## AUTHOR'S PUBLICATIONS OF RESEARCH WORKS RELATED TO THE THESIS CONTENTS

1. "Thoracoscopy in diagnosing the causes of pleural effusion," published in the Vietnam Journal of Medicine. 2023, Volume 529 (special issue).

2. "Thoracoscopy in treating complications of tuberculous pleural effusion at the Central Pulmonary Hospital," published in the Vietnam Journal of Medicine. 2023, Volume 529 (special issue), 2023.

MINISTRY OF EDUCATION AND TRAINING

MINISTRY OF HEALTH

**HAI PHONG UNIVERSITY OF MEDICINE AND PHARMACY**

**VU DO**

# STUDY RESULTS OF USING THORACOSCOPY IN ETIOLOGIC DIAGNOSIS AND COMBINED TREATMENT OF PLEURAL EFFUSION

**Major**: Internal medicine

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**SUMMARY OF DOCTORAL THESIS**

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**RECOMENDATION**

Based on current study, with finding on thoracoscopy as invaluable diagnostic technique for guiding or determining the causes of pleural effusion, and as safe and effective therapeutic tool in combined treatment of TPE complications, thoracoscopy should be more widely implemented, and performed earlier in healthcare facilities with sufficient technical capabilities for the diagnosis and treatment of pleural effusion cases. Provincial hospitals can develop and apply thoracoscopy in the aforementioned pathologies.

*2. Thoracoscopy used in combined treatment for TPE cases*

Forty-five patients with tuberculous pleural effusion and complications underwent thoracoscopic intervention in their combined treatment. Average age of the group was 47.3 (± 19.5 years) and the male/female ratio was 4/1. Interventions were indicated for pleural effusion with thickened and adherent pleura in 37 out of 45 patients (82.2%). The primary intervention methods included pleural adhesiolysis, lung decortication, and pleural peel. In the group of patients with TPE complications, 95.6% of patients were treated with pure thoracoscopic procedures, and 4.4% required surgery. The main interventions included pleural adhesiolysis, lung decortication, and pleural peel.

The average chest tube retention time was 6.4 (± 3.1) days. The average hospital stay after thoracoscopy was 10 ± 4.9 days. The complication rate was low, with only one patient (2.2%) experiencing purulent pleuritis. No major complications or deaths occurred.

All patients were discharged when pleural effusion resolved, and CXR showed complete lung expansion. Five patients (11.1%) had mild peripheral pleural thickening on ultrasound at discharge. After 3 months of follow-up, four patients showed no residual pleural thickening, and one patient had mild pleural thickening detected on ultrasound but had no significant functional impact and remained asymptomatic.



## INTRODUCTION

Pleural pathology represents a prevalent clinical entity encountered across diverse medical disciplines. Although the diagnosis of pleural effusions typically entails a straightforward process, the identification of their etiologies and the prescription of optimal therapeutic interventions may present complexities in specific instances.

According to Durgeshwar et al. (2022), conventional diagnostic methods for pleural effusion achieve 60-80% accuracy, such as microbiological tests, biochemistry, and pleural fluid cytology. However, even after analyzing the initial pleural fluid, 20-40% of cases with undetermined causes necessitate invasive procedures for precise diagnosis. Biopsy guided by CT results in an 87% diagnostic success rate in malignant pleural effusions. Thoracoscopy could reveal superior results, with high sensitivity in diagnosing malignant pleural effusion (ranging from 91% to 94%), it could even reach 93% to 100% in pleural fluid tuberculosis. In Vietnam, Nguyen Viet Co and colleagues pioneered to perform thoracoscopy in 1980s for diagnosing pleural diseases. Since then, thoracoscopy has become increasingly popular, not only in diagnosis but also in widespread therapeutic applications, yielding positive outcomes.

**Research objectives:**

1. *To describe the characteristics and etiologic diagnoses of pleural effusion cases determined through thoracoscopy at the Central Lung Hospital.*
2. *To remark the outcomes of thoracoscopy used in the combined treatment of cases with tuberculous pleural effusion in the studied subjects.*

## THESIS STRUCTURE

The thesis is presented in 125 pages, including the following parts: Introduction 2 pages, Overview 37 pages, Subjects and Research methods 21 pages, Research results 28 pages, Discussion 30 pages, Conclusion 2 pages, Recommendations 1 page. The thesis consists of 48 tables (results section 42 tables), 08 charts and 12 figures, using 130 reference documents including 31 Vietnamese documents and 99 English documents.



## CONCLUSION

The study of 163 patients with exudative pleural effusion diagnosed and treated using thoracoscopy as diagnostic or combined procedures at the Central Pulmonary Hospital from January 2020 to December 2022, has gained some mains findings:

*1. Characteristics of patient group the with PE diagnosed by thoracoscopy:*

The group of patients having average age of 51.2 (± 19.1), with more male (72.4%) than female. The common clinical symptoms included chest pain (94.4%), dyspnea (62.5%), dry cough (37.9%), productive cough (31.9%). On physical examination, the pleuritic syndrome was present in 92.6%;

Thoracoscopic procedure used as an etiologic diagnostic tool revealed 122 patients with TPE (74.8%), 21 with IPE (12.9%), and 20 MPE cases (12.3%).

Right-sided effusions were more common. Chest CT showed common nodular lesions in all three groups, especially in the groups with MPE (65%) and IPE (61.9%). Consolidated lesions were also common in all groups (43.4-61.9%). Lung collapse was most common in the TPE group (51.6%). The group of MPE exhibited nodular pleural thickening (65%) and infiltrative pleural parenchymal lesions (55%), while the TPE group commonly showed thickened and adherent pleura (42.6%), fibrous septations (27.9%), and pathognomonic pleural nodules (15.6%).

Diagnostic values for TPE of thoracoscopic biopsies analysed by microscopic, Bactec culture, and histopathological analysis were of 6.6%, 22.9%, and 100%, respectively. Diagnostic values for MPE with thoracoscopy was 100%, equivalent to other cutaneous biopsy techniques and significantly higher than specimens obtained through bronchoscopic biopsy.

Out of 163 cases, 94 patients (57.7%) reported postoperative pain but no significant complications or death was recorded.

invasive nature of thoracoscopic intervention and the reduced pain it caused, the lungs were well-expanded, allowing patients to initiate early and active breathing exercises, thereby promoting faster respiratory function recovery.

The complication rate was low, with only one patient (2.2%) experiencing purulent pleuritis; there were no deaths following the intervention. Chest tubes were removed when observation showed no air and fluid in the drainage, chest X-rays demonstrated full lung expansion, and there were no localized air-fluid collections. The average duration of chest tube retention after thoracoscopy in our study was 6.4 ± 3.1 days, with the longest duration being 20 days in a patient with purulent pleuritis complications. All patients were discharged when their overall condition stabilized, pleural effusion resolved, chest X-rays showed complete lung expansion, and the average hospital stay after thoracoscopy was 10 ± 4.9 days. The shortest stay was 5 days, and the longest was 28 days in a patient with purulent pleuritis complications.

Five patients (11.1%) were discharged with fully expanded lung X-rays, and ultrasound still showed peripheral pleural thickening of mild degree. These patients were all instructed to continue breathing exercises along with tuberculosis treatment. After 3 months of follow-up, four patients showed no residual pleural thickening, and one patient had mild pleural thickening detected on ultrasound but remained asymptomatic.

The favorable outcomes after thoracoscopic intervention in this patient group indicate that early thoracoscopy for treating complications of pleural effusion due to tuberculosis is a safe treatment method with a low complication rate, providing very good results for patients. It is recommended for widespread application.



# Chapter 1: OVERVIEW

## 1.1. Diagnosis of pleural effusion

*Clinical finding*

Common systemic symptoms of pleural effusion include: mild fever or high fever; body fatigue, loss of appetite... (non-specific).

Common symptoms of pleural effusion include: intermittent dry cough, cough that appears or increases when changing positions; Chest pain increases during coughing; Shortness of breath related to the amount of fluid in the pleural cavity.

The classical physical signs is “triple reduction” syndrome: decreased alveolar murmur, dull percussion, decreased vibrato in the effusion area.

*Routine chest x-ray (CXR)*

The radiographic appearance of pleural effusion is an area with a uniformly hazy image. Depending on the extent of fluid accumulation, the image may progress from a faint haziness in the posterior costophrenic angle to a uniform opacity covering half of the chest, extending from the diaphragm to the upper lung apex in a frontal CXR.

Indirect signs may include an expanded pleural cavity, displacement of the mediastinum toward the opposite side, and associated lesions such as thickening and calcification of the pleura or pleural calcified plaques.

*Computerized tomography (CT)*

Chest CT imaging allows for a comprehensive assessment of the overall condition of lung membrane injuries, including the location, thickness of the pleura, and images of pleural calcification. Lesions such as pleural thickening, loculated fluid collections, and pleural adhesions are also depicted on CT scans. Chest CT aids in the identification of

subtle lung tissue lesions that may go unnoticed on standard CXR. Additionally, chest CT serves as a guiding tool for managing pleural fluid in challenging cases.

*Pleural ultrasound*

With the aim of detecting and evaluating the characteristics of pleural fluid, estimating the quantity of fluid, ultrasound provides more accurate information than CXR in assessing the degree of pleural effusion and assists in determining the precise location for pleural fluid aspiration.

Ultrasound can detect fluid quantities ranging from 5-50 ml within the pleural cavity. Ultrasound examination also aids in identifying additional lesions, such as septations within the pleural effusion, pleural calcification, assessing the degree of adhesion and pleural thickening, measuring pleural thickness to differentiate solid masses from pleural effusion within the thoracic cavity. It precisely determines the location of the pleural effusion, evaluates other lung membrane lesions, and more.

*Aspiration and testing of pleural fluid*

Performing pleural fluid aspiration for diagnostic purposes and determining the cause of pleural effusion requires analyzing the extracted fluid for:

Distinctive characteristics of pleural fluid: Color, odor of the fluid.

Analysis of different cell types in pleural fluid: Various types of white blood cells.

Cellular and histopathological analysis: Rapid diagnosis, cellular block techniques.

pH level in pleural fluid; Glucose; Amylase...

Cancer markers.

Microbiological examination.

TB markers: Adenosine deaminase (ADA); Interferon-γ (IFNγ).

*Invasive techniques*



*Complications of thoracoscopic procedures*

In our study, no significant complications were recorded. Ninety-four patients (57.6%) experienced pain at the surgical site, with no other significant complications reported. There were no cases of death related to thoracoscopy. The low complication rate indicates that this is indeed a safe procedure with very high effectiveness.

**4.2. Thoracoscopic procedure in combined treatment for TPE cases**

In the group of 122 patients with pleural effusion due to tuberculosis diagnosed by the aforementioned thoracoscopy, 45 patients were found to have complications in the pleural cavity, and they underwent further thoracoscopic intervention to address these complications.

*Diagnostic and interventional methods*

The majority of interventions were indicated for pleural effusion with thickened and adherent pleura, with 37 patients (82.2%). Seven patients (15.6%) were diagnosed with pleural thickening, and one had pleural effusion with a septated collection. Of the patients, 95.6% were treated with thoracoscopy, with the primary intervention methods being pleural adhesiolysis, pleural peel, and lung decortication. Two patients (4.4%) could not undergo thoracoscopic intervention and had to undergo surgery; these were cases that presented late, with widespread pleural thickening and adhesions.

*Post-thoracoscopic outcomes*

All patients with pleural effusion due to tuberculosis treated with thoracoscopic intervention received anti-tuberculosis treatment, respiratory exercises, functional respiratory recovery, removal of the chest tube when pleural effusion ceased, and complete lung expansion. Due to the minimally

observed through thoracoscopy could be present in all groups of different causes of pleural effusion but with varying proportions. Therefore, lesion images observed through thoracoscopy are highly suggestive for diagnosing the cause of effusion, in addition to facilitating accurate and easier biopsy, even in difficult locations for blind or guided biopsy with the support of chest CT or ultrasound.

*Diagnostic effectiveness of thoracoscopy*

The cause was determined with 100% accuracy after thoracoscopic intervention, specimen collection for microbiological and histopathological examinations. Comparative analysis among different methods for diagnosing the cause of pleural effusion showed that thoracoscopic biopsy had a significantly higher diagnostic rate for tuberculosis (122/122 patients) compared to other cutaneous biopsies of the pleura (80/122 patients) and bronchoscopic biopsies (2/122 patients). The diagnosis of pleural effusion due to cancer from specimens collected through thoracoscopy was equivalent to pleural biopsy guided by ultrasound or chest CT (20/20 patients) and significantly higher than specimens collected through bronchoscopic biopsy (1/20 patients).

*Duration of pleural drainage and hospital stay by disease group*

The duration of pleural drainage in the tuberculosis group was 3.8 ± 2.7 days, in the cancer group was 3.4 ± 3.2 days, and in the *"inflammatory"* group was 3.7 ± 6.2 days. The average time of stay with pleural drainage was quite similar among the groups, approximately 3-4 days. The post-thoracoscopy hospital stay was longer in the cancer group (17.1 ± 16 days) and inflammation group (16.7 ± 13.0 days) compared to the tuberculosis group (8.5 ± 4.6 days). The duration of hospital stay after the intervention was mainly related to treatment issues after a definitive diagnosis was established.



*Pleural biopsy via chest wall:* Utilizes biopsy needles inserted through the skin, chest wall, into the pleural cavity to obtain specimens. Biopsies can be blind or guided by ultrasound or chest CT scan for enhanced diagnostic accuracy.

*Thoracoscopy:* Allows direct observation of lesions in the pleura, lungs, mediastinum, and diaphragm, enabling precise sampling and testing of suspected lesions. It is a safe and effective technique with high diagnostic value.

*Bronchoscopy:* Has limited diagnostic value due to its low direct diagnostic yield. It is recommended for patients with pleural effusion showing lung tissue lesions on CXR or a history of hemoptysis, aspiration of foreign bodies, or to identify the distant origin of pleural effusion.

**1.2. Overview of thoracoscopy**

*Thoracoscopy in the Diagnosis of Pleural Diseases*

Indicated in cases of pleural effusion where the cause cannot be determined by conventional methods. Thoracoscopy can be performed using a semi-rigid or rigid endoscope.

*Pleural effusion due to malignancy*

Thoracoscopy is an effective method for accurate diagnosis and therapeutic intervention in malignant pleural effusion. It is highly efficient in the staging of lung cancer, metastatic adenocarcinoma, and disseminated cancers.

*Pleural effusion due to tuberculosis*

Observable lesions often appear as homogeneous white or brownish nodules, spreading throughout the pleural space, diaphragm, and along the vertebral column; thickening of the pleura; and pleural fluid often has a yellowish-orange color. Biopsy of these lesions, combined with bacterial culture for tuberculosis, yields a high diagnostic rate.

*Pleural effusion due to purulent pleurisy*

Thoracoscopy is indicated in pleural effusion caused by non-drainable purulent inflammation, either by failed fluid aspiration or the insertion of drainage tubes. It aids in observing the condition of the pleural cavity, obtaining diagnostic specimens for microbiology and cytology, and assessing the thickness of the pleura and associated tissue lesions.

*Combined treatment of tuberculous pleurisy*

The treatment of pleural effusion due to tuberculosis primarily involves internal medicine, with the initial focus on anti-tuberculosis medication. During the course of treatment, there are cases where effusion rapidly recurs, loculated effusion forms multiple septa due to fibrin, or repeated aspirations result in purulent pleurisy, adhesions, etc. In such situations, repeated aspirations may not be as effective, and early intervention to release the pleura is needed to facilitate quick lung expansion along with internal medicine treatment. Early complications of tuberculous pleurisy can be addressed through thoracoscopy: cutting thick fibrous adhesions, removing pseudomembranes, thoroughly aspirating pleural fluid, especially loculated effusions encapsulated by inflammatory fibrous tissue, to release the lung, promote optimal lung expansion, prevent complications of adhesion, and facilitate rapid respiratory function recovery for patients.



*Lesions detected by ultrasound*

On ultrasound images, free-flowing pleural effusion was common in all three groups, especially in 100% of cancer cases. There was a statistically significant difference in this sign between the groups ($p = 0.001$). Thickening of the pleura was most common in the cancer group (30%). The incidence of pleural effusion with septation was relatively high in all three groups (around 20%). Loculated effusion was only found in the tuberculosis group (6.6%).

### *4.1.3. Thoracoscopy for etiologic diagnoses of pleural effusion*

A total of 163 patients underwent thoracoscopy to observe lesions, obtain biopsy specimens for microbiological and histopathological examinations. The results showed that out of 163 cases, 122 (74.8%) had pleural effusion due to tuberculosis, 21 (12.9%) due to inflammation, and 20 (12.3%) due to cancer. All cases were able to determine the cause after thoracoscopic intervention and examination.

*Characteristics of lesions observed through thoracoscopy*

Lesions of tuberculosis nodules and granulomas on the pleura were characteristic in patients with tuberculous pleuritis, with a prevalence of 15.6%. Interestingly, these lesions were entirely absent in patients with cancer and inflammation ($p < 0.05$). "Scattered small nodules on the pleura" were also more prevalent in the tuberculosis group, accounting for 47.5% of patients ($p < 0.001$). Images of ulcerative lesions, infiltration of the pleura and lung parenchyma, and nodular ulcer were most common in the cancer group. Particularly, the image of granular lesions on the pleura was most common in the cancer group with a prevalence of up to 65%, and there was a significant difference between the disease groups for this lesion ($p < 0.001$). We observed that various lesion images on the pleura

*Physical symptoms*

Crackles and wheezes were commonly found in all three groups, with 14% in the inflammation group, 18% in the tuberculosis group, and 25% in the cancer group. Reduced breath sounds were highly prevalent in all groups, especially in the tuberculosis and inflammation groups (>93%). Localized pleural friction rub was most common in the tuberculosis group (20%). Lymphatic chest involvement was mainly observed in the tuberculosis group (20%), a common sign in patients with tuberculosis pleurisy leading to pleural thickening and chest constriction. Statistical analysis showed a significant difference in the incidence of pleural friction rub between the disease groups ($p < 0.05$).

### *4.1.2. Paraclinical characteristics*

*Standard CXR*

Right-sided pleural effusion was present in 49.1% of patients, more than the left side (39.9%). Bilateral pleural effusion occurred in 11% of cases. This result was consistent with the findings of many authors indicating a higher prevalence of right-sided effusion.

The study's results showed that, out of 163 patients, moderate pleural effusion was predominant (38.6%), followed by extensive (34.4%) and minimal (27%). Our study's results were similar to those of other authors.

*CT scan characteristics of lesions*

CT scans provided a clearer evaluation of specific lesions, especially those difficult to assess on standard chest X-rays due to pleural effusion. Nodular lesions were common in all three groups, especially in the cancer group (65%) and inflammation group (61.9%). Consolidated lesions were also commonly seen in all groups, ranging from 43.4% to 61.9%. Pulmonary collapse was most common in the tuberculosis group (51.6%).



## *Chapter 2.* RESEARCH SUBJECTS AND METHODS

### 2.1. Study Participants

Patients with pleural effusion, regardless of gender, aged 16 and above, admitted to the Central Lung Hospital from 1/2020 to 12/2022, diagnosed, and treated with thoracoscopy.

Patients meeting one of the following criteria: (1) Diagnosed with pleural effusion of unclear etiology (pleural effusion despite undergoing tests searching for cancer cells, microbiological causes, blind lung biopsy, and pleural biopsy have not identified the cause) with an indication for thoracoscopy for diagnosis; (2) Diagnosed with tuberculous pleurisy, long-standing effusion, indicated for thoracoscopy to dissect pseudo-membranes, adhesions, and release loculated effusions encapsulated by inflammatory fibrous tissue to avoid complications of adhesion.

Complete medical records, relevant tests, and autopsy results at the Central Lung Hospital.

No contraindications for thoracoscopy.

Patient consent to participate in the study after detailed explanation of possible complications during the thoracoscopy procedure.

*Exclusion criteria:*

Patients with transudative pleural effusion, purulent effusion, or chyle effusion; patients contraindicated for anesthesia or thoracoscopy due to the absence of pleural space, severe respiratory failure ($PaO_2 < 60$ mmHg unrelated to pleural effusion), coagulation disorders, or cardiovascular abnormalities; severely ill or cachectic patients with Zubrod and Karnofsky scores greater than 3.

## 2.2. Research Method

*Study Design:* Descriptive and exploratory research.

*Sample size and sample selection method*

All patients with unexplained pleural effusion who meet the study criteria during the study period were included using a convenient non-probability sampling technique.

All patients were interviewed for medical history, underwent pre-treatment and post-treatment clinical and laboratory examinations. Information was recorded in a standardized medical record template.

*Sampling method and sample size for Objective 1:*

The expected number of patients undergoing thoracoscopy for diagnosis was calculated using the sample size calculation formula as follows:

$$n = Z^2_{1-\alpha/2}\frac{p(1-p)}{d^2}$$

α (accuracy): 0,5; n: patient number

p: The estimated incidence of pleural effusion of unknown cause is: 0,25 (based on number practiced in Lung National Hospital and other research)

d (absolute error): 0,08; $Z_{1-\alpha/2}$: standard score, Z1-α/2 = 1,96

Calculation from the formula: **n = 113**

In this study, we collected data from **163 patients.**

*Sampling method and sample size for Objective 2:*

Convenience sampling was employed, including all cases in the above group diagnosed with tuberculous pleural effusion after thoracoscopy, with observed complications within the pleural cavity. These complications included fibrin patches, fibrous adhesions creating



# *Chapter 4.* DISCUSIONS

## 4.1. Characteristics of patients with pleural effusion diagnosed by thoracoscopic examination

### *4.1.1. Clinical* characteristics

***Age and gender***

Out of 163 patients, 118 (72.4%) were male, and 45 (27.6%) were female, with males being 2.6 times more prevalent. The average age of the study participants was 51.2 ± 19.1 years, with no statistically significant age difference between males and females. The age distribution revealed the highest proportion in the 56-65 age group for males (23.7%) and the 66-75 age group for females (20%).

***Clinical symptoms***

*General symptoms*

Fever was the most common symptom in the study (42.6% of patients), followed by weight loss (25.8%) and peripheral lymphadenopathy (2.5%). Analyzing systemic symptoms by the underlying cause, fever was most common in the tuberculosis group (42.6%), followed by the inflammation group (28.6%), and was lowest in the cancer group (5%), with a statistically significant difference (p = 0.004). Weight loss was most common in the cancer group (50%) and less prevalent in the tuberculosis group (22.2%) and inflammation group (23.8%), although not statistically significant (p = 0.142).

*Functional symptoms*

The most common functional symptoms in the study group were chest pain (94.4%) and dyspnea (62.5%). Cough was also prevalent, with dry cough in 37.9% and productive cough in 31.9%. Hemoptysis occurred in only 2.3% of cases. The study results were consistent with those of other authors in the country.

and chest X-rays show complete expansion. Of the discharged patients, 5 (11.1%) had fully expanded lung X-rays, with peripheral pleural thickening detected on ultrasound at a mild level. These patients were instructed to continue breathing exercises along with tuberculosis treatment. Follow-up after 3 months revealed that 4 patients showed no pleural thickening, while 1 patient had mild peripheral pleural thickening detected on ultrasound with no symptoms.



loculated effusions in the pleural cavity, thickening and adherence of the pleural membrane, etc. Patients with identified complications were further designated for intervention treatment, such as breaking down fibrous adhesions, disrupting loculated pleural effusions, peeling off thickened pleural membranes, detaching adhered lungs from the chest wall, etc. The goal was to restore the lungs to their normal anatomical position. In this study, we selected 45 patients who met the specified criteria.

*Research content and main outcome measurement variables*

The research procedure was conducted in the following steps:

*Clinical Examination:* Medical history, disease history, treatment process, general symptoms, functional symptoms, physical examination.

*Investigation and tests:* Diagnostic imaging (CXR, chest CT, pleural ultrasound), blood tests, bronchoscopy, microbiological tests, lymph node aspiration, blind or CT-guided pleural biopsy, or ultrasound-guided biopsy.

*Pleural fluid aspiration for laboratory tests.*

*Diagnostic thoracoscopy for determining the cause of pleural effusion:* Describing the images of lesions, biopsying suspected lesions, obtaining specimens for further examination.

*Therapeutic thoracoscopy for managing complications of tuberculous pleuritis:* Evaluating diagnostic effectiveness, treatment outcomes, lung re-expansion, etc.

*Post-intervention follow-up:* Duration of chest tube retention, complications, hospitalization time after the intervention.

*Data Processing*

The collected data were entered into the KoboToolbox software and analyzed using STATA 17.0.

## *Chapter 3.* RESEARCH RESULTS

### 3.1. Clinical and paraclinical characteristics of the study group with bronchoscopic diagnosis of pleural effusion

**Table 3.1. Results of bronchoscopic pleural biopsy diagnosis**

| Diagnose | Number | % |
|---|---|---|
| Malignancies | 20 | 12,3 |
| Tuberculosis | 122 | 74,8 |
| Chronic inflammation | 21 | 12,9 |

Among 163 cases of pleural effusion with undetermined causes, bronchoscopic pleural biopsy diagnosed 20 cases of cancer (12.3%), 21 cases of chronic inflammation (12.9%), and 122 cases of tuberculosis (74.9%).

**Table 3.2. Distribution of age groups and gender**

| Gender / Age group | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | n | (%) | n | (%) | n | (%) |
| 16-25 | 12 | 10,2 | 5 | 11,1 | 17 | 10,4 |
| 26-35 | 19 | 16,1 | 9 | 20,0 | 28 | 17,2 |
| 36-45 | 10 | 8,5 | 8 | 17,8 | 18 | 11,0 |
| 46-55 | 16 | 13,6 | 4 | 8,9 | 20 | 12,3 |
| 56-65 | 28 | 23,7 | 7 | 15,6 | 35 | 21,5 |
| 66-75 | 20 | 17,0 | 9 | 20 | 29 | 17,8 |
| >75 | 13 | 11,0 | 3 | 6,7 | 16 | 9,8 |
| Total | 118 | 100 | 45 | 100 | 163 | 100 |
| Average | 52,3 ± 19 | | 48,4 ± 19,4 | | 51,2 ± 19,1 | |
| p | 0,127 | | | | | |



| | | |
|---|---|---|
| Tuberculosis of parietal and diaphragmatic pleura | 6 | 13,3 |
| Fibrous septum | 14 | 31,1 |
| Pleural ligament | 2 | 4,4 |
| Thick and sticky pleura | 37 | 82,2 |
| Parenchymal damage | 19 | 42,2 |

**Table 3.40. Early complications of thoracoscopic intervention**

| Symptoms | Count (n=45) | % |
|---|---|---|
| No symptom | 44 | 97,8 |
| Prolonged air leak | 0 | 0 |
| Inflammation of empyema | 1 | 2,2 |
| Dead | 0 | 0 |

**Table 3.41. Post-thoracoscopic course**

| Pleural drainage time | Mean ± SD | Min | Max |
|---|---|---|---|
| Pleural drainage time | 6,4 ± 3,1 | 0 | 20 |
| Time from thoracoscopy to discharge from hospital | 10,0 ± 4,9 | 5 | 28 |

**Table 3.42. Lesions on ultrasound before discharge**

| Pleural damage | Count (n=45) | % |
|---|---|---|
| Pleural fluid or localized outbreak | 0 | 0 |
| Slight thickening of the pleura in the peripheral area | 5 | 11,1 |
| Dead | 0 | 0 |

Patients start tuberculosis treatment while in the hospital and are discharged when their general condition stabilizes, pleural effusion resolves,

The majority of ultrasound results (89.8%) showed multiple wall lesions and thickening of the pleura.

**Table 3.35. Pre-endoscopic diagnoses**

| Pre-endoscopic diagnosis | Count (n) | Rate (%) |
|---|---|---|
| Septated pleural effusion | 1 | 2,2 |
| Septum + Pleural thickening | 37 | 82,2 |
| Empyemic cavity | 7 | 15,6 |
| Total | 45 | 100 |

The majority of interventions were indicated for pleural effusion with wall and thickening of the pleura. There was one patient with pleural effusion and compartmentalized effusion; 15.6% of patients were diagnosed with pleural sediment.

**Table 3.37. Endoscopic intervention procedures**

| Intervention methods | Count (n) | Rate (%) |
|---|---|---|
| Break the septum and remove the pseudomembranous membrane | 2 | 5,1 |
| Breaking the septum + peeling off the pleura | 43 | 94,9 |
| Total | 45 | 100 |

**Table 3.38. Combined lesions in patients with TPE**

| Combined damage | Count | % |
|---|---|---|
| Lemon yellow fluid | 5 | 11,1 |
| Red fluid | 0 | 0,0 |
| Purulent fluid | 39 | 86,7 |



The patients in the study group had an average age of 51.2 ± 19.1, with an average age of 52.3 ± 19 for males and 48.4 ± 19.4 for females. The youngest patient was 16 years old, and the oldest was 92 years old.

**Table 3.4. Gender distribution according to the causes**

| Disease / Gender | Tuberculosis (n=122) | | Malignancies (n=20) | | Inflammation (n=21) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Male | 86 | 70,5 | 15 | 75,0 | 17 | 81 |
| Female | 36 | 29,5 | 5 | 25,0 | 4 | 19 |
| Total | 122 | 100 | 20 | 100 | 21 | 100 |
| p | 0.589 | | | | | |

The male-to-female ratio is higher for all causes of the disease.

**Table 3.9. Functional symptoms according to the causes**

| Disease / Symptom | Tuberculosis (n=122) | | Malignancies (n=20) | | Inflammation (n=21) | | p |
|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | |
| Drycough | 45 | 36,9 | 11 | 55,0 | 7 | 33,3 | 0.247 |
| Sputum | 39 | 32 | 6 | 30,0 | 7 | 33,3 | 0.974 |
| Hemoptisi | 4 | 3,3 | 0 | 0,0 | 0 | 0,0 | 0.549 |
| Chest pain | 115 | 94,3 | 19 | 95,0 | 20 | 95,2 | 0.978 |
| Dypsnee | 71 | 58,2 | 16 | 80,0 | 17 | 81,0 | 0.030 |

**Table 3.10. Physical symptoms according to the causes**

| Disease / Symptoms | Tuberculosis (n=122) | | Malignancies (n=20) | | Inflammation (n=21) | | p |
|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | |
| Moist rales | 22 | 18,0 | 5 | 25,0 | 3 | 14,3 | 0,687 |
| Wheezing | 0 | 0 | 0 | 0 | 0 | 0 | - |
| Solidified | 5 | 4,1 | 0 | 0 | 0 | 0 | 0,549 |
| Triple reduction syndrome | 114 | 93,4 | 17 | 85,0 | 20 | 95,2 | 0,320 |
| Locally dull percussion | 0 | 0 | 0 | 0 | 0 | 0 | 0,889 |
| Locally reduced alveolar murmur | 21 | 17,2 | 2 | 10,0 | 2 | 9,5 | 0,308 |
| The chest swells | 0 | 0 | 0 | 0 | 0 | 0 | - |
| Flat chest | 12 | 9,8 | 0 | 0 | 0 | 0 | 0,008 |
| Heart | 8 | 6,6 | 3 | 15,0 | 3 | 14,3 | 0,098 |
| Digest | 2 | 1.6 | 1 | 5,0 | 1 | 4,8 | 0,479 |
| Peripheral lymph nodes | 2 | 1.6 | 1 | 5,0 | 1 | 4,8 | 0,279 |



There were 94 cases (57.7%) of patients with pain at the surgical site. No other significant complications were noted. There were no cases of mortality after endoscopy.

**3.2. Thoracoscopic intervention in combined treatment TPE**

Of total 45 patients with gender ratio male/female is 4/1 and average age of 47.3 ± 19.5 (male 49.6 ± 18.1; female 38.3 ± 23.4).

**Table 3.26. Time from symptom onset to hospital admission**

| Duration | Count (n) | Rate(%) |
|---|---|---|
| ≤2 week | 15 | 33,3 |
| 2 weeks to 1 month | 14 | 33,1 |
| 1 month to 2 months | 7 | 15,6 |
| Over 2 months | 9 | 20,0 |
| Total | 45 | 100 |

Only 33.3% of patients were admitted to the hospital within 2 weeks of the onset of symptoms. The majority of patients, 33.1%, were admitted 2 to 4 weeks after the first symptoms.

**Table 3.34. Pleura images through ultrasound (US)**

| Lesions detected through US | Count (n) | Rate (%) |
|---|---|---|
| | n | % |
| Free pleural fluid | 10 | 22,4 |
| Pleural thickening | 21 | 46,9 |
| Septum | 19 | 42,9 |
| Pleural fluid in multiple foci (loculated) | 5 | 10,2 |
| Free pleural fluid, septum | 5 | 10,2 |
| Pleural fluid in multiple foci, septa, and pleural thickening | 40 | 89,8 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Parenchymal damage | 26 | 21,3 | 5 | 25 | 6 | 27,3 | 0,0 |
| Parietal pleural roughness | 7 | 5,7 | 13 | 65 | 3 | 13,6 | <0, |
| Visceral pleural warts | 0 | 0,0 | 0 | 0.0 | 0 | 0,0 | - |
| Parietal pleural nodule | 41 | 33,6 | 10 | 50 | 11 | 50 | 1,0 |
| Visceral pleural nodules | 6 | 4,9 | 2 | 10 | 1 | 4,6 | 0,1 |
| Infiltration of the parietal pleura | 26 | 21,3 | 3 | 15 | 4 | 18,2 | 0,1 |
| Visceral pleural infiltrates | 37 | 30,3 | 11 | 55 | 8 | 36,4 | 0,4 |
| smooth walled pleura | 0 | 0,0 | 0 | 0,0 | 1 | 4,6 | 0,3 |
| Visceral pleura is smooth | 7 | 5.7 | 1 | 5.0 | 0 | 0.0 | 0.5 |
| Small nodules scattered in the parietal pleura | 58 | 47.5 | 7 | 35 | 10 | 45.5 | <0. |
| Scattered nodules in visceral pleura | 3 | 2.5 | 0 | 0.0 | 0 | 0.0 | 1.0 |



**Table 3.13. Location on standard CXR according to the causes**

| Disease / Location | Tuberculosis (n=122) | | Malignancies (n=20) | | Inflammation (n=21) | | p |
|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | |
| Right | 59 | 48,4 | 11 | 55,0 | 10 | 47,6 | 0,011 |
| Left | 55 | 45,1 | 5 | 25,0 | 5 | 23,8 | |
| Both | 8 | 6,6 | 4 | 20,0 | 6 | 28,6 | |
| Total | 122 | 100 | 20 | 100 | 21 | 100 | |

In the tuberculosis group, the most common lesions are often found in the right lung (48.4%), followed by the left lung (45.1%). The incidence of lesions on both sides of the lungs is higher in the cancer group (20%) and inflammation group (28.6%) compared to the tuberculosis group (6.6%). Right lung lesions are more prevalent in the cancer group (55%).

**Table 3.14. Degree of pleural effusion according to the causes**

| Diseases / Degree | Tuberculosis (n=122) | | Malignancies (n=20) | | Inflammation (n=21) | | p |
|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | |
| Less | 33 | 27,1 | 3 | 15,0 | 8 | 38,1 | 0.348 |
| Average | 50 | 41,0 | 7 | 35,0 | 6 | 28,6 | |
| More | 39 | 32,0 | 10 | 50,0 | 7 | 33,3 | |
| Total | 122 | 100 | 20 | 100 | 21 | 100 | |

In the tuberculosis group, moderate pleural effusion accounted for the highest proportion (41%), followed by the large amount (32%). The cancer group had the highest proportion of large pleural effusion (50%). The inflammation group had the lowest proportion of small pleural effusion (38.1%).

**Table 3.15. Lesions on chest CT according to the causes**

| Disease / Lesion | Tuberculosis (n=122) | | Malignancies (n=20) | | Inflammation (n=21) | | p |
|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | |
| Infiltration | 40 | 32,8 | 6 | 30,0 | 5 | 23,8 | 0,677 |
| Node | 53 | 43,4 | 13 | 65,0 | 13 | 61,9 | 0,102 |
| Cave | 0 | 0,0 | 0 | 0,0 | 1 | 4,8 | 0,035 |
| Cavernous fibrosis | 9 | 7,4 | 0 | 0,0 | 0 | 0,0 | 0,196 |
| Lime | 9 | 7,4 | 1 | 5,0 | 0 | 0,0 | 0,410 |
| Condensed | 53 | 43,4 | 10 | 50,0 | 13 | 61,9 | 0,312 |
| Deviation of the trachea | 2 | 1,6 | 0 | 0,0 | 0 | 0,0 | 0,708 |
| Collapsed lung | 63 | 51,6 | 10 | 50,0 | 8 | 38,1 | 0,476 |
| Umbilical lymph nodes | 3 | 2,5 | 3 | 15,0 | 2 | 9,5 | 0,035 |
| Alveolar dilatation | 10 | 8,2 | 5 | 25,0 | 2 | 9,5 | 0,079 |
| Bronchiectasis | 6 | 4,9 | 5 | 25,0 | 1 | 4,8 | 0,006 |
| Mediastinal lymph nodes | 12 | 9,8 | 6 | 30,0 | 3 | 14,3 | 0,048 |



**Table 3.16. Pleura ultrasound images according to the causes**

| Damage | Tuberculosis (n=122) | | Malignancies (n=20) | | Inflammation (n=21) | | p |
|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | |
| Free pleural effusion | 73 | 59,8 | 20 | 100,0 | 17 | 81,0 | 0,001 |
| Pleural thickening | 25 | 20,5 | 6 | 30,0 | 3 | 14,3 | 0,456 |
| Pleural septa | 28 | 23,0 | 4 | 20,0 | 4 | 19,0 | 0,898 |
| Loculated in many foci | 8 | 6,6 | 0 | 0,0 | 0 | 0,0 | 0,243 |

**Table 3.21. Lesion findings through thoracoscopic endoscopy**

| Damage | Tuberculosis (n=122) | | Malignancies (n=20) | | Inflammation (n=21) | | p |
|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | |
| Tuberculosis nodules/granules of parietal and/or diaphragmatic pleura | 19 | 15,6 | 0 | 0,0 | 0 | 0,0 | 0,0 |
| Fibrous wall | 34 | 27,9 | 4 | 20 | 7 | 31,8 | 0,6 |
| Thick and sticky pleura | 52 | 42,6 | 2 | 10 | 8 | 36,4 | 0,0 |