J Korean Radiol Soc 2005;52:241 - 245

Fluoroscopy-Guided Percutaneous Transthoracic Biopsy: Comparison between Fine Needle Aspiration Biopsy and Core Biopsy with an Automated Cutting Needle[1]

Eunhee Kim, M.D., Tae Sung Kim, M.D., Yong Hwan Jeon, M.D., Joungho Han, M.D.[2]

Purpose: To compare the diagnostic accuracy and complication rates of fluoroscopy-guided percutaneous transthoracic fine needle aspiration biopsy (FNAB) and core biopsy (CB).

Materials and Methods: Ninety-one fluoroscopy-guided lung biopsies were performed in 86 patients using a 22-gauge fine needle ($n=52$) or a 21-gauge automated cutting needle ($n=39$). The size of pulmonary lesions were 1 - 9 cm. Histologic diagnosis rates and complications rates of the two groups were compared.

Results: The overall sensitivity of FNAB was 98% (51/52) which was higher than that of CB 89.7% (35/39) ($p=0.160$, Fisher's exact test). For the diagnosis of malignancy, sensitivities of FNAB and CB were 97.2% (35/36) and 89.7% (26/29), respectively ($p=0.316$). For the diagnosis of benignancy, sensitivities of FNAB and CB were 100% (16/16) and 90% (9/10), respectively ($p=0.384$). The specific histologic diagnosis rate of CB was 80% (8/10) in benignancy, which was higher than that of FNAB 56% (9/16) ($p=0.398$). The pneumothorax rates were 7.7% (4/52) for FNAB and 15.4% (6/39) for CB ($p=0.316$).

Conclusion: Although not statistically significant, a higher overall sensitivity was found in fluoroscopy-guided FNAB in the diagnosis of both malignancy and benignancy, and FNAB also achieved lower complication rates. More specific histologic diagnoses were obtained with CB.

Index words : Lung
Lung neoplasms
Percutaneous biopsy

Since the introduction of automated core biopsy cutting needles, there have been reports of good results in diagnostic accuracy in percutaneous transthoracic biopsies of intrapulmonary lesions. However, this technique has a relatively high incidence (9 - 54%) of complications such as pneumothorax (1 - 4). In the majority of papers dealing with the efficacy of percutaneous core biopsies, the technique has been performed under CT guidance (1 - 6). Percutaneous transthoracic needle biopsies can be performed under either fluoroscopy- or CT-guidance depending on the circumstances at the institute and the preferences of attending radiologists. To our knowledge, there has been little research performed on the comparison between fine needle aspiration biopsy

[1]Department of Radiology, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea
[2]Department of Pathology, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea
Received January 25, 2005 ; Accepted April 13, 2005
Address reprint requests to : Tae Sung Kim, M.D., Department of Radiology, Samsung Medical Center, Sungkyunkwan University School of Medicine, 50, Ilwon-dong, Kangnam-gu, Seoul 135-710, Korea.
Tel. 82-2-3410-2518 Fax. 82-2-3410-2559
E-mail: tskim@smc.samsung.co.kr

(FNAB) and core biopsy (CB) under fluoroscopic guidance in English literature.

The aim of this study was to compare the diagnostic accuracy and complication rates between FNAB and CB when performed under fluoroscopic-guidance.

Materials and Methods

Between December 2003 and March 2004, 91 fluoroscopy-guided transthoracic biopsies were performed by an experienced chest radiologist. Biopsy procedures were performed in 86 patients (33 women, 53 men; aged 19-86 years; mean, 58 years) using a 22-gauge fine needle (Chiba needle) ($n=52$) or a 21-gauge automated cutting needle (Autovac biopsy needle; angiomed®, Karlsruhe, Germany) ($n=39$). In five patients, both the fine needle and the automated cutting needle techniques were used for a single lung lesion during the procedure. After explaining the possible complications, informed consent was obtained from all patients prior to performing the procedure. In this prospective study, we tried to use each method alternately in randomized patients in order to lower the possibility of patient selection bias.

The majority of the lung lesions were located peripherally, but anterior mediastinal masses ($n=5$) and a pleural mass were included in the study. The size of the lesions were 1 - 7 cm in diameter (mean, 3.1 cm) for FNAB, and 1 - 9 cm (mean, 3.6 cm) for CB. Prior to performing the procedure, posteroanterior chest radiograph and CT scans were carefully reviewed in order to determine the optimal needle track, taking into consideration the diameter of the lung lesion and the length of the needle pathway. When using the FNAB technique, needle penetration through the lesion was performed repetitively in a to-and-fro movement (10 - 15 times), applying continuous negative pressure with a 20-mL syringe after the tip of the needle had reached the margin of the lesion. The actual biopsy site of the lesion was monitored throughout the procedure by fluoroscopy. A hemostat was used to keep the operator's hands out of the X-ray beam and to prevent excessive needle penetration beyond the lesion. Specimens obtained from FNAB were smeared on glass slides and fixed in a 95% alcohol solution. Core tissues obtained from CB were fixed in a formalin solution. The procedure was completed when it was determined that the specimens that were obtained were completely adequate, because an on-site cytopathologist was not available during the procedure in the institute. The average length of time to perform the complete procedure was approximately 15 minutes and no procedure took longer than 30 minutes. Immediately following the procedure, the patients were advised to rest for at least 4 hours in a puncture-site-down position (7). A chest radiograph was obtained in all patients one hour post-biopsy to check for a possible pneumothorax.

The histopathologic diagnosis rates and the incidences of complications (pneumothorax, perilesional hemorrhage, and hemoptysis) of the two groups were compared using Fisher's exact test and Student's t-test, respectively. A p value of less than 0.05 was considered to be significant.

Results

The average number of pleural punctures was 1.4

Table 1. Comparison between Percutaneous Transthoracic Fine Needle Aspiration Biopsy and Core Biopsy with an Automated Cutting Needle under Fluoroscopic Guidance

		FNAB ($n=52$)	CB ($n=39$)	p value
Average size of lesions (cm)		3.1	3.6	$p=0.003$
Average No. of pleural punctures		1.4	2.1	$p=0.312$
Overall sensitivity		98.1% (51/52)	89.7% (35/39)	$p=0.160$
Overall of specific diagnosis rate		65.3% (34/52)	82% (32/39)	$p=0.098$
Malignancy	Sensitivity	97.2% (35/36)	89.7% (26/29)	$p=0.316$
	Specific diagnosis	69.4% (25/36)	82.8% (24/29)	$p=0.257$
Benignancy	Sensitivity	100% (16/16)	90% (9/10)	$p=0.384$
	Specific diagnosis	56% (9/16)	80% (8/10)	$p=0.398$
Pneumothorax		7.7% (4/52)	15.4% (6/39)	$p=0.316$
Chest tube insertion		0% (0/52)	2.6% (1/39)	$p=0.428$
Hemoptysis		7.7% (4/52)	2.6% (1/39)	$p=0.387$
Perilesional hemorrhage		11.5% (6/52)	12.8% (5/39)	$p=1.000$

Note. — FNAB; 22-gauge fine needle aspiration biopsy, CB; core biopsy using a 21-gauge automated cutting needle

(range, 1 - 3) for FNAB and 2.1 (range, 1 - 5) for CB (p = 0.312, student t test). Overall sensitivities and specific diagnosis rates of FNAB and CB and corresponding results for both malignancy and benignancy are summarized in Table 1. The rate of inadequate specimens obtained and failure rate of FNAB for both malignancy and benignancy was 1.9% (1/52), and that of CB was 10.3% (4/39). The complications rates (pneumothorax, chest tube insertion, hemoptysis, and perilesional hemorrhage) are also summarized in Table 1. Minor hemoptysis (less than 1/2 cup) occurred during the procedure in 7.7% (4/52) of FNAB and 2.6% (1/39) of CB. In all cases the hemoptysis subsided within two days without any specific treatment.

According to the final diagnosis, there were 36 malignancies and 16 benignancies in the FNAB group (n = 52). Of the malignant cases, 35 of 36 (97.2%) were diagnosed correctly by FNAB. The remaining case with malignant lymphoma only displayed atypical lymphoid cells on the FNAB specimen, which was not sufficient for the specific diagnosis of malignant lymphoma. Specific cell type was diagnosed by FNAB in 25 of 36 (69.4%) malignancies, and the remaining ten cases were diagnosed as non-small cell lung cancer. Of the benignant cases, there were nine nonspecific inflammatory lesions, five cases of tuberculosis, one abscess, and one aspergillosis. Two of the nine nonspecific inflammatory lesions could be considered a specific diagnosis because subsequent video-assisted thoracoscopic surgeries also revealed nonspecific chronic inflammation. Therefore, nine cases (56%), including these two nonspecific inflammatory lesions, were specifically diagnosed by FNAB in benignancy. The remaining seven inflammatory lesions were considered both clinically and radiologically to be tuberculosis or organizing pneumonia, and have been followed up for 4 - 8 months with antituberculous (n = 5) or antibiotics (n = 2) medication without any further diagnostic work-up. In addition, all seven cases showed regression of the lesion during the follow-up period.

According to the final diagnosis, there were 29 malignancies and 10 benignancies in the CB group (n = 39). Of the malignant cases, 26 of 29 (89.7%) were diagnosed correctly by CB. Of the three patients with false negative results, two patients were found to have adenocarcinoma by either FNAB or surgery, although a prior CB revealed only chronic inflammation or necrotic material. In the remaining patient, a tissue sample using the CB technique was not obtained due to hemoptysis. Specific cell type was diagnosed by CB in 24 of 29 (82.8%) malignancies, and the remaining two cases were diagnosed as non-small cell lung cancer. Of the benignant cases, there were three cases of tuberculosis, two aspergillosis, one benign fibrous tumor of the pleura, one fibrocollagenous tissue, one chronic eosinophilic pneumonia, one chondroid hamartoma, and one anthracofibrotic nodule as a final diagnosis. Eight (80%) of the cases were specifically diagnosed by CB. An adequate tissue sample was not obtained using the CB technique in one benign case due to perilesional hemorrhage, which was later found to be chronic inflammation, suggestive of tuberculosis, on both the simultaneous FNAB and the subsequent video-assisted thoracoscopic surgery. The remaining case with a nonspecific inflammatory lesion was considered to be tuberculosis, and has been followed up for seven months with antituberculous medication and has shown gradual regression.

Discussion

The reported range of inadequate specimens obtained with FNAB is 2.4% - 25.5% in the literature (8 - 10). In our group, the overall rate of inadequate specimens obtained and failure rate with FNAB was 1.9% (1/52). The sensitivity of FNAB in the diagnosis of malignancy in our group (97.2%, 35/36) was within the reported range of 82% - 99% (8, 11, 12). Our rate of an accurate specific diagnosis of benign lesions in FNAB (56%, 9/16) was also within the reported range of 39% - 77% (1, 10, 13 - 15). Our overall sensitivity of CB under fluoroscopic guidance was 89.7%, while the reported range of CB under CT guidance is 62% - 93% (1 - 6).

Since repeated to-and-fro passes through the lesion (10 - 15 times) after one pleural puncture were technically possible in FNAB, the number of pleural punctures in FNAB (1.4 times) were smaller than that of pleural punctures in CB (2.1 times); only a single shot was possible with each pleural puncture in CB using an automated cutting needle. The FNAB technique would increase the chance of obtaining an adequate amount of tissue with fewer pleural punctures. The reported rate of pneumothorax in the literature is 7.6% - 46% for FNAB (13, 16 - 19) and 9% - 54% for automated biopsy systems (1 - 4). In our group, the rate was 7.7% (4/52) for FNAB and 15.4% (6/39) for CB. Our rate of chest tube insertion in CB (2.6%, 1/39) was also within the reported range of 2% - 18% (1, 4, 6, 17, 20). However, no chest tube insertion was necessary for FNAB. We think that the higher

pneumothorax rate in CB was due to the slightly larger caliber of needle (21-gauge vs. 22-gauge) and larger number of pleural punctures. The pneumothorax rate (15.4%) and chest tube insertion rate (2.6%) after CB under fluoroscopic guidance in our study were low compared to the rates reported in literature using the CB technique under CT guidance. These results seem to be related to the smaller caliber of needles and a shorter procedure time, which lead to a shorter needle dwell time, although a direct comparison between fluoroscopy- and CT-guided biopsies was not investigated in our study. The lower capacity of chest radiography to detect a small-sized pneumothorax than CT may have also influenced our low pneumothorax rate (4). Our hemoptysis rates (7.7% for FNAB and 2.6% for CB) were within the reported range of 0% - 10% (4, 8, 9, 19, 21).

Among the 39 patients who underwent a CB, four patients were not correctly diagnosed; an adequate tissue sample was not obtained in two patients (both due to hemoptysis and perilesional hemorrhage), and in the remaining two patients a false negative diagnosis of malignancy was made due to inadequate specimens. When the size of the lesion is small and the first shot results in hemoptysis or hemorrhage without obtaining adequate core tissue, the second targeting becomes difficult because of persistent coughing and difficulty in the patients ability to hold their breath. Furthermore, the margin of the lesion is obscured by perilesional hemorrhage. In such a situation, repetitive to-and-fro passes of a fine needle through the lesion under continuous fluoroscopic monitoring will increase the chance of obtaining tissue with a lower possibility of complications than multiple gun shots. The CB technique with an automated cutting needle has several advantages such as increased diagnostic accuracy for nonmalignant lesions and better characterization of cell types in malignancy (4, 8). However, it can be risky when the great vessels are located near the lesion or in the direction of the needle pathway. Moreover, CB with large-bore cutting needles has been associated with fatal complications such as massive endobronchial hemorrhage (22). Although a specific cell type diagnosis of both malignancy and benignancy was obtained less frequently with FNAB than with CB, the subcategorization of malignancy into small cell versus non-small cell lung cancer was possible with FNAB in our group, enabling the determination of a subsequent treatment modality. All patients with no specific diagnosis but nonspecific inflammatory lesion in FNAB specimens were followed up with regression of the lesions. Therefore, it is best to reserve automated cutting needles for biopsies of pulmonary lesions with strong clinical suspicion of benignancy, large pulmonary or mediastinal masses, or when a prior FNAB has failed to give a specific histologic diagnosis (23).

In our experience, CT-guided biopsies requires longer procedural time than do fluoroscopy-guided biopsies, especially when the lesion is small, because several attempts with repeated scanning are usually needed for the exact needle localization to the lesion. When the amount of inspiration in a patient is not constant during scanning, which occurs frequently due to pain during deep inspirations after needling, the localizing procedure becomes more difficult and time-consuming. The needle dwell time is also prolonged, which presumably increases the risk of pneumothorax. In fluoroscopy-guided biopsies, however, we can localize the lesion both expeditiously and with precision because we can manipulate the direction of the needle toward the lesion on a real-time basis. Therefore, it is usually best to perform a CT-guided biopsy in specific situations such as when a lung nodule is inconspicuous on fluoroscopy.

In summary, although not statistically significant, fluoroscopy-guided FNAB showed a higher sensitivity than that of CB in the diagnosis of both malignancy and benignancy with a lower complication rate. Considering the subcategorization of malignancy into small cell- and non-small cell lung cancer is more often feasible using the FNAB technique, FNAB may be enough for the diagnosis of malignancy and for the determination of a subsequent treatment modality. However, CB may be a more favorable technique when benignancy is suspected at CT, because a specific histologic diagnosis is more readily obtained by CB than by FNAB. Ed. Note: confirm wording

References

1. Klein JS, Salomon G, Stewart E. Transthoracic needle biopsy with a coaxially placed 20-gauge automated cutting needle: results in 122 patient. *Radiology* 1996;198:715-720
2. Haramati LB. CT-guided automated needle biopsy of the chest. *AJR Am J Roentgenol* 1995;165:53-55
3. Gruden JF, Klein JS, Webb WR. Percutaneous transthoracic needle biopsy in AIDS: analysis in 32 patients. *Radiology* 1993;189: 567-571
4. Lucidarme O, Howarth N, Finet JF, Grenier PA. Intrapulmonary lesions: percutaneous automated biopsy with a detachable, 18-gauge, coaxial cutting needle. *Radiology* 1998;207:759-765
5. Burbank F, Kaye K, Belville J, Ekuan J, Blumenfeld M. Image-guided automated core biopsies of the breast, chest, abdomen and pelvis. *Radiology* 1994;191:165-171

6. Boiselle PM, Shepard JA, Mark EJ, Szyfelbein WM, Fan CM, Slanetz PJ, et al. Routine addition of an automated biopsy device to fine-needle aspiration of the lung: a prospective assessment. *AJR Am J Roentgenol* 1997;169:661-666
7. Moore EH, Shepard JO, McLoud TC, Templeton PA, Kosiuk JP. Positional precautions in needle aspiration lung biopsy. *Radiology* 1990;175:733-735
8. Bocking A, Klose KC, Kyll HJ, Hauptmann S. Cytologic versus histologic evaluation of needle biopsy of the lung, hilum and mediastinum: sensitivity, specificity and typing accuracy. *Acta Cytol* 1995;39:463-471
9. Arakawa H, Nakajima Y, Kurihara Y, Niimi H, Ishikawa T. CT-guided transthoracic needle biopsy: a comparison between automated biopsy gun and fine needle aspiration. *Clin Radiol* 1996;51:503-506
10. Stanley JH, Fish GD, Andriole JG, Gobien RP, Betsill WL, Laden SA, et al. Lung lesion: cytologic diagnosis by fine needle biopsy. *Radiology* 1987;172:389-391
11. Crosby JH, Hager B, Hoeg K. Transthoracic fine-needle aspiration. *Cancer* 1985;56:2504-2507
12. Todd TR, Weisbrod G, Tao LC, Sanders DE, Delarue NC, Chamberlain DW, et al. Aspiration needle biopsy of thoracic lesions. *Ann Thorac Surg* 1981;32:154-161
13. Greene R, Szyfelbein WM, Isler RJ, Stark P, Jantsch H. Supplementary tissue-core histology from fine-needle transthoracic aspiration biopsy. *AJR Am J Roentgenol* 1985;144:787-792
14. Sagel SS, Ferguson TB, Forrest JV, Roper CL, Weldon CS, Clark RE. Percutaneous transthoracic aspiration needle biopsy. *Ann Thorac Surg* 1978;26:399-405
15. Castellino RA, Blank N. Etiologic diagnosis of focal pulmonary infection in immunocompromised patients by fluoroscopically guided percutaneous needle aspiration. *Radiology* 1979;132:563-567
16. vanSonnenberg E, Casola G, Ho M, Neff CC, Varney RR, Wittich GR, et al. Difficult thoracic lesions: CT-guided biopsy experience in 150 cases. *Radiology* 1988;167:457-461
17. Milman N. Percutaneous lung biopsy with a semi-automatic, spring-driven fine needle: preliminary results in 13 patients. *Respiration* 1993;60:289-291
18. Kazerooni EA, Lim FT, Mikhail A, Martinez FJ. Risk of pneumothorax in CT-guided transthoracic needle aspiration biopsy of the lung. *Radiology* 1996;198:371-375
19. Stevens GM, Jackman RJ. Outpatient needle biopsy of the lungs: its safety and utility. *Radiology* 1984;151:301-303
20. Wagner HJ, Barth P, Schade-Brittinger C, Plein S, Klose KJ. Postmortem evaluation of four randomly selected automated biopsy devices for transthoracic lung biopsy. *Cardiovasc Intervent Radiol* 1995;18:300-306
21. Taber RE, Lupovitch A, Kantzler PJ. Fine-needle aspiration biopsy of lung tumors. *Ann Thorac Surg* 1986;42:344-347
22. Norenberg R, Claxton CP Jr, Takaro T. Percutaneous needle biopsy of the lung: report of two fatal complications. *Chest* 1974;66:216-218
23. McLoud TC. Should cutting needles replace needle aspiration of lung lesions? *Radiology* 1998;208:569-570

대한영상의학회지 2005;52:241 - 245

투시조영하 경피적 경흉부 생검술: 세침흡인술과 자동화 절제 바늘을 이용한 핵 생검의 비교[1]

[1]성균관의대 삼성서울병원 영상의학과
[2]성균관의대 삼성서울병원 병리과

김은희 · 김태성 · 전용환 · 한정호[2]

목적: 투시 조영하 경피적 경흉부 세침흡인술(fine needle aspiration biopsy)과 핵 생검(core biopsy)의 진단적 정확성과 합병증 발생율을 비교하고자 하였다.

대상과 방법: 86명의 환자에 대해 91개의 폐 생검을 시행하였는데, 이 중52개는 22게이지(gauge) 세침을 이용하였고, 39개에서는 21게이지 자동화된 절제 바늘로 시행하였다. 폐 병변의 크기는 1 - 9 cm 이었다. 두 군간의 조직학적 진단율과 합병증 발생율을 비교하였다.

결과: 총 민감도는 세침흡인술이 98%(51/52)로 핵 생검의 89.7%(35/39) 보다 높았다(p=0.160, Fisher's exact test). 악성 병변의 진단시, 세침흡인술과 핵 생검의 민감도는 각각 97.2%(35/36)와 89.7%(26/29) 였다 (p=0.316). 양성 병변의 진단시, 세침흡인술과 핵 생검의 민감도는 각각 100%(16/16)와 90%(9/10) 였다 (p=0.384). 양성 병변시 핵 생검의 특정 조직학적 진단율(80%,8/10)은 세침흡인술의 진단율(56%, 9/16) 보다 높았다(p=0.398). 기흉 발생율은 세침흡인술에서 7.7%(4/52), 핵 생검에서는 15.4%(6/39) 였다(p=0.316).

결론: 통계적으로 유의한 차이는 없었지만 투시조영하에서 시행한 세침흡인술은 악성병변과 양성병변 모두에서 핵 생검보다 진단적인 민감도가 높았으며, 낮은 합병증 발생율을 보였다. 핵 생검은 양성 병변에서 특정 조직 진단율이 세침흡인술보다 높았다.