

The role of percutaneous ultrasound-guided true-cut needle biopsy in patients with sheet-like pleural thickening

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Background

Pleural biopsy for histological confirmation is the standard diagnostic procedure for pleural diseases.

Aim

To identify the role of percutaneous ultrasound (US)-guided true-cut needle biopsy in patients with sheet-like pleural thickening.

Patients and methods

A prospective interventional simple controlled trial was conducted on 60 patients with computed tomographic evidence of pleural thickening. Percutaneous US-guided pleural biopsies using a true-cut needle were performed for pathological tissue characterization; complications were recorded.

Results

All patients were diagnosed, with only five (8%) patients found to have self-limiting pneumothorax, with no need for a chest tube. Fifty-three percent of patients had a histopathological diagnosis of mesothelioma, 14% had a histopathological result of adenocarcinoma, whereas 33% had chronic fibrosing pleuritis.

Conclusion

The US-guided procedure has a major advantage as it is being real time, rapid, available bedside, and well tolerated, and no serious complications were observed in good case selection and procedure.

Keywords:

closed pleural biopsy, computed tomography, medical thoracoscopy, ultrasound

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Introduction

Pleural effusions are a common clinical problem with more than 50 recognized causes. The exudative pleural effusion is more worrisome of malignancy. If the pleural effusion is associated with sheet-like pleural thickening, the probability of malignancy is high. Malignant pleural effusion has many causes, mostly metastasis (bronchogenic, breast, etc.) or primary mesothelioma, especially in habitats near industrial regions. The first and most important differential diagnosis of exudative effusion associated with thickening is a chronic inflammatory process, mostly tuberculosis [1].

Determination of a specific diagnosis can represent a major difficulty. Pleural biopsy for histopathological confirmation is the standard diagnostic procedure for pleural diseases. Aspiration cytology, Abrams needle closed pleural biopsy (CPB), thoracoscopic guided, and ultrasound (US)-guided and computed tomography (CT)-guided assessed biopsy are various tools to achieve our target [2].

The Abrams needle is the instrument most commonly used for closed biopsy of the parietal pleura. It allows aspiration of pleural fluid, thus confirmation that the

needle has entered the pleural space. However, the Abrams needle is not suitable for a patient with a scanty of free or loculated effusion because of the danger of lacerating the lung, liver, or spleen. The diagnostic yield of CPB with respect to malignant pleural effusion is low because of patchy involvement of the pleura in malignant pleural effusion. Also, pleural malignant deposits tend to be predominant close to the midline and diaphragm, which are areas that are best avoided when performing CPB [3].

However, medical thoracoscopy requires a degree of expertise and is not available in many parts of the world as it is relatively complicated to perform, especially in frail patients; therefore, image-guided pleural biopsies are the preferred initial diagnostic procedure [4].

Chest sonography has been found to be useful in detecting pleural and pleural-based lesions and evaluating pleural involvement by lung tumor as well

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as defining localizing loculated or minimal effusion before thoracentesis [5].

The true-cut needle is a thin, disposable instrument with a sharp cutting edge. A tissue core up to 20 mm in length can be obtained with its use. The depth of insertion can be guided by the thickness of the pleura as measured by CT.

US-assisted true-cut needle biopsy is preferred than blinded (CPB) or thoracoscopy as it is an easy, low-cost, adequate, and real-time interventional procedure that allows better and adequate readjustment of the needle, obliquity of access, direction, and depth of penetration and use of color Doppler imaging allows to avoid traversing the vascular element. Visualization of the aerated lung allows to decrease the incidence of complications such as pneumothorax, hemothorax, and lung laceration [6].

Patients and methods

A prospective interventional simple controlled trial was conducted on 60 patients with CT evidence of pleural thickening. They were recruited from the inpatient as well as the out-patient clinic of Thoracic Medicine Department being referred to the interventional radiology unit, Bab El Sheria, Al-Azhar University Hospitals, during the period from March 2015 to October 2017. Patients were recruited after they had signed a written consent after a detailed explanation of the study protocol was provided. Local ethical approval had been obtained.

Inclusion criteria were as follows: patients with pleural thickening either mass or sheet-like thickening with or without pleural effusion.

Exclusion criteria were as follows:

- (1) Previously known etiology of pleural effusion.
- (2) Patients with bleeding tendency or blood coagulation defects.
- (3) Markedly obese patients.

Procedure

Prior detailed clinical examination with cross-sectional imaging mostly CT scan were done to all patient for full evaluation of pleural thickening in patient with or without pleural effusion not respond to medical treatment.

Written consent was obtained and an explanation of the procedure was provided for all patients before the

procedure. The patients' age ranged from 29 to 65 years. All patients underwent routine bleeding profile labs including hemoglobin level. Anticoagulant therapy was postponed before the procedure. The patient was kept fasting at least 6 h before biopsy. High-frequency probing US examinations of the pleura were performed to detect the thickest, accessible as well as safest segment of the pleura to be biopsied. The posterior approach was preferred than the anterior approach if diffuse thickening was present. Thickening adjacent to the effusion is preferred to thickening without or far from effusion as the effusion is considered a safe backup space if the needle tip traverses the entire lesion thickness. Doppler assessment of the pleural thickening, as well as the access where the needle to pass, is mandatory to avoid vascular injury. For a very thin pleural thickening less than 1 cm, usually, an oblique approach is applied for trial to get more elongated core as much as we can. The skin at the biopsy site was sterilized and anesthetized.

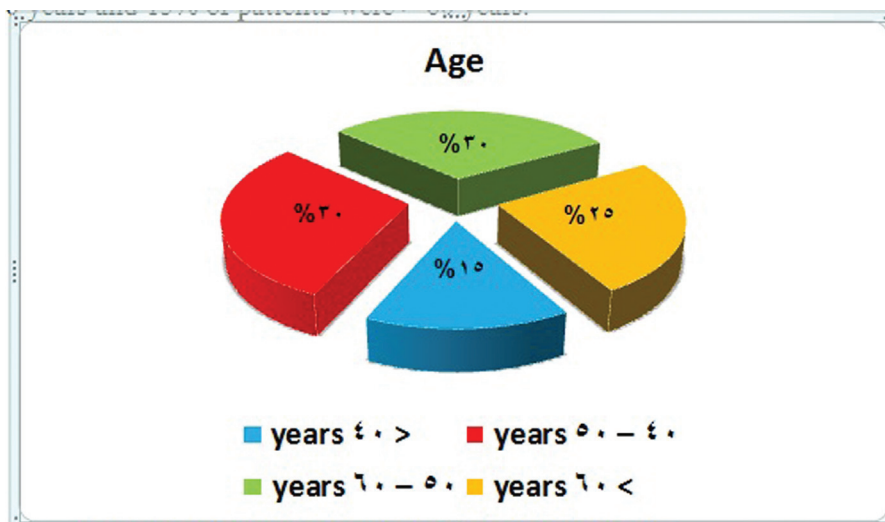
Flushing of the entry site was performed with a local anesthetic spray and then injection of 5–10 ml of 2% xylocaine local anesthesia usually under US guidance for infiltration of the needle access till the outer pleural surface, followed by making a stab incision with a size 11 scalpel blade alongside the intended biopsy track. The skin incision was followed by the introduction of automatic true-cut needle biopsy 18 G with a specimen notch of 20 mm (or 16 G if favorable pleural thickness) was fired when traversing the adequate length of the thickened pleura. The biopsy sample was placed inside a small tube containing diluted formalin and then sent to the histopathology unit.

Adequate postprocedure care: the pleural biopsy site was re-examined by means of US immediately after the procedures for suspected pneumothorax. Chest radiograph was performed for all patients. All patients were observed for at least 1 h before discharge and 24 h close follow-up was performed if any complication was detected.

Results

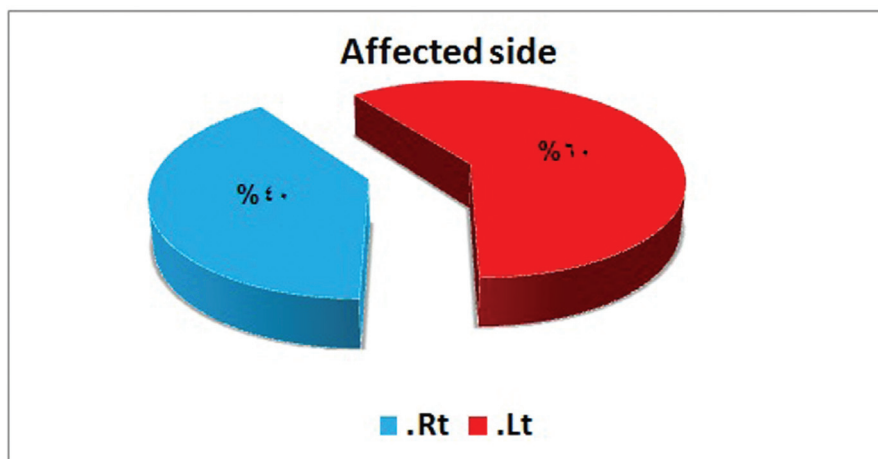
In our study, 60 patients with pleural thickening were subjected to chest US-assisted true-cut needle biopsy. Their age ranged from 29 to 65 years; the mean age was 50.9 ± 10.2 . Fifteen percent of the patients were less than 40 years, 30% of patients were 40 to 50 years, 30% of patients were 50–60 years, and 15% of patients were more than 60 years of age (Fig. 1).

Figure 1



Description of age of the studied patients.

Figure 2



Description of the affected side of the studied patients.

Table 1 Sex distribution of the studied patients

Variables	Sex of studied patients [n (%)]
Sex	
Male	27 (45)
Female	33 (55)

Table 1 shows the sex distribution of the studied patients. Fifty-five percent (33 patients) of the patients were females and 45% (27 patients) of the patients were males.

About 60% (36 patients) of the patients were right sided and 40% (24 patients) of the patients were left sided (Fig. 2).

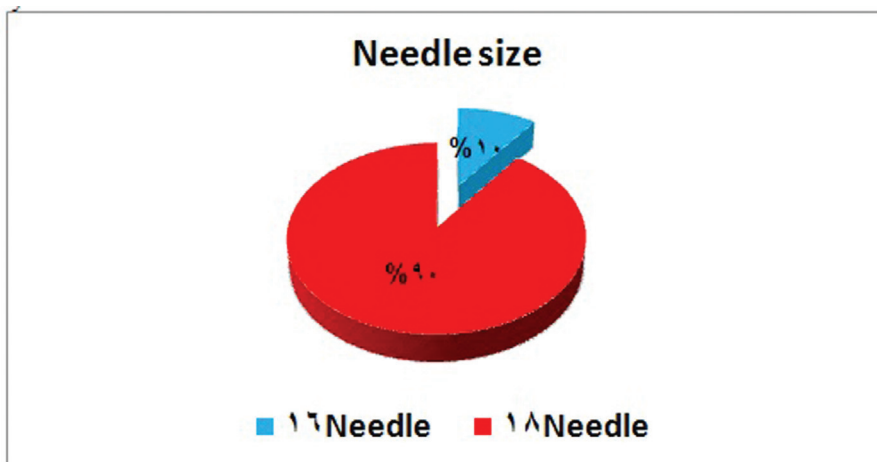
Twenty eight percent (17 patients) of the patients were approached anteriorly, whereas 72% (43 patients) were approached posteriorly (Table 2).

In terms of the needle size used in the procedure, in 10% (six patients) of the patients, needle 16 G was used and in 90% (54 patients), needle 18 G was used (Fig. 3).

According to the histopathological examination of the taken cores, the patients were divided into three groups; 14% (eight patients) of the patients had adenocarcinoma, 33% (20 patients) of the patients had chronic fibrosing pleuritis, and 53% (32 patients) of the patients had malignant mesothelioma (Table 3 and Fig. 4).

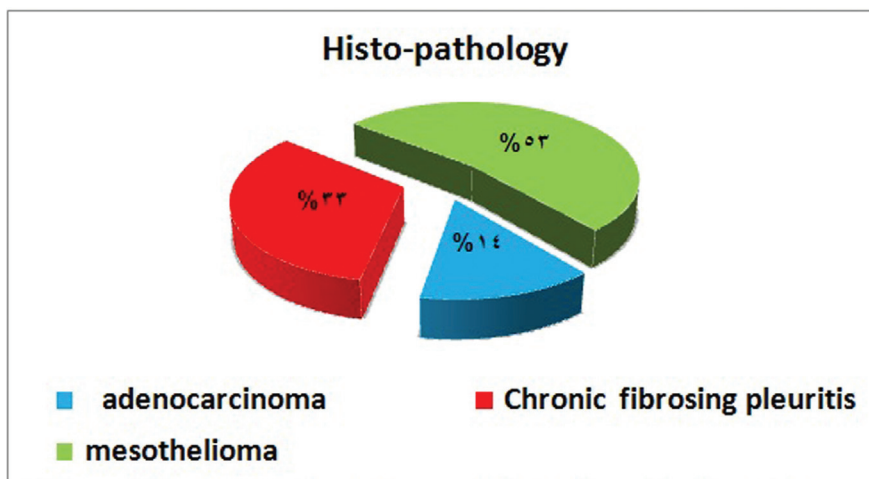
In terms of pleural thickening, thirty nine (65%) out of the sixty patients had thin sheet-like pleural thickening (smooth), while the remaining 21 patients (35%) had nodular sheet-like pleural thickening (Table 4).

Figure 3



Description of needle size used in the procedure.

Figure 4



Causes of pleural thickening in the studied patients.

Table 2 Description of the approach of the studied patients

Variables	Approach [n (%)]
Approach	
Anterior	17 (28)
Posterior	43 (72)

Table 3 Description of histopathological examination of the taken cores

Variables	Histopathology [n (%)]
Histopathology	
Adenocarcinoma	8 (14)
Chronic fibrosing pleuritis	20 (33)
Mesothelioma	32 (53)

In terms of the incidence of complications, 92% (55 patients) of the patients did not develop complications and 8% (five patients) developed self-limited pneumothorax (Fig. 5).

Discussion

Chest US has developed rapidly in the last decade, being useful in the evaluation of many chest wall, pleural as well as peripheral pulmonary parenchymal diseases [6].

It is an easy bedside test that is used on a wide scale as a primary investigation in the ICU and nowadays, it is even included in the FAST scan in emergency units [7].

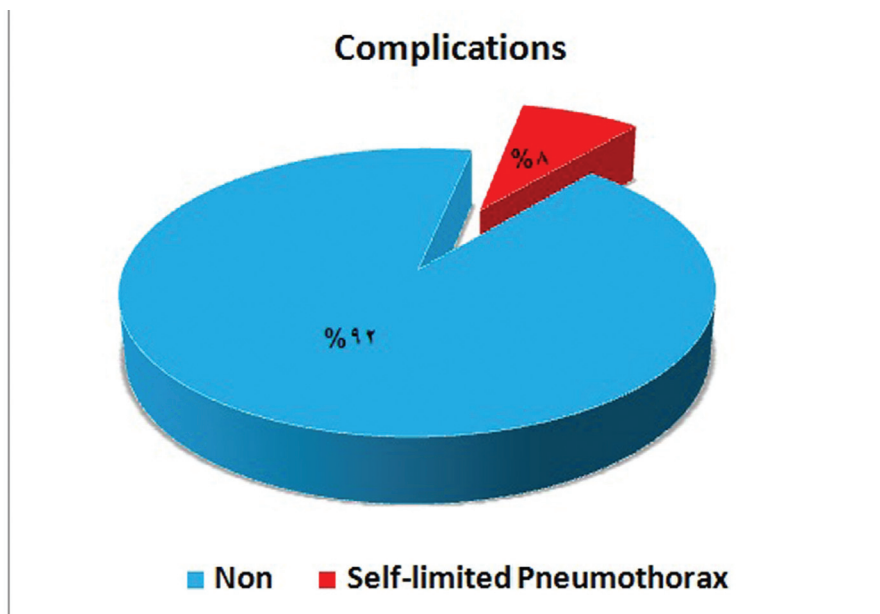
Chest US is used in guiding biopsy, thoracocentesis, and other interventional procedures of the lung, pleural space, and mediastinum as well.

In our study, we used a curved sector probe for examination of the chest usually after a previous CT

Table 4 Description of thickening of the pleura in the studied patients

Variables	Thickening [n (%)]	
	Thin sheet like (smooth)	Nodular sheet like
Size (cm)		
<1	33 (85) Mean=7.1±1.7 mm	0
>1	6 (35) Mean=15.5±1.7 mm	21 (100) Mean=16.7±8.3 mm
Total	39 (65)	21 (35)

Figure 5



Description of the complications that occurred.

scan to localize the thickest portion of the lesion with the safest access and then used either a superficial high-frequency linear rather than sector probe in the biopsy procedure according to the better image and depth of the chest wall. True-cut needle biopsy was feasible even without significant pleural effusion, and less invasive and more accurate than thoracoscopic biopsy, being real time in terms of access and depth of the traversing needle.

Case number 1

A male patient, 53 years old, had right-sided nodular pleural thickening without a right posterolateral approach of 18 G needle. Histopathology indicated epithelial mesothelioma (Fig. 6 and Microphoto 1).

Case number 2

A male patient, 60 years old, with left nodular pleural thickening, was biopsied with a 16 G needle anterolateral approach. Histopathology indicated epithelial mesothelioma (Fig. 7 and Microphoto 2)

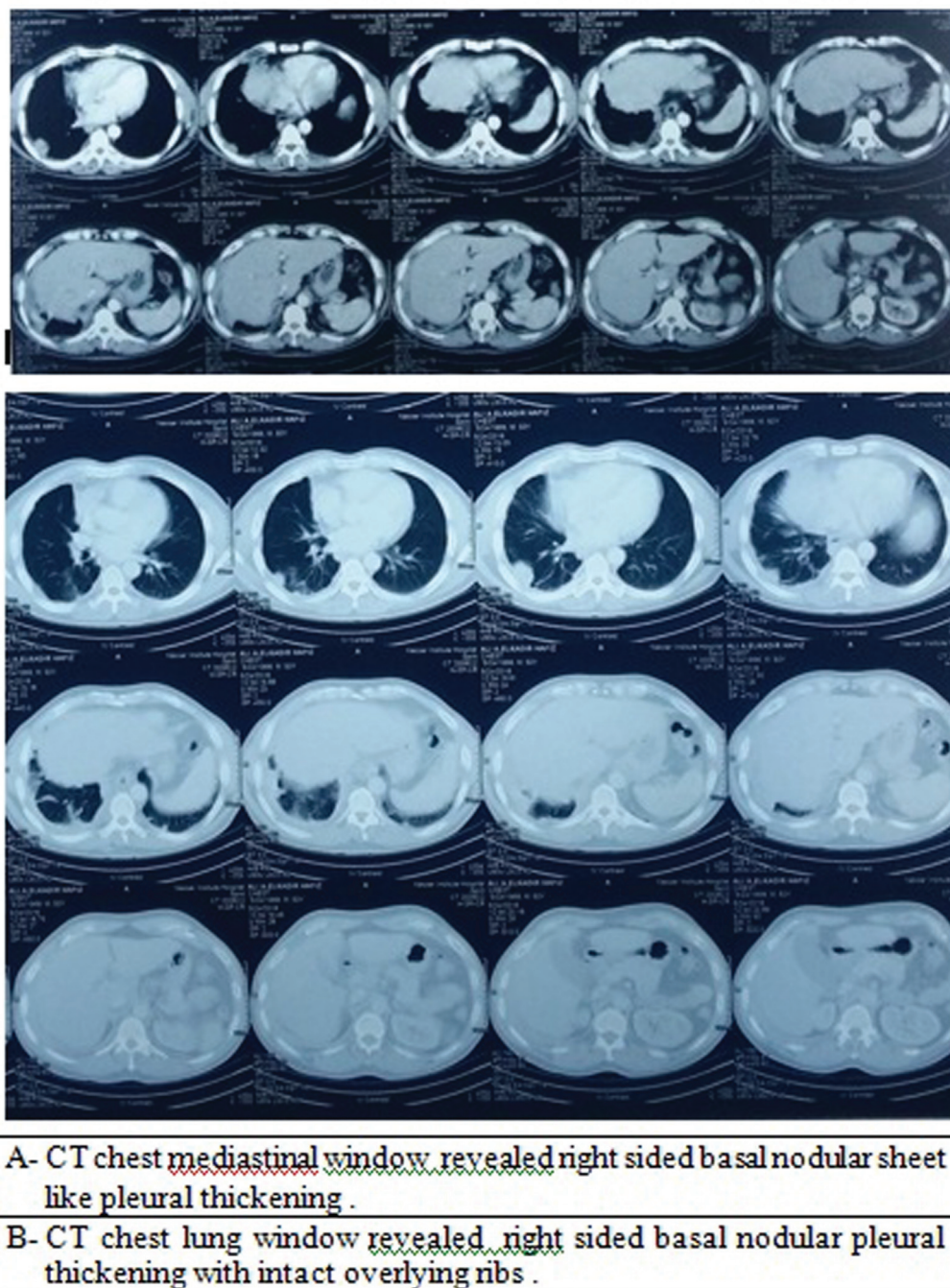
In our study, forty eight patients out of the sixty patients was diagnosed by the procedure While two

cases not diagnosed by the procedure and re-biopsy was performed and revealed inflammatory fibrosing alveolitis (Microphoto 3).

The current study was carried out on 60 patients; their age ranged from 29 to 65 years, with a mean age of 50.9±10.2. Thirty two (67%) out of the sixty patients was malignant, 24 out of the 32 cases (53%) were malignant mesothelioma, while 8 cases (14%) were metastatic Adenocarcinoma microphotograph 4. This is in agreement with the Metintas and colleagues study, they found 49 out of 75 cases with malignant disease (65.3%) patients. As regard Ahmed *et al.* [8] 48 patients with malignancy of 60 (80%) patients with relatively higher percent of mesothelioma in our study about 53% compared with 36% in Metintas *et al.* [6] - 38% in Bahr *et al.* [9]. Forty-three percent in Lee *et al.* [10] studies likely related to the residence of our patient may be related to industrial area.

If pleural thickening was less than 1 cm with effusion, the cutting needle was carefully introduced through the incision site at 45° to the skin in the direction of the

Figure 6



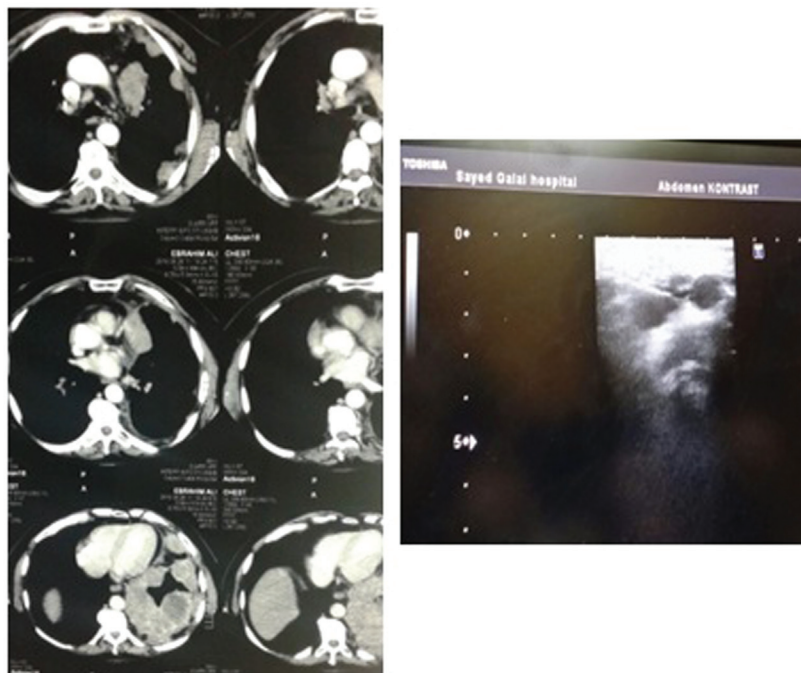
(a) CT chest mediastinal window indicated right-sided basal nodular sheet-like pleural thickening. (b) CT chest lung window indicated right-sided basal nodular pleural thickening with intact overlying ribs. CT, computed tomography.

chosen intercostal space above the lower rib to the depth indicated by US.

Fortunately, in our study, all cases - with pleural thickening - were diagnosed by the procedure (96.7%) of the studied cases, except two cases (3.3%) where the biopsy was insufficient for diagnosis, & re-biopsy in these two patient revealed inflammatory lesions, compared to a study by Lee and colleagues they diagnosed 80% of pleural biopsied patient & (6 out of the 30 patients (20%) were not diagnosed by the

procedure [10]. As well as 46% in Bahr *et al.* [9]. This may be attributed to good prebiopsy case selection, adequate oblique access based on prebiopsy cross-sectional CT images as well as real-time imaging. In our study, we excluded cases with focal pleural thickening underlying broad ribs limits access. US-guided pleural true-cut biopsies were well tolerated, and no serious complications were observed. Only five (8.3% of all patient) patients had self-limited pneumothorax that was observed for 24h, with no need for chest tube insertion compared with one

Figure 7

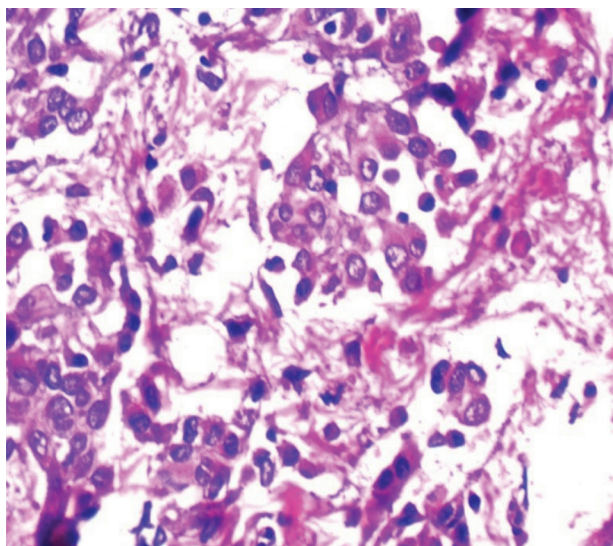


A- CT chest mediastinal window revealed left sided nodular pleural thickening involving both costal and mediastinal pleural reflection .

B- High frequency ultrasound with nodular hypoechoic pleural thickening biopsied with true cut needle biopsy in oblique course .

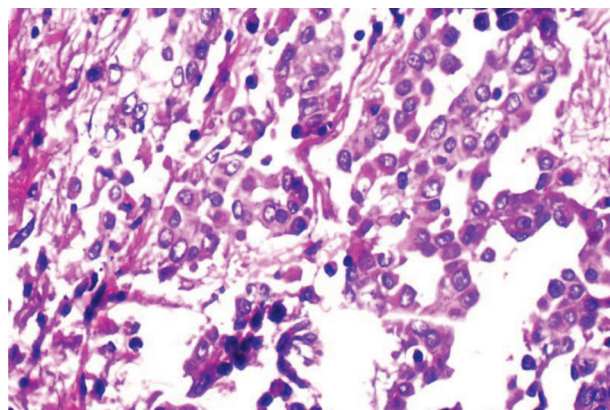
(a) CT chest mediastinal window indicated left-sided nodular pleural thickening involving both costal and mediastinal pleural reflection. (b) High-frequency ultrasound with nodular hypoechoic pleural thickening biopsied with true-cut needle biopsy in oblique course. CT, computed tomography.

Microphoto 1



Shows malignant Mesothelioma, the epithelial cells are arranged in groups the Tumor cells have acidophilic cytoplasm, and are cubical or flattened, with relatively uniform vesicular nuclei with prominent nucleoli. H&E $\times 400$.

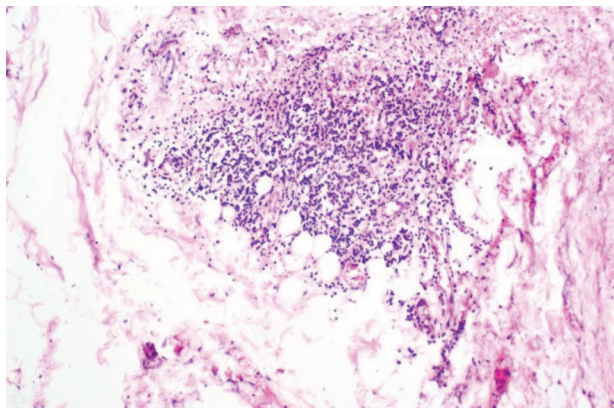
Microphoto 2



Shows malignant Mesothelioma, the epithelial cells are arranged in papillary and tubular patterns of growth. Tumor cells have acidophilic cytoplasm, and are cubical or flattened, with relatively uniform vesicular nuclei with prominent nucleoli. H&E $\times 400$.

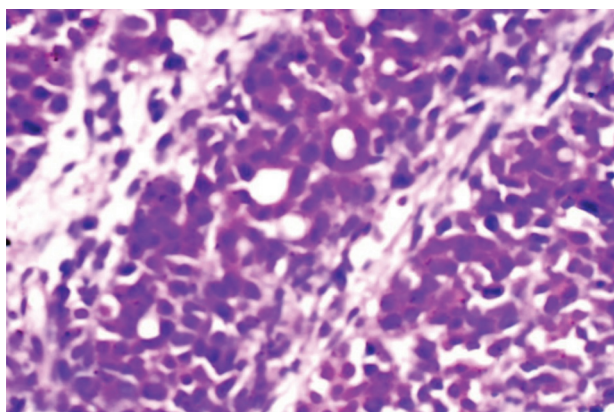
patients over 20 (5%) in Ahmed *et al.* [8]. Postprocedure pain was noted in 36 (60%) patients compared with 18 of 20 (90%) patients in Ahmed *et al.* [8].

Microphoto 3



Show fibrous tissue of the Pleura infiltrated by lymphocytes H&E ×100.

Microphoto 4



Show Adenocarcinoma the malignant cells arranged in glandular pattern H&E ×100.

The US-guided procedure has a major advantage as it is real time, rapid, and bedside available; about four (6.6%) cases in our study done at ICU, no radiation exposure, many patients had dyspnea or severe cough with prolonged lying supine for long time over CT or fluoroscopy not tolerated [11].

Case number 3

A female patient, 50 years old, had right-sided encysted effusion with sheet-like nodular pleural thickening; histopathology revealed epithelial mesothelioma basal linear calcification posterior approach 18 G needle biopsy posterior approach (Microphoto 1).

In the current study, 20 out of the 60 patients were benign disease (fibrosing pleuritis) (33.3%); this is in agreement with the Metintas and colleagues study they

found 23 (31%) out of the 75 patients were benign disease.

Case number 4

A male patient, 64 years old, had smooth right-sided sheet-like pleural thickening less than 1 cm with associated pleural effusion; posterior approach 18 G needle biopsy indicated chronic fibrosing alveolitis (Microphoto 2).

Conclusion

The US-guided procedure has a major advantage, being real time, rapid, bedside available, well tolerated, and no serious complications were observed in good case selection and procedure.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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