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Complications and associated risk factors of image guided biopsies of thoracic lesions

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ABSTRACT

Aims: The aim of this study is to determine the complications and associated risk factors of image guided percutaneus transthoracic biopsies of throracic lesions.

Methods: Fiftyseven patients who had ultrasound and computed tomography guided percutaneus fine needle and tru-cut biopsy between 2006-2008 was evaluated retrospectively. Sixty biopsies were performed. Sensitivity and accuarcy were calculated, and each patient was reviewed for complications, including pneumothorax and thoracic tube insertion.

Results: Fine needle aspiration and tru-cut biopsy results sensitivities and accuarcies were similar to those in literature. Pneumothorax were most frequent complication. Length of normal lung paranchyma between the lesion and pleura and repeated puncture of pleura more than two times were associated with increase rate of pneumothorax and the results were statisticaly significant.

Conclusion: Transhoracic computed tomography and ultrasound guided biopsies are found to be cheap, easly achievable and safe processes.

Keywords: Thorax, biopsy, trasthoracic, computed tomography, pneumothorax

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INTRODUCTION

Lung cancers have increased significantly in the 20th century and have become the most common cause of death from cancer in the world. Lung cancer, which was more common in smokers in the fifties, has increased its incidence in non-smokers today. While it was the most common cancer in men in the past, today the gap between men and women has closed rapidly.[1]

Since lung cancers usually cause symptoms in advanced stages, mortality rates are high. However, when detected at an early stage, 5-year survival rates increase significantly.[2] Although imaging methods have developed, it is not always possible to distinguish between benign and malignant lung lesions radiologically. Cytological or histopathological diagnosis is required in order to plan the necessary treatment and to prevent unnecessary thoracotomy. Today, the most commonly used method for this purpose is transthoracic needle biopsies.[3] Biopsies performed with radiological methods are preferred because of lower complication rates, cheapness and accessibility, and high diagnostic value. Computed tomography (CT) and ultrasonography (US) have long been used both as imaging techniques and as a guide to percutaneous interventions.[4]

The aim of this study is to determine the feasibility, complication rates, factors affecting complication rates, and diagnostic values of percutaneous transthoracic needle biopsies performed under US and CT guidance in thoracic masses.

METHODS

This study is an extension of radiology speciality thesis "Accuracy of image guided transthoracic biopsies of thoracic lesions." This study was carried out with the approval of the institutional board. Ethical approval was not obtained for that (2006-2008) period. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Fifty seven patients who had CT or US-guided transthoracic needle biyopsy in the radiology clinic of

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our institution between January 2006 and 2008 were evaluated retrospectively. Male patients between 32-80 years of age and female patients between 43-77 years of age, who had a nodule or mass with suspected malignancy in previous CT scan or chest X-ray were included in the study. Patients who had previous thoracic surgery were exculeded. Three patients whose results were non diagnosic or those needed spesific diagnosis had multiple biopsies. Total biopsy procedures avaluated was 60.

Bleeding parameters (PT, APTT, INR), hepatitis markers (Anti HCV, HbsAg) and anti-HIV antibodies were checked before the biopsy. Patients whose bleeding parameters were long enough to pose a risk for the biopsy procedure were referred to a pulmonologist and called for biopsy again at a later date after the bleeding parameters were corrected.

All the biopsies performed by same radiologist. 20G and 22G Chiba needles were used for fine needle aspiration biopsies. 18G and 20G semiautomatic needles were used for tru cut biopsies. The imaging method to be used was selected according to the location of the lesion in the thorax. After the biopsy procedure, patients were sent to the service after the control chest X-ray was taken. All patients were followed up in the chest diseases clinic. Control PA chest radiographs were taken at the first and sixth hours after the procedure. Patients who did not develop pneumothorax or other complications were discharged. Patients who developed mild pneumothorax were followed up for 24 hours. A chest tube was inserted in the patients whose pneumothorax increased or symptoms developed during the follow-up.

Patient data including age and sex were collected. Lesion parameters such as size, location were recorded. Data of biopsy procedure such as imaging method, needle type and size, lesions distance to pleura, number of pleural punctures, number of samplings, number of repeated biopsies were recorded. Post procedure complications encountered during and up to 24 hours from the biopsy were noted.

Biopsy results were classified as diagnostic and non diagnostic according to pathology report. Diagnostic results were classified as spesific and non spesific on the basis of hystological subtypes. If the patiend had two biopsies for same lesion, each biopsy was considered as a seperate procedure.

The differences between diagnostic and nondiagnostic procedures, effect of different variables on complication rates were analyzed using Student's t-test or Pearson's Chi-squared test in SPSS for Windows. A p value of less then 0.05 was determined to be significant

RESULTS

A total of 57 patients, 39 male and 18 female, were included in this study. The mean age of our patients was found to be 62.8 (32-84). After the first procedure, cyto-histopathological diagnosis could be made in 49 of the patients, and the diagnosis could not be made in eight patients. Biopsy was repeated for the second time in three patients who could not be diagnosed. With repeated biopsies, the number of procedures was 60.Six of the procedures were performed under US guidance and 54 were performed under CT guidance. The average long dimension of the lesions was 53 mm (1.5-15 mm), and the short demension average was 3.7 mm (1-12 mm). One of the lesions was an extrapulmonary mediastinal mass, and the pleura or lung parenchyma was not passed. Seventeen of the lesions were pleural based and the lung parenchyma was not passed. Different lengths of intact lung parenchyma were passed to reach the other 39 lesions. The mean length of intact lung parenchyma transpassed was 15 mm (10-120 mm).

Fine-needle aspiration biopsy (FNAB) was performed in 50 of the procedures, tru-cut core biopsy was performed in nine, and co axal tru-cut piece biopsy was performed in one of the procedures. In three cases who had second biopsy, FNAB was performed in the first time. Two of patients had FNAB in the second time, and one patient had tru-cut core biopsy in the second time.

20G needles were used in 10 of FNAB procedures, and 22G needles were used in 40 of FNAB procedures of them. 18G semi-automatic cutting needles were used in six and 20G in three of the nine procedures in which Tru-cut biopsy was performed.

Pneumothorax was the most common complication. Pneumothorax developed in five (8.3%) of 60 procedures. Tube drainage was performed in two (3.3%) of these cases. In these two patients, pneumothorax occurred immediately after the procedure. In the other three cases, mild pneumothorax developed during the procedure and no treatment was needed.

In two of the cases self limiting pulmonary hemorrhage was observed in the needle tract. No other complications were observed in any of the cases.

DISCUSSION

Lung cancers have increased significantly in the 20th century and have become the most common cause of death from cancer in the world. Lung cancer, which was more common in smokers in the past, has also increased its incidence in non-smokers. While it was the most common cancer in men in the past, today the gap between men and women has closed rapidly.[1]

Since lung cancers usually cause symptoms in advanced stages, mortality rates are high. However, when detected at an early stage, 5-year survival rates increase significantly.[2] Although imaging methods have developed, it is not always possible to distinguish between benign and malignant lung lesions radiologically.

Transthoracic biopsies, which are frequently used in the diagnosis of lung mass lesions today, reduce the need for thoracotomy or mediastinoscopy in peripheral, mediastinal or hilar lesions that are difficult to reach with bronchoscopy and brushing techniques. Thus, mortality, morbidity rates and cost reduction are provided. Percutaneous transthoracic biopsies are a more reliable and easily tolerated method compared to other interventional diagnostic methods.[25,26] Transthoracic needle biopsies are performed under guidance of an imaging method. The choice of guide imaging modality depends on the size and location of the lesion, its relationship to adjacent anatomical organs such as fissures and vascular structures, and the personal preference of the radiologist. The guiding method can be selected with the evaluation of a thorax CT examination performed before the biopsy. Fluoroscopy, US or CT can be used as a guide method. The radiologist's familiarity with biopsy with all three imaging modalities will facilitate the most appropriate selection.[24,27] CT is generally used as a guide method in lesions that are not suitable for biopsy under US guidance. It provides a great advantage in small lesions that are adjacent to risky organs. The most important advantages are the accurate determination of the safe path and the ability of showing the needle tips exact placement within the lesion. In this way, complications such as pneumothorax and hemorrhage are reduced. Biopsy can be taken from the solid component instead of necrosit areas in the lesion, and sensitivity also increases

The success rates and complications of both techniques should be considered when determining which biopsy needle to choose for a lesion. An ideal method should be able to distinguish between malignant and benign lesion and also provide a specific diagnosis if the lesion is benign.[24] It is important to distinguish between small cell and non-small cell lung carcinomas in the treatment planning of lung cancers. Unnecessary thoracotomy is avoided in advanced stage patients diagnosed with non-small cell carcinoma with a specific diagnosis.[25,31,32] Large lesion sizes increase the chance of definitive diagnosis.

Although FNABs have high success rates in detecting malignant lesions, the diagnosis should be approached with suspicion in benign lesions. Especially non-specific benign findings should not be trusted and biopsy should be repeated. The use of cutting needle biopsies is recommended for lesions requiring a specific diagnosis.[29,30] In this study, when the FNAB result in one patient showed chronic inflammation, a cutting needle biopsy was performed again and the result was adeno carcinoma.

In recent studies, it was stated that the use of 18G and 20G cutting needles increased the specific diagnosis rates, while in some studies it was stated that the malignancy detection rates were lower in core biopsies.[24] In their study, Charig and Phillips showed that cytopathologist-guided fine-needle aspiration biopsies and tru cut biopsies had similar success rates.[29] In this study, the success rate of FNAB and cutting needle procedures were consistent with the literature.

The most common complications of transthoracic needle biopsies are pneumothorax and parenchymal hemorrhage. Less frequently, hemothorax, thoracic wall hematoma, and vasovagal reactions may occur. Air embolism, massive hemoptysis, cardiac tamponade, malignant cell seeding in needle tract, and bronchopleural fistula are rare complications.

In our study, the rate of pneumothorax was 8.3%, and pneumothorax developed in two patients during the procedure and within six hours after the procedure in three patients. While treatment was not required for pneumothorax, which was minimal in three patients, thoracic tube was needed in two (3.3%) patients with increased pneumothorax on follow-up radiographs.

It has been reported that pneumothorax, which is the most common complication, is seen in 0-61% of FNABs and 26-54% in cutting needle biopsies. In this study pneumothorax was seen in 10% of FNABs and none of tru cut biopsies. We think that the reason for not seeing any pneumothorax in our tru cut biopsies is, we mostly prefered tru cut biopsies for large pleura based lesions and we didn't transpassed intact lung paranchyma during biopsies which is highly corraleted with pneumothorax rate as we mentioned before. Severe pneumothorax rates requiring chest tube insertion have been reported to be 1.6-18% for FNABs and 3.3-15% for cutting needle biopsies.[17,22,33-36] Our pneumotorax rate requiring chest tube insertion was consistent with literature.

In the literature, the relationship of pneumothorax with various predisposing factors has been revealed in many studies. We examined the effects of these factors in cases with pneumothorax and compared them with the results of the literature. In order to prevent pneumothorax during the procedure, needle insertion into the lung should be done quickly. Otherwise, it will poke the parenchyma before perforating the pleura, causing pleural pain. The resulting pain causes the patient to breathe, which leads to pleural rupture and the associated pneumothorax. At least 1 cm of lung

tissue must be passed through so that the needle does not slip back into the pleural space during breathing. This precaution is particularly important at the base of the lung, where respiratory displacement is greater.[28,37] To reach the lesion, as few pleural passages as possible coaxial method should be used. Emphysema areas and fissures should be avoided while choosing the needle path.

In our study, patients with an intact parenchyma distance of less than three centimeters and those of three centimeters or more were divided into two groups, and in the statistical analysis, it was observed that the frequency of pneumothorax was statistically higher in patients with a healthy parenchyma distance of three centimeters and above (**Table 1**).

Table 1. The incidence of pneumothorax according to the intact paranchyma length transpassed.

			Pneumothorax		Total
			Not developed	Developed	
Intact lung paranchyma transpassed to reach lesion	2 cm or less	n	44	1	45
		n%	97.8%	%2.2	100%
	3 cm or more	n	11	4	15
		n%	73.3%	%26.7	100%
Total		n	55	5	60
		n%	91.7%	%8.3	100%
p<0.012					

Different results have been obtained in different studies regarding the needle diameter used in biopsy and the frequency of pneumothorax.[37-39] Patients to whom used 20G and 22G needles were collected in one group, and patients to whom used 18G needles were collected in a group and compared with the frequency of pneumothorax. No statistically significant difference was found between these two groups.

The increase in the frequency of pneumothorax in patients who had three or more pleural punctures was found to be statistically significant (**Table 2**). The distribution of pneumothorax by age and sex was examined. The difference between sex and age groups were not found statisticaly significant.

Table 2. The incidence of pneumothorax according to the distance of parenchyma.

			Pneumothorax		Total
			Not developed	Developed	
Pleura transpassing count	2 or less	n	53	3	56
		n%	94.6%	5.4%	100%
	3 or more	n	2	2	4
		n%	50%	50%	100%
Total		n	55	5	60
		n%	91.7%	8.3%	100%
p<0.032					

The second most common complication of transthoracic needle biopsies is self limiting pulmonary hemorrhage.[22] Massive pulmonary hemorrhage is very rare and usually originates from the bronchial arteries. It should not be forgotten that another source of bleeding is the intercostal arteries and care should be taken during entry. When performing biopsy to hilar or mediastinal regions and paracardiac areas, it is necessary to know the pericardium anatomy and recesses well. Because bleeding into the pericardial cavity can be fatal.[3] Berquist et al.[40] reported 2 deaths due to post-biopsy hemorrhage.

Two of our patients had hemorrhage in needle tract that did not require treatment. None of the patients developed hemoptysis or procedural death.

Tumor cell seeding in the biopsy tract is a potential, but extremely rare, complication of percutaneous needle biopsies. There are studies indicating that the risk increases after intervention with thick-diameter cutting biopsy needles due to tissue damage. It has also been reported that it is mostly seen in malignant tumors such as mesothelioma, and the co-axial needle technique prevents this complication.[7]

CONCLUSION

In this study, a total of 60 percutaneous transthoracic needle biopsies which were performed on 57 patients were evaluated. As a complication, pneumothorax developed in five patients and parenchymal hemorrhage that did not require treatment developed in two patients.

An increase in the amount of pneumothorax and related symptoms was detected in two patients who developed pneumothorax, and a chest tube was inserted. No other complications were detected and no procedure-related mortality occurred. The frequency of pneumothorax was found to be increased significantly according to the intact parenchyma distance transpassed and count of pleural punctures.

When we evaluate these results, we think that percutaneous transthoracic needle biopsies performed under the guidance of US and CT are easy to apply, reliable, have high diagnostic rate and have acceptable complications.

ETHICAL DECLARATIONS

Ethics Committee Approval: This study is an extension of radiology speciality thesis "Accuracy of image guided transthoracic biopsies of thoracic lesions." This study was carried out with the approval of the institutional board. Ethical approval was not obtained for that (2006-2008) period.

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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