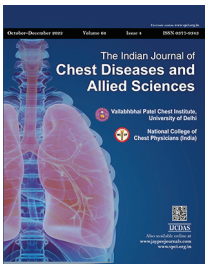
ORIGINAL ARTICLE

Medical Thoracoscopy: Diagnostic Role in the Management of Undiagnosed Pleural Effusions and its Complications



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Abstract

Introduction: Cases of undiagnosed exudative pleural effusions are common in clinical practice and pose a diagnostic challenge for pulmonologists. Medical thoracoscopy allows both direct visualizations of pleural space for diagnostic evaluation and chemical pleurodesis for therapeutic purposes.

Objectives: This study investigated the diagnostic role of medical thoracoscopy in the cases of undiagnosed exudative pleural effusions and complications of thoracoscopic pleural biopsy.

Patients and methods: Between December 2016 and August 2019, 195 patients of undiagnosed exudative pleural effusions underwent medical thoracoscopy in our institute. Pleural biopsies were taken and sent for histopathological and microbiological examination.

Results: The diagnostic yield of medical thoracoscopy in this study was 89.7%. Definite diagnosis was achieved in 175 out of 195 patients of the study population and only 20 (10.3%) patients were failed to be diagnosed by medical thoracoscopy. Histopathological results of thoracoscopic pleural biopsy among the study population revealed tubercular pleuritis in 31.79% (62 patients), metastatic adenocarcinoma in 23.07% (45 patients), malignant mesothelioma in 18.46% (36 patients), parapneumonic effusions in 6.66% (13 patients), metastatic squamous cell carcinoma in 5.64% (11 patients), small cell carcinoma in 3.07% (6 patients), malignant lymphoma in 0.51% (1 patient), and rheumatoid pleuritis in 0.51% (1 patient). Only 19.4% (38 patients) had minor complications like pain, minor bleeding, subcutaneous emphysema, and re-expansion pulmonary edema.

Conclusion: Thoracoscopy is a safe, well-tolerated procedure with minimal risk allowing the accurate diagnosis of undiagnosed pleural effusion. Besides determining the underlying cause, it also provides unique therapeutic approaches like pleurodesis to patients with malignant pleural effusions.

Keywords: Medical thoracoscopy, Pleuroscopy, Undiagnosed exudative pleural effusions.

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Abbreviations used in this Article

CT = Computed tomography; MPE = Malignant pleural effusion

Introduction

A pleural effusion is defined as an excessive accumulation of fluid in the pleural space. It is associated with many medical conditions that predispose to fluid accumulation via many different mechanisms, including increased pulmonary capillary pressure, decreased oncotic pressure, increased pleural membrane permeability, and obstruction of lymphatic flow.[1] Pleural effusion is a common condition affecting around 1.5 million people in the United States.[2] It can also occur in association with some systemic diseases, drugs, and organ dysfunction.[3] Despite the diagnostic tests available, pleural effusions remain undiagnosed in 20% of cases, which is a clinical problem.[4–6]

Pleural effusions are divided into transudative and exudative effusions.[7] The primary aim to differentiate transudates and exudates is that, in case of transudative effusions, no further diagnostic interventions are necessary and therapy is directed to the underlying cause of heart failure, cirrhosis, or renal dysfunction. Alternately, if the effusion proves to be an exudate, a more extensive diagnostic investigation is indicated.

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Light's criteria rule is the most common method used to separate transudative from exudative pleural effusion, based upon measurement of the serum and pleural fluid protein and lactate dehydrogenase.[8]

Investigation of a pleural effusion should follow a stepwise approach to diagnosis. Diagnosis begins with the clinical history, physical examination, and chest radiography and is followed

by thoracentesis when appropriate.[9] Sensitivity for pleural fluid cytology is low, and the diagnostic yield improves when combined with pleural tissue, examined histologically and cultured for mycobacteria.[10]

Medical thoracoscopy is an endoscopic evaluation of the pleural space. It is a minimally invasive procedure that was first devised in 1910 by Hans Christian Jacobaeus, a Swedish internist,[11] who is also considered as the "Father of thoracoscopy." Between 1915 and 1955, thoracoscopy was almost exclusively used therapeutically in the pneumothorax treatment of tuberculosis. In the early 1960s, thoracoscopy was used, mainly by pulmonologists in Europe, on a much broader basis for the diagnosis of many pleuropulmonary diseases. It enables taking of pleural biopsies under direct vision, therapeutic drainage of effusions and pleurodesis in one sitting.[12]

The most frequent diagnostic indication for thoracoscopy is an undiagnosed pleural effusion for which etiological diagnosis could not be reached after pleural fluid microscopic, biochemical analyses, and cytology.[13–19] Thoracoscopy is particularly helpful in diagnosing malignant pleural effusions (MPEs). In cases of suspected mesothelioma, for example, the diagnosis can be difficult by cytological examination of pleural fluid and histological examination of the small samples obtained by closed-needle pleural biopsy. Medical thoracoscopy improves the diagnostic yield for mesothelioma to above 90%.[20–23]

Thoracoscopy can be used in patients with known lung malignancies, having cytologically negative pleural effusions. Since complete resection of tumors is possible in only 6% of such patients,[24] medical thoracoscopy can be used to identify subset of patients who could potentially benefit from surgical resection while preventing surgery for the patients with unresectable disease.

Methods

The study was prospective, nonrandomized observational study conducted at post-graduate department of respiratory medicine, GMC Srinagar with the aim to detect the diagnostic yield of medical thoracoscopy in cases of undiagnosed pleural effusions and find out its complication rate.

All patients of undiagnosed exudative pleural effusions presenting to post-graduate department of respiratory medicine, GMC Srinagar during the study period of December 2016 to August 2019 were considered for the study after taking into consideration the exclusion criteria. The study was approved by the local ethical committee. A total of 195 patients were selected for the study. All included patients were subjected to written informed consent. After a detailed history and examination, patients were advised investigations of complete blood counts, liver and kidney functions, and bleeding profile (prothrombin time and International Normalized Ratio).

Sputum smears examinations for the presence of acid-fast bacilli were done. Radiological examination, through plain chest X-ray posteroanterior views as well as CT scanning of the chest, was done. Pleural fluid was aspirated and sent for biochemical, bacteriological, and cytological examination.

The inclusion and exclusion criteria for the study are as follows:

Inclusion criteria

- Radiological evidence of pleural effusion.
- Exudative pleural effusion as per "Light's criteria."
- Pleural fluid cytology negative for malignant cells.
- Patients whose pleural fluid examination through initial diagnostic thoracentesis could not yield a definitive diagnosis.

Exclusion criteria

- Patients with Transudative pleural effusion, according to "Light's criteria."
- Patients whose initial pleural fluid examination through thoracentesis could yield a definitive diagnosis.
- Patients who were not fit for undergoing thoracoscopy as in the following cases:
  - Patients with severe hypoxemia despite continuous oxygen administration.
  - Patients with unstable cardiovascular or hemodynamic status.
  - Patients with coagulation defects.
- Patients in whom the pleural space was judged to be inaccessible easily, those who had their pleural space obliterated by fibrous tissue or those who were suspected of having multi-loculated effusions.
- Patients with very thickened pleura as demonstrated by computed tomography (CT) scanning as it will impair the expansion of the underlying lung following the procedure.
- Patients with honeycomb lung, pulmonary arteriovenous aneurysms, suspected hydatid cysts, and highly vascularized pulmonary lesions.
- Uncooperative patients.
- Lack of informed consent.

Technique

Medical thoracoscopy was performed by chest physicians in the department of respiratory medicine after obtaining written informed consent. Thoracoscopy was done under local anesthesia with rigid thoracoscope. Prior to the procedure, patients were kept fasting for about 6 hours. After gaining proper intravenous access, patients were made to lie in lateral decubitus position with affected side facing upwards.

The site of port was selected with ultrasonic guidance usually between fifth and sixth intercostal space in mid-axillary line. The skin, subcutaneous tissue, intercostal muscles, and parietal pleura were anesthetized with 10 mL of 2% lignocaine. Intravenous tramadol and midazolam were also given in all patients for adequate analgesia and sedation. Around 1–2 cm long incision was given at desired site, and blunt dissection of subcutaneous tissue and intercostal muscles was done to reach pleural cavity. Trocar was introduced and pleural fluid was aspirated. Rigid thoracoscope was introduced and thorough examination of pleural cavity and pleura was done.

Mostly, 5–6 biopsies were taken from parietal pleura at the involved site. After taking biopsies, pleural cavity was properly examined for any active bleed. In cases of MPEs, talc pleurodesis was done using 4 gm of graded talc.

At the end of the procedure, a standard chest tube size 28–32F was introduced through trocar site and connected with under water seal followed by proper suturing of the wound. During the following 5 days, vital signs, temperature, use of supplemental oxygen, and all medical and surgical complications were recorded. The intercostal chest drainage tube was kept in place till the fluid drain per day was less than 100 ml/day after which it was removed.

Results

A total of 195 patients of undiagnosed exudative pleural effusions were recruited in this study from December 2016 to August 2019. The maximum number of patients was in the age group of greater than 60 years 74.3% ($N = 145$).

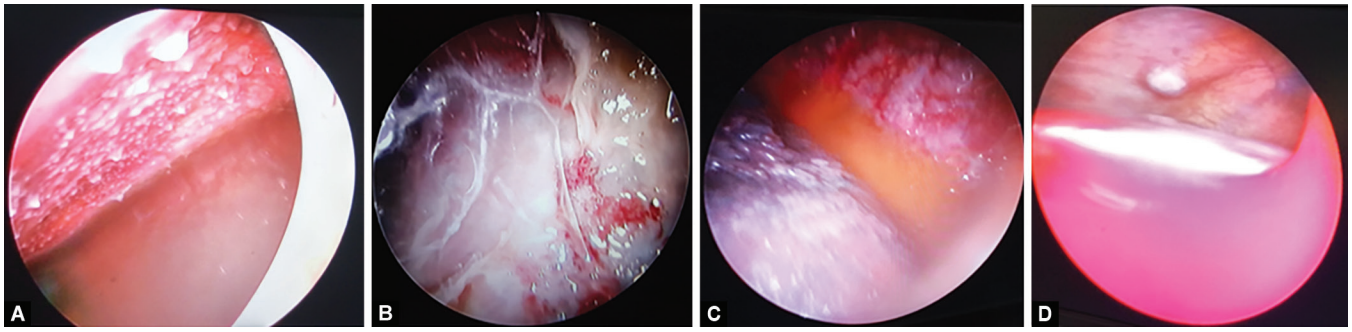
Table 1: Gross appearance of pleura on thoracoscopy

Gross thoracoscopy findings	*n (%)*
Pleural nodules	123 (63.07%)
Hyperemia	109 (55.89%)
Pleural adhesions	58 (29.74%)
Pleural plaques	32 (16.41%)
Sago grain nodules	49 (25.12%)
Normal	9 (4.6%)

Only 19.4% (38 patients) had minor complications like pain 8.7% (17 patients) and minor bleeding 3.5% (7 patients), which were controlled spontaneously, subcutaneous emphysema 5.1% (10 patients), and re-expansion pulmonary edema 2% (4 patients) (Table 3).

Discussion

Main indication for thoracoscopy in our study was evaluation of exudative pleural effusion which remained undiagnosed after pleural fluid analysis. Even after extensive diagnostic evaluation of a patient with pleural effusion, the etiology often remains unclear. Pleural fluid studies and blind pleural biopsy have their own limitations. The direct visualization of the pleural surface during medical thoracoscopy is a major advantage which may help to suspect a diagnosis and permit targeted biopsy from the abnormal



Figs 1A to D: Thoracoscopy images taken from patients in the study group: (A) Sago grain nodules; (B) Pleural adhesions; (C) Pleural nodular infiltration; and (D) Solitary pleural nodule

Among the 195 patients included in this study, 128 (65.6%) were male patients and 67 (34.4%) were female patients. There was no selection bias as all patients who met the inclusion criteria were included in the study. The gross appearance of the pleural fluid was blood-tinged in 17% of cases and straw-colored in 83% of the cases.

In addition to pleural effusion, CT imaging revealed mediastinal and hilar lymphadenopathy, pleural thickening, pulmonary consolidation or infiltration, pulmonary mass or nodules, pulmonary nodularity, and pleural atelectasis.

In the present study, gross thoracoscopic findings showed the presence of multiple variable sized nodules in 63.07% patients (mainly in cases of adenocarcinoma), pleural adhesions in 29.74% patients, pleural plaques in 16.41% patients (mainly parapneumonic effusions), hyperemic pleura in 55.89% patients (mainly mesothelioma followed by chronic nonspecific pleuritis), sago grain nodules in 25.12% patients (tubercular pleuritis), and smooth apparently healthy pleura in 4.6% patients (Table 1). Gross thoracoscopic appearances of various lesions have been shown in Figure 1.

Among the 38.9% (76 patients) of nonmalignant effusions, most common were granulomatous inflammation consistent with tuberculosis 81.6% (62 patients), followed by nonspecific pleuritis 17.1% (13 patients). Rheumatoid pleuritis caused effusion in 1.31% (1 patient).

Histopathological results of thoracoscopic pleural biopsy among the study population revealed tubercular pleuritis in 31.79% (62 patients), metastatic adenocarcinoma in 23.07% (45 patients), malignant mesothelioma in 18.46% (36 patients), parapneumonic effusion in 6.66% (13 patients), metastatic squamous cell carcinoma in 5.64% (11 patients), small cell carcinoma in 3.07% (6 patients), lymphoma in 0.51% (1 patient), and rheumatoid pleuritis in 0.51% (1 patient) (Table 2).

Table 2: Histopathological results of thoracoscopic pleural biopsy

Histopathologic subgroups	*n (%)*
Granulomatous inflammation	62 (31.79%)
Metastatic adenocarcinoma	45 (23.07%)
Malignant mesothelioma	36 (18.46%)
Parapneumonic effusion	13 (6.66%)
Metastatic squamous cell carcinoma	11 (5.64%)
Small cell carcinoma	6 (3.07%)
Malignant lymphoma	1 (0.51%)
Rheumatoid pleuritis	1 (0.51%)
No definite diagnosis	20 (10.3%)
Total patients	195

Table 3: Thoracoscopic complications

Complications	*n (%)*
No complications	157 (80.5%)
Pain	17 (8.7%)
Subcutaneous emphysema	10 (5.1%)
Minor bleeding	7 (3.5%)
Re-expansion pulmonary edema	4 (2.0%)
Total patients	195

Table 4: Comparison with other studies

Study or subgroup	*No. of patients*	*Diagnostic yield*	*Complication rate*
Mootha et al.[25]	35	74.3%	Empyema (5.2%)
Prabhu et al.[26]	68	97%	Prolonged air leak (1.4%) Subcutaneous emphysema (4.4%)
Mohamed et al.[27]	117	93%	Subcutaneous emphysema (1.7%) Prolonged air leak (0.85%) Wound infection (0.85%)
Helala et al.[28]	40	95%	Subcutaneous emphysema (2.5%) Pain (7.5%)
Patil et al.[29]	129	85.2%	Prolonged air leak (4.6%) Subcutaneous emphysema (3.9%) Empyema (2.3%) Tract malignancy (1.5%)
Our study	195	89.7%	Pain 17 (8.7%) Subcutaneous emphysema 10 (5.1%) Minor bleeding 7 (3.5%) Re-expansion pulmonary edema 4 (2.0%)

pleural regions with direct vision. It also gives the ability to break down the adhesions using biopsy forceps.

In the present study, 195 patients underwent medical thoracoscopy for the diagnosis of undiagnosed pleural effusions. The incidence of undiagnosed pleural effusion in our study was 10.3%. This figure is comparable to other studies where undiagnosed pleural effusion was observed in 8–25% of cases (Table 4). In the present study, medical thoracoscopy confirmed the diagnosis in 175 out of 195 (89.7%) patients who underwent this procedure and similar observations were made in other studies.[27–29] Malignant pleural effusion was the etiological diagnosis in 99 patients (50.76%). Out of 99 malignant effusions, most common cause was metastatic adenocarcinoma in 45.45% (45 patients). About 36.36% (36 patients) had malignant mesothelioma. In 11.1% (11 patients), metastatic squamous cell carcinoma was the cause of effusion and small cell carcinoma in 6.06% (6 patients). Malignant lymphoma caused effusion in 1% (1 patient). Among the non-malignant effusions, most common were granulomatous inflammation caused by tuberculosis (31.79%).

Minimal complications like pain, minor bleeding, subcutaneous emphysema, and re-expansion pulmonary edema were reported in the study. There were no reported mortality and no observed major complications. Loddenkemper[30] reported that the most serious, but rare complication is severe hemorrhage caused by trauma to the blood vessel. Other reported complications are empyema, prolonged air leakage, subcutaneous emphysema, post procedure fever, wound infection, cardiac arrhythmias, hypotension, and seeding of the chest wall from mesothelioma.[31] Overall, the side effects of medical thoracoscopy appear to be few and it is extremely safe, and the results are consistent with our study.

The possible reasons for the variation in diagnostic yield of thoracoscopic biopsy in different studies include experience and skill of the thoracoscopist, inadequate sampling, pathological errors (not taking deeper cuts), fibrinous necrotic layer covering the actual pathological area, and the presence of dense adhesions.[32]

Conclusion

The results of our study suggest that thoracoscopy is a safe, well-tolerated procedure with minimal risk allowing the accurate diagnosis of undiagnosed pleural effusion.

Besides the determination of underlying cause, it also gives the opportunity to provide unique therapeutic approaches to patients with MPEs like pleurodesis.

In conclusion, medical thoracoscopy is an indispensable tool with both diagnostic and therapeutic value.

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