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ORIGINAL ARTICLE

Diagnosis of exudative pleural effusion using ultrasound guided versus medical thoracoscopic pleural biopsy

Enas E. Mohamed [a,*], Iman M. Talaat [b,1], Alaa El-Din A. Abd Alla [a,2], Amr M. ElAbd [c,3]

[a] Chest Diseases Department, Faculty of Medicine, Alexandria University, Egypt
[b] Pathology Department, Faculty of Medicine, Alexandria University, Egypt
[c] Radiology Department, Faculty of Medicine, Alexandria University, Egypt

Abstract *Introduction:* Medical thoracoscopy increases the diagnostic yield in patients with non-diagnosed pleural effusion when thoracocentesis and closed pleural biopsy (CPB) are non-diagnostic. Chest ultrasound (US) is a very useful imaging method for pleural diseases and the technique of ultra sound-guided cutting biopsy with a tru-cut needle has been well described.

Aim of the work: The aim of this work was to diagnose exudative pleural effusion using ultrasound guided versus medical thoracoscopic pleural biopsy.

Subjects and methods: Forty patients with, non-diagnosed exudative pleural effusion admitted to the chest department, Alexandria university hospital, were enrolled after obtaining informed consents. All patients were subjected to; full history taking, thorough clinical examination, laboratory investigations including prothrombin activity and INR, biochemical, pathological and microbiological evaluation of the pleural aspirate and radiological evaluation. Then the patients were divided (randomly) into 2 groups each containing 20 patients. Pleural biopsies were performed using medical rigid thoracoscopy on group 1 and ultrasound guided tru-cut pleural biopsy on group 2.

Results: The mean age in-group I was 55.0 ± 13.05 years and in-group II was 52.60 ± 17.77 years. There was no statistically significant difference between the two groups regarding

* Corresponding author. Tel.: +20 01224474317.
E-mail addresses: enas_elsayed@yahoo.com (E.E. Mohamed), iman_talaat@yahoo.com (I.M. Talaat), Alaa_ali302007@yahoo.com (A.E.-D.A. Abd Alla), amr_elabdmz@yahoo.com (A.M. ElAbd).
[1] Tel.: +20 01221037274.
[2] Tel.: +20 01222875695.
[3] Tel.: +20 01001490492.

age, sex, smoking, marital status and past medical conditions. There was no statistically significant difference between the two groups regarding radiological findings. There was no statistically significant difference between the two groups regarding the pleural fluid analysis. There was no statistically significant difference between the two groups regarding the gross pleural findings. In group II non-specific pleurisy was found in 5 (25.0%) patients (by thoracoscopy 1 of them was finally diagnosed as metastatic deposits from adenocarcinoma of unknown primary, one was confirmed to be tuberculous pleurisy and the remaining 3 cases were confirmed to be non-specific pleurisy). As regards complications in-group I, local wound infection occurred in 1 (5.0%) patient, and empyema occurred in 1 (5.0%) patient. In-group II, local wound infection occurred in 1 (5.0%) patient, and empyema occurred in 1 (5.0%) patient.

Conclusion: It is better to use thoracoscopy in cases of undiagnosed exudative pleural effusion presented with a sufficient amount of pleural fluid to avoid lung injury while inserting the trocar. Whereas, ultrasound guided tru-cut pleural biopsy may be used in cases of undiagnosed exudative pleural effusion presented with thickened pleura but with an insufficient amount of pleural fluid.

Introduction

Although pleural effusion is a common disorder among patients presenting with respiratory symptoms, there is limited evidence on the accuracy and reliability of symptoms and signs for the diagnosis of pleural effusion [1]. While diagnostic procedures are available to explore most of the body cavities for diagnosis and treatment, examination of the pleural cavity remains difficult, mainly because the negative pressure in the pleural cavity makes direct examination impossible without collapsing the lung. The ability to diagnose pleural and pulmonary disease by conventional techniques, such as blind pleural and lung biopsy, cytology of bronchial washings and brushing and radiologic techniques or cultures is limited and flexible fiberoptic pleuroscopy permits direct examination of the pleura, the superficial portions of the lung, and many other intrathoracic structures. It provides excellent results without complications. Flexible fiberoptic pleuroscopy is not only safe, but also promises to yield more accurate biopsy specimens than conventional blind diagnostic techniques [2].

The differential diagnosis of exudative pleural effusion is often a lengthy process. As regards pleural malignancies, the diagnostic yield of closed pleural biopsy (CPB) is only 50–60% overall, and 20% in malignant mesothelioma (MM). Contrary to thoracocentesis and percutaneous CPB, thoracoscopy permits biopsy with direct visualization. Thoracoscopy is commonly performed after one or two thoracocenteses and at least one non-diagnostic CPB. Thoracoscopy can be performed by a pulmonologist under local/regional anesthesia (medical thoracoscopy) or by a thoracic surgeon under general anesthesia (video-assisted thoracic surgery). The former is primarily used for differential diagnosis of pleural disease and pleurodesis, whereas the latter permits minimally invasive thoracic surgery. Several studies suggest that medical thoracoscopy increases the diagnostic yield in patients with non-diagnosed pleural effusion when thoracocentesis and CPB are non-diagnostic [1,3].

Blind percutaneous pleural biopsy has traditionally been performed to investigate the etiology of exudative pleural effusion in which the initial thoracocentesis has been non-diagnostic. In view of the increasing use of image-guided and thoracoscopic pleural biopsies, the role of ultrasound guided pleural biopsy in the investigation of pleural effusion is increasing [4].

Chest ultrasound (US) is a very useful imaging method for pleural diseases and the technique of US-guided cutting biopsy with a tru-cut needle has been well described [5,6].

Aim of the work

The aim of this work was to diagnose exudative pleural effusion using ultrasound guided versus medical thoracoscopic pleural biopsy.

Subjects and methods

Study population and subjects

Forty patients with, non-diagnosed exudative pleural effusion admitted to the chest department, Alexandria university hospital, were enrolled after obtaining informed consents. All patients had a prothrombin activity > 70%.

Study measurements

All patients were subjected to the following:

- Full history taking including: age, sex, smoking index and history of other diseases.
- Thorough clinical examination including: general examination and local chest examination.
- Laboratory investigations including: prothrombin activity and INR.
- Biochemical, pathological and microbiological evaluation of the pleural aspirate.
- Radiological evaluation was carried out by:
  - Plain X-ray chest postero-anterior and lateral views.
  - Computed tomographic (CT) scan of the chest with focus made on the side and amount of effusion, pleural lesions, underlying lung lesions, metastasis and any other lesions that could be detected.

Then the patients were divided (randomly) into 2 groups each containing 20 patients. Pleural biopsies were performed

using medical rigid thoracoscopy on group 1 and ultrasound guided tru-cut pleural biopsy on group 2.

Medical rigid thoracoscopy (group I)

Thoracoscopic examination was done using rigid thoracoscopy [(Karl Storz; Tuttlingen, Germany] and its equipment and videoscopy unit (camera [Karl Storz Endoskope Telecam Pal 20211020], light source [Henke-Sass Wolf Gmbh d-7200 Tuttingen]), TV box connected to the PC and television (LCD 32″).

The procedure was performed in an endoscopy suite especially equipped for the procedure, in the chest department, faculty of medicine, Alexandria University.

The patient was positioned lying down in a lateral decubitus position with the involved side facing upwards. The patient's blood pressure, pulse rate, intravenous line and oxygen saturation were monitored continuously using a portable monitor connected totally with all its leads and its pulse oximetry to the patient. Supplemental oxygen was given to the patient to maintain oxygen saturation. The entire lateral chest wall was scrubbed with iodopovidone. The patient was then subjected to local anesthesia and conscious sedation; 15–20 ml lidocaine 2% for local anesthesia, and conscious sedation was achieved by midazolam 15 mg/ml.

After raising a 2 cm subcutaneous wheal and anesthetizing the skin, subcutaneous tissues, muscle planes, rib periosteum and parietal pleura by about 20 cc of 2% lidocaine, a 2 cm transverse skin incision was made by a scalpel parallel to the rib along the intercostal space chosen for the trocar and obturator of the medical rigid thoracoscope insertion in the wheal. Blunt dissection of the intercostal tissues was performed by spreading straight Kelly clamp (or artery clamp) both parallel and perpendicular to the underlying muscles which were separated and the parietal pleura was gently palpated by the index finger and was penetrated by the Kelly clamp. The rigid trocar and obturator of the medical rigid thoracoscope were inserted through the incision, down the preformed tract, penetrating the pleural membrane into the pleural cavity.

Once in place, we remove the obturator and insert a suction tube (-20 cm H_2O) connected to suction apparatus [HOSPI-VAC sm350 REF210358] through the trocar to drain any associated pleural fluid.

After drainage of the fluid, medical rigid thoracoscope was introduced through the trocar into the pleural space. The thoracoscope was connected to a video camera in order to display the whole procedure on a monitor (LCD 32″) and can be recorded on a CD by TV BOX connected to the PC. Inspection and full visualization all around the pleural cavity were then done by the rigid thoracoscope. The parietal pleura including the costal, diaphragmatic sometimes mediastinal pleura as well as the visceral pleura was thoroughly examined for any lesions such as nodules, plaques, adhesions, thickening, mottling or anthracosis. Multiple forcep biopsies were taken from any suspicious gross pathological lesion in the parietal pleura. The visceral pleura was not biopsied. The biopsies were taken by one of the rigid forceps made especially for the rigid thoracoscope as Basket/Crocodile/Straight/Crush which was passed through the channel of the rigid thoracoscope. The biopsies were then kept in a sterile bottle filled with formalin and then these bottles were sent to pathology laboratory for histopathological

examination and diagnosis of at least one specimen for microbiological investigations (transported in 0.9% saline).

After the procedure, the trocar and thoracoscope were removed and then thoracostomy tube (chest tube 24-Charrière) was inserted and fixed in position to the skin of the chest wall using zero silk interrupted vertical mattress sutures with purse string suture far around the chest tube for easy closure of the skin flap after chest tube removal (cosmetic suture). Well-cared dressing was applied. The dressing was routinely changed and inspected daily for the functioning of the chest tube either working well (oscillating) or obstructed (need to be flushed) or out of place (need to be re inserted). Plain chest X-ray and CT chest were done just after the procedure to make sure that the chest tube was in place. Daily plain X-ray chest was done to verify that the lung was fully expanded. Then when full expansion of the lung occurs, pleurodesis was performed (only in recurrent or malignant cases). The chest tube was first clamped with two clamps and was disconnected from the suction tube of the draining device. Twenty cubic centimeter of lidocaine (one percent concentration) was instilled into the pleural cavity through the chest tube to anesthetize the pleura. Under the strict aseptic technique, fifty cubic centimeter of iodopovidone (ten percent concentration) was added to fifty cubic centimeter of normal saline in a sterile bowl and aspirated into the fifty cubic centimeter Tommy's syringe. The syringe was attached to the chest tube and the solution was instilled through the chest tube after both clamps have been removed, then the remaining fifty cubic centimeter of the solution was instilled in the same manner.

Once all the solution was instilled, the patient was allowed to take few breaths, with the chest tube unclamped, so that all the solution could be pulled into the pleural space. The tube was then clamped and connected to the draining device. Chest radiograph was done daily to assure full lung re-expansion. Once this latter was achieved, the chest tube was removed. After removing the chest tube, a plain chest radiograph was obtained to check the full expansion of the lung.

Close observation for any complication was carried out and recorded. The complications were then managed. The most common, serious and important complication is failure of lung expansion, which is considered a complication when lung failed to expand just after the end of the procedure. This was checked by oscillations of the chest tube and the first chest X-ray P-A view done after the procedure.

Follow up of the patients was carried out radiographically by plain chest X-ray until removal of the chest tube.

Ultrasound guided tru-cut pleural biopsy (group II)

The sonography was done using Toshiba Just Vision 200 SSA-320A; Toshiba Medical Systems Corporation, Tochigi-ken, Japan. The preferred position for the procedure was the sitting position, with the subject's arms folded across the chest and supported by a bedside table. Surveillance of the dorso-lateral thoracic wall was performed by means of a standard 3.75 MHz sector probe. The size of the effusion was documented as follows: minimal (if the echo-free space was confined to the costophrenic angle), small (if the space was greater than the costophrenic angle but still within the range of the area covered with a 3.75 MHz curvilinear probe), moderate (if the space was greater than a one-probe range but within a two-probe

range and large (if the space was larger than a two-probe range). The biopsy site was subsequently identified, with safety being a main determinant. As a rule, the aspirations and biopsies were performed in mid-scapular line. For minimal to moderate effusions, the biopsies were taken from the site of maximum effusion as determined by US. In case of a large effusion, the puncture site was chosen to be as low as possible, but not within 25 mm of the diaphragm. All aspirations and biopsies were performed under direct US guidance and patients were requested to remain motionless during the procedures.

Percutaneous ultrasound-guided pleural biopsy was done with a 14- or 18-gauge cutting needle (Allegiance, Chateaubriand, France) or (Temno; Bauer Medical International, Santo Domingo, Dominican Republic) with the use of a local anesthetic. These needles have a 20-mm-long specimen notch on a central stylet that was manually advanced before application of the cutting needle so that the needle did not travel any further, allowing good control of the needle position. The puncture site was disinfected and anesthetized by infiltration with 2 percent lidocaine. 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. Under the sterile technique and local anesthesia, at least four tru-cut needle biopsies (transported in 4% formalin and at least one specimen for microbiological investigations (transported in 0.9% saline) were obtained.

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.

For focal pleural masses, the biopsy needle was advanced along the maximal diameter of the lesion. For diffuse pleural

thickening, the cutting needle was advanced along the plane of maximal pleural thickness to allow the majority of the biopsy specimen notch to lie within the abnormal pleura.

The patients had at least 4 h of bed rest after the procedure; routine post biopsy observations (pulse rate, blood pressure, and respiratory rate) were made. All patients were observed for at least 4 h prior to discharge, and complications were noted. Chest radiographs were obtained after the procedure to exclude pneumothorax.

Results

The mean age in-group I was 55.0 ± 13.05 years and in-group II was 52.60 ± 17.77 years. In-group I 13 out of 20 patients (65.0%) were males, while in-group II 9 out of 20 patients (45.0%) were males. As regards smoking, in-group I 12 patients (60.0%) were non-smokers while in-group II 13 patients (65.0%) were non-smokers.

The mean pack-years for smokers in-group I was 42.78 ± 20.78, whereas, it was 53.71 ± 29.27 in-group II. Hypertension (HTN) was present in 2 patients (10.0%) and 4 patients (20.0%) in the two groups, respectively, whereas, diabetes mellitus (DM) was present in 3 patients (15.0%) and 1 patient (5.0%) in the two groups, respectively.

There was no statistically significant difference between the two groups regarding age, sex, smoking, marital status and past medical conditions (Table 1).

Radiological findings

In-group I; right moderate pleural effusion was detected in 7 (35.0%) patients, left moderate pleural effusion was detected in 3 (15.0%) patients, right massive pleural effusion was detected in 7 (35.0%) patients and left massive pleural effusion was detected in 3 (15.0%) patients. Encystment was detected in 2 (10.0%) patients. Thickened pleura was detected in 11 (55.0%) patients. Pleural nodules and soft tissue shadow were not detected in any patients and malignant lymph nodes (M.L.N) were enlarged in only 1 (5.0%) patient.

In-group II; right moderate pleural effusion was detected in 6 (30.0%) patients, left moderate pleural effusion was detected in 6 (30.0%) patients, right massive pleural effusion was detected in 3 (15.0%) patients and left massive pleural effusion was detected in 5 (25.0%) patients. Encystment was not detected in any patients. Thickened pleura was detected in 12

Table 1 Comparison between the two studied groups according to personal data.

	Group I	Group II	p
Age			
Median (min.–max.)	58.0 (21.0–70.0)	58.0 (17.0–83.0)	0.629
Mean ± SD	55.0 ± 13.05	52.60 ± 17.77	
Sex			
Male	13 (65.0%)	9 (45.0%)	0.204
Female	7 (35.0%)	11 (55.0%)	
Marital status			
Single	1 (5.0%)	2 (10.0%)	1.000
Married	17 (85.0%)	16 (80.0%)	
Widow	2 (10.0%)	2 (10.0%)	
Smoking			
Non smoking	12 (60.0%)	13 (65.0%)	0.744
Smoking	8 (40.0%)	7 (35.0%)	
Pack/year for smokers			
Median (min.–max.)	40.0 (15.0–80.0)	50.0 (6.0–90.0)	0.335
Mean ± SD	42.78 ± 20.78	53.71 ± 29.27	
Residence			
Alexandria	17 (85.0%)	11 (55.0%)	0.100
Behira	3 (15.0%)	7 (35.0%)	
Kafr El Sheikh	0 (0.0%)	1 (5.0%)	
Matrouh	0 (0.0%)	1 (5.0%)	
Past history			
HTN	2 (10.0%)	4 (20.0%)	0.503
DM	3 (15.0%)	1 (5.0%)	

Table 2 Comparison between the two studied groups according to radiological findings (chest X-ray and CT).

	Group I	Group II	p
Radiological findings			
Pleural effusion			
Right moderate	7 (35.0%)	6 (30.0%)	0.394
Left moderate	3 (15.0%)	6 (30.0%)	
Right massive	7 (35.0%)	3 (15.0%)	
Left massive	3 (15.0%)	5 (25.0)	
Encystment	2 (10.0%)	0 (0.0%)	0.487
Thickened pleura	11 (55.0%)	12 (60.0%)	0.749
Pleural nodules	0 (0.0%)	2 (10.0%)	0.487
Soft tissue shadow	0 (0.0%)	2 (10.0%)	0.487
M.L.N	1 (5.0%)	1 (5.0%)	1.000

(60.0%) patients. Pleural nodules and soft tissue shadow were detected in 2 (10.0%) patients and M.L.N were enlarged in only 1 (5.0%) patient.

There was no statistically significant difference between the two groups regarding radiological findings (Table 2).

Pleural fluid analysis

In-group I; the mean value of pleural total protein was 4.37 ± 0.51 mg/dl, the mean of pleural albumin was 3.34 ± 0.30 mg/dl, and the mean of pleural lactic acid dehydrogenase (LDH) was 572.65 ± 463.27 mg/dl. The mean of pleural total white blood cells (WBCs) was 3635.20 ± 1982.27/mm^3, with negative pleural culture and sensitivity, negative for malignant cells and negative pleural fluid examination for acid-fast bacilli (AFB). The mean of

pleural/serum protein ratio was 65.27 ± 5.86, pleural/serum LDH ratio was 82.04 ± 5.36 and the mean of pleural-serum albumin gradient was $0.50 \pm 0.22 \times 10^3$/μL.

In-group II; the mean value of pleural total protein was 4.48 ± 0.49 mg/dl, the mean of pleural albumin was 3.36 ± 0.34 mg/dl and the mean of pleural LDH was 451.75 ± 75.0 mg/dl. The mean of pleural total WBCs was 3812.90 ± 1303.75/mm^3, with negative pleural culture and sensitivity, pleural fluid was positive for malignant cells in only one case and negative pleural fluid examination for AFB. The mean of pleural/serum protein ratio was 63.95 ± 6.22, pleural/serum LDH ratio was 84.19 ± 3.82 and the mean of pleural-serum albumin gradient was 0.4 ± 0.12.

There was no statistically significant difference between the two groups regarding the pleural fluid analysis (Table 3).

Table 3 Comparision between the two studied groups according to pleural fluid analysis.

	Group I	Group II	p
Pleural total protein			
Median (min.–max.)	4.20 (3.70–6.0)	4.35 (3.80–5.20)	0.468
Mean ± SD	4.37 ± 0.51	4.48 ± 0.49	
Pleural albumin			
Median (min.–max.)	3.35 (2.90–4.0)	3.30 (2.90 − 4.0)	0.808
Mean ± SD	3.34 ± 0.30	3.36 ± 0.34	
Pleural LDH			
Median (min.–max.)	432.5 (256–2222)	480 (310–590)	0.704
Mean ± SD	572.65 ± 463.27	451.75 ± 75.0	
Pleural total WBCs			
Median (min.–max.)	3150 (1240–7000)	3560 (1050–6541)	0.441
Mean ± SD	3635.20 ± 1982.27	3812.90 ± 1303.75	
N%			
Median (min.–max.)	52.50 (16.0–80.0)	44.50 (10.0–67.0)	0.244
Mean ± SD	50.06 ± 24.39	44.70 ± 19.52	
L%			
Median (min.–max.)	42.50 (16.0–77.0)	45.0 (26.0–82.0)	0.198
Mean ± SD	43.10 ± 23.82	49.20 ± 20.08	
M%			
Median (min.–max.)	3.0 (1.0–25.0)	3.0 (1.0–8.0)	0.691
Mean ± SD	4.55 ± 5.32	3.38 ± 1.98	
B%			
Median (min.–max.)	1.40 (0.60–7.50)	1.25 (0.20–3.0)	0.881
Mean ± SD	1.72 ± 1.56	1.50 ± 0.85	
E%			
Median (min.–max.)	0.50 (0.10–1.50)	0.90 (0.20–6.0)	0.066
Mean ± SD	0.58 ± 0.38	1.23 ± 1.30	
Pleural fluid culture and sensitivity	0 (0.0%)	0 (0.0%)	−
Pleural fluid for AFB	0 (0.0%)	0 (0.0%)	−
Pleural fluid cytology	0 (0.0%)	1 (5.0%)	1.000
Pleural/serum protein ratio			
Median (min.–max.)	63.95 (55.80–80.0)	60.95 (55.10–74.30)	0.492
Mean ± SD	65.27 ± 5.86	63.95 ± 6.22	
Pleural/serum LDH ratio			
Median (min.–max.)	81.35 (73.10–95.20)	84.30 (77.50–92.30)	0.152
Mean ± SD	82.04 ± 5.36	84.19 ± 3.82	
Pleural-serum albumin gradient			
Median (min.–max.)	0.40 (0.20–0.90)	0.45 (0.20–0.70)	0.640
Mean ± SD	0.50 ± 0.22	0.4 ± 0.12	

Table 4 Comparison between the two studied groups according to gross findings (thoracoscopic in Group I or by ultrasound in Group II).

	Group I	Group II	p
Amount of drained pleural fluid			
Median (min.–max.)	3.25 (0.75–8.0)	–	–
Mean ± SD	3.84 ± 1.81	–	
Side			
Right	14 (70.0%)	10 (50.0%)	0.197
Left	6 (30.0%)	10 (50.0%)	
Parietal pleura	20 (100.0%)	20 (100.0%)	–
Visceral pleura	20 (100.0%)	20 (100.0%)	–
Costal pleura	20 (100.0%)	20 (100.0%)	–
Diaphragmatic pleura	6 (30.0%)	4 (20.0%)	0.716
Diffuse thickening	4 (20.0%)	7 (35.0%)	0.480
Nodules	18 (90.0%)	15 (75.0%)	0.204
Plaques	2 (10.0%)	2 (10.0%)	1.000
Adhesions	6 (30.0%)	11 (55.0%)	0.110
Others			
Anthracosis	5 (25.0%)	–	–
Mottling	1 (5.0%)	–	

Gross pleural findings

In-group I; the mean amount of drained pleural fluid was 3.84 ± 1.81 L, the right side was affected in 14 (70.0%) patients, the left side was affected in 6 (30.0%) patients. Parietal pleura, visceral pleura, and costal pleura were affected in 20 (100.0%) patients whereas diaphragmatic pleura was affected only in 6 (30.0%) patients. Diffuse thickening was detected in 4 (20.0%) patients. Nodules were detected in 18 (90.0%) patients. Plaques were detected in 2 (10.0%) patients. Adhesions were detected in 6 (30.0%) patients. Anthracosis was detected in 5 (25.0%) patients, and mottling was detected in only 1 (5.0%) patient.

In-group II; the right side was affected in 10 (50.0%) patients; the left side was affected in 10 (50.0%) patients. Parietal pleura, visceral pleura and costal pleura were affected in 20 (100.0%) patients whereas diaphragmatic pleura was affected only in 4 (20.0%) patients. Diffuse thickening was detected in 7 (35.0%) patients. Nodules were detected in 15 (75.0%) patients. Plaques were detected in 2 (10.0%) patients and adhesions were detected in 11 (55.0%) patients.

There was no statistically significant difference between the two groups regarding the gross pleural findings (Table 4).

Histopathological diagnosis and complications

In-group I; the histopathological diagnosis was large cell carcinoma (LCC) in 3 (15.0%) patients and malignant mesothelioma in 1 (5.0%) patient. Metastatic deposits from known primary were found in 7 (35.0%) patients (from the breast in 3 (15.0%) patients, from the endometrium in 1 (5.0%) patient, from the kidney in 1 (5.0%) patient, from the colon in 1 (5.0%) patient and from the Intestine in 1 (5.0%) patient). Metastatic deposits from adenocarcinoma of unknown primary were found in 4 (20.0%) patients. Tuberculous pleurisy was found in 4 (20.0%) patients and non- specific pleurisy was found in 1 (5.0%) patient.

In-group II; the histopathological diagnosis was small cell lung cancer (SCLC) in 1 (5.0%) patient, LCC in 2 (10.0%) patients and malignant mesothelioma in 2 (10.0%) patients. Metastatic deposits from known primary were found in 8 (40.0%) patients (from the breast in 3 (15.0%) patients, from the thyroid in 1 (5.0%) patient, from the endometrium in 1 (5.0%) patient, from the kidney in 1 (5.0%) patient, from the colon in 1

Table 5 Comparison between the two studied groups according to histopathological diagnosis, and complications.

	Group I	Group II	p
SCLC	0 (0.0%)	1 (5.0%)	1.000
LCC	3 (15.0%)	2 (10.0%)	0.673
Malignant mesothelioma of known primary	1 (5.0%)	2 (10.0%)	0.487
Breast	3 (15.0%)	3 (15.0%)	1.000
Thyroid	0 (0.0%)	1 (5.0%)	0.487
Endometrium	1 (5.0%)	1 (5.0%)	0.605
Renal	1 (5.0%)	1 (5.0)	1.000
Colon	1 (5.0%)	1 (5.0%)	1.000
Intestine	1 (5.0%)	1 (5.0%)	1.000
Of unknown primary	4 (20.0%)	1 (5.0%)	0.342
Inflammatory			
Tuberculous pleurisy	4 (20.0%)	1 (5.0%)	0.342
Non-specific pleurisy	1 (5.0%)	5 (25.0%)	0.041[*]
Complications			
1-Local wound infection	1 (5.0%)	1 (0.0%)	1.000
2-Empyema	1 (5.0%)	1 (5.0%)	1.000
Management of complications			
Dressing, ABC	1 (5.0%)	1 (5.0%)	
ICT, antibiotics	1 (5.0%)	1 (5.0%)	
Outcome (cure)	2 (10.0%)	2 (10.0%)	

[*] Statistically significant.

(5.0%) patient and from the intestine in 1 (5.0%) patient). Metastatic deposits from adenocarcinoma of unknown primary were found in 1 (5.0%) patient. Tuberculous pleurisy was found in 1 (5.0%) patient and non- specific pleurisy was found in 5 (25.0%) patients (by thoracoscopy 1 of them was finally diagnosed as metastatic deposits from adenocarcinoma of unknown primary, one was confirmed to be tuberculous pleurisy and the remaining 3 cases were confirmed to be non-specific pleurisy).

As regards complications in-group I, local wound infection occurred in 1 (5.0%) patient, and empyema occurred in 1 (5.0%) patient.

As regards complications in-group II, local wound infection occurred in 1 (5.0%) patient, and empyema occurred in 1 (5.0%) patient (Table 5).

Discussion

Medical thoracoscopy can be done under general or local anesthesia as stated by the European Respiratory Society (ERS) depending on the indication and severity of illness, as well as on the experience of the physician and institutional biases [1,7].

Although the ultrasound guided tru-cut pleural biopsy may appear to be unsuitable for pleural biopsy because there is no facility for aspiration of fluid to confirm entry into the pleural space, it is particularly useful in the presence of thickened pleura, which is found in tuberculosis and certain malignant processes [6,8].

In the present study, we placed the studied patient on his lateral decubitus position with the affected side facing up and no increase in dyspnea was noticed in any patient. This was similar to previous studies, on the body positional effect on gas exchange in unilateral pleural effusion, which reported improved dyspnea, oxygenation and pulmonary function tests on lateral decubitus position with the affected side facing up [1,9,10].

In the current study, we preferred to use local anesthesia with conscious sedation in-group I patients and local anesthesia only in-group II, as it is safer, lacks the complications of general anesthesia and general condition of some patients with massive effusion may not allow the use of general anesthesia. Similarly, most previous studies performed thoracoscopy under local anesthesia and conscious sedation [7,11–15]. In contrast, some previous studies performed thoracoscopy under general anesthesia [16,17]. We recognize that general anesthesia would markedly facilitate all the intervention; however, it would increase the patient's risk.

In-group II unfortunately, it was not possible to drain any amount of pleural fluid associated with the pleural pathology whereas in-group I, drainage of several liters (up to 8 L in one case) of pleural fluid was done at once with no risk of re-expansion pulmonary edema. This was possible by immediate equilibration of pressure secondary to direct entrance of air through the cannula into the pleural space from around the draining catheter during the procedure. In a previous study by De Campos et al. [18] who detected 12 patients (2.2%) developed re-expansion pulmonary edema, the total fluid drained during thoracoscopy in those patients was always > 3000 ml (range, 3200–5000 ml). Prolonged duration of collapse and rapid re-expansion of the lung because of application of negative pressure were assumed to be the underlying causes of re-expansion pulmonary edema in this study. They

recommended performing one or two therapeutic thoracenteses before thoracoscopy, with the drainage of at least 1500 ml at each procedure for patients with large pleural effusions and to evaluate lung expansion. Other studies suggest that large pleural effusions should be drained in a controlled fashion avoiding evacuation of more than 1–1.5 L at one time or slowed to about 500 ml/h, and aspiration discontinued if the patient develops chest discomfort, persistent cough, or vasovagal symptoms [19,20].

Some of our patients experienced sharp transient pain while the biopsies were taken. The administration of local intrapleural lidocaine resolved this nuisance. Other patients experienced little or no discomfort when the parietal pleura was touched. This could be due to decreased pleural sensation in most patients with chronic pleurisy (malignant or benign) [21]. Consistent with our observation Oldenburg et al. [22], reported transient sharp pain in all their cases during parietal pleural biopsy. This was greatly relieved by pre-treatment of the site of the biopsy with lidocaine.

In the present study, we found that thoracoscopic appearances were mostly confirmed histologically, as the presence of nodules mostly indicates malignancy, while diffuse thickening, adhesions and plaques suggest tuberculous or other inflammatory pleural affections.

This was in agreement with Enk and Viskum [23], who performed 556 thoracoscopies and reported that in patients with gross pleural abnormality, thoracoscopic appearances were quiet diagnostic. Boutin et al. [24] performed rigid thoracoscopy in 188 cases of idiopathic pleural effusion and reported congestion, fine granulations and pleural thickening suggesting non-specific inflammation in 12 (6.5%) cases and nodules or masses suggestive of malignancy in 92 (49%) patients. George et al. [12] performed rigid thoracoscopy in 12 cases of idiopathic pleural effusion; they demonstrated pleural nodules in 4 cases and adhesions in 8 cases.

Histopathological diagnosis was matched with the gross appearance in the last 3 studies [12,23,24]. However, we definitely need biopsies and histopathological diagnosis as pleural nodules were found also in some cases of tuberculous pleural affection. Other studies reported that thoracosopic appearances were not reliable, and that it was danger to rely upon inspection of the pleura alone without biopsies [22,25–28].

Similarly, sonographic appearances of group II were mostly confirmed histologically, as the presence of nodules mostly indicates malignancy, while diffuse thickening suggests tuberculous or other inflammatory pleural affections.

The sensitivity of diagnostic thoracoscopy in our study was 100%, signifying a high diagnostic yield of medical thoracoscope. The diagnostic sensitivity in previous thoracoscopic studies varied from 66% to 100% [13,21,29–31]. In-group II, tru-cut biopsies yielded pleural tissue in 100% of patients and the diagnostic sensitivity was 90% which was much higher than a previous study by Chang et al. [6] who reported that; Tru-cut biopsies yielded pleural tissue in 78.7% of patients enrolled into this study, and it had diagnostic sensitivity of 65.2% for pleural TB and 66.7% for malignancy. This was nearly similar to a previous similar study by Rosie et al. [32], who reported that the overall accuracy of percutaneous image guided biopsy was about 91%, which means that thoracoscopic biopsies may be superior to sonographic guided tru-cut biopsies.

In-group I, fortunately we were able to obtain biopsies from all the studied patients. In contrast to our results Francois et al. [11], performed diagnostic thoracoscopy in 149 cases and reported failure to reach the diagnosis in 10 cases (6.8%). They explained this failure by the presence of extensive pleural adhesions that limited the access to the pleural cavity. Also, Sophie et al. [29], described failure to obtain biopsies in 3 case out of 50 cases (6%) during medical thoracoscopy due to either extensive pleural adhesions or lack of any pleural abnormality during thoracoscopy.

Differences between our findings and those of others [21,29] can be attributed to the lack of accurate definition of the term excessive adhesions. It remains a subjective description and another could report what could seem excessive to one as some adhesions. In-group II, tru-cut biopsies yielded pleural tissue in 100% of patients which was much higher than a previous study by Chang BD et al. [6] who reported that tru-cut biopsies yielded pleural tissue in 78.7% of patients enrolled onto this study, which may be attributed to the recent advances in the ultrasound field.

In the present study, in-group I, 1 patient was diagnosed as non-specific pleurisy. He received non-specific antibiotic therapy and the follow up for 6 months revealed full cure with no recurrent effusion. The incidence of non-specific pleurisy in previous studies performing thoracoscopy in undiagnosed pleural effusion varied from 0% [16] up to 38.2% [11]. Hansen et al. [30] reported 45 out of 147 (31%) cases of chronic non-specific pleurisy however, 12 patients were proved malignant later on. Similarly, Davidson et al. [21] reported 8 out of 29 (27.59%) cases of chronic non-specific pleurisy however, 4 cases were proved to be malignant later on. Both authors did not mention how the final diagnosis was assured [21,30].

In-group II, non-specific pleurisy was the final diagnosis in 5 (25.0%) patients (by thoracoscopy 1 of them was finally diagnosed as metastatic deposits from adenocarcinoma of unknown primary, the second one was confirmed to be tuberculous pleurisy and the remaining 3 cases were confirmed to be non-specific pleurisy), so it is essential either to follow up cases with non-specific pleurisy or to confirm the diagnosis by thoracoscopy.

In-group I, complications were encountered in 2 (10%) patients. The incidence of complications in the previous studies was variable. The reported incidence of complications following rigid thoracoscopy varied from 1.8%, [25] up to 20% [16]. Similarly in-group II, complications were encountered in 2 (10%) patients. with no pneumothorax. This differs from a previous study by Benamore et al. [33] who reported that the rate of new pneumothorax detected by chest radiography was 4.7%.

The incidence of complications in the previous similar studies was minimal. The reported incidence of complications following image guided tru-cut pleural biopsy was about 3% [32,33] the higher rate of complications in our study may be attributed to fewer number of cases (only 20 patients in each group) in comparison with previous similar studies.

During the past decade, thoracoscopic biopsy has become a widely accepted means of diagnosis if findings from pleural fluid cytologic examination and blind pleural biopsy are non-diagnostic. The advantages are its sensitivity of 91–98% for the diagnosis of pleural malignancy [34,35] and its potential therapeutic benefit, such as enabling talc pleurodesis. Thoracoscopy has the disadvantage of requiring general anesthesia or sedation, requiring chest tube drainage and inpatient stay, having the potential of failure due to adhesions preventing pneumothorax, being substantially more expensive than image-guided biopsy, and having a higher complication rate [36,37].

Some authors have also shown that it is safe to biopsy the pleura with the tru-cut needle under ultrasound guidance in situations in which the pleura is thickened and when the pleural effusion is small in amount or loculated [6,32].

In conclusion, it is better to use thoracoscopy in cases of undiagnosed exudative pleural effusion presented with a sufficient amount of pleural fluid to avoid lung injury while inserting the trocar whereas, ultra sound guided tru-cut pleural biopsy may be used in cases of undiagnosed exudative pleural effusion presented with thickened pleura but with an insufficient amount of pleural fluid.

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