DOI: http://dx.doi.org/10.5915/30-1-16283

Fine Needle Aspiration Biopsy of Peripheral Pulmonary Lesions under Real-time Sonographic Guidance

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Abstract

The utility of fine needle aspiration biopsy (FNAB) guided by real-time ultrasonography was studied in 25 patients referred with peripheral lung opacities on chest x-ray examination and in whom fiberoptic bronchoscopy was negative. The lesion, as seen on a chest x-ray, was visualized sonographically in 22 (88%) patients, and aspiration biopsy was performed in 20 of these 22 patients, two patients being excluded due to sonographic evidence of a hydatid cyst. Aspiration biopsy was diagnostic in 17 (85%) of the 20 patients studied including 12 patients with malignancy and five patients with benign lesion. One patient developed a small asymptomatic pneumothorax, detected on routine postprocedure chest x-ray examination. Thus fine needle aspiration biopsy under ultrasonographic guidance is a safe, economical method with a high diagnostic yield in the evaluation of peripheral lung opacities, especially in developing countries where computed tomography scan facilities are limited and costly.

Key words: Real-time sonography, peripheral lesion, echo pattern, fluid bronchogram.

The investigation of a peripheral pulmonary lesion detected by chest radiography begins by sputum examination and bronchoscopy. If these investigations prove nondiagnostic, percutaneous transthoracic needle aspiration of these lesions is indicated, preferably under image guidance. Advances in the ultrasound (US) machine have improved the ability of the US to guide interventional procedures; however, it remains under utilized.[1] In the abdomen, US-guided aspiration of various lesions is an established procedure[2] especially in diseases of the liver,[3] pancreas,[4] and kidney.[5] Sonographic guidance during neurological procedures is common for biopsies of deep-seated intracranial lesions or to facilitate drainage of suspected abscesses or syrinxes.[6] In the chest, fluoroscopy and computed tomography (CT) have been used to guide transthoracic aspiration. Fluoroscopy fails when the lesions are small or are near the mediastinal, diaphragmatic, or apical lung surfaces.[7] While CT can help in some of these situations,[8] its main limitation in our part of the world that it is expensive and unavailable in most centers. Unlike CT scanners, US equipment is readily available in almost all centers. We present our experience with sonographic guidance in the biopsy of peripheral pulmonary lesions.

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Materials and Methods

Twenty-five consecutive patients, 16 men and nine women, 32-80 years old (mean age 62.5 years), with a peripheral pulmonary lesion, thought to be abutting the chest wall or diaphragm on chest radiography, were evaluated. Peripheral pulmonary lesion was defined as one that was more than 2 cm in diameter on chest radiograph and was not visualized within the bronchial tree at fiberoptic bronchoscopy.[9] In all patients, sputum cytology, bacteriology, and fiberoptic bronchoscopy failed to make histologic diagnosis. These patients were enlisted for ultrasonography and transthoracic fine needle aspiration biopsy (FNAB) under ultrasound guidance. Patients were selected for the procedure on the basis of visibility of the pulmonary lesion as shown by chest sonography. Patients with bleeding diathesis, mediastinal lesion, and sonographic and/or serologic evidence of hydatid cysts, were excluded from FNAB.

Real-time ultrasonography was performed with a Shimazdu SDU-700 ultrasound machine using 3.5 and 5.0 MHZ transducers. In each patient, multiple scans were obtained using different body positions (supine, prone, sitting, lateral) until the most satisfactory scan was obtained. The liver and gallbladder were used as a reference echo pattern of solid and fluid-containing lesions respectively. Normal areas of lung were scanned to serve as a control. Sonographic images of the lesions were analyzed regarding echogenicity, size, shape, margins, and internal sonographic pattern.

A fine needle aspiration biopsy was performed using a 22-gauge steel needle, consisting of an outer sheath and an inner stylet. After obtaining the most optimal view of the lesion, the transducer was held fixed on the chest wall and the fine needle inserted during suspended mid-inspiration. The needle tip, seen as a white spot on monitor screen, was advanced until it entered the lesion. The stylet then was removed and 20-ml syringe attached to the needle. Four to five vigorous movements of the needle were made inside the lesion while maintaining constant suction with the syringe, and then the needle was withdrawn. If the aspirated material was unsatisfactory, a second aspiration was done.

The aspired material was splayed on glass slides and sent for cytology as well as acid fast and Gram's staining. Finally, the needle was flushed with 0.9% saline and the washings were sent for culture. Inspiratory and expiratory chest x-ray films were obtained at 3 and 24 hours after the procedures. The final diagnosis was confirmed by thoracotomy, biopsy of lymph nodes, or clinical follow up.

Results

Of the 25 patients studied, the majority of the lesions (18/25) were on the right side of chest. Most of the lesions were abutting the diaphragm and the chest wall (nine each), while seven lesions were in the apical region on chest radiograph. The diameter of the lesions was between 2-5 cms in 16 out of 25 lesions, while two patients had pleural effusion along with the pulmonary lesion. Ultrasonography could visualize the lesion in 22 (88%) of the patients. Two patients with a sonographic pattern of a hydatid cyst, confirmed later by serology, were excluded from aspiration. Of the 20 patients subjected to ultrasound-guided FNAB, the procedure was diagnostic in 17 (85%), consisting of malignancy in 12, tuberculosis in three, and pneumonia in two cases.

Sonographic features (Table 1)

The majority of the malignant masses had either a uniformly hypoechoic (58%) pattern or hypoechoic pattern with pleural effusion (25%). Only 2 (17%) of the malignant masses showed uniformly isoechoic pattern, and two (40%) had mixed echogenicity. One tubercular lesion (20%) showed an isoechoic pattern with sonographic fluid bronchogram. All of the three (100%) patients with pneumonia showed an isoechoic pattern with positive sonographic fluid bronchogram. All of the 12 malignant lesions and two hydatid lesions showed well-defined sharp margins. Pneumonias and tubercular lesions showed irregular ill-defined margins.

Ultrasound-guided fine needle aspiration biopsy

Twenty patients underwent US-guided percutaneous fine needle aspiration. Aspiration was successful in 19 (95%) patients. Aspiration failed to obtain adequate tissue material in one patient despite three attempts.

Ultrasound-guided FNAB was diagnostic in all the 12 cases of malignancy that were subject to aspiration (Table 2). Aspiration was diagnostic in three out of the five patients with tuberculosis, demonstrating tubercle bacilli on AFB staining, confirmed later with culture. In three peripheral lesions with sonographic fluid bronchogram, cytology showed nonspecific inflammation, but Gram's staining and culture confirmed pneumococcus in two patients. The third lesion was resolved with antibiotic therapy.

Two patients having lesions of mixed echogenicity with irregular margins, in whom aspiration was nondiagnostic, were treated with antitubercular therapy on clinical suspicion. They showed marked clinical and radiological improvement over an eight-week period.

One out of 20 patients (5%) subjected to US-guided FNAB developed a procedure-related complication in the form of a small asymptomatic pneumothorax, detected on routine check x-ray chest and resolved on its own. Three patients had chest pain at the aspiration site and required oral analgesics.

Discussion

Until recently, ultrasonography was considered to be of limited utility in the evaluation of chest disease because the ribs and air-filled lungs act as barriers to ultrasound visualization of intrapulmonary disease.[10] However, the presence of fluid in the pleural space, tumor, consolidation, or atelactasis in the lung provides ample sonographic windows for evaluating unilateral thoracic opacifications.[12] Using the CT scan as the gold standard, ultrasound was found to be 95.1% sensitive in detecting pleural lesions and 82.8% sensitive for parenchymal lesions. We found the US 88%

Table 1. Sonographic appearance in 22 patients.

	Number of Patients	Hypoechoic		Hyper/Isoechoic		Mixed echo genecity
		Uniform	Nonuniform	Uniform	Nonuniform with F. Bronch.*	
Malignant lesions	12	7 (58)	3 (25)	2 (17)	-	-
Tubercular lesions	5	-	-	2 (40)	1 (2)	2 (40)
Inflammatory lesions	3	-	-	-	3 (100)	-
Hydatid cyst	2	2 (10)	-	-	-	-
Total	22	9	3	4	4	2

* F. Bronch. = Sonographic Fluid Brochogram.
Numbers in parentheses indicate percents.

Table 2. Etiology of lesions and results of fine needle aspiration in 20 patients

Nature of lesion	Number of cases	Number of cases diagnosed by US-guided FNAB
Malignancy	12	12 (100)
Adenocarcinoma	7	
Epidermoid carcinoma	3	
Oat cell carcinoma	1	
Lymphoma (NHL)	1	
Benign	8	5 (62.5)
Tuberculosis	5	3 (60)
Pneumonia	3	2 (66)

Numbers in parentheses represent percentages.

sensitive in detecting peripheral pulmonary lesions. The lesions in three patients in our study could not be visualized with sonography. Computed tomography scans of the chest revealed a 1.0-1.5 cm gap between the lesion and the chest wall, intervened by a normal air-filled lung. Thoractomy was done in two of three, showing small cell carcinoma in one and epidermoid carcinoma in another. In the third, diagnosis of a non-Hodgkins lymphoma was made after biopsy of cervical lymph node.

Transthoracic needle biopsy of pulmonary lesions is not a new technique. Its first use is attributed to Leyden (1183) who employed it to diagnose pneumonia.[13] Since then, the technique has evolved much with the advances in image guidance and types of needle.

Percutaneous transthoracic fine needle aspiration biopsy using fluoroscopic guidance was a standard method of obtaining tissue diagnosis of pulmonary parenchymal lesion.[11] However, fluoroscopic visualization is difficult when the lung nodules are pleural based, at the lung apex, in axilla or near the diaphragm and mediastinum.[7,14] In comparison, US visualization of lung masses for guiding biopsy is best in the very areas that are difficult to biopsy under fluoroscopy.[11] Computed tomography scan can guide FNAB in these areas and especially the mediastinum. But unlike ultrasound, CT scan cannot provide real-time images of the needle tip[15] and is time consuming and costly. Ultrasound guidance, therefore, would be ideal in such situations.

The diagnostic yield of transthoracic FNAB under US guidance in our study was 85% in the 20 patients who underwent biopsy. This goes with the observations of Yang et al, (84%) and Ikezoe et al (84.2%).[15,16] In malignant lesions, US-guided FNAB was 100% were diagnostic in all the 12 cases (100%). Yang et al, also found FNAB to be diagnostic in 100% malignant lesions. Others have reported a success rate of 84 to 91.3%.[14,15] In benign lesions, our success rate with FNAB was 62.5%. Others have reported a success rate of 57% to 60%.[15,16] Pederson et al,[14] could diagnose one (20%) out of five benign peripheral lung lesions. The reason for a higher diagnostic yield in malignant lesions as compared to benign lung lesions is that while a few cells may be enough to diagnose malignancy, a bigger piece of tissue may be needed to exactly categorize a benign lesion. Ikezoe et al, compared the results of aspiration biopsy and had a diagnostic yield of 77.8%, while aspiration biopsy was positive in 18.2% only.[15]

We had a small asymptomatic pneumothorax in only

one (5%) out of the 20 patients subjected to FNAB under US guidance. The reported incidence of pneumothorax in CT-guided needle biopsies is believed to be due to the use of this imaging technique for more difficult lesions that require greater biopsy time and multiple passes with the needle.[17]

We conclude that ultrasonography is a very useful imaging method in the evaluation of peripheral intrathoracic lesions, especially for those in the lung apex, axilla, or near the diaphragm, where fluoroscopic visualization is difficult. It is a quick, safe, and efficient method with a high diagnostic yield. It can be used in critically ill patients. Yu et al, have shown that portable chest sonography in critically ill patients helped management in 90% of the 41 patients studied.[18] The role of chest sonography in a developing country, like ours, is even more, where CT scan facilities are few and costly.

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