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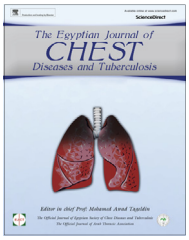

ORIGINAL ARTICLE

Ultrasound-guided forceps for pleural biopsy

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KEYWORDS

Pleura;
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Abstract *Purpose:* Ultrasound guided forceps for pleural biopsy is a technique that can cover the diagnostic yield gap between the needle biopsy of the pleura and thoracoscopy or thoracotomy. This technique enables operator to take biopsy from multiple pleural sites. Study objectives were: (1) to describe the ultrasound guided forceps for pleural biopsy as a technique not in common use in our practice to obtain pleural biopsy. (2) To evaluate the diagnostic yield of this technique in undiagnosed exudative pleural effusion.

Methods: This study included 96 patients admitted to Chest Department – Assiut University Hospital during the period from March 2010 to January 2012. All patients had exudative pleural effusion with the first pleural tapping being undiagnostic. Patients with bleeding tendency or blood coagulation defects were excluded from the study. Each one was submitted for the procedure once. The equipment used were ultrasound apparatus (ALOKA – Prosound – SSD – 3500SV), biopsy forceps (KARL – STORZ – Germany 10329L – BS), trocar and cannula of Cope's needle and rubber inlet seal. The procedure was performed under local anesthesia (Xylocaine 2%) and aseptic condition. The patients were premedicated by analgesic (Ketorolac thromethamine 20 mg). Three to five biopsy fragments were obtained from each case and sent in 10% formaldehyde to the pathology laboratory. All patients were submitted for thoracoscopy under local anesthesia and thoracoscopic forceps biopsies of pleura were taken.

Results: Compared to thoracoscopy the sensitivity of ultrasound guided forceps pleural biopsy in the diagnosis of malignant and tuberculous lesions was 85% and 88% respectively. The technique was absolutely specific in the diagnosis of malignant and tuberculous lesions.

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Conclusions: Ultrasound-guided forceps for pleural biopsy is a simple, efficient, and safe procedure. It can be carried out easily and safely even in sick and obese patients. On the other hand, the procedure appears similar to the thoracoscopy in obtaining adequate pleural tissue specimens. Yet, it is simpler and less traumatic.

Clinical implications: Ultrasound-guided forceps for pleural biopsy can overcome many of the limitations of the conventional needle biopsy procedures, provides multiple biopsy specimens of the parietal pleura that are inaccessible to the biopsy needle, and can be carried out easily and safely even in sick and obese patients. The diagnostic yield is nearly similar to thoracoscopy.

Introduction

Pleural effusion is an important and common clinical finding. In some diseases it represents the initial or only sign and its presence can alter the prognosis and treatment of concomitant disease.

Physical, biochemical, bacteriological and cytological examinations of pleural fluid are important for etiological diagnosis. However, the etiology of pleural effusion may be obscure after initial thoracentesis in a significant proportion of patients [1,2]. In addition to thoracotomy and open pleural biopsy; various biopsy techniques are available to diagnose pleural disease. These range from older techniques such as blind or closed needle biopsy of the pleura, to newer techniques including image-guided and thoracoscopic pleural biopsy [3]. Closed needle biopsy of the pleura is a routine invasive investigation in the etiologic diagnosis of exudative pleural effusion. The diagnostic accuracy of the needle biopsy however, is limited because it takes pleural tissues from around a single puncture site. Moreover, biopsy of extra pleural tissue is possible [4].

Thoracoscopy and thoracotomy are the ultimate diagnostic options. These procedures enable us to take biopsy from multiple pleural sites under vision. However, these latter procedures are associated with certain complications and discomfort to the patient [5,6]. One of the image-guided procedures is forceps biopsy of the pleura under sonographic guidance which enable the physician to take biopsy from multiple pleural sites and can cover the diagnostic yield gap between the needle biopsy and the more invasive procedures such as thoracoscopy and thoracotomy [7,8].

So the aims of this study are: (1) to describe the ultrasound-guided forceps for pleural biopsy as a technique not in common use in our practice to obtain pleural tissue. (2) To evaluate the diagnostic yield of this technique in undiagnosed exudative pleural effusion.

Materials and methods

This prospective interventional study conducted in the Ultrasound Unit – Chest Department – Assiut University Hospital during the period from March 2010 to January 2012. This study included a total number of 96 patients who were admitted to our Chest Department, Assiut University Hospital, all of them had exudative pleural effusion with the first pleural tapping was non-diagnostic. Also all of them were eligible to do medical thoracoscopy in our endoscopy unit using semi-rigid thoracoscope (LTF; Olympus; Tokyo, Japan). Patients with bleeding tendency or coagulation profile abnormalities were excluded from the study. Each one was submitted for the procedure once after their agreement to contribute to this study. The equipment used were ultrasound apparatus (ALOKA – Prosound – SSD – 3500SV), biopsy forceps (KARL – STORZ – Germany 10329L – BS)(Fig. 1), trocar and cannula of Cope's needle and rubber inlet seal (this specimen usually fixed at the proximal port of light bronchoscope chanell) as shown in (Figs. 2 and 3).

The Procedure (Figs. 4–11) is performed using the free-hand technique under sonographic observation. The targeted skin site for instrument introduction is determined according to the site of the pleural lesion which is identified by US. The patient is then premedicated by analgesic (Ketorolac thromethamine 20 mg) and lying either in a sitting or semi-recumbent position. The skin at the biopsy site is cleaned and anesthetized with 5–10 ml of 2% xylocaine followed by making a stab incision with No. 11 scalpel blade along the intended biopsy track. The skin incision is followed by introduction of the trocar and cannula into the pleural space. The trocar is then withdrawn and the mouth at the cannula occluded with the thumb simultaneously with closure of the cannula valve to prevent leaking any air into the pleural cavity. Rubber inlet seal is then fixed at the mouth at the cannula to ensure that no fluid or air could pass during introduction of the forceps. During forceps introduction through the cannula the valve is opened and simultaneously the US probe is applied to the chest wall using sterile jell. The operator holds the probe and the cannula while the assistant holds the forceps which is directed sonographically to the targeted pleural lesion to take biopsy. Following biopsy, the forceps is withdrawn gradually and the cannula valve closed. Further biopsy from different sites is achieved by the reintroduction of the forceps and changing the angle of the cannula at the skin simultaneously with the changing position of the US probe. All biopsies are

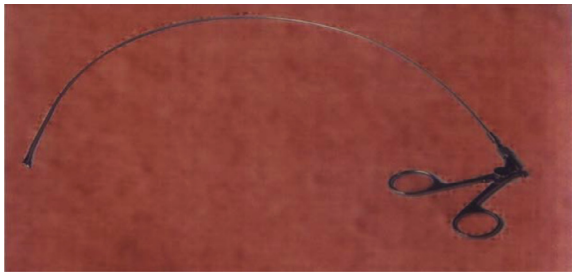

Figure 1 Biopsy forceps (KARL – STORZ – Germany 10329 – BS).

Figure 2 Trocar and cannula of Cope's needle.

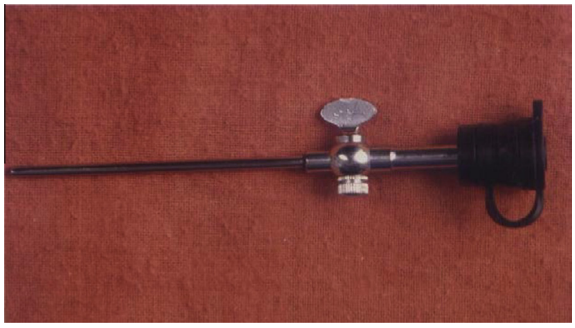

Figure 3 Rubber inlet seal fixed at the proximal port of Cope's cannula.

Figure 4 Lesion identification by US.

placed in 10% formalin and sent to the pathologist for histopathological examination.

Results

During the period from March 2010 to January 2012, 96 patients with exudative pleural effusion underwent ultrasound guided forceps for pleural biopsy, all of them were eligible to do medical thoracoscope in our endoscopy unit for the purpose of evaluating a new technique in diagnosing exudative

Figure 5 Determination of the targeted skin site for instrument introduction.

Figure 6 Local anesthesia after skin cleaning.

Figure 7 Small skin incision with No. 11 scalpel blade along the intended biopsy track.

pleural effusion. Table 1 shows that fifty-two of the cases were successfully diagnosed as having malignant pleural effusion, 32 (61.6%) of them were male and 20 (38.4%) were female with mean age 55.7 ± 12.7. Also 32 patients were diagnosed as having tuberculous pleural effusion, 21 (65.7%) of them were male

Figure 8 Introduction of Cope needle into the pleural space.

Figure 9 Rubber inlet seal is fixed at the mouth of the cannula after trocar withdrawing.

Figure 10 Forceps introduction through the cannula and its direction determined sonographically to the targeted lesion to take biopsy.

while 11 (34.3%) were female with younger mean age 24.8 ± 5.7. Non-specific pleuritis was detected in 11 patients while pleural fibrosis was detected in only one patient. Table 2 shows the overall histopathological results obtained by US-guided biopsy forceps of the pleura and thoracoscopic biopsy where 44 patients were diagnosed as having malignant pleural effusion. All of them have the same histopathological results by medical thoracoscope. Six patients were diagnosed as having suspicious malignant pleural effusion via US-guided

Figure 11 Gradual withdrawing of the forceps after cutting biopsy.

biopsy forceps technique, however by thoracoscope 4 of them were diagnosed as having malignant pleural effusion while 2 patients were still diagnosed as having suspicious malignant pleural effusion however with follow up there was radiological evidence of malignancy and they developed rapid accumulation of pleural fluid; so they were considered as having malignant pleural effusion. All patients who were successfully diagnosed as having tuberculous (28 patients) by US-guided biopsy forceps technique have the same results when doing thoracoscope. Those who were diagnosed as having non specific pleuritis (12 patients) by US-guided biopsy forceps technique revealed to have the same results by medical thoracoscope except one patient who was diagnosed as having TB pleural effusion via thoracoscopic specimens. Follow up of the remaining 11 patients for 4 months showed no recurrence of the pleural effusion with no evidence of malignant or tuberculous lesions. Three patients were diagnosed as having pleural fibrosis using US-guided biopsy forceps technique while one of them revealed to be having TB effusion on doing thoracoscope and two patients still had the same pathology however with follow up one of them was clinically and laboratory correlated to be having TB lesion and improved on anti-TB management. The second one was diagnosed as collagen disease and missed follow up. Normal pleural tissue was detected in pleural specimens obtained using US-guided biopsy forceps technique in 3 patients, two of them were diagnosed as having malignant lesion and one as TB lesion by medical thoracoscope. Measuring the validity of US-guided biopsy forceps technique among 96 patients as regards the diagnosis of malignant effusion revealed that it has 85% sensitivity, 100% specificity and 92% diagnostic accuracy (Table 3). Also measuring the validity of US-guided biopsy forceps technique among 96 patients as regards the diagnosis of tuberculous effusion revealed that it has higher sensitivity (88%), 100% specificity and higher diagnostic accuracy (96%) (Table 4).Table 5 showed that the US-guided biopsy forceps technique was generally well tolerated by the patients with no major complications recorded. Small pneumothorax was detected in 6 patients, subcutaneous pleural fluid leakage in 5 patients and local chest pain in 6 patients.

Discussion

The importance of this work originates from the fact that the etiology of pleural effusion may frequently constitute a diagnostic difficulty. A variety of procedures are available and could be used for obtaining pleural biopsy to determine the cause of pleural effusion. Most of these pleural biopsy procedures are fully evaluated [3].

Table 1 Age and sex distribution of 96 patients with pleural effusion of different final pathological diagnosis.

Final pathology of pleural effusion	Sex (No. & %)			Age (yr)	
	Male	Female	Total	Range	Mean ± SD
Malignant	32 (61.6%)	20 (38.4%)	52	25–75	55.7 ± 12.7
Tuberculosis	21 (65.7%)	11 (34.3%)	32	17–36	24.8 ± 5.7
Non-specific pleuritis	7 (63.7%)	4 (36.3%)	11	30–50	40 ± 10
Pleural fibrosis	1	–	1	32	32
Total	61 (63.6%)	35 (36.4%)	96	17–75	45.4 ± 17.7

Table 2 The overall histopathological results obtained by US-guided biopsy forceps of the pleura and thoracoscopic biopsy.

Histopathological results	US-guided biopsy	Thoracoscopic biopsy
Malignancy	44	50
Suspicious Malignancy	6	2
Tuberculosis	28	31
Non-specific pleuritis	12	11
Pleural fibrosis	3	2
Normal pleural tissue	3	–
Total	96	96

Many studies revealed that even after several modifications of needle design and biopsy procedures, the needle biopsy technique continues to have several limitations. Closed needle biopsy allows taking biopsy only from the costal part of the parietal pleura around the site of needle introduction and cannot take biopsy from the diaphragmatic and mediastinal parts where these sites are more commonly affected than the costal part especially in malignant effusion [9]. Pleural tissue may be absent from the needle specimen or it may be inadequate or unsuitable for proper diagnosis in about 2% to 14% of cases [10–12].

The biopsy of extra pleural tissues occurred in 0.8% of cases during the needle biopsy. The incidence being higher (16%) with minimal fluid [12,13]. Moreover, needle biopsy of the pleura is usually performed with the patient in a sitting position which may not be a comfortable position for sick or obese patient [4]. Regarding the diagnostic yield, needle biopsy is usually positive in 40–60% of patients with malignant pleural disease while in patients with tuberculosis, it is positive for granuloma in 50–80% [14].

On the other hand, thoracoscopy using a rigid thoracoscope or newer semi flexible thoraco fiberscope, allows visually guided multiple biopsies from different parts of the pleura, thereby yielding better results than those achieved by needle biopsy [5,15]. It is indicated if the cause of pleural effusion remains undiagnosed after the needle biopsy procedure. Moreover, thoracoscopy helps to perform pleurodesis and to provide rapid symptomatic recovery due to complete drainage [16]. Thoracoscopy can be performed under sedation and local anesthesia by trained pulmonologists, but requires special instruments. Currently, the expertise and newer instruments are not widely available, and semi flexible thoracoscopy provides only small biopsy specimens. Thoracoscopy also requires chest tube drainage for lung expansion and is associated with complications, particularly in sick patients [15]. Regarding yield of thoracoscopy, the diagnostic sensitivity of this procedure is 93–97% in patients with tuberculous or malignant pleural disease [14].

Table 5 Complications of the US-guided biopsy forceps of the pleura.

Types of complications	No.
Small pneumothorax	6
Subcutaneous pleural fluid leakage	5
Local chest pain	6

Table 3 Parameters of validity of US-guided biopsy forceps of the pleura among 96 patients as regards diagnosis of malignant effusion.

Malignancy (present) No. (52)		Malignancy (absent) No. (44)		Sensitivity (%)	Specificity (%)	+ve Predictive value (%)	−ve Predictive value (%)	Diagnostic accuracy (%)
True positive No. (44)	False negative No. (8)	False positive No. (0)	True negative No. (44)	85	100	100	85	92

Table 4 Parameters of validity US-guided biopsy forceps of the pleura among 96 patients as regards diagnosis of tuberculous effusion.

Tuberculosis (present) No. (32)		Tuberculosis (absent) No. (64)		Sensitivity (%)	Specificity (%)	+ve Predictive value (%)	−ve Predictive value (%)	Diagnostic accuracy (%)
True positive No. (28)	False negative No. (4)	False positive No. (0)	False positive No. (64)	88	100	100	94	96

In this work we aimed at evaluating one of the image-guided procedures which is not routinely used in our practice despite its potential safety and diagnostic value. This is the US-guided biopsy forceps of the pleura [7]. In this procedure we tried to take multiple bites from different sites and parts of the parietal pleura or from sonographically detected parietal pleural lesions using instrument set composed of different pieces previously mentioned in the material and method. This procedure can overcome many of the limitations of the conventional needle biopsy procedures. It can be performed while the patient is lying either in a sitting or semi-recumbent position. The technique provides multiple pleural biopsy specimens from parts inaccessible to the biopsy needle. It is not possible to find extra pleural tissue in the biopsy taken by this procedure.

On the other hand US-guided forceps biopsy of the pleura is simpler, less traumatic, more suitable and comfortable than thoracoscopy and thoracotomy, and can be carried out easily and safely even in very sick and obese patients [4,7,8]. Using the US-guided forceps, it was possible to get the final pathological diagnosis in 11 out of 12 patients with pleural effusion as reported previously by Seitz et al. [7].

Nearly similar idea and technique were used by Uthaman et al. but under fluoroscopy guidance and they could achieve diagnosis in 26 out of 28 cases [4]. In our study US-guided forceps biopsy of the pleura helped us to reach final pathological diagnosis in 84 out of 96 patients with pleural effusion. The sensitivity of ultrasound-guided forceps pleural biopsy in the diagnosis of malignant and tuberculous lesions was 85% and 88% respectively. The technique was absolutely specific in the diagnosis of malignant and tuberculosis lesions. The diagnostic accuracy of our procedure for both lesions was 92% and 96% respectively.

Conclusions

Ultrasound-guided forceps for pleural biopsy is a simple, efficient, and safe procedure. It can be carried out easily and safely even in very sick and obese patients. On the other hand, the procedure appears similar to the thoracoscopy in obtaining adequate pleural tissue specimens, yet, it is simpler and less traumatic.

Conflict of interest

None.

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