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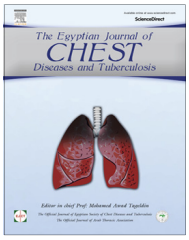

ORIGINAL ARTICLE

Ultrasound guided pleural brushing: A new method for obtaining pleural specimen in malignant effusion

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KEYWORDS

Ultrasound;
Pleural brush;
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Abstract *Purpose:* Encouraging positive diagnostic yields in malignant pleural effusion could be obtained by pleural brushing performed through two techniques, the first was closed and the second was thoracoscopic. Until now the ultrasound guided pleural brushing is not included within these techniques and its diagnostic yield therefore is not evaluated. So the aim of this study was to evaluate the diagnostic yield of this procedure and its contributions as a technique not used previously in the interventional pulmonology practice to obtain pleural specimen for cytological examination in malignant pleural effusion.

Methods: This prospective interventional study was conducted in the Chest Department – Assiut University Hospital during the period from July 2014 to September 2015. Patients who had highly suspicious malignant pleural effusion (clinical, radiological, and laboratory) were hospitalized and enrolled in this study. Patients with bleeding tendency or coagulation profile abnormalities were excluded from the study. Patients were also excluded from this study if the etiology of effusion was proved to be benign. Informed written consent was obtained from all patients. The equipment used in our study were ultrasound apparatus (ALOKA – Prosound – SSD – 3500SV), biopsy forceps (KARL – STORZ – Germany 10329L – BS), the bronchoscopic cleaning brush (PENTAX CS6002SN) trocar and cannula of Cope's needle and the semi rigid thoracoscope (LTF; Olympus; Tokyo, Japan). Thoracentesis, pleural brushing and biopsy forceps of the pleura were performed for all enrolled patients in the ultrasound unit of the Chest Department while thoracoscopy was done in the endoscopy unit only for patients in whom the diagnosis could not be achieved by these procedures.

Results: Among 22 patients who were finally documented to have malignancy, the ultrasound guided pleural brushing provided diagnosis in 9 (41%)/22 cases, it was exclusively diagnostic in 3 patients. Interestingly, the yield of this procedure had its contributions regarding the final pathological diagnosis of our cases, it could augment the positive yield to be 55% instead of 41% (for pleural fluid cytology alone), 82% instead of 68% (for biopsy forceps alone) and 86% instead of 72% (for both fluid cytology and forceps biopsy). The recorded complications in our study were minimal and not associated with any mortality.

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Conclusions: Ultrasound-guided pleural brushing is a new method for obtaining pleural specimens. It is a simple and relatively safe procedure. This technique provides additional diagnostic yield in malignant pleural effusion. We recommend it beside others in our diagnostic practice for suspicious malignant effusion especially when thoracoscopy is not available.

Introduction

The development of a pleural effusion in a patient with a known malignancy often raises the possibility that the effusion is due to malignant involvement of the pleura. Accurate diagnosis of the cause of the pleural effusion in such a patient is essential as the treatment and prognosis may vary. Thoracentesis and cytological analysis of pleural fluid cytology is usually the initial diagnostic step. The diagnostic yield of the latter procedure, however, is not always satisfactory and has been variably reported to be between 40% and 87% in different studies [1–3].

In addition to thoracotomy; various techniques are available to reach the pathological diagnosis of the pleural effusion through pleural biopsy and brushing. Included within these methods are the blind or closed needle biopsy of the pleura, closed pleural brushing [4], thoracoscopic pleural biopsy, thoracoscopic pleural brushing [5–7], and lastly the image guided procedures such as fluoroscopy, computed tomography (CT) and ultrasound (US) guidance [8–13].

Encouraging yields could be obtained by different ultrasound guided pleural procedures. However, until now the ultrasound guided pleural brushing is not included within these procedures and its diagnostic yield therefore is not evaluated. So the aim of this study was to evaluate the diagnostic yield of this procedure and its contributions as a technique not used previously in the interventional pulmonology practice to obtain pleural specimen for cytological examination in malignant pleural effusion.

Materials and methods

This prospective interventional study conducted in the Chest Department – Assiut University Hospital during the period from July 2014 to September 2015. Patients who had highly suspicious malignant pleural effusion (clinical, radiological, and laboratory) were hospitalized and enrolled in this study. Patient with bleeding tendency or coagulation profile abnormalities was excluded from the study. Patient was also excluded from this study if the etiology of effusion proved to be benign. Informed written consent was obtained from all patients.

The equipment used in our study were ultrasound apparatus (ALOKA – Prosound – SSD – 3500SV), biopsy forceps (KARL – STORZ – Germany 10329L – BS) (Fig. 1), the bronchoscopic cleaning brush (PENTAX CS6002SN) trocar and cannula of Cope's needle and rubber inlet seal (this piece usually fixed at the proximal port of light bronchoscope channel) as shown in (Fig. 2), and the semi rigid thoracoscope (LTF; Olympus; Tokyo, Japan) .Thoracentesis, pleural brushing and biopsy forceps of the pleura were performed for all enrolled patients in the ultrasound unit of the Chest Department while thoracoscopy was done in the endoscopy unit only for patients in whom the diagnosis could not be achieved by these procedures.

At least 50 ml of the pleural fluid was initially aspirated for cytological examination. The ultrasound guided procedures (brush and forceps) were performed under local anesthesia (Xylocaine 2%) and aseptic condition. The patients were premedicated by analgesic (Ketorolac tromethamine 20 mg) and lying either in a sitting or semi-recumbent position. The ultrasound guided forceps biopsy of the pleura was done following the same steps described by Agmy et al. [14]. Similarly, the pleural brushing was performed however, the brush introduced instead of the forceps through the Cope's cannula (Fig. 3). The brushing was done by scratching the targeted areas up and down multiple times and at least 4 samples were taken per patient. The specimens smeared from the brush onto the slides and fixed immediately by immersion in alcohol 95%. Three to five biopsy fragments were also obtained from the pleura in each case using the forceps and sent in 10% formaldehyde to the pathology laboratory. Following the procedures, all patients were observed clinically and complications

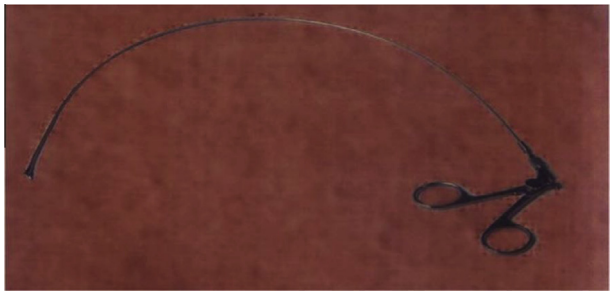

Figure 1 Biopsy forceps (KARL – STORZ – Germany 10329 – BS).

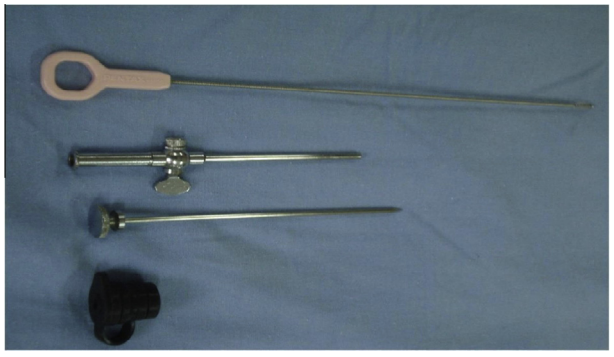

Figure 2 (top-down) PENTAX cleaning brush, Cope's cannula, Cope's trocar and the rubber piece.

Figure 3 Ultrasound picture showed the brush (arrow) inside the pleural cavity.

were noted. Chest radiograph was also obtained to exclude pneumothorax.

Results

Results are shown in Tables 1 and 2 and Fig. 4. Twenty-seven patients were initially suspected to have malignant effusion; five cases were excluded because they had benign diagnosis. The total number of patients who were finally documented to have malignancy and included in this study was 22 patients. Their ages ranged between 25 and 75 years with a mean value of 55.7 ± 12.7 years. There were 18 males (82%) and 4 females (18%). The respiratory symptoms found in studied cases were in the form of dyspnea in 14 (64%) cases, cough in 13 (59%) cases, chest pain in 7 (32%) cases, and hemoptysis in 5 (23%) cases. The effusion was right sided in 12 (55%) cases, left in 9 (41%) cases and bilateral in 1 (4%) case. The extent of effusion on chest X-ray was more than 2/3 of the hemithorax in 13 (59%) cases and between 1/3 and 2/3 in 9 (41%) cases. Regarding the thoracic ultrasound findings, pleural effusion alone was detected in 9 (41%) cases while associated findings were detected in the remaining cases including nodular pleural thickening in 7 (32%) cases, smooth pleural thickening in 5 (23%) cases, pleural masses in 1 (4%) case, septated effusion in 3 (14%) cases and findings suggestive of endobronchial obstruction in 4 (18%). Sonographically, the morphology of the pleural fluid was anechoic in 6 (27%) cases, heterogeneously echogenic in 12 (55%) cases and homogeneously echogenic in 4 (18%) cases. Regarding the color of pleural fluid, it was straw colored in 10 (46%) cases, serosanguinous in 8 (36%) cases and hemorrhagic in 4 (18%) cases. The pathological diagnosis obtained by different procedures among the studied patients was metastatic adenocarcinoma in 12 (55%) cases, metastatic squamous cell carcinoma in 4 (18%) cases, metastatic small cell carcinoma in 2 (9%) cases, and mesothelioma in 3 (14%) cases and lymphoma in 1 (4%) case. Regarding the diagnostic yield of each procedure; the pleural fluid cytology was positive in 9 (41%) cases, the pleural brushing in 9 (41%) cases and the biopsy forceps of pleura in 15 (69%) cases. Combination of both fluid cytology and pleural biopsy raises the positive yield to 16 (72%). Moreover, adding the results of pleural brush to yield of pleural biopsy raises this

Table 1 Characteristics of 22 patients proved to have malignant pleural effusion.

Data	Value
Age	
Range	25–75 years
Mean ± SD	55.7 ± 12.7
Sex	
Male	18 (82%)
Female	4 (18%)
Respiratory symptoms	
Cough	13 (59%)
Hemoptysis	5 (23%)
Dyspnea	14 (64%)
Chest pain	7 (32%)
Side of effusion	
Right	12 (55%)
Left	9 (41%)
Bilateral	1 (4%)
Extent of effusion on chest X-ray	
More than 2/3 of the hemithorax	13 (59%)
Between 1/3 and 2/3	9 (41%)
Less than 1/3	0
Thoracic ultrasound findings	
Anechoic fluid	6 (27%)
Heterogeneously echogenic	12 (55%)
Homogeneously echogenic	4 (18)%
Pleural effusion alone	9 (41%)
Septated effusion	3 (14%)
Nodular pleural thickening	7 (32%)
Smooth pleural thickening	5 (23%)
Pleural masses	1 (4%)
Evidence of endo bronchial obstruction	4 (18%)
Color of pleural fluid	
Straw color	10 (46%)
Serosanguinous	8 (36%)
Hemorrhagic	4 (18%)
Final pathological diagnosis	
Adenocarcinoma	12 (55%)
Squamous cell carcinoma	4 (18%)
Small cell carcinoma	2 (9%)
Mesothelioma	3 (14%)
Lymphoma	1 (4%)

Table 2 Positive yield of the individual procedures and their combinations in the malignant studied patients (number = 22).

Procedure	Diagnostic yield	Sole diagnostic technique
PFC	9 (41%)	1 (4%)
PB	9 (41%)	3 (14%)
BFP	15 (68%)	7 (32%)
PFC + BFP	16 (72%)	
PB + PFC	12 (55%)	
PB + BFP	18 (82%)	
PB + PFC + BFP	19 (86%)	

PFC, Pleural fluid cytology; PB, Pleural brush; BFP, Biopsy forceps of pleura.

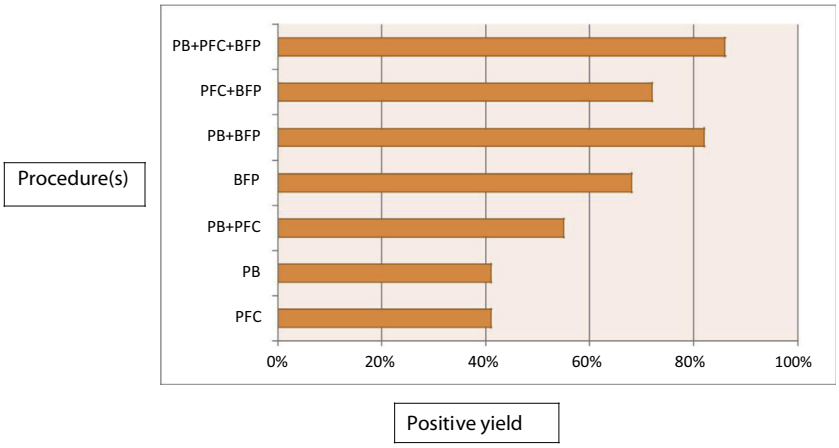

Figure 4 Positive yield of the individual procedures and their combinations in the malignant studied patients (number = 22).

yield to 18 (82%). Combination of the three procedures was able to diagnose 19 (86%) of the cases. The remaining 3 cases were diagnosed by medical thoracoscopy in 2 patients (adenocarcinoma and mesothelioma) and peripheral lymph node biopsy in 1 patient (lymphoma). The only key for diagnosis was the pleural fluid cytology in 1 (4%) of cases, the ultrasound guided pleural brushing in 3 (14%) cases and the ultrasound guided biopsy forceps of pleura in 7 (32%) cases. Both fluid cytology and pleural biopsy were positive in 2 (9%) cases in which the pleural brush was negative. In 6 (27%) cases in whom, the three procedures were positive for malignancy, the malignant cell types obtained by cytological assessment from pleural fluid and brush were in complete concordance with those obtained by histologic assessment by forceps biopsy. The complications of ultrasound guided procedures were minimal and not associated with any mortality. They were recorded in 4 (18%) cases and included transient local chest pain, subcutaneous pleural fluid leakage, small pneumothorax, low grade fever and transient hypotension.

Discussion

Pleural effusions are a common finding in patients with cancer, and the diagnosis is important in view of prognosis and management. In this study three main procedures were performed in all patients aiming at accurate pathological diagnosis. The first procedure was the thoracentesis which is the most commonly used step in the diagnostic work-up of pleural effusion (fully evaluated procedure). The second was the ultrasound-guided biopsy forceps of pleura that technique which is not commonly used in our practice to obtain pleural biopsy (underutilized technique). The third one was the ultrasound-guided pleural brushing, the procedure that not previously used in the interventional pulmonology, and to the best of our knowledge, this study is the first report to investigate the utility of this procedure in malignant effusion.

The yield of the pleural fluid cytology in our study was positive in 9 (41%) cases. This result was within the usual range of positive yield the fluid cytology (40–87%) reported in different studies among patients with malignant pleural effusion [1–3] . The 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. In our study US-guided forceps biopsy of the pleura helped us to reach final pathological diagnosis in 15 (68%)/22 patients with malignant pleural effusion. Through using the same procedure, it was possible to get the final pathological diagnosis in 84 (87%)/96 patients and in 11 (91%)/12 patients with pleural effusion as reported previously by Agmy et al. and Seitz et al. respectively [14,15]. Nearly similar idea and technique were used by Uthaman et al. but under fluoroscopy guidance and they could achieve diagnosis in 26 (93%)/28 cases [9]. The lower positive yield of this technique in our study may be due to the variation in number of patients and type of pathology.

The importance of pleural brushing comes from that the physician be able to take pleural specimen with risk of bleeding lower than that may be associated with forceps biopsy. Additionally the decision to take biopsy could be difficult when the targeted lesions were on the visceral pleura or near vascular structure. Before our study, two methods for pleural brushing were known and reported in few studies, the first was closed pleural brushing and the second was thoracoscopic pleural brushing. Closed pleural brushing procedure was positive and provided diagnosis in patients with malignant effusion in 31 (91%)/34 cases [5], 6 (86%)/7 cases [16], and 12 (57%)/21 cases [17]. On the other hand, thoracoscopic pleural brushing was positive among patients with malignant effusion in 13 (20%)/20 cases [6], 18 (72%)/25 cases [8], and 10 (62%)/16 cases [7]. In our study which is the first experience with the ultrasound guided pleural brushing, we found lower positive yield among patients with malignant pleural effusion, the procedure provided diagnosis in 9 (41%)/22 cases however it was exclusively diagnostic in 3 patients. Interestingly, the yield of the ultrasound guided – pleural brushing had its contributions regarding the final pathological diagnosis of our cases, it could augment the positive yield to be 55% instead of 41% (for pleural fluid cytology alone), 82% instead of 68% (for biopsy forceps alone), and 86% instead of 72% (for both fluid cytology and forceps biopsy).

Conclusions

Ultrasound-guided pleural brushing is a new method for obtaining pleural specimens. It is a simple and relatively safe

procedure. This technique provides additional diagnostic yield in malignant pleural effusion. We recommend it beside others in our diagnostic practice for suspicious malignant effusion especially when thoracoscopy not available.

Conflict of interest

Authors have no conflict of interest to declare.

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