Ultrasound-Guided Tissue-Core Biopsy of Thoracic Lesions with Trucut and Surecut Needles*


The value of ultrasound-guided tissue-core needle biopsy was assessed in 54 patients with thoracic lesions adjacent to the chest wall. Of these, six were apical and two mediastinal. Biopsy was performed with Trucut or Surecut (modified Menghini) needles in 22 patients, and with both in 32 patients in order to compare the two types of needle. Definitive diagnosis was made in 46 patients (85 percent), of whom 41 had malignancy of various cell types, and five had benign lesions. Of the remaining eight, three had apical lesions, and two had consolidation distal to a proximal tumor. There was complete histologic agreement in 25 of 32 patients where biopsy was performed with both needles. Roentgenographic size of the lesion had relatively little influence on the diagnostic yield. Complications comprise moderate hemoptysis in one patient (2 percent), trivial hemoptysis or hemothorax in three, and symptomless pneumothorax in two which resolved spontaneously. We conclude that tissue core needle biopsy of thoracic lesions under ultrasound guidance is an accurate and safe technique which provides specimens adequate for routine histologic examination. The diagnostic yield from Trucut and Surecut biopsies is comparable.

Peripheral lung lesions are often difficult to diagnose by sputum cytology or bronchoscopy, and percutaneous biopsy under fluoroscopic control is a well established technique. However, thoracic lesions adjacent to the chest wall with no intervening bone or lung can be visualized by ultrasonography, and biopsy using this means for guidance is both highly accurate and safe. Moreover, it has been successful in some cases where fluoroscopically guided attempts have failed, either due to poor visualization or location of lesions in the lung apices and mediastinum where access is comparatively difficult.

With the exception of Ikezoe et al., who used a cutting needle (Trucut) in 26 of their 38 patients, fine bore aspiration needles were used in all the larger studies. One potential drawback is that the specimens are small and suitable only for cytologic examination. Consequently, a highly skilled cytologist is essential. In practice, such expertise is not widely available. In contrast, tissue-core biopsy specimens are suitable for routine histologic examination, and their larger size may enable one to obtain more detailed information such as the exact nature of benign lesions and tumor subtypes in malignant ones. The aim of this study is to determine the usefulness of ultrasound-guided biopsy of thoracic lesions adjacent to the chest wall using comparatively large bore needles. In the majority of patients, two types of needles were used so that their efficacy can be directly compared.

Patients and Methods

Fifty four patients (36 men and 18 women, aged 39 to 82 years, mean 66 years) with a thoracic mass judged to be adjacent to the chest wall by posteroanterior and lateral chest x-ray films (CXR) were selected. The maximum diameter and depth of the lesion were measured from the CXR in cases where the margins were clearly defined. An ultrasound scanner with static B probes of 5 and 7.5 MHz and mechanical sector probes of 3.5 and 5 MHz was used for locating the lesion and guiding the biopsy. A cutting needle (14 gauge Trucut) was used in 15 patients; an aspiration tissue biopsy needle (15 or 16 gauge Surecut) was used in seven patients; and both needles were used in 32 patients whose lesions were judged to be large enough for this to be performed with reasonable safety. The Surecut is a modified Menghini needle which enables a core of tissue to be aspirated. Both the needle and its attached syringe were usually mounted on a "pistol" device (Fig 1) which allowed the operator to biopsy with one hand, leaving the other hand free to manipulate the ultrasound transducer. The CXRs and ultrasonograms of three typical patients are shown in Figures 2 through 7.

After obtaining informed consent, the patient was put in the supine, prone, lateral decubitus, or sitting positions according to the site of the lesion. The lesion was then located sonographically, and its depth from the skin surface measured on the monitor with electronic calipers. The puncture site was disinfected and anesthetized by

*From the Departments of Medicine, Radiotherapy, Morbid Anatomy, and Diagnostic Radiology, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, NT, Hong Kong. Manuscript received October 8; accepted November 3.

Reprint requests: Dr. Pang, Department of Medicine, Chinese University of Hong Kong, Shatin, N.T., Hong Kong

FIGURE 1. "Pistol" device on which the Surecut needle is mounted. This enables the operator to biopsy with one hand.
infiltration with 2 percent lidocaine. When both needles were used, biopsy with the Surecut was performed first. The patient was asked to hold his breath, and the needle was inserted into the lesion under ultrasound guidance. Suction was applied while the needle was further advanced to the required depth. The tissue core specimen obtained was placed in formalin, except when infection was strongly suspected. In these cases, part of the specimen was placed in sterile saline solution. Trucut biopsy then followed along the same subcutaneous track, and the specimen was handled similarly. A single pass with both needles was performed in most cases. If this did not yield sufficient material, a further attempt was made. Special care was taken not to exceed the measured depth of the lesion. Although aerated lung beyond the lesion was punctured occasionally, the depth of penetration was minimal.

The specimens were initially examined by histopathologists routinely, and all were then reviewed by one of us (BLH).

RESULTS

A definitive histologic diagnosis was made in 46 of the 54 patients (85 percent); tissue from the remaining eight patients was nondiagnostic. Of the 46 patients, 41 had malignant lesions, and five were benign. Firm histologic subtyping was possible in all but two malignancies (epidermoid carcinoma in 11; adenocarcinoma in 17, including one metastatic breast cancer; poorly or undifferentiated large cell carcinoma in nine; small cell carcinoma in two). The exact nature of the latter two tumors was uncertain, but they may have originated from vascular and thymic tissue, respectively. There were no false positive results. The five benign lesions consisted of single cases of tuberculous involvement of rib and pleura, pulmonary tuberculosis, retrosternal thyroid, lung abscess, and fibrous pleural plaque. Apart from the two tumors of uncertain histogenesis, there was no disagreement between the initial histologic reports and the reviewer's diagnoses.

Details of the eight patients in whom biopsy did not reveal a diagnosis are shown in Table 1. Three of these patients had apical lesions out of a total of six apical and two mediastinal lesions in the whole series. Further investigation and subsequent clinical course proved or
strongly suggested that six of the lesions were malignant, and two were benign. Based on this, the overall diagnostic accuracy was 87 percent (41 of 47) for malignancy, and 71 percent (5 of 7) for benign lesions.

Figure 8 illustrates the influence of needle type on histologic diagnosis. Both Trucut and Surecut needles were used on 32 patients: results were concordant in 25 and discordant in seven. Of the latter group, three patients each were diagnosed on material obtained from one type of needle but not the other (carcinoma, five and TB, one). In the remaining patient, both biopsy specimens showed malignancy, but subtyping was possible in the Trucut specimen only (epidermoid carcinoma).

Figure 9 shows the effect of lesion size on diagnosis. Data are available in 36 patients for maximum diameter (mean 6.0 cm; SD 2.8 cm; range 1.5 to 11 cm) and in 34 patients for maximum depth (mean 4.8 cm; SD 2.1 cm; range 1 to 9 cm).

Complications include pneumothorax in two pa-

patients (4 percent; both with apical lesions), and hemorrhage in four patients (8 percent; one mediastinal lesion). Both pneumothoraces were detected on routine CXR after biopsy; the patients were symptomless and required no treatment. A single needle was used in one, and both types in the other. Of the hemorrhage group, one developed a small hemor-thorax (two types of needle), and two had trivial hemoptysis (single needle in one, and two types of needle in the other) which all resolved spontaneously. One patient with superior vena caval (SVC) obstruction had a vasovagal attack and moderate hemoptysis after biopsy with both types of needle and required a 500 ml blood transfusion. This was the only serious complication in the series (2 percent).

DISCUSSION

A lesion adjacent to the chest wall with no intervening aerated lung or bone can be detected by ultrasonography because it acts as an acoustic window which allows the penetration of ultrasound. In 1976, Chandrasekhar et al reported successful percutaneous biopsy of peripheral pulmonary masses under A- or B-mode ultrasound guidance in four patients. Since then, introduction of real time scanners enabled the operator to locate a lesion more accurately even though it might be moving because of cardiac pulsation or respiration. Compared with fluoroscopy-guided biopsy, this technique is less time-consuming and does not involve exposure to x-rays.

Our diagnostic rate of 85 percent is comparable to
those of the three largest studies using fine bore aspiration needles (100, 79, and 81 percent, respectively). However, no information on histologic subtyping of lung tumors was reported in the two larger studies, whereas, we could confidently classify nearly all our patients with malignancy even on specimens obtained with one type of needle. In other studies of fine needle lung biopsy (not ultrasound guided) in which tumor subtypes are reported, accurate identification of tumor cell type is not possible in one quarter to one third of cases. This additional information can affect management decisions, such as the administration of chemotherapy for small cell lung cancer.

In the case of benign lesions, a specific diagnosis could not be made in the majority of patients undergoing fine needle biopsies, whereas this was achieved in five of our seven patients (71 percent). The experience of Ikezoe et al, who performed both fine needle and Trucut biopsies, also suggests that the latter is superior: 63 vs 94 percent for malignant lesions, and 18 vs 78 percent for benign lesions, respectively. The difference in results is almost certainly due to the larger quantity of tissue required for the specific diagnosis of benign lesions.

Tissue core biopsies provide specimens suitable for routine histologic examination, a service available in all hospitals. Compared with fine needle aspiration biopsy, this is a major advantage since a highly skilled cytologist is not required. We suspect that the impressive diagnostic rates reported for fine needle lung biopsy, especially for malignant lesions, are at least in part due to the expertise of experienced cytologists, and this may not be freely available in most hospitals.

Of the eight patients whose biopsies were nondiagnostic, three had apical lesions (Table 1). There were, in total, six apical and two mediastinal lesions in our study. Localization and access are more difficult at these sites, and while both mediastinal lesions were diagnosed, we were successful with three of the six apical lesions only (50 percent). In contrast, fine needle aspiration biopsy was successful in eight patients with apical/superior mediastinal lesions who had a negative fluoroscopy guided biopsy. Ikezoe et al also thought that this technique was useful for apical tumors, although the diagnostic rate for their three apical and two periapical lesions was not specifically reported. It is possible that manipulation of a fine needle may be easier than the rigid, larger bore Trucut and Surecut at the apices, which are surrounded by bony structures and may need to be approached through the muscular posterior chest wall.

Three of the undiagnosed patients (cases 3, 4, 5, Table 1) had consolidation or collapse-consolidation of lung tissue. This may be difficult to distinguish from solid tumor on ultrasonography. In cases 3 and 5, the lung tumor was probably remote from the biopsy site. The other four patients with lung tumors (cases 2, 6, 7, 8) were probably true "misses," although coexisting severe silicosis in case 7 might have increased the difficulty in performing a biopsy of the thin-walled apical lesion.

Direct comparison of the two types of needle (Fig 8) suggests that neither is superior to the other. Results are concordant in 25 of 32 patients. Of the remaining seven patients, three were diagnosed by the Trucut, three were diagnosed by the Surecut, and one had malignant tissue in both specimens but subtyping was possible only in the Trucut material.

Available data on Lesion size (Fig. 9) suggests that even small lesions can be diagnosed. Although numbers are not large enough for firm conclusions, it appears that the diagnostic rate is less good for very...
small lesions (less than 2.5 cm maximum diameter), but is not influenced by the depth of the lesion.

Although complications occurred in 6 of 54 patients (11 percent), only one was serious: vasovagal attack and moderate hemoptysis requiring blood transfusion in a patient with SVC obstruction (2 percent). In retrospect, biopsy in patients with SVC obstruction should be approached with greater caution. Complications in the other five patients were trivial: symptomless pneumothorax in two, and slight hemoptysis or hemothorax in three. None required treatment, and the pneumothoraces and hemothorax would have remained undetected but for our policy of routine CXR after biopsy. Three of the six patients with complications had apical or mediastinal lesions, and both needles were used in four. It is probable that the site of the lesion, and multiple biopsies with large bore needles may account for the higher incidence of complications compared with studies using fine needles under ultrasound guidance (complication rate 0 to 2 percent).11,12

More frequent and serious complications occur in fluoroscopy-controlled lung biopsy using aspiration13,14 or cutting needles.15,16 In two recent studies of the latter,15,16 pneumothorax occurred in 17 and 26 percent of patients, respectively. Between 5 and 19 percent had hemoptysis, which was moderate in 0 and 7 percent. The necessity of penetrating pleura and lung to reach the deeper lesions, poor visualization of lesions in certain areas by fluoroscopy, and the effect of cardiopulmonary motion may all contribute to the higher complication rate when compared with our series. Complications appear to be related to the depth of the lesion, and severe hemorrhage was significantly higher in patients with lesions more than 8 cm from the skin surface.17 It has been recommended that the maximum penetration of the lung by a cutting needle should not exceed 3 cm18 or 4 cm19 beneath the pleura. Since ultrasound only detects superficial lesions abuting the chest wall, and the depth of our biopsies was determined by prior measurement, it is highly unlikely that penetration of lung tissue beyond the lesion would exceed even the most conservative safety recommendation of 3 cm.19

In conclusion, tissue-core biopsy of thoracic lesions adjacent to the chest wall under ultrasound guidance is an accurate and safe technique. Compared with fine needle aspiration biopsy, it is likely to yield more detailed diagnostic information in both malignant and benign lesions, and the skill of an expert cytologist is not required. However, it appears to be less ideal for apical lesions. Although the complication rate is higher, this is still acceptably low, and serious complications are very uncommon.

REFERENCES
2 Ikezoe J, Sone S, Higashihara T, Morimoto S, Aisawa J, Kuriyama K. Sonographically guided needle biopsy for diagnosis of thoracic lesions. AJR 1984; 143:229-34
3 Pedersen OM, Aasen TB, Gulvkv A. Fine needle aspiration biopsy of mediastinal and peripheral pulmonary masses guided by real-time sonography. Chest 1986; 89:504-08
5 Cint D, Hawkins HB. Aspiration biopsy of peripheral pulmonary masses using real-time sonographic guidance. AJR 1984; 142:1115-16
7 Torp-Pedersen S, Juul N, Vyberg M. Histological sampling with a 23 guage modified Menghini needle. Br J Radiol 1984; 57:151-54
Biploy of Thoracic Lesions (Pang et al)


18 Zavala DC, Bedell GN. Percutaneous lung biopsy with a cutting needle. Am Rev Respir Dis 1972; 106:186-93