm as much as 39.4%, and the majority of participants did not experience post-FNAB and CNB complications (95.5%; Table 1).

Most participants had two punctures in each technique (FNAB = 93.9% and CNB = 63.6%). In both groups, the results of anatomical malignancy were found, which FNAB of 57.6% and CNB of 71.2%. Materials in both groups were declared adequate, which FNAB of 72.7% and CNB of 89.4% (Table 2).

3.2. Correlation between tumor size, age, and number of punctures with Post-FNAB and CNB complications

Most participants had tumor size >70 mm in diameter, 23 participants (36.5%) had no complications, but 3.8% had hemoptysis and 7.7% had pneumothorax ($p = 0.857$). Most uncomplicated participants were aged >50 years as much as 96%, but there were still participants who had hemoptysis (2%) and pneumothorax (2%) who were also >50 years old ($p = 0.198$). Most FNAB participants did not experience complications on 2 punctures as much as 95.2% ($p = 1.000$) and CNB participants did not experience complications on more than 2 punctures as much as 87.5%, but there were still occurrences of pneumothorax and hemoptysis on more than 2 punctures ($p = 0.040$; Table 3).

3.3. Correlation between lung tumor size and location with FNAB and CNB on anatomic pathology findings

Most participants' tumor size was >70 mm which had FNAB results in the malignant category (39.5%), non-malignant (40.0%), and undiagnosed (38.9%) with $p = 0.757$. Meanwhile, the results of CNB categories were malignant (40.4%), non-malignant (33.3%) and undiagnosed (7.6%) with $p = 0.510$. Most tumors were located in the right superior lobe, which FNAB results were malignant (39.5%), non-malignant (30.0%) and undiagnosed (27.8%; $p = 0.306$). Meanwhile,

Table 1
Characteristics of participants.

Variables	n (%)
Sex	
Male	54 (81.8)
Female	12 (18.2)
Age	
20–30 years old	2 (3.0)
31–40 years old	2 (3.0)
41–50 years old	11 (16.7)
>51 years old	51 (77.3)
Tumor Location	
Right lung	41 (62.1)
Left lung	25 (37.9)
Lung Lobe Location	
Right superior lobe	23 (34.8)
Right middle lobe	6 (9.1)
Right inferior lobe	6 (9.1)
Left superior lobe	20 (30.3)
Left inferior lobe	2 (3.0)
>1 right lobes	5 (7.6)
>1 left lobes	4 (6.1)
Needle Access	
Anterior	44 (66.7)
Posterior	20 (30.3)
Lateral	2 (3.0)
Tumor Size	
21–30 mm	2 (3.0)
31–40 mm	7 (10.6)
41–50 mm	1 (1.5)
51–60 mm	18 (27.3)
61–70 mm	12 (18.2)
>70 mm	26 (39.4)
Complication	
Hemoptysis	1 (1.5)
Pneumothorax	2 (3.0)
None	63 (95.5)

Table 2
Characteristic differences between FNAB and CNB.

Variables	FNAB	CNB
Number of Punctures		
2 times	62 (93.9)	42 (63.6)
>2 times	4 (6.1)	24 (36.4)
Findings		
Malignant	38 (57.6)	47 (71.2)
Non-malignant	10 (15.2)	13 (19.7)
Undiagnosed	18 (27.3)	6 (9.1)
Anatomical Pathology Results		
Malignant		
Squamous cell carcinoma	5 (7.6)	9 (13.6)
Adenocarcinoma	19 (28.8)	25 (37.9)
Small cell carcinoma	0 (0.0)	5 (7.6)
Atypical cells	8 (12.1)	1 (1.5)
Metastasis	1 (1.5)	5 (7.6)
Malignant round tumor cells	5 (7.6)	1 (1.5)
Non-malignant		
Granulomatous inflammation	1 (1.5)	4 (6.1)
Non-specific chronic inflammation	9 (13.6)	9 (13.6)
Undiagnosed		
Not representative/necrosis	18 (27.3)	7 (10.6)
Material Adequacy		
Adequate material	48 (72.7)	59 (89.4)
Inadequate material	18 (27.3)	7 (10.6)

CNB results were malignant (34.4%), non-malignant (26.7%), and undiagnosed (75.0%; $p = 0.240$). The conformity level of anatomical pathology results from FNAB and CNB subject were malignant category of 35 participants (92.1%), non-malignancy of 7 participants (70%) and undiagnosed of 4 participants (11.2%; $K = 0.43$; $p = 0.001$; Table 4). The accuracy value of the suitability of the results of anatomical pathology of the two techniques was 69.69%.

Table 3
Complications of patients with FNAB and CNB.

Variables	Complications			*p*
	Hemoptysis	Pneumothorax	None	
Tumor size				
21–30 mm	0 (0.0)	0 (0.0)	2 (3.2)	0.857
31–40 mm	0 (0.0)	0 (0.0)	7 (11.1)	
41–50 mm	0 (0.0)	0 (0.0)	1 (1.6)	
51–60 mm	0 (0.0)	0 (0.0)	18 (28.6)	
61–70 mm	0 (0.0)	0 (0.0)	12 (19.0)	
>70 mm	1 (100.0)	(100.0)	23 (32.0)	
Age				
20–30 years old	0 (0.0)	0 (0.0)	2 (3.2)	0.198
31–40 years old	0 (0.0)	1 (50.0)	1 (1.6)	
41–50 years old	0 (0.0)	0 (0.0)	11 (17.5)	
>51 years old	1 (100.0)	1 (50.0)	49 (77.8)	
FNAB punctures				
2 times	1 (1.6)	2 (3.2)	59 (95.2)	1.000
>2 times	0 (0.0)	0 (0.0)	4 (100.0)	
CNB punctures				
2 times	0 (0.0)	0 (0.0)	42 (100.0)	0.040*
>2 times	1 (4.2)	2 (8.3)	21 (87.5)	

Note: *significant $p < 0.05$.

4. Discussion

Several factors can increase the diagnostic value of transthoracic biopsy and prove the safety of thoracic ultrasound in guiding CNB in peripheral lung tumors, chest wall tumors, anterior mediastinal lesions. The size of the lesion does not appear to affect the diagnostic accuracy with thoracic ultrasound as a guide, but it is reported that the diagnostic rate is decreased in lesions located close to the ribs and influenced by the patient's respiratory movement and there are no serious complications from the procedure [14].

Core needle biopsy is significantly higher adequate material preparation than FNAB. Adequate material from the FNAB is found to correlate with tumor size. The addition of the number of needles passed in the FNAB technique is reported to increase the material to be more adequate. The operator's experience in the univariate analysis is reported to play a role in providing adequate material. FNAB specimens at a lesion size of 35 mm are reported to be adequate to obtain specimens to be used for further molecular testing. On the other hand, direct assessment by an on-site anatomic pathologist may be the best way to ensure sample adequacy [15].

The diagnostic accuracy of transthoracic biopsy material is significantly affected by the lesion size. Accuracy will decrease in lesions smaller than 20 mm and accuracy will increase in lesions measuring 50 mm. The larger the lesion, the greater the chance that the tissue or tumor cells will undergo necrosis, so that the more likely the specimen is inadequate to make a definitive diagnosis. Thoracic ultrasound cannot identify the incidence of necrosis of a tumor lesion, so the strategy in sampling large lesions is to target the biopsy area at the periphery to avoid the central area of lung mass which has a high probability of necrosis area. The rates of necrosis in lesions measuring 20 mm, 21–49 mm, and 50 mm were 3.9%, 11.7%, and 28.8%, respectively [16].

The diagnostic accuracy of transthoracic biopsy decreases with lung tumor size. If the lesion is small, it may move during the respiratory phase so that the needle falls to accurately target the lesion throughout the patient's respiratory cycle [8,15,17]. The location and size of the tumor lesion will affect FNAB accuracy. A good location for the FNAB technique is when the tumor lesion is located in the periphery with large size. Lung tumor located in the superior lobe is more easily accessible by the biopsy needle with a straight needle angle, as this position makes it easier for the needle to collect material without changing the pleural space [18]. The location of the mass attached to the pleura will also cause less movement during respiration to increase accuracy [18,19].

This study found no correlation between age, lesion size, and the

Table 4
Correlation of lung tumor location with FNAB and CNB techniques.

Variables	FNAB			*p*	CNB			*p*
	Malignant	Non-malignant	Undiagnosed		Malignant	Non-malignant	Undiagnosed	
Tumor size								
21–30 mm	0 (0.0)	1 (10.0)	1 (5.6)	0.757	0 (0.0)	2 (13.3)	0 (0.0)	0.510
31–40 mm	3 (7.9)	2 (20.0)	2 (11.1)		4 (8.5)	3 (20.0)	0 (0.0)	
41–50 mm	1 (2.6)	0 (0.0)	0 (0.0)		1 (2.1)	0 (0.0)	0 (0.0)	
51–60 mm	11 (28.9)	2 (20.0)	5 (27.8)		14 (29.8)	2 (13.3)	2 (50.0)	
61–70 mm	8 (21.0)	1 (10.0)	3 (16.7)		8 (19.1)	3 (20.0)	0 (0.0)	
>70 mm	15 (39.5)	4 (40.0)	7 (38.9)		19 (40.4)	5 (33.3)	2 (50.0)	
Lung Lobe Location								
Right superior lobe	15 (39.5)	3 (30.0)	5 (27.8)	0.306	16 (34.4)	4 (26.7)	3 (75.0)	0.240
Right middle lobe	4 (10.5)	1 (10.0)	1 (5.6)		6 (12.8)	0 (0.0)	0 (0.0)	
Right inferior lobe	2 (5.3)	1 (10.0)	3 (16.7)		3 (6.4)	3 (20.0)	0 (0.0)	
Left superior lobe	13 (34.2)	3 (30.0)	4 (22.0)		15 (31.9)	5 (33.3)	0 (0.0)	
Left inferior lobe	1 (2.6)	0 (0.0)	1 (5.6)		1 (2.1)	1 (6.7)	0 (0.0)	
>1 right lobes	0 (0.0)	2 (20.0)	3 (16.7)		2 (4.3)	2 (13.3)	1 (25.0)	
>1 left lobes	3 (7.9)	0 (0.0)	1 (5.6)		4 (8.5)	0 (0.0)	0 (0.0)	

* The results of Kappa test = 0.43; $p < 0.001$.

number of FNAB needle passes on the incidence of complications. A study conducted by Capalbo reported age as a factor that affects complications, with the incidence of pneumothorax due to CNB reported to be the majority in young patients, parenchymal bleeding in the elderly, and complications occurring more in the right lung. Fifty percent of pneumothorax cases occur in the superior lobe of the lung on the CNB technique, 40% of parenchymal hemorrhages in the inferior lobe on FNAB. In terms of size, the CNB technique is more complicated than the FNAB in lesions sized less than 3.5 cm. However, unlike our study, Capalbo's study was not performed at the same time as a biopsy so there was no detail provided regarding the incidence of complications of each technique. Parameters associated with complications were needle access, lesion size, age, needle diameter, and the number of needle passes. Concerning age, pulmonary parenchymal bleeding and hemoptysis complications occur more frequently in the elderly who undergo CNB, possibly because they usually use anticoagulant therapy due to comorbid disease. There was no significant correlation between the number of needles passed with complications and diagnostic accuracy because the average success with only 1 pass, in contrast to other studies that reported pneumothorax will occur more often in those who undergo many needles passes because this can cause a lot of trauma to the pleura or so that coaxial needle is needed in the future [13].

5. Conclusion

There is no correlation between lung tumor size and anatomic pathology findings in each biopsy technique. There is no correlation between lung tumor location and anatomic pathology findings in each biopsy technique. There is no correlation between tumor size, age, and the number of FNAB needle passes with the incidence of each complication. There appears to be a significant correlation between more than two CNB needle passes and the incidence of complications. CNB can detect anatomical malignancy and specimen adequacy better than FNAB.

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Author contribution

All authors contributed toward data analysis, drafting and revising the paper, gave final approval of the version to be published and agree to be accountable for all aspects of the work.

Trial registry number

1. Name of the registry: Health Research Ethics Coommitee in the Dr. Soetomo General Academic Hospital, Surabaya, Indonesia
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3. Hyperlink to your specific registration (must be publicly accessible and will be checked): -.

Guarantor

Isnin Anang Marhana.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Provenance and peer review

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Declaration of competing interest

Isnin Anang Marhana, Kadek Widianiti, and Etty Hary Kusumastuti declare that they have no conflict of interest.

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Appendix A. Supplementary data

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