Efficacy of Computed Tomography-Guided Fine Needle Aspiration in Diagnosis of Lung Mass by Trained Internists

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Objective: *To determine the efficacy of Computed Tomography (CT)-guided fine needle Aspiration (FNA) in diagnosis of lung masses by trained internists including factors affecting the adequacy of specimens and occurrence rate of complications.*
Material and Method: *96 patients, aged 25-86 years old underwent CT-guided FNA of thoracic lesions by internists who had been trained for this procedure at the Central Chest Institute of Thailand during March 2007-2008. Demographic data, procedure success and adequacy of specimens for cytological evaluation were summarized including other factors-size and depth of lesion, condition of emphysema and complications of procedure.*
Results: *Success of procedure was 97.9%. Adequacy of specimen was 94.7%. Occurrence of pneumothorax was 19 out of 96 cases (19.8%). And 1 case needed to insert inter costal drainage (1.1%). Hemoptysis after procedure was 1.06%. Besides, larger than 3 cm in diameter of lesion presented satisfied specimens more than that of the smaller one. Pneumothorax is the most common complication, which revealed a statistically significant with emphysema around mass.*
Conclusion: *FNA is an effective and useful tool in diagnosis of pulmonary lesions for trained internists. Success of procedure and adequacy of specimen for cytological evaluation are considerably high and low complications occurred.*

Keywords: *Lung mass, CT guided FNA*

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Lung cancer is a major cause of death in the Thai population. Treatment of lung cancer depends on stage of disease, so accurate diagnosis at the early stage is neccesary.

There are 3 main methods for making diagnosis of the lung cancer such as bronchoscopy, transthoracic needle aspiration biopsy and surgery.

Bronchoscopy with tissue biopsy, semi invasive technique, performed by a pulmonologist used in case of intraluminal or peribronchial mass. The advantage of bronchoscopy is getting tissue for histological diagnosis and can also determine the spread of cancer to the carina; however respiratory failure may occur in about 1-2%[1].

Surgical biopsy done by the surgeon is the best method for tissue diagnosis but it is invasive and high risk technique.

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Fine needle aspiration (FNA) is a minimally invasive outpatient technique, accepted as a safe and accurate method for cytological diagnosis. The most common complication is pneumothorax which is usually a small amount. Only 1.6-3% of cases need inter costal drainage (ICD)[2-4].

In the Central Chest Institute of Thailand (CCIT), patients were refered to get definite diagnosis of lung mass from the other hospitals on average 100-120 cases per month, about 60-70% refered from the countryside and in the waiting queue approximately 1-2 weeks for FNA. After getting the diagnosis, there are about 20-30% of patients who will be refered back without any treatment due to late stage cancer, patient ' s requirement to treat near hometown, etc.

If the diagnosis of lung mass can be done in their hometown hospital, it will save cost and the patient could have early treatment.

Therefore the objective is to encourage making of FNA by trained internists who can effectively take care of complications. Moreover, motivation of FNA can be supported by evaluating the efficacy of CT guided FNA in diagnosis of lung mass by trained

internist.

Objective

1. To study the efficacy of FNA done by the trained internists in the diagnosis of lung mass.

2. To determine the factors affecting the adequacy of specimens.

3. To determine the rate of complications.

Material and Method

A descriptive study was carried out in all patients in CCIT with a mass lesion in the lung.

All cases had been confirmed by Chest x-ray (CXR) or CT Chest and were diagnosed by FNA method at the Department of Radiology during March 2007 until March 2008.

The present study was approved by the local institutional review boards. All patients provided written informed consent to the procedure.

The procedure was performed by two internists who had been trained in the procedure with a radiologist. Use of 21-gauge spinal needle punctures through the chest wall navigating by use of CT modeled Siemens Somatom plus 40 (FNA under CT guidance).

The exclusion criteria are as below

1. Patients who have a high possibility of complications occurred from the procedure, such as malignant hypertension, vascular mass, history of unilateral pneumonectomy.

2. Patients who have a high possibility to fail the procedure, such as dyspnea, uncooperative patient or pneumothorax before the procedure is performed.

The aspiration procedure was repeated if the amount of material obtained appeared inadequate on visual inspection. After that, the sample was smeared on slides and fixed in 95% alcohol for cytological evaluation.

In the suspected case of pulmonary tuberculosis, bacterial or fungal infection, the specimen was smeared on slides for acid fast bacilli stain, gram stain or culture, respectively.

For data collection, patient's general data will be recorded such as size and location of the mass, lung penetration depth, puncture of needle through fissure or surrounding emphysema.

Success of the procedure will be confirmed by CT image which displays needle tip inside the lesion.

Adequacy of the collected specimens were recorded by a cytopathologist, indicated "Satisfied Specimen" will be recorded according to the[5],

- Specific benign lesions: include all benign neoplasms, inflammatory processes and infectious processes.

- Atypical cells present, probably benign: Specimens that show an epithelial or mesenchymal component with nuclear atypia, represent a reactive or reparative change.

- Atypical, suspicious for malignancy: Specimens that show atypical feature thought by cytopathologist to have a significant risk of presenting a malignant neoplasm.

- Malignancy present: All specimens in which a definitive diagnosis of malignancy can be made.

- Infection present from culture or stained slide.

In case of atypical cell presents, inflammation, negative for malignancy and unsatisfied specimen from FNA, symptoms and diagnosis would be tracked by observing the medical record to get the final diagnosis.

Complications from the procedure will also be recorded such as pneumothorax, hemoptysis. Severity of complications were divided as below,

Major complication

1. Outpatient-Admission is required for treatment due to complication.

2. Inpatient-Treatment is required due to complication with longer stay in hospital.

3. Side effect causing permanent complications or death.

Minor complication

1. Complication that does not require any treatment.

Statistical analysis

Descriptive data in term of means, standard deviation (SD), frequency and percentage were used for basic information and efficacy of the procedure. Pearson Chi-square and Fisher's exact test were used to determine the relationship between the adequacy of the specimens and size of mass, location of mass and depth of mass from skin. The relationship between the occurrence of pneumothorax and puncture through the fissure, surrounding emphysema, depth of the mass, distance of needle passed through the lung and the size of the mass would be determined as well. The statistical significance was set at $p < 0.05$.

Results

Demographic data of 94 patients with lung

mass lesions on CT scan is given in Table 1. There were more males than females approximately 1.8:1. The lesion diameters were between 0.9-11 cm. Distance of the lesion from pleural surface was 0-5 cm. Depth of mass from skin was 1.5-9 cm. Characteristics of mass between male and female was not significantly different. Location of mass lesion was generally found in the right lung more than left lung and found in the upper part more than lower part.

Success of procedure was 94 out of 96 patients (97.9%). Two patients failed the procedure due to pneumothorax.

The specimens were satisfied for evaluation in 89 out of 94 patients (94.7%), the remained 5 patients had unsatisfied specimens and final diagnosis was benign lesion. Of the 89 patients, 54 patients had a malignant disease, 2 had atypical cell (1 was TB and 1 was loss follow-up), 9 have been infected, 8 had inflammation and 16 defined as negative for malignancy. Final diagnosis of the later group was presented as follow.

1. Malignancy 2 cases.

2. Non-malignancy 9 cases, classified as 1 of chronic inflammation, 2 of infection, 1 of TB and 5 of benign lesion.

3. Loss to follow-up 5 cases.

In addition, one patient with chronic inflammation from FNA, but the final determination was malignant process.

For sensitivity's view point of the FNA separated by histopathology excluding 6 cases of loss to follow-up patient. FNA of malignancy showed positive results in 54 out of 57 cases (94.7%). Of infection/inflammation/TB FNA results were positive in 17 cases of 22 (77.3%).

All of 10 patients with benign tumor could not be diagnosed by FNA.

From Table 2, Satisfied specimens presented with larger than 3 cm lesion diameter more than that of smaller than or equal to 3 cm ones, statistically significant ($p = 0.044$).

Moreover, lesions that were located near the skin within 5 cm likely presented as satisfied specimen more than deeper ones.

The lesions that were attached to pleura, 100% could be diagnosed by FNA as shown in Table 3.

From this presentation, a lesion that exceeded 3 cm in diameter presented significantly malignancy more than benign or infection ($p < 0.05$) as shown in Table 4, which excluded 6 cases of loss to follow-up patients.

Of the 54 patients with malignancy from FNA, the most found cell type was adenocarcinoma in 22 out of 54 patients (40.7%). Second one was non-small cell carcinoma which cell type could not definitely be determined (no data presented).

Complication was found in 20 out of 96 patients (20.8%), the most common complication was

Table 1. Demographic data

Variable	Male (n = 60) Mean ± SD	Female (n = 34) Mean ± SD	Total (n = 94)
Age (years) (Range)	63.2 ± 13.4 (25-81)	56.6 ± 11.7 (27-86)	60.8 ± 13.12 (25-86)
Size of mass (cm) (Range)	5 ± 2.3 (1.7-11)	3.9 ± 1.7 (0.9-7)	4.6 ± 2.2 (0.9-11)
Depth of mass from skin (cm) (Range)	4.4 ± 1.6 (1.5-8.2)	4.7 ± 1.7 (1.5-9)	4.5 ± 1.6 (1.5-9)
Depth of mass from pleural surface (cm) (Range)	0.9 ± 1.2 (0-5)	1.4 ± 1.3 (0-5)	1.1 ± 1.2 (0-5)

Table 2. Correlation of lesion size with adequacy of specimen

Lesion size (diameter)	Specimens		Total
	Satisfied	Unsatisfied	
≤ 3 cm	28	4	32
> 3 cm	61	1	62
Total	89	5	94

p-value = 0.044

pneumothorax, 19 out of 20 patients (19.8%) which were major complication in 15.8% of total pneumothorax. One of them needed ICD (5.3% of total pneumothorax and 1.1% of total patients).

Furthermore, there were 30 patients with lesion attached to chest wall that had no pneumothorax. Therefore, occurrence rate of pneumothorax in case of needle traverse lung parenchyma was 25.8% with p = 0.042.

For patients with surrounding emphysema, prevalence rate of pneumothorax increases, statistically significant (p = 0.006) and Odds Ratio was 6 times (95% Cl, 1.5-23.9) as given in Table 5.

Possibility of pneumothorax occurred in the patients with lung lesion smaller than or equal to 3 cm of lesion size was more than that of bigger ones (p = 0.003) as given in Table 6.

In cases of the needle passing through the fissure, there was a chance of pneumothorax in about 50% (3 cases of 6 cases), were statistically not significant (p = 0.052).

The risk of pneumothorax was also not correlated with increasing distance of the lesion from the pleural surface or the depth of the mass from the

Table 3. Correlation of satisfied specimen with depth of lesion from pleura

	Attach to pleura	Depth from pleura	Total
Satisfied specimen	30	59	89
Unsatisfied specimen	0	5	5
Total	30	64	94

p-value > 0.05

Table 4. Correlation of lesion size with cytological evaluation

Lesion Size (Diameter)	Cancer	Inflection, Inflammation, Other tumors	Total
≤ 3 cm	45	16	61
> 3 cm	12	15	27
Total	57	31	88

p-value < 0.05

Table 5. Correlation of surrounding emphysema and pneumothorax

Pneumothorax Emphysema	Pneumothorax	No pneumothorax	Total
Emphysema	5	5	10
No emphysema	12	72	84
Total	17	77	94

p-value = 0.006

Table 6. Correlation of lesion size with pneumothorax

Pneumothorax Lesion Size (Diameter)	Pneumothorax	No pneumothorax	Total
≤ 3 cm	11	21	32
> 3 cm	6	56	62
Total	17	77	94

p-value = 0.003

skin.

For another complication, self-resolving hemoptysis after or during the procedure revealed only 1 case (1.06%) of all patients.

Discussion

From the results of the present study, the rate of procedural success by internists who had been trained basic of procedure is as high as 97.9%. Satisfied specimen is 94.7%, which corresponding to other studies of FNA by the radiologist as about 90%-97%[2,4].

Regarding the above results, it can be confirmed that FNA can carry out in the diagnosis of lung mass by trained internists, especially pulmonologists. This is one of alternative diagnostic methods for a lesion that is unreachable from bronchoscopy.

Satisfied specimen for cytologic evaluation found in lesions exceeding 3 cm in diameter or the lesion close to the pleural surface more than that of smaller or deeper ones.

As considered for sensitivity of FNA diagnosis, high sensitivity, 97.4% is found in the malignancy group. Sensitivity is less in the infection/inflammation groups as 77.3% and that benign tumor could not be diagnosed in the present study may be due to small sample sizes. However, the result is still in line with other FNA related studies which mention sensitivity for diagnosis of malignancy among more than 90%[6] higher than the benign tumor/infection/inflammation varies from 19.7-68%[7].

The most common complication of FNA is pneumothorax. According to the authors of several articles, the prevalence of pneumothorax ranges from 27-41.6% and 4-18% for ICD required[4,6,8,9]. This meets the results of the present study that a small amount of pneumothorax was found in 19.8%. And, only one patient needed to use ICD (5.3% of total pneumothorax).

Influence factors that cause high possibility of pneumothorax are patients with emphysema located in needle puncture direction[9]. Moreover, FNA of the mass smaller than or equal to 3 cm has more chance of pneumothorax than the larger one[9].

Needle penetration through fissure has no relation with pneumothorax. It is different from other studies[10,11], which mentioned that they had had a relationship with each other.

The prevalence of pneumothorax did not increase with increasing distance of the lesion from the pleural surface the same as the present study of Cox JE et al[9].

As mentioned above, there are various factors causing pneumothorax. This causes various prevalence rates of pneumothorax and might be different from several studies. Each factor is recommended to study in detail in the future.

Conclusion

Success rate of FNA procedure that was carried out by trained internists including adequacy of specimen for cytological evaluation is considerably high and fewer complications occurred. As a result, FNA is one of alternative methods for internist aparts from bronchoscopy for lung mass diagnosis. Its diagnostic sensitivity is high, especially in case of suspected lung cancer.

The factors that may affect the adequacy of the specimens are the size of the lesion larger than 3 cm and location closed to the chest wall.

In cases with pulmonary emphysema along the needle direction and the mass diameter of less than or equal to 3 cm, the FNA procedure should be avoided or performed carefully because of increased risk of pneumothorax.

Potential conflicts of interest

None.

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ความสัมฤทธิ์ผลของการใช้เข็มดูดเจาะผ่านผนังทรวงอกในการวินิจฉัยก้อนในปอดโดยใช้เอกซเรย์คอมพิวเตอร์นำทาง โดยอายุรแพทย์ที่ผ่านการอบรม

ชมพูนุท วิจิตรสงวน, พงษ์ลดา สุพรรณชาติ, สมบูรณ์ นิคมประศาสน์

วัตถุประสงค์*: เพื่อศึกษาสัมฤทธิ์ผลของการใช้เข็มดูดเจาะผ่านผนังทรวงอกในการวินิจฉัยก้อนในปอด โดยใช้เอกซเรย์คอมพิวเตอร์นำทางเพื่อวินิจฉัยก้อนในปอด โดยอายุรแพทย์ที่ผ่านการอบรมรวมถึงปัจจัยที่มีผลต่อความพอเพียงของสิ่งส่งตรวจเพื่อวินิจฉัยทางเซลล์วิทยา และอัตราการเกิดภาวะแทรกซ้อน*

วัสดุและวิธีการ*: ผู้ป่วยทั้งหมด 96 ราย ได้รับการทำ FNA โดยใช้เอกซเรย์คอมพิวเตอร์นำทางที่สถาบันโรคทรวงอก ระหว่างเดือนมีนาคม พ.ศ. 2551-2552 โดยอายุรแพทย์เก็บข้อมูลปัจจัยพื้นฐาน ความสำเร็จของหัตถการและความพอเพียงของสิ่งส่งตรวจเพื่อประเมินสัมฤทธิ์ผลของ FNA รวมถึงตัวแปรอื่นๆ ได้แก่ขนาดและความลึกของก้อน ภาวะถุงลมโป่งพองรอบก้อน อัตราการเกิดภาวะแทรกซ้อนจากการทำหัตถการ*

ผลการศึกษา*: ความสำเร็จของหัตถการ 97.9% ความพอเพียงของสิ่งส่งตรวจ 94.7% อัตราการเกิดลมรั่วในโพรงเยื่อหุ้มปอด 19 ราย จาก 96 ราย คิดเป็น 19.8% และต้องใส่ท่อเพื่อระบายลมออก 1 ราย (1.1% ของผู้ป่วยทั้งหมด) พบว่ามีภาวะไอเลือดออกหลังทำหัตถการเพียง 1.06% นอกจากนี้ยังพบว่าความพอเพียงของสิ่งส่งตรวจมีความสัมพันธ์กับขนาดของก้อนโดยก้อนที่มีขนาดเส้นผ่าศูนย์กลางใหญ่กว่าหรือเท่ากับ 3 เซนติเมตร จะมีโอกาสได้สิ่งส่งตรวจพอเพียงสูงกว่าก้อนที่มีขนาดเล็ก สำหรับอัตราการเกิดลมรั่วในโพรงเยื่อหุ้มปอดจะพบสูงขึ้นอย่างมีนัยสำคัญทางสถิติในผู้ป่วยที่มีภาวะถุงลมโป่งพองรอบก้อน*

สรุป*: การเจาะดูดก้อนในปอดโดยใช้เอกซเรย์คอมพิวเตอร์นำทาง เป็นอีกทางเลือกหนึ่งในการวินิจฉัยก้อนในปอดโดยอายุรแพทย์ เนื่องจากสามารถทำได้เอง โดยมีอัตราความสำเร็จของหัตถการและได้สิ่งส่งตรวจพอเพียงในการวินิจฉัยสูง รวมถึงมีภาวะแทรกซ้อนที่รุนแรงต่ำ*