

# Single Plane Fluoroscopic Guided Biopsy of Thoracic Lesions

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## Abstract

Single plane fluoroscopic guided biopsy was performed successfully in 61 of 70 patients with thoracic lesions using inexpensive spinal needles. Lesions smaller than 2cm and those located within 2cm distance from vascular structures were not biopsied using this technique. Post-biopsy pneumothorax developed in 15 of the 46 biopsies of the intrapulmonary lesions. Five patients required a chest tube placement for symptomatic pneumothoraces. There were no fatalities. It is suggested that in a selected group of patients single plane fluoroscopic guided biopsy is a safe and fast method for diagnosis of a thoracic lesion (JPMA 46:73,1996).

## Introduction

Percutaneous needle biopsy of thoracic lesions is an established method of determining the type of lung or pleural mass, the nature of mediastinal widening and pathology of a rib abnormality<sup>1-3</sup>. Depending upon the size and location of a lesion, biopsy may be earned out by clinical palpation, single or bi-plane fluoroscopy, ultrasonography or computed tomography (CT)<sup>1</sup>. Various types of needles have been utilized to achieve a high degree of success with minimal complications. Serious complications are uncommon, but most are related with pneumothorax or injury to vascular structures. Aerated lung parenchyma provides inherent contrast for fluoroscopic visualization of a target and guidance for a biopsy + needle. Peripherally located pulmonary lesions or mediastinal masses may be approached extrapleurally. We report our experience with single plane fluoroscopic guided biopsy of the + thoracic lesions.

## Materials and Methods

Between 1986 and 1990 a total of 123 biopsies were carried out on thoracic structures, excluding the thoracic spine in the Department of Radiology at the Aga Khan University Hospital, Karachi. In 70 consecutive patients 76 biopsies were done on 70 lesions guided by, single plane fluoroscopy. Retrospective analysis of data from these biopsies form the basis of this report. In the rest, CT and ultrasound guidance was utilized in 38 and 15 patients respectively. All biopsies were carried out using non-remote control fluoroscopy equipment normally used for gastrointestinal radiology. In 48 patients, biopsy was done in prone or supine position, in the remaining 28, prone oblique, supine oblique or decubitus positions were utilized. Forty-nine biopsies were performed with a single needle pass through the pleural surface. In 27, 2 or more needle passes were made needle sizes used were 20 gauge (20G) in 34 patients, 22G in 19, 18G in 18, 25G in 3 and 16G core biopsy needle in two instances. Indications were reviewed before each biopsy'. The following criteria were applied to lesions that were chosen for single plane fluoroscopy guided biopsy: a) pulmonary lesions 2 cm in size or larger, b) right paratracheal masses and c) rib lesions localizable on fluoroscopy. Excluded from considerations were lesions smaller than 2 cm and all lesions located within 2 cm from descending thoracic aorta, hilar regions or cardiac borders. Relative contraindications included chronic obstructive pulmonary disease (COPD), asthma, bleeding disorder, inability on the part of the patient to stay still or hold breath. Pre-biopsy screening included estimations of prothrombin time (PT) activated partial thromboplastin time (APTT) and platelets. Informed consent was obtained in each case.

Technique: Confirmation of location of the pulmonary lesion was carried out using standard chest radiography (Figure a and b),

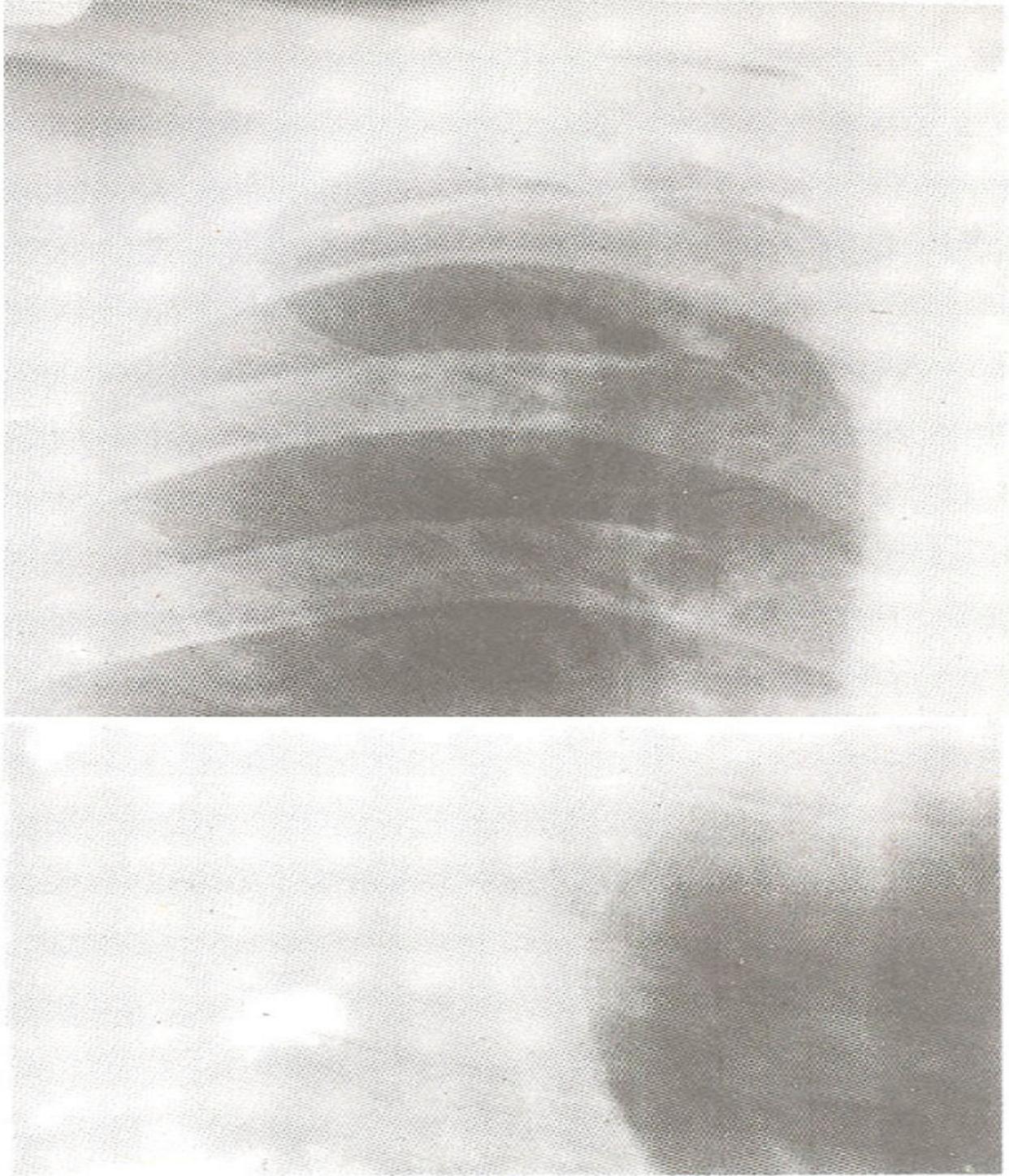


Figure 1. Chest radiographs (a) PA (b) Lateral of a carcinoma of the right upper lobe. The lesion was located closer to the posterior chest wall. Therefore, a posterior biopsy approach was planned.

fluoroscopy, plane tomography or CT. The depth of the lesion from the skin was measured on radiographs and recorded. Arrangements were made for a quick cytological evaluation during each biopsy. Each lesion was localized on standard non-remote control fluoroscopy table normally used for gastrointestinal radiology. The site of skin entry was chosen at the shortest distance from the target. To

achieve this, the patient was rolled like a barrel and stabilized using pillows. The skin directly overlying the lesion was localized with a metal marker during fluoroscopy and then with an ink marker. When necessary, the scapula was mobilized. Under aseptic conditions local anaesthesia was infused down to the periosteum of the nearby rib. Under fluoroscopy, a needle was held on the skin vertically with a needle holder or plastic clamp while the collimators of the fluoroscopy field were coned down to the target lesion. With the lesion, the needle shaft and the needle hub in perfect alignment and the patient holding breath, the needle was advanced vertically to 2-3 cm short of the calculated distance from the target under intermittent fluoroscopy (Figure 2a to d).

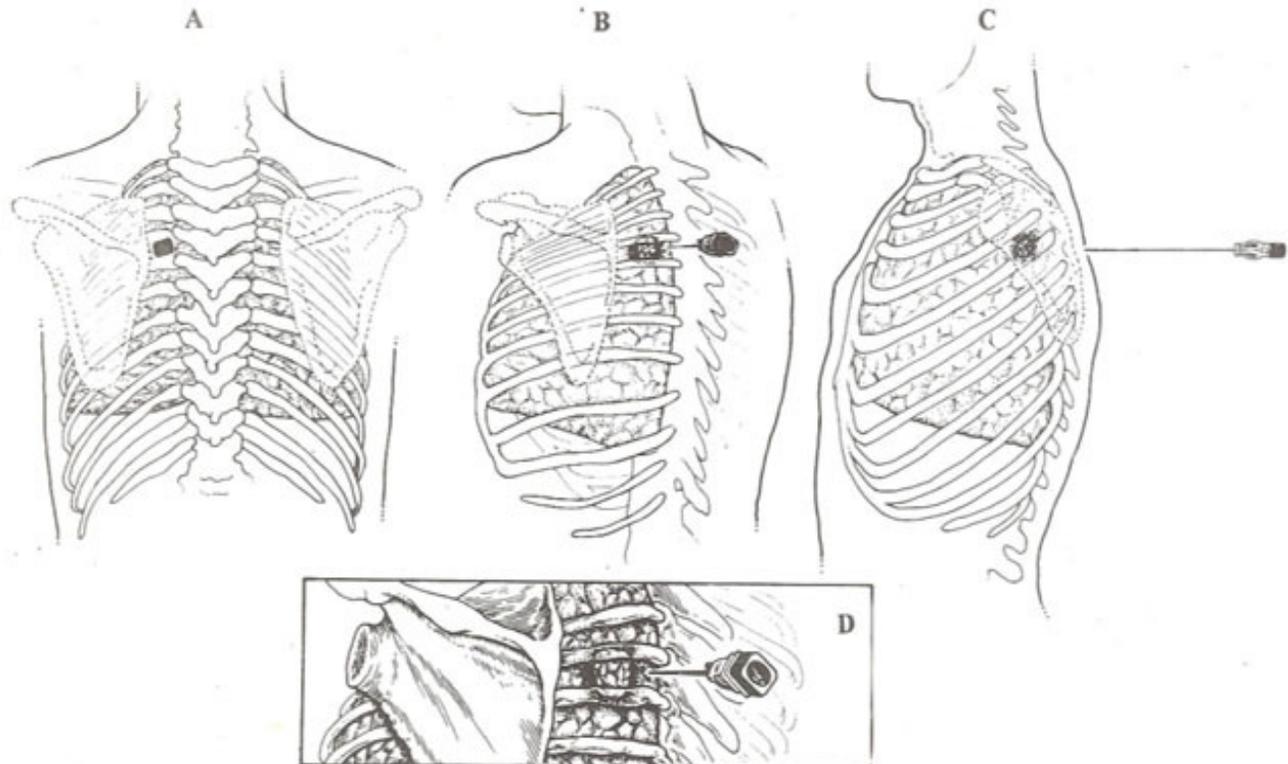


Figure 2. Schematic drawing of a biopsy needle and a target mass relative to the position of a patient as described on single plane fluoroscopic guidance. (a) With the patient in the prone position the biopsy needle is placed on the skin in such a way that the needle tip, the shaft, the needle hub and the target mass are in perfect alignment. The needle is then inserted down to about two cm short of the measured distance from the target. (b & d) with needle in place the patient is being turned through a right angle from the previous prone to lateral position. (c) The patient in the lateral position with the needle in place. The whole length of the needle is visualized with its tip close to the lung mass. Further insertion of the needle, maintaining the original trajectory, will place the needle tip into the target mass for biopsy.

The patient was allowed to breathe gently in between needle thrusts.

The patient was then turned at a right angle from previous position so that the shaft of the needle with its tip pointing to the center of the target was visualized. Under fluoroscopy control, the needle was advanced further maintaining the original direction until the needle tip was seen entering the lesion and resistance was felt (Figure 3a and b).

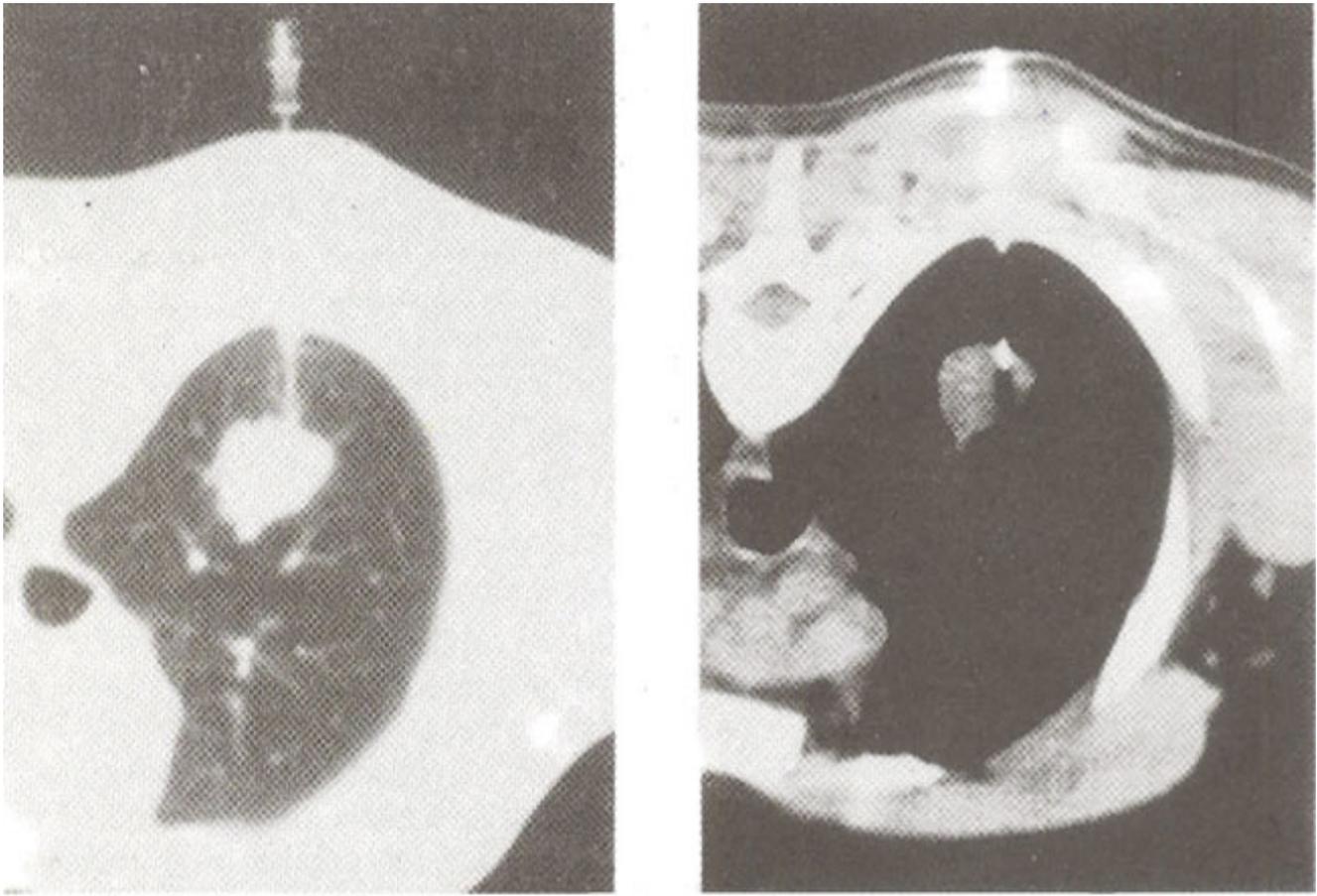


Figure 3. CT scans of the needle placement into the lung mass. (a) lung windows and (b) soft tissue windows.

For coaxial approach, a 22G biopsy needle was used within an 18G guiding needle. The 18G guiding needle was advanced to the periphery of the target lesion followed by insertion of 22G biopsy needle via the lumen of 18G guiding needle and the target entered by 22G biopsy needle. The lesion extending to the pleura were biopsied using extra-pleural approach. In 3 patients right paratracheal lesions were biopsied using 25G needle.

Rib lesions located at the maximum curvature of the thorax were tricky to localize. Careful fluoroscopy and several spot films with metal markers over the skin were needed to accurately localize a lesion. The percutaneous approach and biopsy was carried out with needle tangential to pleura to minimize risk of pneumothorax. In each case, the specimen was collected using standard suction method. In two patients core biopsy of mediastinal masses were taken. Cytology slides were stained and examined on the spot by a cytologist for adequacy of biopsy material. Biopsy needles were rinsed in absolute alcohol for preparation of a cell block.

To check for pneumothorax, post-biopsy erect fluoroscopic chest film of the side of the biopsy was carried out. Standard erect PA chest was done at 1, 2 and 4 hours earlier if patient became symptomatic. After 4 hours asymptomatic patients were discharged home. Following biopsy parameters were recorded. The size and location of the lesions, size of the needles, number of the needle passes, adequacy of the biopsy specimen and the complication of hemoptysis, pneumothorax and chest tube placement. At least 6 months radiographic follow-up was available in patients with biopsy results negative for malignancy.

## Results

In 70 patients, 76 biopsies were performed using a single plain fluoroscopic guidance. Adequate biopsy

material for cytology or histopathology was obtained in 61 patients: in 58 at the first attempt, in 3 at second attempt, while in other 3 insufficient material was obtained even after second attempt. The remaining six patients refused repeat biopsy.

There were 46 intrapulmonary lesions (23 in the outer lung field and 23 in the mid-lung field) and 24 extra-pleural lesions (10 rib abnormalities, 11 mediastinal masses and 3 lesions were pleural based without rib abnormalities). Nineteen intrapulmonary lesions were 2-3 cm in diameter, 16 were 3-5 cm in size and 11 larger than 5 cm.

Complications included hemoptysis in 15 cases none required any treatment. Pneumothorax occurred in 15, five requiring insertion of a chest tube. No tension pneumothorax was encountered. All pneumothoraces appeared within the first hour after biopsy.

Using aspiration biopsy technique, a core of tissue was obtained in 32 patients. On follow-up there was one false negative result where a patient initially diagnosed to have lung hematoma was confirmed to have lung carcinoma on open lung biopsy. There were no false positive results. Of the 46 intrapulmonary lesions, malignant cells were obtained in 26 patients (16 primary cancers, 8 metastases and 2 sarcomas). 16 showed evidence of benign disease and 4 biopsies were non-diagnostic. Of the 16 with non-malignant biopsies, 6 had specific benign pathological features (3 healed granulomas and one each tuberculosis, lung abscess and hamartoma). The other 10 demonstrated non-specific benign process. Of the 24 extrapleural lesions (10 rib lesions, 11 mediastinal and 3 extrapleural lesions) the biopsy results of 10 rib lesions were secondary deposits in 4 tuberculous infections of the ribs and healing rib fractures in 2 each. Of 11 mediastinal masses, there were 5 neoplastic masses and 3 suggestive of lymphoma, The 3 extrapleural lesions were all benign, 3 were non-diagnostic.

## Discussion

Percutaneous needle biopsy is generally indicated in the clinical settings of newly detected pulmonary nodule, pleural masses, mediastinal lymphadenopathy and rib lesions. When performed under local anaesthesia on out-patient basis biopsy can significantly shorten the length of hospital stay by quickly confirming a diagnosis. Knowledge of the cell type of lung cancer from biopsy and the result of staging is important in determining the prognosis and influencing treatment choices. Many reports have demonstrated a good correlation between cytologic types of primary and metastatic tumors at the time of biopsy and histology obtained at open lung biopsy<sup>4,5</sup>.

Positive biopsy for malignant cells in the absence of cancer i.e. the false positive rate for malignancy is extremely low at 0.03%<sup>1</sup>. Hence, diagnosis for cancer is almost always correct when the biopsy confirms it. Needle tract seeding of cancer cells does occur but is exceedingly rare and does not present as a real clinical problem<sup>6</sup>. The sensitivity for positive biopsy for cancer is dependent upon the prevalence of neoplastic disease amongst lung nodules. In our series, there were many patients with benign process because tuberculosis and inflammatory disease are common in our country.

Pneumothorax is a known and potentially serious complication of lung biopsy. In our series pneumothorax was seen in 15 of the 46 patients, in whom pleura was punctured. Five patients required a chest tube for symptomatic pneumothorax. Various methods have been proposed to reduce the risk of post-biopsy pneumothorax. These include injection of autologous "blood patch" fragments of Gelfoam (UpJohn, Kalamazoo, Mich.) or tissue adhesive via the biopsy needle; placing the patient in lateral decubitus position and administering 100% oxygen<sup>7-9</sup>. The reported frequency of pneumothorax after lung biopsy ranges between 19 and 44% with an average of 30%. About 7-9% of lung biopsies require chest tube placement<sup>1,7</sup>. Tension pneumothorax occurs rarely, but becomes symptomatic rapidly and must be treated as a medical emergency. Symptomatic tension pneumothorax is more likely to occur in the patient with COPD in whom even a shallow pneumothorax can lead to marked dyspnea. Two of

Our patients with underlying COPD became symptomatic with shallow post-biopsy pneumothoraces<sup>7</sup>. Our experience with biopsy induced pneumothorax was similar to those reported in the literature. With careful planning pleural puncture can be avoided even when lesion only partially abuts the pleura. If aerated lung is not traversed, the chance of a pneumothorax drops down to 2% compared with an average of 30% for an aerated lung<sup>10</sup>.

Biopsy of the rib lesion is generally easy, but we found localization of a rib lesion along the lateral chest wall, high up in the axilla, under the scapula and at the base of the neck to be difficult. Careful planning helped us to pin point the skin directly over the rib lesion.

Mediastinal lesions amenable to fluoroscopic guidance are masses projecting laterally from the right mediastinal border. Wide mediastinum displaces pleura laterally allowing extrapleural approach. Surrounded by aerated right upper lobe these lesions are usually easy to approach via the anterior intercostal spaces. Before a core biopsy of mediastinal mass is contemplated every effort must be made to exclude that the target mass is not a vascular structure. Since lymphoma commonly affects mediastinum, a core biopsy or mediastinoscopy is frequently required to confirm the diagnosis. Lesions smaller than 2 cm especially in obese patients may not be suitable for a biopsy using single plane fluoroscopy guided biopsy. Perihilar lung lesions that cannot be differentiated from vascular structures should not be biopsied using fluoroscopy guidance. Also this technique is not available for biopsy of non-bulky mediastinal lymphadenopathy that does not cause mediastinal widening. Lung lesions located around the hilar regions, close to the cardiac border or descending thoracic aorta and mediastinal lymphadenopathy are best biopsied under CT guidance. CT provided more precise needle placement for smaller lesions especially those targets that are located close to vital vascular structures. Many special types of needles have been used for the biopsy of lung mass. Cutting needles with various slots and notches and non-cutting needles with assorted beveled or serrated ends have been developed to obtain biopsy specimen for histology and cytology<sup>5</sup>. It has been shown that diagnostic yield with inexpensive, readily available spinal needles is as good as with any other special needle<sup>1</sup>. The success of any biopsy procedure depends upon the operator's skill and the ability of the patient to cooperate. Using CT for biopsy guidance is more expensive than fluoroscopy. Therefore, CT guided biopsy should be reserved for those lesions that cannot be safely biopsied with fluoroscopy guidance. In 10 of our patients, thoracic mass was diagnostic on chest CT study but were found to be suitable for fluoroscopic guided biopsy. Ultrasound for biopsy guidance is limited to lesions contiguous with the periphery of the chest cavity along the chest wall, diaphragms and the mediastinum. In conclusion single plane fluoroscopic guided biopsy of lung and mediastinal lesions is a cost effective and speedy procedure to reach definitive diagnosis of intrathoracic lesions. The use of expensive specialized needles does not seem to be necessary for a successful biopsy.

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