J Korean Radiol Soc 2008;58:475 - 479

Percutaneous Needle Aspiration Biopsy (PCNA) of Pulmonary Lesions: Evaluation of a Reaspiration or a Rebiopsy (second PCNA)[1]

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Purpose: To evaluate the effectiveness of the reaspiration or rebiopsy of pulmonary lesions (second PCNA) in cases where the pathologic results are inconclusive upon initial percutaneous needle aspiration biopsy (PCNA).

Materials and Methods: A total of 364 PCNA cases (350 initial PCNA, 14 second PCNA) were performed under CT or fluoroscopy guidance for all the 350 patients enrolled. The procedure was performed by either using an automated biopsy gun with a 20-G needle (298 cases) or a 20-G aspiration needle (66 cases). The pathologic agreement rates between the initial and second PCNA, as well as the causes for a second PCNA, were evaluated. Finally the type and rate of complication were also evaluated.

Results: The second PCNA rate was 4.0% (14/350). The causes for a second PCNA, following the initial PCNA included unexpected pathologic results (n = 7) and inconclusive pathologic results (n = 7). Of the seven cases which had unexpected pathologic results from their initial PCNAs, five had similar pathologic results after a second PCNA. Also, of the seven cases of inconclusive pathologic results, such as atypical cells, the scanty cellularity or necrosis upon an initial PCNA, six cases revealed a malignancy on a second PCNA. The overall complication rate, including both the initial and second PCNAs was 14.0% (51/364).

Conclusion: A second PCNA was performed to help resolve the exact diagnosis for a pulmonary lesion in cases of inconclusive pathologic results upon an initial PCNA.

Index words : Tomography, X-Ray Computed
Fluoroscopy
Biopsy
Lung diseases

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Received February 1, 2008 ; Accepted March 31, 2008
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A percutaneous needle aspiration biopsy (PCNA) of the lung is a well established method used for the cytologic diagnosis of pulmonary lesions (1). PCNA is generally regarded as a safe procedure with limited morbidity and extremely rare mortality. The diagnostic accuracy has been reported as greater than 80% for benign disease and as greater than 90% for for malignant disease (2-8). Automated needle biopsies are presently available and reports have shown the diagnostic accuracy of this technique comparable to aspiration biopsy (3). Reaspiration or rebiopsy (a second PCNA) cases might occur in cases where the initial pathologic results were inconclusive. Few radiologic reports address the potential increase in diagnostic effectiveness of a second PCNA in the lung. The purpose of this study was to evaluate the agreement rate of the pathologic results between an initial PCNA and a second PCNA in the lung of cases with inconclusive results.

Materials and Methods

Three hundred and eighty four consecutive percutaneous thoracic biopsies using automated biopsy devices or fine needle aspiration were performed at our institution between July 2004 and December 2006. Of these, 20 were cases of extrapulmonary thoracic lesions such as chest wall (n = 10), mediastinum (n = 5), or pleura (n = 5), and were excluded from this study. Hence, the remaining 364 cases of PCNA were performed on pulmonary parenchymal lesions. Of the 364 cases, 14 included patients having undergone a second PCNA due to unexpected or inconclusive pathologic results from an initial PCNA. All the repeated PCNAs were performed at the same site as the initial PCNA site. Hence, a total of 350 patients [219 male (62.5%) and 131 females (37.5%)], were part of this study. The age range of the study population was 8 - 88 years (mean, 62.5 years). In addition, the range in lesion diameter was 0.5 - 13.6 cm (mean 3.4 cm). The lobar location of the lesions was distributed as follows: right upper lobe (n = 111), left upper lobe (n = 88), left lower lobe (n = 79), right lower lobe (n = 69) and right middle lobe (n = 17). All patients underwent a diagnostic chest CT examination prior to a biopsy. All PCNA cases were performed using CT (Hispeed, GE Medical Systems, Milwaukee, WI, U.S.A.) in 251 or fluoroscopy (Integris Allura, Siemens, Erlangen, Germany) in 113 as an imaging guidance. Selection of imaging guidance was based on the ease of accessibility and proper visibility of each lesion on CT or fluoroscopy. A contrast media was not used on CT or fluoroscopy. Prior to each procedure, the risks and benefits of the procedure were communicated to each patient. Moreover, patient consent was obtained in each case. The procedure was performed with patients in the prone, supine, oblique, or lateral decubitus positions. A total of 298 cases were performed using an automated core biopsy gun (Magnum®, Bard, Covington, GA, U.S.A.) with a 20-gauge needle; whereas 66 cases used a 20-gauge aspiration needle. Following the procedure, the patients were monitored and also underwent a posteroanterior erect expiratory chest radiograph at two hours after having undergone a PCNA.

The pathologic agreement rate between the initial and second PCNA, as well as the causes of a second PCNA, was evaluated. Moreover, the rate and type of PCNA complication were also evaluated. The data were analyzed via the Chi-square test and Fisher's exact test using the SAS (Statistical Analysis System 9.1 version) software.

Results

Of the 350 patients enrolled for a PCNA, 14 had to undergo a second PCNA (4.0%). The mean diameter of the second PCNA lesions was 4.3 cm (range, 1.5 - 10.8 cm). The lobar location of the lesions was as follows: five in the right upper lobe, three in the left upper lobe, three in the left lower lobe, two in the right lower lobe and one in the right middle lobe.

Of the 251 cases which underwent an initial PCNA using CT as an imaging guidance, seven cases required a second PCNA. Of 113 cases of initial PCNA using fluoroscopy, seven cases required a second PCNA. Therefore, there was no statistically significant difference between the CT and fluoroscopy methods as far as imaging guidance with respect to a second PCNA (p = 0.1428). Of the 14 total cases requiring a second PCNA, the same image guidance method initially used for the initial PCNA was used in 11 cases for the second PCNA. On the other hand a CT was performed in seven cases, as opposed to four for fluoroscopy. In three of the cases requiring a second PCNA, a different image guidance method was used for the second PCNA (CT) from the initial guidance method (fluoroscopy).

Of 287 cases of initial PCNA using an automated gun as a biopsy tool, a second PCNA was necessary in 11 cases. Moreover, of the 63 cases using needle aspiration as an initial PCNA, a second PCNA was necessary in the

three cases. Furthermore, no statistically significant difference between the automated gun biopsy and needle aspiration as a biopsy tool for a second PCNA (p = 0.7266). Nine cases used the same aspiration or biopsy tool for the initial and second PCNA (automated gun using 20-gauge needle: 8 cases; 20-gauge aspiration needle: 1 case). For the other three cases, a 20-gauge aspiration needle was used in the initial PCNA, followed by an automated gun using a 20-gauge needle for the second PCNA. In the other two cases, an automated gun using 20-gauge needle was used in the initial PCNA, followed by a 20-gauge aspiration needle for the second PCNA.

The causes for a second PCNA included unexpected pathologic results for the clinical or radiologic findings (n = 7) and inconclusive pathologic results (n = 7) for the initial PCNA. The 7 cases with inconclusive pathologic results included cases with atypical cells (n = 2), scanty cellularity (n = 2), necrosis (n = 2) and hemorrhage (n = 1). The two cases of atypical cells indicated non-small cell lung cancer for the initial PCNA, followed by melanoma for the second PCNA. The two cases of scanty cellularity revealed small cell lung cancer for the initial PCNA, followed by adenocarcinoma for the second PCNA. The two cases of necrosis indicated small cell lung cancer for the initial PCNA, followed by a melanoma on the second PCNA. Lastly, the hemorrhagic case on the initial PCNA revealed interstitial fibrosis on the second PCNA. Of the seven cases of unexpected pathologic results for the initial PCNA, five shared the same initial PCNA pathologic results with the results of the second PCNA including inflammation (n = 3), sarcoma (n = 1) and tuberculosis (n = 1). The two cases with pathologic results which were different for the initial and second PCNA included combined cases of pneumonia and tuberculosis, as well as inflammation and metastasis, respectively. In cases of non-tumor lesions on the initial and second PCNA, the final diagnosis of each lesion was supported by the clinical and radiological follow up studies (Table 1).

The cumulative complication rate of the initial and second PCNA was 14.0% (51 of 364 cases). A series of complications occurred on the initial PCNA, which primarily included pneumothorax (n = 39), hemoptysis (n = 9), severe pain (n = 2) and lingular atelectasis (n = 1). The two cases of pneumothorax required a chest tube insertion. All cases of hemoptysis were mild and did not require a vascular embolization. Severe pain and lingular atelectasis were overcome without any medical treatment. In the case of CT guided initial or second PCNA, each of the complications include the pneumothorax (n = 25), hemoptysis (n = 5), severe pain (n = 1) and lingular atelectasis (n = 1). Of the cases with fluoroscopy guided initial or second PCNA, the complications comprise pneumothorax (n = 14), hemoptysis (n = 4) and severe pain (n = 1). As for the complication rate of the pneumothorax, no statistically significant difference was found between the CT and fluoroscopy as an imaging guidance (p = 0.4881). As for the hemoptysis complication, no statistically significant difference was found between the CT and fluoroscopy imaging guidance methods (p = 0.4675). In particular, for the 14 second PCNA cases, only a mild hemoptysis developed in one case. No other complications

Table 2. Complications in 364 Cases of Initial and Second PCNA

Complications (n = 51, 0.14%)	CT	Fluoroscopy
Pneumothorax (n = 39, 0.107%)	25	14
Hemoptysis (n = 9, 0.025%)	5	4
Severe pain (n = 2, 0.005%)	1	1
Atelectasis * (n = 1, 0.003%)	1	0

*Lingular atelectasis

Table 1. Pathologic Results of Second PCNA

	Initial PCNA	Second PCNA
Unexpected pathologic results on initial PCNA (n = 7)	Inflammation (n = 4)	Inflammation (n = 3) Metastasis (n = 1)
	Sarcoma (n = 1)	Sarcoma (n = 1)
	Tuberculosis (n = 1)	Tuberculosis (n = 1)
	Pneumonia (n = 1)	Tuberculosis (n = 1)
Inconclusive pathologic results on initial PCNA (n = 7)	Atypical cells (n = 2)	Non-small cell carcinoma (n = 1) Melanoma (n = 1)
	Scanty cellularity (n = 2)	Adenocarcinoma (n = 2)
	Necrosis (n = 2)	Small cell carcinoma (n = 1) Melanoma (n = 1)
	Hemorrhage (n = 1)	Interstitial fibrosis (n = 1)

were observed in the remaining 13 cases (Table 2).

To date, this study did not reveal a significant difference between the rate of cases requiring further PCNA, depending on the location of the lesions; however, small enough numbers were included in the sample numbers were included ($p = 0.9091$).

Discussion

Of the seven cases with inconclusive pathologic results including atypical cells, scanty cellularity or necrosis on initial PCNAs, six cases revealed a malignancy on the second PCNA. Hence, a second PCNA might be necessary in cases which indicate atypical cells, scanty cellularity or necrosis on an initial PCNA. Although technical failure is an important factor of PCNA, avoidance of a necrotic or hemorrhagic area during the PCNA of lung lesions is also important and reduces the frequency of requiring further evaluation such as a second PCNA. Of the seven cases with unexpected pathologic results from an initial PCNA, taking into consideration clinical or radiological findings, different pathologic results on second PCNA were obtained in two cases. Although the other five cases, the pathologic results were the same. The final pathologic results for the two cases were tuberculosis and metastasis, hence, a second PCNA might be considered in cases with unexpected pathologic results from initial PCNAs. Although, in the 14 cases in which only PCNA was used as a second biopsy method, other additional testing, including a bronchoscopic biopsy or transbronchial lung biopsy might be considered on a situation-specific basis.

In this study, the mean diameter of the second PCNA cases was larger than that for overall cases. This may be due to large necrotic or hemorrhagic foci of the lesions in some cases. Therefore, exact targeting of the lesions using CT guidance might be helpful in certain cases with a large necrotic or hemorrhagic portion.

The complication rate for the study cases was 14.0% (51/364). The complication results as a function of imaging guidance method, the complication rates of the pneumothorax were 10.0% (25/251) for the CT and 12.4% (14/113) for the fluoroscopy method. Regarding the development of the pneumothorax, no statistically significant difference was demonstrated between the CT and fluoroscopy imaging guidance methods ($p = 0.4881$). However, pneumothorax still remains the most common complication of the CT-guided lung biopsy (7, 9). Some reports concluded that smaller needles are safer (10, 11). We used the same needle diameter for the automated gun core biopsy and the aspiration biopsy, to correctly compare the risk rates, which depend upon the diameter of needle. The complication rates of hemoptysis were 2.0% (5/251) on CT and 3.5% (4/113) on fluoroscopy. With regards to the development of hemoptysis, no statistically significant difference was found between CT and fluoroscopy as an imaging guidance ($p = 0.4675$). Hence, CT or fluoroscopy might be a helpful imaging guidance to decrease hemoptysis rates in PCNAs of the lung. Moreover, no severe complications were reported for cases requiring a second PCNA case. Although this study has some limitations such as small cases of second PCNA and a retrospective study, The second PCNA has some useful and safe method for conclusive diagnosis of pulmonary lesions in cases of inconclusive or unsatisfactory results from an initial PCNA. In particular, a second PCNA was more important in cases of atypical cells, scanty cellularity, or necrosis of the pathologic results on initial PCNA.

In conclusion, a second PCNA might be a helpful tool in the diagnosis of pulmonary lesions in cases of unexpected or inconclusive pathologic results on initial PCNA.

References

1. Geraghty PR, Kee ST, McFarlane G, Razavi MK, Sze DY, Dake MD. CT-guided transthoracic needle aspiration biopsy of pulmonary nodules: needle size and pneumothorax rate. *Radiology* 2003;229:475-481
2. Laurent F, Latrabe V, Vergier B, Montaudon M, Vernejoux JM, Dubrez J. CT-guided transthoracic needle biopsy of pulmonary nodules smaller than 20 mm: results with an automated 20-gauge coaxial cutting needle. *Clin Radiol* 2000;55:281-287
3. Tsukada H, Satou T, Iwashima A, Souma T. Diagnostic accuracy of CT-guided automated needle biopsy of lung nodules. *AJR Am J Roentgenol* 2000;175:239-243
4. Yamagami T, Iida S, Kato T, Tanaka O, Nishimura T. Combining fine-needle aspiration and core biopsy under CT fluoroscopy guidance: a better way to treat patients with lung nodules? *AJR Am J Roentgenol* 2003;180:811-815
5. Welker JA, Alattar M, Gautam S. Repeat needle biopsies combined with clinical observation are safe and accurate in the management of a solitary pulmonary nodule. *Cancer* 2005;103:599-607
6. Khouri NF, Stitik FP, Erozan YS, Gupta PK, Kim WS, Scott WW Jr, et al. Transthoracic needle aspiration biopsy of benign and malignant lung lesions. *AJR Am J Roentgenol* 1985;144:281-288
7. Laurent F, Latrabe V, Vergier B, Michel P. Percutaneous CT-guided biopsy of the lung: comparison between aspiration and automated cutting needles using a coaxial technique. *Cardiovasc Intervent Radiol* 2000;23:266-272
8. Perlmutt LM, Johnston WW, Dunnick NR. Percutaneous transthoracic needle aspiration: a review. *AJR Am J Roentgenol* 1989;152: 451-455

9. 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
10. Stanley JH, Fish GD, Andriole JG, Gobien RP, Betsill WL, Laden SA, et al. Lung lesions: cytologic diagnosis by fine-needle biopsy. *Radiology* 1987;162:389-391
11. Chin WS, Yee IST. Percutaneous aspiration biopsy of malignant lung lesions using the Chiba needle. An initial experience. *Clin Radiol* 1978;29:617-619

대한영상의학회지 2008;58:475 - 479

폐병변의 경피적 흡인 생검술 (PCNA): 재흡인 혹은 재생검 (두 번째 PCNA)의 평가[1]

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목적: 첫 경피적 흡인 생검술(PCNA)에서 병리학적 결론이 나지 않은 경우의 폐병변에 대한 재흡인, 재생검의 결과와 유용성을 알아보고자 하였다.
대상과 방법: 350명의 환자에서 CT나 투시 유도하에 시행된 364예의 PCNA (350예의 첫 PCNA와 14예의 두 번째 PCNA)를 대상으로 하였는데 298예는 20G 자동생검총을, 66예는 20G 흡인침을 이용하였다. 처음과 두 번째 PCNA에서의 병리학적 일치도와 두 번째 PCNA의 원인을 알아보고 합병증의 종류와 빈도에 대하여 알아보았다.
결과: 두 번째 PCNA의 빈도는 4.0% (14/350)였다. 두 번째 PCNA의 원인은 첫 PCNA에서 임상적 영상의학적 소견을 고려할 때 예기치 않은 병리학적 결과가 나온 7예와 병리학적으로 결론을 내리지 못한 7예였다. 첫 PCNA에서 예기치 않은 병리학적 결과가 나온 7예중 5예는 두 번째 PCNA에서 첫 PCNA와 같은 결과가 나왔다. 첫 PCNA에서 비전형 세포, 불충분한 세포, 괴사 등의 병리학적 결론을 내리지 못한 7예중 6예는 두 번째 PCNA에서 악성이었다. 처음과 두 번째 PCNA에서 전체적인 합병증의 빈도는 14.0% (51/364)였다.
결론: 첫 PCNA에서 병리학적 결론이 나지 않을 경우의 폐병변에 대해 두 번째 PCNA는 정확한 진단에 도움을 줄 수 있을 것이다.