Percutaneous Transthoracic Needle Aspiration Biopsy of Localized Lung Lesions Under Fluoroscopic or Ultrasound Guidance

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Abstract

Diagnostic percutaneous transthoracic needle aspiration biopsy (TNAB) under fluoroscopic or ultrasound guidance was performed in 195 patients with peripheral lung lesions. Final diagnosis was confirmed in 178 cases. These consisted of 150 cases of malignant and 28 cases of non-malignant lung lesions. Most cases of the latter belonged to the infectious group. Sensitivity of TNAB in the diagnosis of malignancy and lung infections were 92.0 per cent and 62.5 per cent respectively. Needles with different sizes were used and the needle number 18G was found to obtain both cytological and histological samples and showed the highest sensitivity. Among cases that TNAB provided both types of samples, histology alone showed higher sensitivity in diagnosis than cytology alone. However, by cytological examination, malignant tumors could be interpreted for definite cell type in more cases than by histology. To reach the highest diagnostic yield, the results of both samples should be combined. We also found that the aspirated samples with solid or semisolid features were more diagnostic than those with other features. Pneumothorax, the most common complication of the TNAB procedure, was found in only 2.0 per cent of our series.

Key word : Needle Aspiration, Transthoracic, Lung Mass

The incidence of lung cancer is increasing in most countries as well as Thailand. The good outcome depends on early diagnosis and treatment. The best diagnostic method should be rapid, simple, highly accurate, non-invasive and produce high diagnostic yield in early lung cancer detection. Several procedures were used as routine diagnostic methods of lung cancer, for example sputum exami-

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nation for cytology; bronchoscopic examination with bronchial washing, brushing, biopsy and transbronchial biopsy. Among the methods used now adays, percutaneous transthoracic needle aspiration biopsy (TNAB) is one of the most useful procedures for it is simple, non-invasive, produces high diagnostic yield in lung cancer detection and causes low complications[1-3].

TNAB should be performed with the aid of roentgenographic imaging guidance to locate the exact site of the lung lesion and to demonstrate that the tip of the needle is in the lesion[4-7]. It is better to perform TNAB under the guidance of computed tomography (CT) than other imaging guidance especially in small lesions[5]. However, in hospitals with no CT facility, it could also be done under the guidance of fluoroscopy (Flu) or ultrasound (US). However, US guidance could be used only if peripheral mass was attached to the chest wall.

This study dealt with patients having TNAB of the lung lesion performed under Flu or US guidance. The purpose of this study was to describe the results of TNAB of those lung lesions and to discuss the clinical utility of this diagnostic procedure which authors have had experience with for the past eight years.

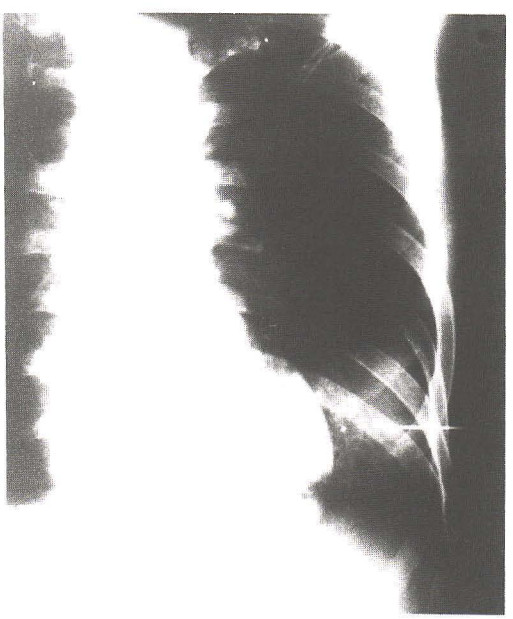

Fig. 1 Image from fluoroscopy (antero-posterior view) reveals the tip of the needle in the left lower lobe mass.

MATERIAL AND METHOD

A prospective study was undertaken of radiologically guided TNAB of the lung performed at the Central Chest Hospital from April 1988 to May 1996. During the period of April 1988 to July 1991, single plane fluoroscopy was used to locate the lesion and the tip of the needle (Fig. 1). From August 1991 to May 1996, most of the procedures were carried out under US guidance especially in lesions attached to the chest wall. The patients included in the study had peripheral lung lesions and could not be diagnosed cytologically or histologically by other previous procedures of specimen collection such as sputum examination, bronchoscopy and bronchial biopsy, etc. In each case, the lesion might be attached to the chest wall or located less than 2 cm. from the chest wall, single or multiple, unilateral or bilateral. When there were multiple lesions in the same case, TNAB was performed at the biggest or shallowest site. The patients with small central lesions near the heart and great vessels and those with suspected lesions of vascular origin were excluded.

The study was done in two phases using needles with different sizes. In phase 1, only one of the three needles with different sizes was randomly used in each patient: fine needle number 24G, SURECUT® needle (modified menginii needle) number 18G (1.2) or SURECUT® needle number 17G (1.4) with length of 10 cm. The fine needle number 24 G provided only cytological sample while the other two SURECUT® needles provided both cytological and histological samples. In phase 2, two needles with different sizes were used in the same patient: fine needle number 24G together with SURECUT® needle number 18G or fine needle number 24G together with SURECUT® needle number 17G.

The aspirated samples were smeared onto glass slides, fixed in 95 per cent ethyl alcohol and sent to the cytology laboratory. The biopsied tissue obtained from the procedure was fixed in 10 per cent formalin and subsequently proceeded for histological examination. The results of the biopsies were classified as positive for malignancy on the basis of presence of malignant cells in the samples. Definite cell type or tumor differentiation was classified in each case depending upon cytological or histological findings. In non-malignant lung lesions, a positive result meant that the cytological or histological sample obtained from TNAB showed suffi-

cient features to be interpreted correctly. In suspected cases of tuberculosis or other infections, the specimen was proceeded for Gram stain, stain for acid-fast-bacilli, culture for bacteria, fungi and tuberculosis. In non-TB cases, positive results meant specific organism or if inflammation were found. In TB cases, positive results meant acid-fast bacilli or caseous granulomas were found in specimens. Final diagnosis of lung infection also included cases which improved after treatment with antimicrobial agents.

Fluoroscopy of the chest or chest X-ray was done 30 minutes after the procedure in every case to assess complications such as pneumothorax and pulmonary hemorrhage.

RESULTS

TNAB was performed on 195 cases. Ages ranged from 16-81 years and the mean age was 54 years. One hundred and fifty-one patients were male and 44 were female. The sizes of the lesions varied from 1-10 cm with an average size of 4.2 cm. Eighty-eight lesions (45.1%) were smaller than or equal to 3 cm. while 107 lesions (54.9%) were larger than 3 cm. The most common location after TNAB was the right upper lobe (Table 1). The procedure was performed under Flu guidance in 81 cases, under US guidance in 110 cases, with blind aspiration biopsy in 3 cases and by direct puncture of the lesion in the operating room in 1 case.

Final diagnoses were confirmed in 178 cases. Among these cases, 150 were malignant and TNAB samples were positive in 138 cases (92.0%) or 131 from 142 cases (92.3%) of carcinoma and 7 from 8 cases (87.5%) of sarcoma (Table 2). The lesions were smaller or equal to 3 cm in 49 cases while larger than 3 cm in 101 cases. TNAB samples were positive in 43 cases (87.8%) and 95 cases (94.0%) of those two groups of lesions respectively. The other 12 malignant cases with negative results from TNAB had lesions with a mean size of 4.8 cm. Pathologically, the samples from those cases revealed necrotic tissue, mucinous material, inflammatory process and inadequate specimen.

Final diagnoses of non-malignant lung lesions were made in 28 cases. Among these cases, 24 were infectious process: 10 cases of tuberculosis and 14 cases of non-tuberculosis. TNAB were positive in 15 from 24 cases (62.5%) of infectious process or 5 from 10 cases (50.0%) of tuberculosis and 10 from 14 cases (71.4%) of non-tuberculosis. Specific organisms were found in 4 from 14 cases of non-tuberculosis. They were 2 cases of Aspergillosis, 1 case of Actinomycosis and 1 case of Echinococcosis. TNAB samples from 6 cases of non-tuberculosis revealed chronic inflammatory process. The remaining cases of non-malignant lung lesions were 2 cases of extramedullary hematopoietic lung nodule with negative result, 1 case of benign fibrous histiocytoma with positive result and 1 case of hematoma with positive result. (Table 3)

Comparing the cytological results of TNAB using needles with different sizes, those using needle number 24G were positive in 53 from 72 cases (73.6%) while those using needle number 18G and 17G were positive in 65 from 78 cases (83.3%) and 29 from 51 cases (56.9%) respectively. The needle number 18G produced significantly higher positive results than number 17G ($p<0.005$). (Table 4)

Table 1. Location of the lesion.

Location	Right	Left
Upper	67	51
Middle	5	2 (lingular)
Lower	39	25

(Six cases were not analyzed.)

Table 2. Yield of TNAB in malignant lung lesions.

	TNAB +ve	TNAB -ve	Total
Carcinoma	131 (92.3%)	11 (7.7%)	142 (100%)
Sarcoma	7 (87.5%)	1 (12.5%)	8 (100%)
Total	138 (92.0%)	12 (8.0%)	150 (100%)

Table 3. Yield of TNAB in non-malignant lung lesions.

	TNAB +ve	TNAB -ve	Total
Infection	15 (62.5%)	9 (37.5%)	24 (100%)
- TB	5 (50.0%)	5 (50.0%)	10 (100%)
- Non-TB	10 (71.4%)	4 (28.6%)	14 (100%)
Non-infection	2 (50.0%)	2 (50.0%)	4 (100%)
Total	17 (60.7%)	11 (39.3%)	28 (100%)

Table 4. Cytological result among needles with different sizes.

Needle No.	Cytology +ve	Cytology -ve	Total
24G	53 (73.6%)	19 (26.4%)	72 (100%)
18G	65 (83.3%)	13 (16.7%)	78 (100%)
17G	29 (56.9%)	22 (43.1%)	51 (100%)

Table 5. Cytological result using 2 needles with different sizes in the same case.

	24G +ve	24G -ve	Total
17G or 18G +ve	38 (67.9%)	13 (23.2%)	51 (91.1%)
17G or 18G -ve	0	5 (8.9%)	5 (8.9%)
Total	38 (67.9%)	18 (32.1%)	56 (100%)

Table 6. Histological result between 2 SURECUT® needles with different sizes.

Needle No.	Histology +ve	Histology -ve	Total
18G	71 (94.7%)	4 (5.3%)	75 (100%)
17G	47 (90.4%)	5 (9.6%)	52 (100%)

Table 7. Cytological and histological results in the same case.

	Cytology +ve	Cytology -ve	Total
Histology +ve	86 (70.5%)	26 (21.3%)	112 (91.8%)
Histology -ve	2 (1.6%)	8 (6.6%)	10 (8.2%)
Total	88 (72.1%)	34 (27.9%)	122 (100%)

Table 8. Interpretation of cytology and histology in malignant cases.

	Cytology	Histology
Malignant tumor cells	4 (6.0%)	2 (3.2%)
Carcinoma or sarcoma	6 (9.0%)	37 (59.7%)
Definite cell type	57 (85.0%)	23 (37.1%)
Total	67 (100%)	62 (100%)

Table 9. Histological results among different features of aspirated samples.

Features	Histology +ve	Histology -ve	Total
Solid	65 (95.6%)	3 (4.4%)	68 (100%)
Semisolid	49 (98.0%)	1 (2.0%)	50 (100%)
Bloody fluid	14 (73.7%)	5 (26.3%)	19 (100%)
Tiny tissue	4 (57.1%)	3 (42.9%)	7 (100%)

Among 56 cases on whom had been performed TNAB using both needles (number 24G together with 18G or 24G together with 17G) and the samples were examined cytologically, those from needle number 24 G were positive in 38 cases (67.9%) while those from needle number 18G or 17G were positive in 51 cases (91.1%). TNAB produced positive results of both samples in 38 cases (67.9 %) and negative results of both samples in 5 cases (8.9%). (Table 5)

The histological results of TNAB using SURECUT® needles number 18G and 17G in different cases showed no significant difference ($p > 0.05$). Those using needle number 18G were positive in 71 from 75 cases (94.7%) while those using needle number 17G were positive in 47 from 52 cases (90.4%). (Table 6)

Among 122 cases on whom had been performed TNAB and the samples were examined both cytologically and histologically, cytological samples were positive in 88 cases (72.1%) while histological samples were positive in 112 cases (91.8%). TNAB produced positive results in both cytological and histological samples in 86 cases (70.5%) and negative results in both samples in 8 cases (6.6%). (Table 7)

Comparing the ability of being interpreted for tumor differentiation between cytological and histological samples obtained from TNAB, 67 cytological samples and 62 histological samples with positive results for malignancy were analyzed. From the total cytological samples, 57 (85.0%) showed definite cell type of tumor, 6 (9.0%) showed either carcinomatous or sarcomatous differentiation with no definite cell type and the other 4 (6.0%) showed only malignant tumor cells with no ability of being interpreted for tumor differentiation. From the total histological samples, only 23 (37.1%) showed defi-

nite cell type of tumor, 37 (59.7%) showed either carcinomatous or sarcomatous differentiation with no definite cell type and the other 2 (3.2%) showed only malignant undifferentiated tumor cells. Interpretation of definite cell type of tumor could be done in 85.0 per cent of cytological samples which was significantly higher than that in histological samples (37.0%) ($p<0.005$) (Table 8).

Comparing the histological results of TNAB among different features of the aspirated samples, 65 from 68 solid tissue samples (95.6%) were positive while 49 from 50 semisolid samples (98.0%), 14 from 19 bloody fluid samples (73.7%) and 4 from 7 tiny tissue samples (57.1%) were positive. (Table 9)

Pneumothorax was found in 4 cases (2.0%). Only one had more than 10 per cent pneumothorax requiring intercostal closed chest drainage for treatment. The other 3 asymptomatic cases had less than 10 per cent pneumothorax and recovered after conservative treatment. Severe pain was found in 3 cases (1.5%). All these cases had lesions smaller than 3 cm and were negative by TNAB.

DISCUSSION

Localized lung lesions especially at periphery are still problems for diagnosis. The lesions seem to be malignant in 10-68 per cent of the cases[8]. TNAB is a proper diagnostic method and can lead more of these cases to definite diagnosis than any other non-invasive procedures. For example, sensitivity of fiberoptic bronchoscopy in diagnosis of peripheral lung tumor was about 60-67 per cent[9,10] while that of TNAB was 82.0-98.6 per cent[3,11]. In most series, specificity of TNAB in diagnosis of malignancy was up to 100 per cent[3, 12-14] and sensitivity of TNAB depended on the size of the lesion[15,16]. From our study, sensitivity of TNAB in the diagnosis of peripheral lung cancers was 92.0 per cent. There was no significant difference of positive results between lesions larger than 3 cm and those of smaller size ($p>0.05$). False positive rate was 0 per cent and false negative rate was 8.0 per cent. In non-malignant lung lesions, most of the cases were in the infectious process. Sensitivity of TNAB in diagnosis of lung infection in our series was 62.5 per cent which was remarkably lower than that of malignancy. However, this procedure could reduce unnecessary thoracotomy in cases of lung infection.

There has been no comparison between the results of TNAB using needles with different sizes in the same patient before. Our study showed that the cytological samples obtained from TNAB using needle number 18G were more diagnostic than those of needle number 24G. The needle with larger size than number 18G did not produce better diagnostic results by cytology. The histological samples obtained from TNAB using needle number 18G were positive in 94.7 per cent of cases which were higher than those of needle number 17G. Among cases that TNAB provided both cytological and histological samples, the sensitivity of histology in diagnosis of these cases was 91.8 per cent while that of cytology was 72.1 per cent. So histology alone showed higher sensitivity than cytology. The combination of both results increased sensitivity of TNAB up to 93.4 per cent. We found that needle number 18G was the most proper one for TNAB in our study because it provided both cytological and histological samples and gave the highest sensitivity

Interpretation of definite cell type of tumor could be done in 85.0 per cent of cytological samples which was much higher than that 37.1 per cent of histological samples. The reason was that the methods of interpretation were different. Satisfactory cytological samples always showed sufficient cytoplasmic details to specify tumor cell type while biopsied tissue on the histological slide always showed only a limited number of malignant cells with difficulty to specify cell type. In order to reach the highest diagnostic yield in terms of sensitivity and specificity, the results of both cytology and histology should be combined.

We found that the TNAB samples for histology with solid or semisolid features were more diagnostic than those with features of bloody fluid or tiny tissue.

Pneumothorax and pulmonary hemorrhage are the usual complications of this procedure occurring in 6-41 per cent in various series[3]. Some conditions such as chronic obstructive lung disease, the patients' age and depth of the lung lesion have been shown to affect the likelihood of pneumothorax. In order to have a safer selection of out patients for TNAB, pulmonary function test and chest radiograph were used in some series to predict severity of pulmonary emphysema and avoid the risk of

patients developing pneumothorax[17-20]. Our study revealed only 2.0 per cent of this complication which was very low and there was no case of pulmonary hemorrhage. The reason was that most cases in our series had lesions attached to the chest wall. TNAB performed in such lesions injured less lung tissue than that performed in deeper central lesions.

The major advantage of TNAB, besides its accuracy, is its low cost requiring no expensive sophisticated equipment except fluoroscopy or ultrasound which is widely available in medium to large sized hospitals. This procedure is not so difficult to perform, requiring no special patient preparation and can be done with safety in out patients with a very low rate of complications[21,22].

SUMMARY

TNAB is an excellent method for diagnosis of peripheral localized lung lesions. From our study, its sensitivity in diagnosis of lung cancer was 92.0 per cent. Pneumothorax was found in only 2.0 per cent of cases. Both the fine needle number 24G and needle number18G (1.2) produced high diagnostic yield in malignancy. We preferred the latter because it provided both cytological and histological samples that produced the highest sensitivity in combination and specified the tumor cell type.

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การวินิจฉัยก้อนในปอดด้วยวิธีใช้เข็มเจาะดูดผ่านผนังทรวงอกโดยใช้เครื่องฟลูโรสโคปหรืออัลตราซาวด์บอกทิศทาง

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จากการใช้เข็มเจาะผ่านผนังทรวงอกและดูดตัดชิ้นเนื้อเพื่อวินิจฉัยก้อนในปอดของผู้ป่วย รวมทั้งสิ้น 195 ราย โดยใช้เครื่องฟลูโรสโคปและอัลตราซาวด์บอกทิศทาง ได้การวินิจฉัยโรคที่แน่นอนในผู้ป่วย 178 ราย เป็นมะเร็งปอด 150 ราย เป็นโรคที่มิใช่มะเร็ง 28 รายซึ่งส่วนใหญ่เป็นการอักเสบติดเชื้อ การตรวจวิธีนี้ให้ผลบวกถึง 92.0% ในกลุ่มมะเร็ง และ 62.5% ในกลุ่มการอักเสบติดเชื้อ รายงานนี้ได้เปรียบเทียบผลจากการใช้เข็มขนาดต่างๆกัน พบว่าเข็ม เบอร์ 18 ให้เนื้อเยื่อซึ่งส่งตรวจได้ทั้งทางเซลล์วิทยาและจุลพยาธิวิทยาและให้ผลบวกสูงกว่าเข็มขนาดอื่น การตรวจเนื้อเยื่อทางจุลพยาธิวิทยาอย่างเดียวให้ผลบวกมากกว่าเซลล์วิทยาอย่างเดียว แต่ในทางตรงข้ามการตรวจทางเซลล์วิทยาช่วยแยกชนิดของมะเร็งได้ดีกว่าจุลพยาธิวิทยา ลักษณะเนื้อเยื่อที่เป็นแท่งของแข็งหรือกึ่งของแข็งให้ผลบวกมะเร็งมากกว่าเนื้อเยื่อแบบอื่น ภาวะแทรกซ้อนจากการตรวจคือลมรั่วในช่องเยื่อหุ้มปอดพบเพียง 2.0% เท่านั้น

คำสำคัญ : เข็มเจาะดูด, ผ่านผนังทรวงอก, ก้อนในปอด

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