

Ultrasound Guided Percutaneous Biopsies of Suspected Mediastinal Lesions

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Summary

Realtime ultrasonography with general purpose sector transducer was used to guide 87 percutaneous biopsies on 82 patients with lesions suspected to be mediastinal masses on plain chest radiographs. In seven patients who had dyspnea the biopsies were done in erect or semi-erect sitting positions. Definitive diagnosis was obtained from 66 lesions (80.5%) where 46 (70.0%) were mediastinal and the remaining 20 lesions (30.0%) arising from the lung. Of the 46 mediastinal lesions where specific diagnosis were made, 42 (91.0%) were anterior and four (0.9%) posterior mediastinal lesions. The majority of these anterior mediastinal masses were lymphomatous nodes followed by germ cell tumours whereas all four posterior mediastinal masses were neurogenic. Of the lung lesions, 19 were primary malignancies. The remaining lung lesion which was located posteriorly was cryptococcus infection. One patient developed massive hemothorax, but subsequently recovered. No significant complications were encountered in the remaining patients. Surgery was carried on 11 patients. There is correlation between definitive diagnosis from percutaneous biopsy and final diagnosis after surgery in 80% of patients. It is proposed that all percutaneous biopsies for thoracic masses which abut the chest wall and cause mediastinal widening on a plain chest radiograph be guided by ultrasound. It can be effectively accomplished with ease and safety even without the use of dedicated biopsy ultrasound probes or biopsy attachments, and on patients in erect or semi-erect positions.

Key words: Mediastinal masses, ultrasound, percutaneous biopsy.

Introduction

Fluoroscopy is the most widely used method to guide percutaneous biopsy of chest lesions^{1,2}. But fluoroscopic guidance is less suitable for percutaneous biopsies of anterior mediastinal masses because of poor delineation of these lesions from the adjacent vascular structures with an associated risk of accidental vascular injury². Although computed tomography (CT) following intravenous administration of contrast media provides an excellent demonstration of mediastinal blood vessels, its routine use to guide mediastinal biopsies would be impractical in our local setting as it imposes demand on scanning time and strains the limited financial resources available.

Ultrasound is generally considered to be of limited utility in the evaluation of mass lesions in the chest because of poor visualisation of these lesions from interference of overlying ribs and/or aerated lung. However, anteriorly and posteriorly located mediastinal masses which abut the chest wall would be accessible to detection by ultrasound as aerated lung is no longer in the path of the ultrasound beam³⁻⁵. Besides, realtime (computer jargon for the presentation of sequential images at frame rates of 30 per second)⁴ ultrasound imaging facilitates differentiation between soft tissue and the vascular structures which exhibit pulsation. Ultrasound would therefore be an appropriate means to guide percutaneous biopsies of mediastinal masses³⁻⁵. We have utilised ultrasound as the method of choice to guide percutaneous biopsies of mediastinal lesions. This paper aims to document our experience using realtime ultrasound with general purpose sector transducer as a means to guide percutaneous biopsies of suspected mediastinal lesions abutting the chest wall and causing widening of the mediastinum on plain chest radiographs.

Materials and methods

From 1987 until August 1991, 82 patients (68 males and 14 females) with ages ranging from four to 77 years (mean 34.8 years) had ultrasound guided percutaneous biopsies for suspected mediastinal masses on plain chest radiographs. A total of 87 biopsies were carried out including repeats on five patients. Guidance was accomplished using general purpose sector transducer; from commercially available ultrasound equipment, namely; Philips SDR 1500 with 3.0 MHz and Toshiba 100A with 3.5 and 3.75 MHz transducers respectively without the aid of biopsy attachments. Sedation was not routinely given.

The plain films of the chest in the frontal (Figure 1a) and lateral projections were initially reviewed to locate the mass so as to enable appropriate positioning of the patient i.e. prone for posterior mediastinal mass and supine for anterior mediastinal mass lesions. In 20 patients CT was also done (Figure 1b).

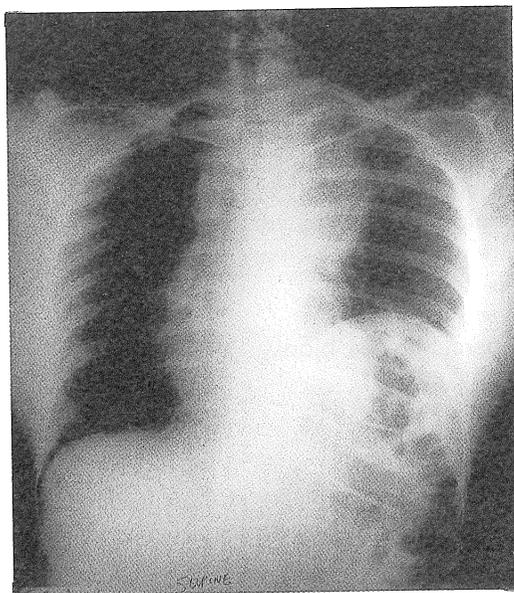


Fig. 1a: Frontal chest radiograph showing superior mediastinal mass projecting over the left mediastinal border.

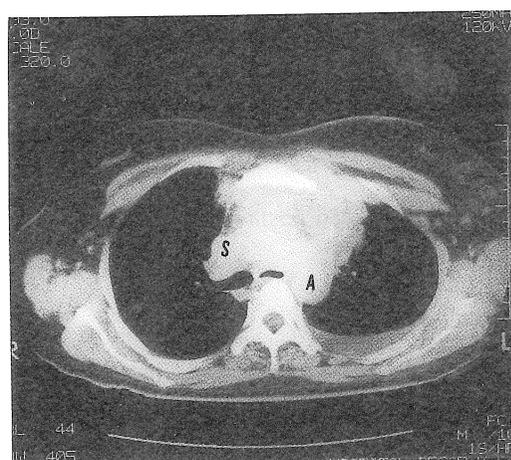


Fig. 1b: CT showed a mediastinal mass anterior to the arch of the aorta. A-aorta, S-superior vena cava.

A parasternal or paraspinal approach was used to biopsy an anteriorly and posteriorly located mass respectively. Preliminary intercostal scanning is then carried out to locate the mass and assess its relationship with vital mediastinal vascular structures. The puncture site on the skin is then identified and the direction and depth of needle puncture determined. The skin was sterilised and a local anaesthetic agent was infiltrated through the entire thickness of the chest wall followed by a small skin incision.

The needle was inserted through the small skin incision. Fine needle aspiration biopsies (FNAB) were done using 21 or 22 gauge and 15 cm long Chiba needles (Cook Inc. Bloomington USA). Histologic samples were obtained by means of Tru-cut biopsy needles (Travenol Inc.). Ultrasound guidance was carried out by an assistant who placed the transducer in the vicinity of the puncture site (Figure 2a). Scanning should be done in a plane which permits optimal demonstration of the mass. The direction of needle puncture is such that it is lying within the scan slice, to ensure accurate placement of needle tip. The entire needle may be seen as an echogenic strip within the mass, otherwise its tip is shown as an echogenic focus (Figure 2b).

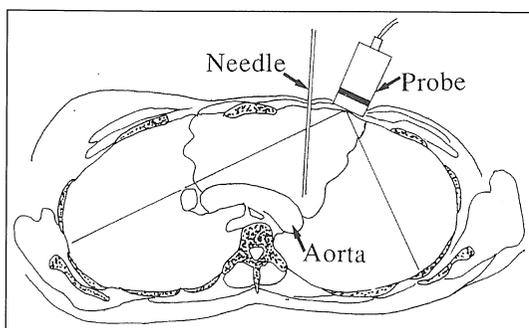
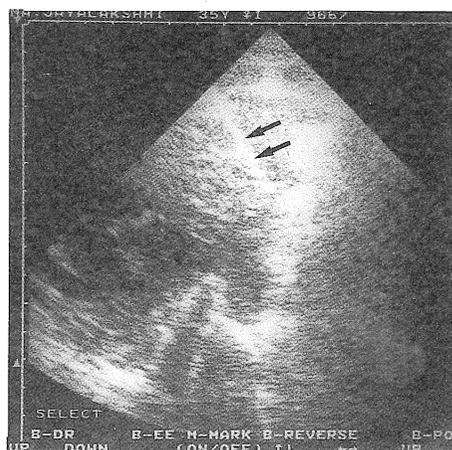


Fig. 2a: The ultrasound transducer is placed at a distance lateral to the puncture site and angulated medially. Needle puncture is made parasternally.

Fig. 2b: The entire length of needle is seen as a linear echogenic strip (arrows).



For aspiration biopsies, two or three quick stabs were made into the mass in different directions as negative suction is being applied with the use of a 20 cc syringe attached to the hub of the Chiba needle. The aspirate is then smeared onto glass slides which were then immersed in 90% alcohol. The remainder of the aspirate was then flushed into a solution bottle for cell block. Tru-Cut biopsy specimens were placed into a bottle containing formalin solution.

Results

Of the 82 lesions, 72 were suspected to be anterior mediastinal masses and 10 as posterior mediastinal masses. A total of 87 percutaneous biopsies were done on these masses which included repeat procedures in five patients. The approach was anterior in 77 biopsies on 72 suspected anterior mediastinal masses whereas the approach for the remaining 10 masses was posterior. In 53 patients both FNAB and Tru-Cut needle biopsies were done. In the remaining 29 patients only FNAB were performed, because

the lesions were judged small and it would be too risky to be biopsied with a Tru-Cut needle. FNAB was also repeated in five of these patients following inconclusive results from the initial biopsies. In seven patients the biopsies were carried out in the semi-erect or erect sitting positions, as they were dyspneic on lying supine. One patient developed massive hemothorax, but he recovered later. No significant complications were encountered in the remaining patients.

The cytologic and histologic results are shown in Table 1. Definitive diagnosis was obtained from 66 lesions (80.5%). The results of the remaining 16 lesions, were inconclusive. Of these lesions a total of 16 FNAB's were done on 11 and five Tru-Cut biopsies on each of the remaining five. The specimens from these lesions were either inadequate or consisted mainly of necrotic materials and non-specific inflammatory cells. Most of them were mediastinal masses which were not large enough

Table 1
Results of 87 biopsies from 82 suspected mediastinal lesions

Location of lesion and biopsy result	FNAB only	FNAB and Tru Cut biopsy	Total
Anterior			
Lymphoma	5	11	16
Thymoma	1	6	7
Embryonal tumour	1	5	6
Endodermal sinus tumour	0	2	2
Seminoma	0	2	2
Germ cell tumour	1	2	3
Teratoma	0	2	2
Bronchogenic cyst	2	0	2
Paraganglioma	0	1	1
Rhabdomyosarcoma	0	1	1
Squamous cell carcinoma of lung	3	3	6
Poorly and undifferentiated carcinoma of lung	4	6	10
Inconclusive	15	5	20
Posterior			
Neuroblastoma	1	0	1
Schwannoma	0	2	2
Ganglioneuroma	0	1	1
Poorly differentiated carcinoma of lung	0	3	3
Cryptococcosis of lung	0	1	1
Inconclusive	1	0	2
Total	34	53	87

to extend beyond the parasternal border and biopsy samples were aspirates using Chiba needles. Twenty lesions were actually pulmonary, where 19 were primary malignancies and the remaining one was cryptococcosis of the lung. Five patients with definitive diagnosis and six patients with inconclusive percutaneous biopsy results had surgery. In four of the five patients (80%) the final diagnosis correlates with the percutaneous biopsy result.

Discussion

Appropriate management of mediastinal lesions require cytologic or histological diagnosis. Thoracotomy and mediastinoscopy are well established means to obtain tissue samples for histology. However, these procedures are invasive, time consuming and subject patients to the risks of general anaesthesia and associated morbidity from surgery. Percutaneous biopsy under radiologic guide has been recognised as a relatively safe and convenient alternative for diagnosis of mediastinal lesions^{1,2,4-7}.

Radiologic guidance can be accomplished by fluoroscopy, CT and ultrasound^{1,2,4-7}. Fluoroscopy is widely utilised because of its availability, convenience of use, low-cost and speed^{1,2}. However, the lack of contrast between the mass and vital vascular structures of the mediastinum makes their distinction on fluoroscopy difficult. Hence, fluoroscopy would not be a suitable means to guide percutaneous biopsies of such lesions in view of the high risk of injuring overlying brachiocephalic vessels, aorta, pulmonary arteries and the heart⁵. Accidental puncture into these vascular structures may lead to a catastrophic outcome, especially when larger bore Tru-Cut needles are used. Computed tomography-guided biopsy allows accurate placement of needles but the technique is time-consuming, tedious and expensive. Its main limitation is that the needle cannot be followed in real-time^{6,7}. Moreover, it requires very good patient cooperation. Computed tomography is therefore not a suitable means to guide percutaneous biopsies on patients who are ill and unable to lie supine.

Since ultrasound can detect lesions which abut the chest wall, the modality is suitable to guide biopsies of such lesions especially anterior and posterior mediastinal lesions³⁻⁵. There are three advantages of ultrasound over fluoroscopic and CT-guided percutaneous biopsies of mediastinal lesions. First, because of their pulsations, vascular structures are easily identified on realtime ultrasonography. This facilitates differentiation and delineation of mass from blood vessels. Monitoring of needle entry and its subsequent adjustments can be accomplished with ease and speed due to convenience of scanning in multiple planes. The second significant advantage of ultrasound is the flexibility of its use. This feature was illustrated in seven of our patients who were dyspneic on lying supine and the biopsies could only be done in erect or semi-erect sitting positions. Hence the entire procedure would not impose further distress on the patients. With the availability of portable realtime ultrasound equipment, it would be possible to perform guided biopsies on ill patients in the wards and intensive care units. Finally, ultrasonography is free of radiation burden to radiologist and patient.

Inconclusive results are related to sampling error, where the tissue samples obtained were either inadequate or contained nonspecific inflammatory cells and necrotic tissues. Our results showed a higher percentage of inconclusive outcome from FNABs where in all instances the tissue samples obtained were insufficient. This is not unexpected since the choice to perform FNAB or Tru-cut biopsy is determined by the location and size of the lesion. Those lesions which are small and cause only subtle widening of the mediastinal border would be difficult to detect on ultrasound, since scanning can only be done from the parasternal area. The parasternal space available for needle puncture and placement of transducer will be limited. This prevents effective guidance. The inconclusive results from Tru-Cut biopsies were due to sampling error where tissue obtained was necrotic and/or consisting of nonspecific inflammatory cells.

A variety of ultrasound-guided percutaneous methods have been described. The use of commercially available dedicated biopsy probes had been advocated by some authors^{4,5}. The 'free-hand' method using general purpose sector probes is also feasible and convenient⁸. Our preference to use this 'free-hand' technique is based on three apparent advantages, namely; a) the probe-skin contact is away from the puncture site, and this ensures optimum sterility to the puncture site; b) there is no absolute need for transducer sterilisation prior to use; and c) since the needle and the probe is not in any way connected to one another, adjustments of probe and needle can be done independently. This facilitates manoeuvres for localisation of needle positions.

In summary, thoracic masses which abut the chest wall such as those located in the anterior and posterior mediastinum allow detection by ultrasound. Percutaneous biopsy of such lesions under ultrasound guidance would be feasible and can be carried out safely and fast. It is proposed that ultrasonographic-guidance should be the method of choice for percutaneous biopsies of thoracic lesions in direct contact with the chest wall.

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