

Yuvarajan Sivagnaname, Praveen Radhakrishnan, Antonious Maria Selvam

Department of Respiratory Medicine, Sri Manakula Vinayagar Medical College and Hospital, Puducherry, India

Thoracoscopic pleural brushing — an innovative method of pleural sampling in diagnostic medical thoracoscopy

Abstract

Introduction: Pleural biopsy is the commonest mode of obtaining thoracoscopic pleural specimens from suspected pleural lesions. However, this may be associated with a risk of bleeding in certain cases. The decision to perform biopsy could be difficult, especially when the lesions are close to vascular structures and the visceral pleura. So, pleural brushing can be used to get safely thoracoscopic specimens in addition to biopsy samples.

Aim: To determine the sensitivity and specificity of thoracoscopic pleural brushing in exudative pleural effusions.

Material and methods: This prospective study was done in the Department of Pulmonary Medicine, Sri Manakula Vinayagar Medical College, Pondicherry, India on 80 patients with exudative pleural effusion in whom pleural fluid analysis and closed pleural biopsy results were inconclusive. All these patients were subjected to medical thoracoscopy after getting informed consent. Pleural biopsy and pleural brushings were taken and sent for analysis.

Results: Thoracoscopic pleural biopsy was diagnostic in 76 of 80 patients (95%). Thoracoscopic pleural brushing was diagnostic in 74 patients (92.5%). Histopathology revealed malignancy (82.7%), granulomatous inflammation (11.5%) and nonspecific inflammation (5.7%). The sensitivity and specificity of pleural brushing were 96% and 75%, respectively. Interestingly, pleural brushing was the only diagnostic modality in one patient that was reported to be adenocarcinoma.

Conclusions: Thoracoscopic pleural brushing is an easy, convenient and safe procedure as it can augment the diagnostic yield of thoracoscopy. It is of significant value, especially in sampling pleural lesions close to vessels and the visceral pleura compared to pleural biopsy.

Key words: pleural brushing, medical thoracoscopy, pleural biopsy

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Introduction

The diagnosis of etiology of pleural effusions remains a challenging issue even after diagnostic thoracentesis and closed pleural biopsy in significant number of cases. In order to get a pleural biopsy or the diagnosis of undiagnosed pleural effusion, several techniques were used, such as percutaneous needle pleural biopsy, CT guided pleural biopsy, medical thoracoscopy, video assisted thoracoscopy and open thoracotomy [1, 2].

Medical thoracoscopy plays a huge role with a great diagnostic yield in the diagnosis of exudative pleural effusion. Pleural biopsy is considered to be a gold standard investigation of choice in patients with undiagnosed exudative pleural effusions. The

term “medical thoracoscopy” can be used to describe the diagnostic and therapeutic exploration of the pleural space carried out by the pulmonary physician, in the endoscopy unit, mostly under local anesthesia with or without conscious sedation, unlike video-assisted thoracoscopic surgery (VATS), which is conducted under general anesthesia with single lung ventilation [3].

Pleural biopsy with forceps is the usual mode of obtaining thoracoscopic specimens from suspected pleural lesions. However, this may be associated with complications like bleeding that hinders further biopsy, additionally, the decision to take biopsy could be difficult, especially when the targeted lesions are on the visceral pleura or near the vessels.

Address for correspondence: Sivagnaname Yuvarajan, Department of Respiratory Medicine, Sri Manakula Vinayagar Medical College and Hospital, Puducherry, India;

e-mail: nsivagnaname@yahoo.com

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On the other hand, pleural brush could be used to safely obtain pleural specimens through medical thoracoscopy from suspected areas either in the parietal, visceral pleura or near the vascular structure [2]. Pleural brushing can also be performed under direct vision in suspicious areas — in addition to thoracoscopic pleural biopsy. Decision to perform biopsy could be difficult in certain cases where the lesions are close to vascular structures and visceral pleura. So, pleural brushing can be used to safely get thoracoscopic specimens — in addition to biopsy samples, which could increase the diagnostic yield.

Aims and objectives

1. To evaluate the role of thoracoscopic pleural brushing in exudative pleural effusions.
2. To determine the sensitivity and specificity of thoracoscopic pleural brushing in exudative pleural effusions.

Materials and methods

This prospective study was carried out on 80 patients with exudative pleural effusion in whom pleural fluid analysis and closed pleural biopsy results were inconclusive, and who were admitted to our ward from September 2016 to September 2018. Sample size was calculated basing on the prevalence and study subjects from the previous study using free cal software.

All these patients were subjected to medical thoracoscopy after getting informed consent. Medical thoracoscopy was performed with Olympus semi-rigid thoracoscope. Patients with hemodynamic instability, bleeding diathesis, rib crowding were excluded from the present study. The procedures were done with complete aseptic precaution under local anesthesia (Lidocaine 2%, 10–20 mL) and conscious sedation with intravenous midazolam (0.5 mg/kg body weight). Intravenous tramadol 5 mg was given for analgesia prior to the procedure.

Patients were placed in the lateral decubitus position with the affected side upward. They were given supplemental oxygen. After local anesthesia, a 2–3 cm skin incision was made in the mid-axillary line either in the fifth or sixth inter-costal space (the site confirmed after evaluation with bedside ultrasound before the procedure). The skin incision was followed by the introduction of a 10-mm disposable blunt trocar with a cannula into the thoracic cavity. After the trocar was removed, pleural fluid was suctioned, and then

the thoracoscope was introduced into the pleural space followed by the inspection of both parietal and visceral pleura. Pleural brushing was done initially followed by forceps biopsy of the pleura. Brushing was taken from suspected pleural lesions in the parietal pleura, visceral pleura or near vascular structure. The brushing was performed by scratching the suspected areas up and down multiple times and at least 4 samples were taken per patient. Between 6 and 10 forceps biopsies were taken per patient from parietal pleural lesions. The procedure was followed by the placement of a 24–28 F standard chest tube. A chest radiograph posteroanterior view was obtained routinely after the procedure. Pleural biopsy, pleural brushing specimens were sent for histopathological and cytological examination.

Statistical analysis

Data was entered in MS Office Excel and analyzed using software SPSS version 24.0. Description of categorical study variables was done in terms of frequency and percentage. The diagnostic indices (sensitivity, specificity, positive predictive value, negative predictive value, likelihood ratio) of thoracoscopic pleural brushing against the gold standard thoracoscopic pleural biopsy were calculated and were reported with their 95% confidence interval.

Results

This study was done in a tertiary care center of Pondicherry on 80 patients with exudative pleural effusion with initial diagnostic results being inconclusive. The mean age of our patients was 55 ± 5 years with 57 males and 23 females. On inspection of the pleura, most of the patients had nodules both on the parietal and visceral pleura, predominantly near the costophrenic sulcus and over the diaphragmatic pleura (Table 1).

Table 1. Thoracoscopic findings among the cases

Thoracoscopic findings	No = (n)	Percentage [%]
Hypervascularity and congestion	5	6.2%
Nodules in parietal pleura	12	15%
Nodules in visceral pleura	5	6.2%
Nodules in both parietal and visceral pleura	56	70%
No lesions	2	2.5%

Table 2. Thoracoscopic pleural brushing vs thoracoscopic pleural biopsy

Thoracoscopy		Pleural biopsy	
		Negative	Positive
Pleural brushing	Positive	73	1
	Negative	3	3

Thoracoscopic pleural biopsy, which is considered a gold standard test was diagnostic in 76 of 80 patients (95%), whereas thoracoscopic pleural brushing was diagnostic in 74 patients (92.5%) (Table 2). Histopathology revealed malignancy (82.7%), chronic granulomatous inflammation (11.5%) and nonspecific inflammation (5.7%) among the study subjects (Figure 1).

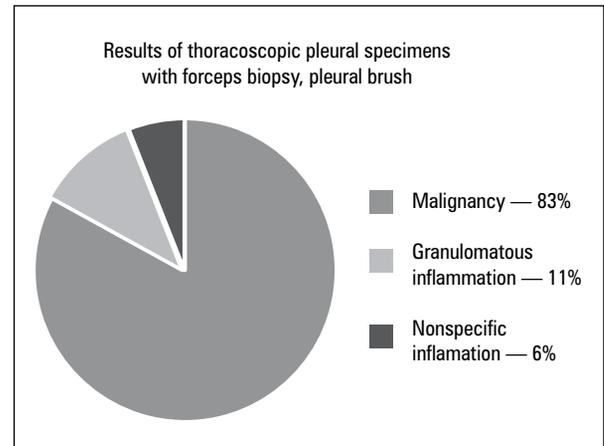
The sensitivity and specificity of pleural brushing were 96% (95% CI: 88.9–99.2%) and 75% (95% CI: 19.4–99.4%), respectively. The positive predictive value and negative predictive values were 98.7% (95% CI: 93–99.8%) and 50% (95% CI: 22.4–77.6%), respectively (Table 3). Accuracy of thoracoscopic pleural brushing was 95% (95% CI: 87.7–98.7%). Among the malignancies, adenocarcinoma was the most common variant. Interestingly, pleural brushing was the only diagnostic modality in one patient that was reported to be adenocarcinoma.

The procedure was well tolerated. Complications were minimal after thoracoscopy. The most common complications included post procedure chest pain (80%), transient fever (20%), and subcutaneous emphysema (25%).

Discussion

A significant number of patients presenting with pleural effusion poses challenges in diagnosis even after diagnostic thoracentesis with subsequent pleural fluid analysis for biochemistry, microbiology and cytology, and a closed pleural biopsy. Our study was carried out on 80 patients with exudative pleural effusion in whom pleural fluid analysis and closed pleural biopsy results were inconclusive. The diagnostic yield of thoracoscopic pleural biopsy was 95%.

The results of the study were comparable with previous studies by Kendall *et al.* [4], who reported yield of thoracoscopic pleural biopsy to be 83% in their study, which included 48 patients. Tscheikuna *et al.* [5] described their experience from Thailand where thoracoscopy was diagnostic in 95% of 34 patients. Elameen

**Figure 1.** Results of thoracoscopic pleural specimens with forceps biopsy, pleural brush

[6] and his colleague got diagnostic accuracy of 92.3% with thoracoscopic pleural biopsy.

On inspection of the pleura with thoracoscope, most of the patients (70%) had nodules both on the parietal and visceral pleura, predominantly near the costophrenic sulcus and over the diaphragmatic pleura. There were no lesions — neither in the parietal nor visceral pleura in 2 patients (2.5%).

Metastatic pleural disease is the most common cause of undiagnosed exudative pleural effusions after initial pleural fluid investigations and closed pleural biopsy. Among the malignancies, adenocarcinoma was the most common variant (90.9%), followed by non-Hodgkin lymphoma (4%), metastatic small cell carcinoma (4%) and mesothelioma (1.1%). These findings are in concordance with the results of Elhalfwy *et al.* [7] who found that 19 out of 30 patients had malignancy as a case of malignant pleural effusion; of those, 6 had mesothelioma, and 13 had malignancy metastasizing to the pleura while adenocarcinoma was the most encountered metastatic malignancy.

Granulomatous inflammation was noted in 11% of patients followed by nonspecific inflammation in 6% of the cases. Even though tubercular pleural effusions are common, the small number

Table 3. Diagnostic indices of thoracoscopic pleural brushing

Diagnostic indices	Value [%]	95% confidence interval
Sensitivity	96.1	88.9–99.2
Specificity	75	19.4–99.4
Positive predictive value	98.7	93–99.8
Negative predictive value	50	22.4–77.6
Positive likelihood ratio	3.84	0.70–21
Negative likelihood ratio	0.05	0.02–0.18
Accuracy	95	87.7–98.7

of patients diagnosed by this procedure suggests that it is diagnosed in the majority without pleuroscopy. Elhalfwy *et al.* [7] could diagnose only 3 tuberculous pleural effusion cases out of 11 patients diagnosed by medical thoracoscope as non-neoplastic etiology of pleural effusion. Kendall *et al.* [4] could not find any case of tuberculous pleural effusions in their study of 48 patients undergoing thoracoscopy for undiagnosed pleural effusions. These wide variations arise probably from the prevalence of disease in study populations, and moreover, tubercular pleural effusions are usually diagnosed by initial pleural fluid analysis or by closed pleural biopsy without any difficulty.

In our study, thoracoscopic pleural biopsy was diagnostic in 76 of 80 patients (95%), whereas thoracoscopic pleural brushing was diagnostic in 74 patients (92.5%). The sensitivity and specificity of pleural brushing were 96% (95% CI: 88.9–99.2%) and 75% (95% CI: 19.4–99.4%), respectively. The positive predictive value and negative predictive values were 98.7% (95% CI: 93–99.8%) and 50% (95% CI: 22.4–77.6%), respectively. Accuracy of thoracoscopic pleural brushing was 95% (95% CI: 87.7–98.7%). Interestingly, pleural brushing was the only diagnostic modality in one patient that was reported to be adenocarcinoma. Ahmed Kames *et al.* in their study found that combined thoracoscopic pleural specimens were diagnostic in 24 patients (96%). And all of them were malignant. Forceps biopsy was positive in 23 patients (92%), while pleural brush and pleural lavage were positive in 18 patients (72%) and 15 patients (60%), respectively [8]. To the best of our knowledge, our study is the first one conducted to evaluate various diagnostic indices (sensitivity, specificity, positive predictive

value, negative predictive value, likelihood ratio) of thoracoscopic pleural brushing in diagnostic medical thoracoscopy.

Conclusions

Thus, thoracoscopic pleural brushing is an easy, convenient and safe procedure as it can augment the diagnostic yield of thoracoscopy. It is of significant value, especially in sampling pleural lesions close to vessels and the visceral pleura compared to pleural biopsy.

Conflict of interests

None declared.

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