



PAKISTAN  
CHEST SOCIETY  
STRIVING FOR PULMONARY CARE

Clinical Practice  
Guidelines

# Medical Thoracoscopy (Pleuroscopy) Guidelines

PAKISTAN CHEST SOCIETY-2026

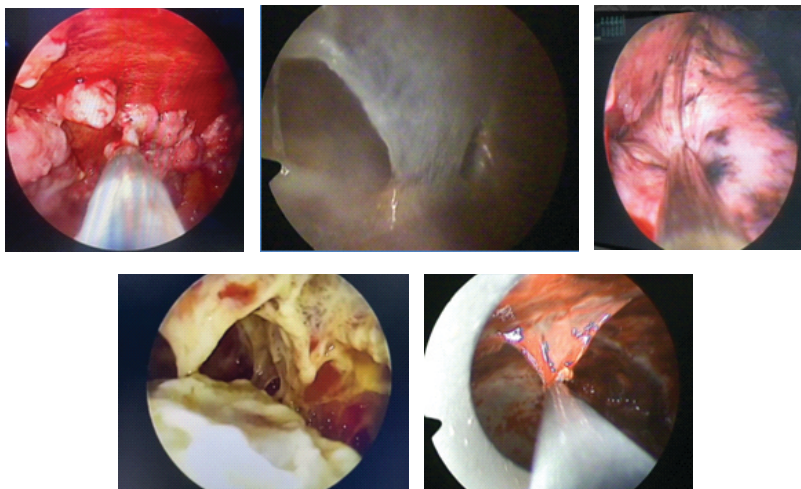


# Medical Thoracoscopy (Pleuroscopy) Guidelines

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Second Edition, March 2026  
**Pakistan Chest Society**



**PAKISTAN  
CHEST SOCIETY**  
STRIVING FOR PULMONARY CARE



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# Preface

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The pursuit of knowledge is a never-ending path that unravels the mysteries of existence. It is with great pride that we introduce the second edition of the Pakistan Chest Society (PCS) guidelines on medical thoracoscopy. Since the release of the first edition, we have witnessed a significant growth in the adoption of this invaluable diagnostic and therapeutic modality across Pakistan. Many centers have successfully established medical thoracoscopic services, and we are committed to supporting the continued expansion of this expertise.



These guidelines have been meticulously updated to reflect the latest international recommendations and incorporate our collective local experience. Medical thoracoscopy remains a powerful tool for pulmonologists to diagnose and manage pleural diseases in a cost-effective and minimally invasive manner, particularly in a country where access to thoracic surgery can be limited.

I would like to express my heartfelt gratitude to the members of the guideline committee for their tireless efforts in updating and refining this document. Their dedication to excellence has ensured that these guidelines remain a valuable resource for both novice and experienced practitioners. This edition covers all aspects of pleural disorders requiring medical thoracoscopy, including patient selection, procedural steps, and post-procedural care. I am confident that these guidelines will continue to serve as a comprehensive resource for healthcare professionals seeking to enhance their skills in pleuroscopy.

I would also like to thank our patients, whose cases and images have enriched this document, and our teachers, whose inspiration has guided us. To all readers, I extend my sincerest appreciation for your interest in advancing the field of respiratory and pleural medicine in Pakistan. Let us strive to continue learning and improving, taking our field to new heights.

Thank you.

## **Prof. Dr. Talha Mahmud**

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Chairman  
Medical Thoracoscopy  
Guideline Working Group

## Message by the President Pakistan Chest Society

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Medical thoracoscopy has become a valuable minimally invasive modality for the diagnosis and management of pleural diseases. These guidelines define indications, procedural techniques, patient selection, and safety considerations. The Pakistan Chest Society hopes these recommendations will expand the safe and appropriate use of medical thoracoscopy across specialized centers.



### **Prof. Shereen Khan**

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President  
Pakistan Chest Society

## Message by the Chairman

### Guideline Committee, Pakistan Chest Society

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It gives me great pleasure to present the 2nd edition of Guidelines for Medical Thoracoscopy (Pleuroscopy), developed under the auspices of the Pakistan Chest Society. Medical thoracoscopy has emerged as an indispensable minimally invasive procedure in the diagnosis and management of pleural diseases, offering high diagnostic yield and facilitating therapeutic interventions such as pleural biopsy and pleurodesis. In our setting, where tuberculosis, malignancy, and undiagnosed exudative pleural effusions remain common clinical challenges, the availability of standardized, evidence-based guidance is both timely and essential.



These guidelines have been meticulously developed to align international best practices with the realities of healthcare delivery in Pakistan, emphasizing patient safety, procedural competency, and optimal resource utilization. I would like to extend my sincere appreciation to the dedicated Working Group for Medical Thoracoscopy, under the able chairmanship of Professor Talha Mahmud, for their scholarly efforts, commitment, and expertise in producing this comprehensive document.

It is our hope that these guidelines will serve as a practical resource for clinicians, enhance procedural proficiency, and ultimately improve patient outcomes across the country.

## **Prof. Muhammad Ashraf Jamal**

Chairman Guideline Committee  
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# Pakistan Chest Society

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**Disclosure:** None of the committee members have any personal financial disclosures to reveal.

## Acknowledgement

We would like to express our sincere gratitude to the esteemed members of the Pakistan Chest Society Medical Thoracoscopy Guidelines committee for their invaluable contributions and expert input in shaping this work. Their dedication to advancing medical knowledge and improving patient care is truly commendable.

We also extend our heartfelt appreciation to our families, whose unwavering support and encouragement have been a constant source of motivation for us.

Our sincere thanks go to the dedicated team of trainee doctors and staff nurses at Shaikh Zayed Hospital, whose tireless efforts and commitment to patient care have been instrumental in making this work possible. We particularly acknowledge their role in preparing patients for procedures and providing exceptional care throughout their stay.

Lastly, we would like to express our deepest gratitude to our patients, who have placed their trust in us and allowed us to use their procedural images for educational purposes. Their selflessness and generosity will undoubtedly contribute to the advancement of medical knowledge and improvement of patient outcomes.

## Dedication

To all patients navigating the complexities of pleural disorders,

In the shadows of uncertainty, we stand as beacons of hope. Your struggles, though unique, are not solitary; they echo the collective quest for relief, for answers, and for a return to the breath of life.

These guidelines are a testament to our unwavering commitment to your care. They embody the relentless pursuit of knowledge, the compassion of caregivers, and the resilience of those who face the challenges of pleural disease.

We dedicate this work to you, not merely as patients, but as individuals whose lives weave the fabric of our purpose. Your stories, though marked by pain and adversity, inspire us to strive for better understanding, more effective treatments, and ultimately, a cure.

May these guidelines illuminate the path to better care, and may they be a reminder that in the journey of pleural health, you are not alone.

In the words of wisdom, 'Hope is a good thing, may be the best of good things and no good thing ever dies' and it is with this enduring hope that we dedicate these guidelines to you.

For every breath taken, for every life touched, we are here.

# List of Abbreviations

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<b>ACEP</b>	American College of Emergency Physicians
<b>ANTT</b>	Aseptic Non-Touch Technique
<b>CXR-PA</b>	Chest X-rays Posteroanterior View
<b>CBC</b>	Complete Blood Count
<b>CT</b>	Computerized Tomographic
<b>ECG</b>	Electrocardiogram
<b>ETT</b>	Endotracheal tube
<b>FB</b>	Foreign Body
<b>Fr</b>	French
<b>INR</b>	International Normalization Ratio
<b>IV</b>	Intravenous
<b>IM</b>	Intramuscular
<b>LAT</b>	Local Anesthetic Thoracoscopy
<b>MDR</b>	Multi-Drug Resistant
<b>MT</b>	Medical Thoracoscopy
<b>NSCLC</b>	Non-Small Cell Lung Cancer
<b>NPO</b>	Nil Per Oral
<b>Nd:YAG</b>	Neodymium-doped Yttrium Aluminium Garnet
<b>NSAID</b>	Non-Steroidal Anti-Inflammatory Drug
<b>PaCO<sub>2</sub></b>	Partial Pressure of Carbon Dioxide
<b>PPE</b>	Parapneumonic Effusion
<b>PSA</b>	Procedural Sedation and Analgesia
<b>SpO<sub>2</sub></b>	Saturation of Oxygen on Pulse Oximeter
<b>S/C</b>	Subcutaneous
<b>TB</b>	Tuberculosis
<b>TUS</b>	Thoracic Ultrasound
<b>VTE</b>	Venous Thrombo-embolism
<b>VAMT</b>	Video Assisted Medical Thoracoscopy
<b>VATS</b>	Video Assisted Thoracoscopic Surgery

# Introduction

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The exploration of the human body has long been a cornerstone of medical practice, with physicians driven by an insatiable curiosity to visualize and understand the intricacies of living tissues. The evolution of endoscopy, a term coined from the Greek words "endo" (inside) and "skopein" (to observe with care), has revolutionized the field of medicine. Since its inception in the 19th century, when French urologist Desormeaux pioneered the use of cystoscopy (to evaluate urinary bladder) in 1865, endoscopy has undergone significant transformations. Medical thoracoscopy, also known as pleuroscopy or pleural endoscopy, is a minimally invasive procedure that enables direct visualization of the pleural space by creating an opening through the chest wall. This technique has a rich history, dating back to 1910 when Swedish physician Hans Christian Jacobaeus first utilized a modified cystoscope to evaluate the pleura and lyse tuberculous adhesions. Jacobaeus' pioneering work laid the foundation for modern thoracoscopy, which has since evolved significantly.<sup>1,2</sup>

The advent of sophisticated video systems in the 1990s revitalized interest in medical thoracoscopy, enabling pulmonary physicians to adopt this technique for diagnostic and therapeutic purposes.<sup>3</sup> The success of laparoscopic surgery sparked a similar revolution in thoracic surgery, with video-assisted thoracoscopic surgery (VATS) becoming increasingly popular for various procedures. Pulmonary physician-led local anesthetic thoracoscopy (LAT) or may be called as video-assisted medical thoracoscopy (VAMT) has emerged as a valuable tool, expanding the diagnostic and therapeutic capabilities of medical thoracoscopy.<sup>3,4</sup> Thoracoscopy involves inserting an endoscope through the chest wall to visualize the pleura, commonly used for pleural fluid drainage, parietal pleural biopsy, and pleurodesis.

It was estimated that there are 1-1.5 million pleural effusions per year in the United States and about 200,000 to 250,000 in the United Kingdom each year.<sup>5</sup> Data from studies conducted in Pakistan have shown that around 60%-65% of patients presenting with unilateral pleural effusion had tuberculous pleural effusion, around 15% had malignancy, and 10%-12% had hepatic hydrothorax/heart failure, while 10%-15% remain undiagnosed.<sup>6</sup> Thoracoscopy requires strict aseptic non-touch technique (ANTT) due to the sterile pleural space, unlike the clean but non-sterile bronchial tree being evaluated during bronchoscopy.<sup>7</sup> As techniques and technology evolve, medical thoracoscopy's role will continue to evolve in managing pleural and pulmonary diseases. Medical thoracoscopy is primarily used for diagnosis but also allows therapeutic interventions like pleural fluid drainage and talc pleurodesis. Its key advantage is enabling direct visualization of pleural surfaces, increasing diagnostic yield comparable to VATS procedures.<sup>4,7</sup> Despite its potential, the applications and utility of medical thoracoscopy vary widely among clinicians and countries. As the Pakistan Chest Society endeavors to revise guidelines for pleuroscopy, it is essential to recognize the procedure's evolution, current status, and future directions. These guidelines aim to provide a comprehensive framework for the safe and effective use of medical thoracoscopy in Pakistan, ultimately enhancing patient care and outcomes.

# Pre-Procedural Evaluation and Patient Preparation

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Better patient outcomes in medical thoracoscopy greatly depend on careful pre-procedure evaluation, patient selection and optimal patient preparation. This minimizes peri-procedural complications, and enhances diagnostic and therapeutic yield. Key elements of this phase include:

- Thorough clinical assessment
- Relevant investigations
- Evaluation of pleural space and lung status
- Patient counseling
- Optimizing respiratory status
- Anesthesia planning

## Indications and Patient Selection

Confirm that there is indication of rigid thoracoscopy. Both diagnostic and therapeutic uses are well established. Likewise assess for contraindications (see indications and contraindications sections). In Pakistan, the primary goal is usually to distinguish between tuberculosis and malignancy. The first and most vital step is ensuring the patient can actually withstand the mechanics of the procedure. Before deciding for thoracoscopy, one should answer a practical question: Can this patient tolerate the lateral decubitus position? During rigid thoracoscopy, the patient is placed on their "good" side (healthy lung is dependent lung) while, during the procedure, a controlled pneumothorax is created (spontaneous entry of air after pleural puncture) on the affected side. This position significantly alters the ventilation-perfusion matching, as the weight of the mediastinum and abdominal contents pushes against the healthy lung.

**Clinical Practice Point:** In our practice, we recommend a "trial of lateral decubitus position." Have the patient lie in the lateral decubitus position for 20 minutes during the initial assessment. If they become tachypneic or their SpO<sub>2</sub> drops below 90%, they are likely poor candidates for a procedure under conscious sedation and may require a more controlled surgical setting or an alternative diagnostic route. Consider therapeutic thoracentesis before the procedure to improve diaphragm and chest wall mechanics, respiratory function, and alleviate dyspnea. International data states that the diagnostic yield for rigid scopes is very high because of the large, deep biopsies; often three times the size of those from semi-rigid scopes (13.9 mm vs 4.4 mm).<sup>8</sup>

In endemic regions including Pakistan, this is crucial. We aren't just looking for malignant cells; we are fighting a high burden of paucibacillary TB. A single session yields enough tissue for histopathology, GeneXpert MTB/Rif assay, mycobacterial cultures, and drug sensitivity testing, addressing the high disease burden effectively. Patient selection for medical thoracoscopy should prioritize safety: "who can safely have one" over "who needs a biopsy". High-risk patients (mMRC grade 3-4 dyspnea, can't lie flat) may face more risks than benefits. For stable patients, rigid thoracoscopy provides a definitive diagnosis in one go, avoiding repeated failed biopsies.

# Pre-requisites of the Procedure

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Although MT is a simple procedure, the interventionist must possess a sound knowledge of surface landmarks and pleural anatomy. He/she should be familiar with the instruments and their handling. It must be checked prior to starting the procedure that all necessary equipment and drugs are in hand. Under water chest drains should be prepared before starting the procedure and electrocautery equipment should be ready. Sterility of the operating room and equipment should be well maintained.

## Pre-Procedure Assessment

### History and Physical Examination

A detailed history and physical examination are of utmost importance to guide appropriate patient selection. The clinical history should focus on the respiratory symptoms, previous episodes of pleural disease, systemic features like fever, weight loss, etc. Also get detailed inquiry about comorbid illnesses like tuberculosis, chronic lung diseases, cardiac disease, and prior malignancy. To refine your patient selection and risk stratification, also include history of allergies, exposures and assessment of functional status. A thorough history-taking is crucial to anticipate any complications. Past TB treatment may indicate pleural adhesions, making thoracoscopy riskier. Also, elderly patients on anti-platelets, anticoagulants, or steroids need careful evaluation to avoid hemorrhagic complications. Dig deeper beyond symptoms to ensure a safe procedure.<sup>9</sup> Great care should be exercised for patients with hypoproteinemia, malignant involvement of the chest wall, and poor functional status. Procedure should be postponed if patient has uncontrolled cough as excessive coughing may lead to subcutaneous emphysema.

**Clinical Practice Point:** Don't forget to check for allergies, especially to local anesthetics or latex. Also, assess for dyspnea. If mMRC grade 3 or 4, proceed with extreme caution. Physical examination should include complete vital signs assessment, evaluation for respiratory distress, and thorough systematic respiratory system examination. Also, examine other systems for any comorbid illnesses. Examination of the chest wall and correlation with chest imaging helps identify safe entry site for thoracoscope. It is the best way to avoid a "dry tap" or, worse, an accidental injury to the liver or spleen. Also look for systemic clues like lymphadenopathy or clubbing, which might give a differential diagnosis before the procedure. A 10-minute thorough clinical workup saves an hour of troubleshooting in the procedure room. While international guidelines provide the framework, the "local flavor" of our history-taking—focusing on TB burden and cardiac stability—is what makes the procedure safe in a Pakistani setup.

### Laboratory Investigations

All patients enlisted for medical thoracoscopy should have the following basic investigations (table 1A) done prior to the procedure. Minimum lab requirements include complete blood counts (CBC) and coagulation profile (PT, aPTT, INR, platelet count). Aim for platelets >50,000/ $\mu$ L and INR <1.5. Additional tests as needed: renal and liver functions, blood typing, viral serologies (HBV, HCV, HIV), and other tests for comorbidities, following institutional protocol.

**Clinical Practice Point:** Have a blood group and cross-match ready, especially if the imaging shows a very vascularized pleura/septations or if you suspect a complex malignancy. It's a small step that can save a life if things go south in the procedure room. Be wary of uremic patients because uremia may lead to platelet dysfunction.

### Imaging

Pre-procedural thoracic ultrasound is a must. It confirms pleural fluid, guides entry site, and assesses septations, thickening, and lung disease. This helps pick the safest entry point, reduces

**Table 1A. Pre-medical Thoracoscopy Investigations.**

Investigations	Comments
Complete blood count	Hemoglobin should be more than 8g/dL Platelet count should be >60,000/mm <sup>3</sup> Manage pancytopenia prior to enlisting for the procedure
Renal function tests and blood glucose	All these should be optimized before the procedure
Coagulation profile	INR should be less < 1.2
Electrocardiogram	Recent angina, myocardial infarction and arrhythmias are contraindications to the procedure
Chest X-ray	Pre-procedure CXR PA and lateral view helps in localizing the diseased area and screen the status of contralateral lung Post-procedure CXR helps in comparison regarding success of the procedure
Ultrasound chest	On site thoracic ultrasound before the procedure to localize the safe entry point and avoid trauma to other organs like diaphragm or lung

complications, and maps diaphragm and organs to avoid injury. If heavy thickening or septations are present, counsel the patient about possible transition to a therapeutic approach (breaking adhesions). Don't rely solely on the traditional safety triangle – ultrasound marking in the lateral decubitus position is key, as the "safe zone" shifts with patient position.

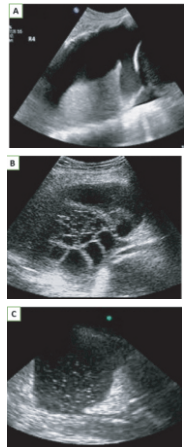
**Clinical Practice Point:** Always look for the lung sliding sign on ultrasound. If it's absent, even in an area that looks like it has fluid, be extremely cautious. It may indicate a fused pleura from old TB, where any attempt at trocar insertion could lead to a significant lung injury.<sup>[4,10]</sup>

# Thoracic Ultrasound Prior to Medical Thoracoscopy

One of the main reasons of inability to perform a good thoracoscopy is failure to select the safest site of entry into the pleural space. This can be secondary to pleural adhesions, minimal pleural effusion or prior pleurodesis.<sup>11,12</sup> Thoracic ultrasound (TUS) use prior to thoracoscopy allows the thoracoscopist to identify the safe access site, apprehend any procedural difficulties he/she may face during the procedure, reduce the risk of complications and length of hospital stay. Ultrasound examination reveals the nature of pleural effusion and helps in applying the right management strategy.<sup>13</sup>

The following TUS characteristics may be seen:

- **Anechoic Effusion:** It appears as black area between visceral and parietal pleura. This may be a transudate or an exudate (transudates are always anechoic and half of the exudates are also echo free). May require drainage depending upon the pretest probability of an underlying disease.<sup>13</sup>
- **Echogenic Effusion:** It appears as cloudy or echogenic area between visceral and parietal pleura (figure 1). This may an exudative effusion (a complicated PPE or empyema) and needs tube thoracostomy along with management of the cause, infective or malignant etc. Diffusely echogenic effusions are usually hemorrhagic or empyema, while if there are swirling particles seen they can be due to high protein content, fibrin or blood.<sup>11,13</sup>
- **Septated or Multiloculated Effusion:** It appears as echogenic or hypoechoic areas interspersed in between linear threads of fibrin giving honeycomb or spider web appearance; or there may be free fluid seen having fibrin bands which have to-and-fro motion on TUS. These septations are best visualized by ultrasound (figure 1) having high sensitivity compared to CT. The lung is seen collapsed and trapped in between the septations. Earlier in the course of disease, medical thoracoscopy may aid in the diagnosis as well as adhesiolysis in these situations.<sup>14</sup>
- **Other Important Findings** which can be of help for a thoracoscopist apart from identifying a good entry site are visualization of pleural or diaphragmatic thickening, pleural or diaphragmatic nodularities (figure 1) and later success of medical pleurodesis.<sup>15</sup>
- The data is robust; using ultrasound for site selection significantly drops the rate of pneumothorax and bleeding. In resource-limited settings, where CT scans might not be required/readily available for every patient, a skilled hand with an ultrasound probe is our most powerful safety tool. Without doubt, ultrasound is more sensitive than CT scan in showing intrapleural septations/loculations. During the medical thoracoscopic procedure, on-site-thoracic-ultrasound can help visualizing complete evacuation of the pleural space and removal of all loculations, setting the lung free to expand. Post-procedure thoracic ultrasound helps in ongoing assessment of complications like re-accumulation of pleural fluid, air leak or trapped lung.



**Figure 1. Anechoic effusion (A), complex multi-septated effusion (B) and complex non-septated effusion (C)**

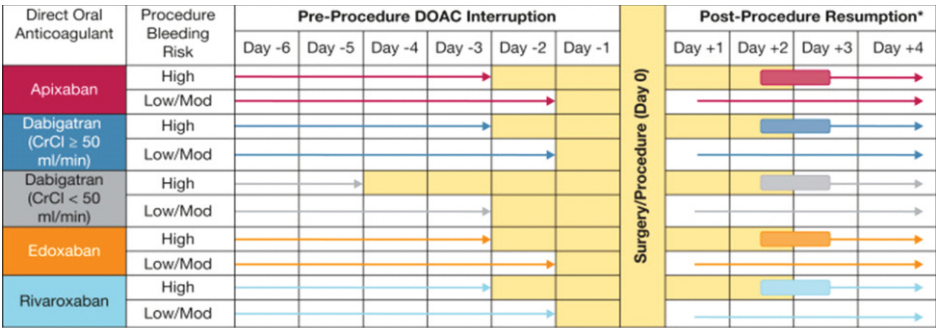
# Premedication for Thoracoscopy

- Prophylactic antibiotics are not recommended routinely but they must be used in patients with asplenia, prosthetic heart valves, prior endocarditis or in patients with PPE/empyema as part of treatment.
- Oral anticoagulants (warfarin, rivoroxaban) should be stopped at least 3 days before the procedure. Warfarin should be held until INR normalize (< 1.5)
- Clopidogrel should be stopped at least 5 days prior to the procedure.
- Aspirin can be continued.
- Discuss regarding discontinuation of anticoagulants or antiplatelets with the cardiologist if the patient has any strong indication for their use.
- Bronchodilators, antibiotics and corticosteroids are continued if the patient is already taking these before the procedure.
- To prevent vasovagal shock atropine 0.4 – 0.8 mg S/C or I/M may be used prior to or during the procedure.
- During procedure SpO2 should be maintained > 92%; and most patients receive supplemental oxygen.

## Coagulation Management

Patients with certain comorbid illnesses may be on anticoagulants (figure 2 and 3). Removal of the agent before procedure is the main concern. In general, five half-lives are required for complete elimination of the anticoagulant. If the procedure is to be performed before that time frame use reversal agent. After procedure, wait to ensure there is no evidence of an internal bleed.

**Figure 2: Peri-procedural anticoagulation management.**



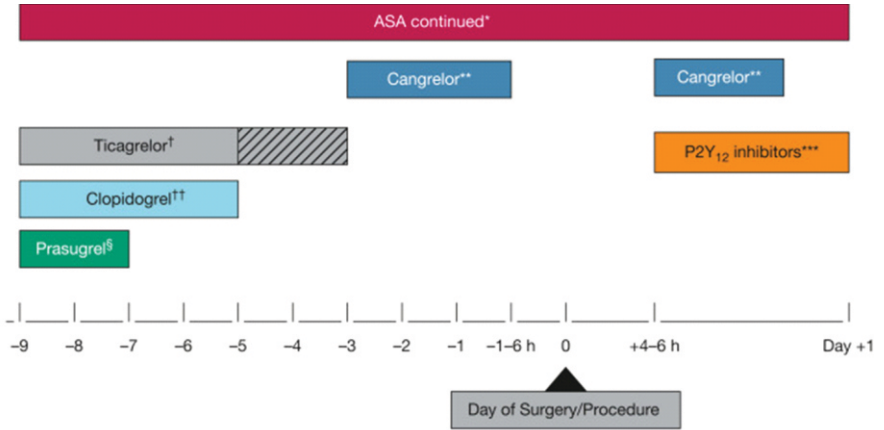
 No DOAC administered that day

\*DOAC can be resumed ~24 hours after low/moderate-bleed-risk procedures, and 48-72 hours after high-bleed-risk procedures. In selected patients at high risk for VTE, low-dose anticoagulants (i.e., enoxaparin, 40 mg daily or dalteparin, 5,000 IU daily) can be given for the first 48-72 hours post-procedure.

Stop warfarin 5 days, LMWH (enoxaparin/ fondaparinux) 24 hours, heparin 4-6 hours, bivalirudin 2-4hrs before the procedure. May resume as per following time line after procedure:

Warfarin 12–24 hours, LMWH 24 hours, UFH 4–6 hours, Bivalirudin 4–6 hours or an increasing hematoma on the post-procedure chest radiograph. Aim to resume most agents within 24 to 48 hours.

**Figure 3: Peri-procedural antiplatelet management.**



**Legend:**

\*Based on surgery/procedure bleed risk assessment.

\*\*Routine use not suggested. If used, initiate within 72 hours from P2Y<sub>12</sub> inhibitor discontinuation at dose of 0.75 mg/kg/min; resume within 6 hours post-procedure for minimum of 48 hours and maximum of 7 days total. Very low quality data for antiplatelet bridging with glycoprotein IIb/IIIa inhibitors (e.g., eptifibatid, tirofiban).

\*\*\*P2Y<sub>12</sub> inhibitors can be resumed within 24 hours post-procedure at a maintenance dose.

†For ticagrelor, 3-5 day interruption

††For clopidogrel, 5 day interruption

§For prasugrel, 7-10 day interruption.

[Reference: Douketis JD, Spyropoulos AC, Murad MH, Arcelus JI, Dager WE, Dunn AS, et al. Perioperative management of antithrombotic therapy: an American College of Chest Physicians clinical practice guideline. Chest. 2022 Nov;162(5):e207-e243].

**Table 1B. Peri-procedural management of direct oral anticoagulants based on bleeding risk and renal function**

Direct Oral Anticoagulant	Bleeding Risk	Pre-Procedure: Last Dose Taken	Post-Procedure: Resumption
Apixaban	High	Day -3	Day +2 to +3
	Low/Mod	Day -2	Day +1
Dabigatran (CrCl ≥ 50 ml/min)	High	Day -3	Day +2 to +3
	Low/Mod	Day -2	Day +1
Dabigatran (CrCl < 50 ml/min)	High	Day -5	Day +2 to +3
	Low/Mod	Day -3	Day +1
Edoxaban	High	Day -3	Day +2 to +3
	Low/Mod	Day -2	Day +1
Rivaroxaban	High	Day -3	Day +2 to +3
	Low/Mod	Day -2	Day +1

**Table 1C. Peri-procedural management of antiplatelet agents**

Medication	Pre-Procedure Interruption Period	Action During/Post-Procedure
ASA (Aspirin)	Continued through the procedure	Continued post-procedure
Ticagrelor	Discontinued 3 to 5 days before surgery	Resume at maintenance dose within 24 hours post-procedure
Clopidogrel	Discontinued 5 days before surgery	Resume at maintenance dose within 24 hours post-procedure
Prasugrel	Discontinued 7 to 10 days before surgery	Resume at maintenance dose within 24 hours post-procedure

# Consent, Preparation and Infection Control

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As with all other medical procedures, fully informed written consent should be obtained from the patient or accompanying close relative (if the patient is unable to give consent). Thorough discussion should be considered regarding the procedure, its likely benefits, risks and potential complications. Nil per oral is recommended 6 hours before procedure. Establish an intravenous access for sedation and possible resuscitation, ideally on ipsilateral side.

Use full aseptic technique. The operator also should scrub and wear a sterile theatre kit with sterile gloves, masks and head cover. Prepare patient's skin by shaving and disinfecting a large area to include from the sternum to the clavicle and across the axilla past the scapula to the spinous processes, and down to the base of the thorax. The area is cleaned with iodine, alcohol or chlorhexidine- based solutions. Give adequate aseptic drying time (3 – 5 minutes for povidone-iodine). After cleaning, the patient is covered with sterile drapes exposing only the marked area as in a standard surgical procedure.

## **Sedation Planning**

Medical thoracoscopy is typically performed under conscious sedation, with analgesia and local anesthesia used to minimize discomfort.<sup>4,9,16</sup>

# Requirements of Medical Thoracoscopy

Following are the basic requirements for performing medical thoracoscopy.<sup>17,18</sup>

## Thoracoscopy Room

Medical thoracoscopy requires a sterile setup with space for equipment and staff. It can be done in a bronchoscopy suite or operation theatre, with access to premedication, recovery, and cleaning areas. Safety's key - have an emergency cart in the room for complications like tension pneumothorax or bleeding. Medical thoracoscopy requires a well-equipped setup:

- **Procedure Room:** Endoscopy/bronchoscopy suite with operation table
- **Sterile Setup:** Area for scrubbing, sterile gowns, sheets, gloves
- **Monitoring:** Pulse oximeter, BP apparatus, ECG, SpO<sub>2</sub>, capnograph (optional)
- **Resuscitation:** Defibrillator, crash cart with laryngoscope, ETT, epinephrine, atropine
- **Thoracoscope Tower** (video processor, light source, medical grade monitor)
- **Sterile Trolley**
- **Suction Machine**
- **Diathermy/Electrocautery**
- **Oxygen Supply (wall/cylinders)**
- **Ultrasound Machine**
- **Support:** Mayo stand, overhead light, storage cupboard
- **Emergency:** Fully equipped cart with CPR board, defibrillator, resuscitation drugs



Figure 4. The medical thoracoscopy room (JPMC Karachi) showing operating table, video thoracoscopy tower, ultrasound machine and crash cart.

## Personnel Required

Following personnel are required to perform thoracoscopy optimally:

- Thoracoscopist (pulmonologist/specialty registrar)
- 2 trained nurses/senior trainee doctors (physician assistants)
- Circulator/monitoring nurse (handles PSA, supplies)

Minimum emergency team: Thoracoscopist + 1 nurse (prolongs procedure). Staff should know the procedure and handle emergencies.

## Ergonomics

Optimal ergonomics in rigid thoracoscopy is crucial for safety, reducing patient discomfort and operator fatigue. Poor scope alignment, equipment positioning, or staff placement can compromise the procedure.<sup>19</sup>

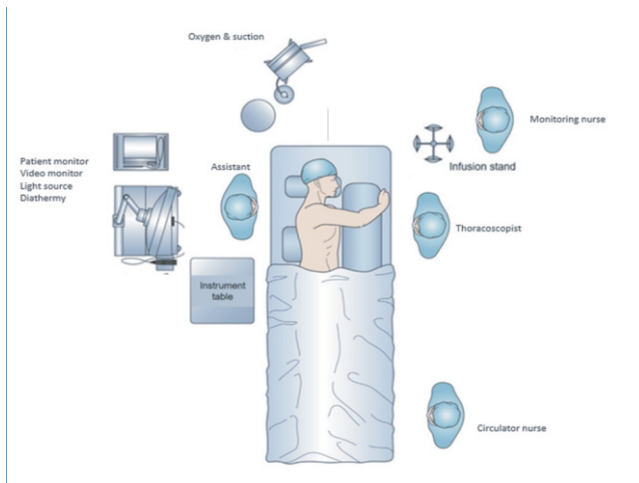
Key ergonomic tips for rigid thoracoscopy (figure 5):

- Maintain straight visual axis: eyes, hand, and monitor aligned
- Monitor opposite operator, at eye level, 3-5 feet away
- Adjust bed height: elbows at 90-100°
- Stabilize with non-dominant hand on trocar/chest wall
- Foot pedal under dominant foot
- Dim lights, avoid complete darkness
- Assistant stands opposite or beside operator
- Instrument trolley within reach
- Negative pressure room ideal, 12-15 air exchanges/hour or HEPA filter exhaust

## Equipment

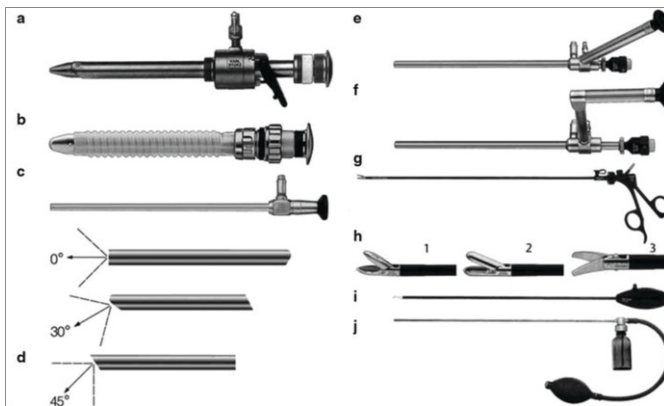
### The Thoracoscope

Since the first detailed description by Jacobaeus in 1910, rigid endoscopic instruments such as stainless-steel trocars and endoscopes have been pivotal in the performance of thoracoscopy (and VATS). The equipment requirements include trocar, thoracoscope/pleuroscope, biopsy forceps, unipolar coagulation forceps, light sources, video system, aspiration system, talc, chest tubes, and drainage systems. The usual diameter of the rigid thoracoscope is 7–9 mm, that of the semirigid pleuroscope 7 mm. For the rigid technique, optical devices exist with various fields of view (0, 30, and 90°); trocars are also available with diameters of 5 and 3.75 mm for performing thoracoscopy in children. The trocar consists of an obturator and cannula with a blunt conical tip, adjacent to which there is a small hole connected to the trocar lumen, open to the exterior, so that penetration into the pleural cavity is signaled. Unlike the instruments for laparoscopy, this trocar does not have to be airtight. Air should be allowed to enter and leave the thoracic cavity freely. Examination will be limited by pain if the diameter of the trocar is larger than 10 mm.



**Figure 5. Key ergonomic tips for rigid thoracoscopy.**

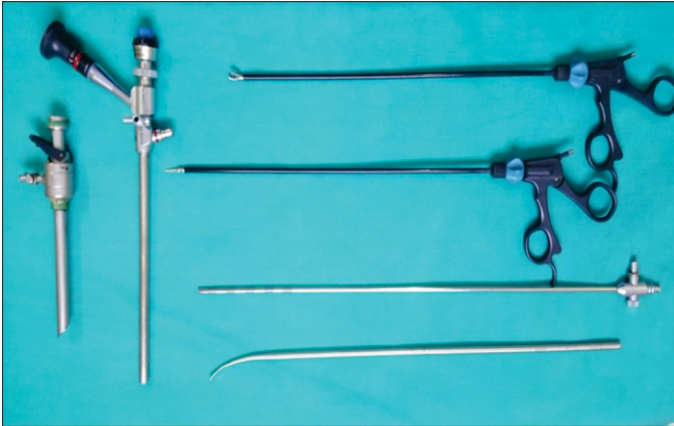
Figure 6 below shows a selection of rigid thoracoscopy instruments. Besides the biopsy forceps, needle biopsy, and suction catheter, the working channel also accommodates electrocautery. A bayonet optical system with an instrumentation channel and the appropriate instruments may facilitate direct fluid suction, electrocautery, or direct insufflation of talc. A Xenon light source satisfies the requirements for high-quality visual exploration and video documentation. The inspection of the pleural space can be performed either directly through the telescope or indirectly by video. Today, most – if not all – centers use video systems.



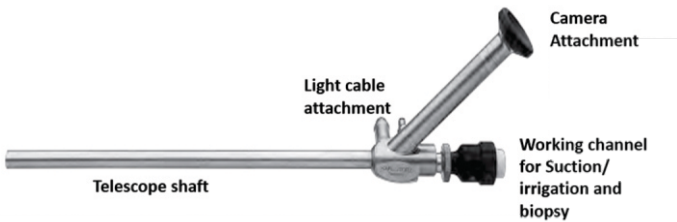
**Figure 6.** Selection of instruments for rigid medical thoracoscopy. (a) Trocar with multifunctional valve with insufflation stopcock, 11 mm, autoclavable (b) Trocar with silicone leaflet valve, 11 mm, autoclavable (c) Telescope, particularly suited for single-incision thoracoscopy, here with light shaft for photography, diameter 10 mm, length 31 cm, trocar size 11 mm (d) Various fields of view. (1) Straightforward telescope 0°, diameter 10 mm, length 31 cm, autoclavable; (2) Forward-oblique telescope 30°, diameter 10 mm, length 31 cm, autoclavable; (3) Telescope 45°, diameter 10 mm, length 31 cm, autoclavable. (e) Straightforward telescope 0° with angled eyepiece, diameter 10 mm, working length 27 cm, with instrument channel 6 mm, trocar size 11 mm, single puncture. (f) Straight-forward telescope with angled eyepiece. (g) Telescope with instrument channel. (h) Telescope with instrument channel and forceps. (i) Telescope with instrument channel and forceps. (j) Suction catheter.

telescope 0°, with parallel eyepiece (bayonet optic), diameter 10 mm, working length 27 cm, with instrument channel 6 mm, trocar size 11 mm, single puncture. (g) Dissecting and biopsy forceps, rotational, that can be dismantled, with connector pin for unipolar coagulation, 5 mm. (h) Single-action jaws: (1) dissecting and biopsy forceps; (2) biopsy forceps; (3) scissors. (i) Dissecting electrodes, with connector pin for unipolar coagulation, L-shaped, size 5 mm, working length 43 cm. (j) Powder blower, with rubber bulb, size 5 mm, working length 42 cm (Karl Storz GmbH & Co. KG, Tuttlingen, Germany: <https://radiologykey.com/medical-thoracoscopypleuroscopy/>).

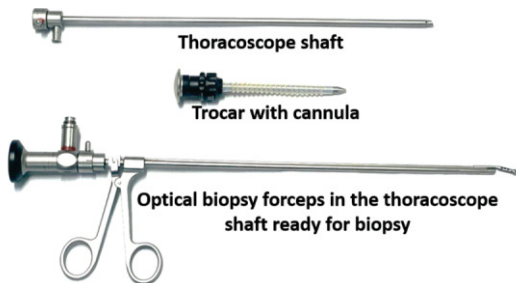
Different size rigid thoroscopes are available with outer diameter varying from 5mm to 13mm (figure 7, 8, 9). Rigid trocar (figure 10) diameter shall be 2mm above the telescope diameter to accommodate the thoracoscope.



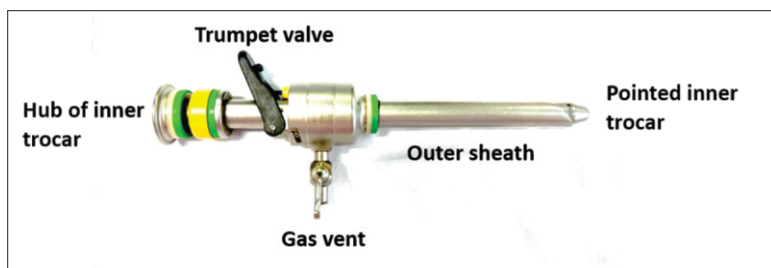
**Figure 7. Rigid thoracoscope (Richard Wolf®) and trocar (left), biopsy forceps, scissors forceps (middle) spray catheter and a curette bougie (right top to bottom).**



**Figure 8. Rigid thoracoscope with various parts.**



**Figure 9. Single incision thoracoscope (9mm) instruments.**



**Figure 10. Rigid thoracoscope trocar and cannula.**

### Ancillary Instruments Trolley

The instrument trolley for medical thoracoscopy should be laid out in a logical order of use to minimize confusion. It should include:

#### Major Equipment:

- Trocars (metal and plastic, various sizes)
- Thorascopes: Either or both
  - Flexi-rigid pleuroscope
  - Rigid thorascopes (0°, 30°, 50°, 90°) for panoramic view
- Image capturing and video recording facilities for medical records
- Biopsy forceps (3mm and 5mm optical)

#### Procedural Essentials:

- Needles (24G and 21G) for local anesthesia
- Syringes (5ml, 10ml, 50ml)
- Surgical swabs and sterile gauze
- Scalpel and disposable blades (No.11)
- Clamps, grasping forceps, swab holder

#### Suction and Drainage:

- Suction catheter/tubing and collection bottles (2L capacity)
- Plastic sterile aspiration tubes (4mm and 6mm diameter)
- Chest tubes (20-32Fr)
- Underwater seal bottles (drainage system)

#### Miscellaneous:

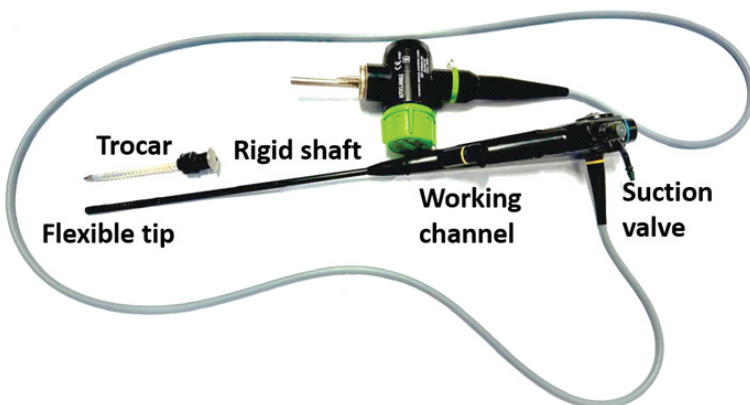
- IV cannula (18, 21, 24G)
- Artery forceps (plain and mosquito)
- Kidney tray and sterile bowl for local anesthesia and saline
- Sterile/disposable covers for camera cables
- Cupulas for local anesthesia and hot saline (anti-fogging)
- Talc atomizer
- Boutin needle (if available) for artificial pneumothorax induction



**Figure 11. Thoracoscopy trolley setup with essential instruments, including thoroscopes, biopsy forceps, suction tubing, chest tubes, connectors and atomizer pump.**

### **Semi-Rigid Thoracoscopy**

Semi-rigid thoracoscopy uses a hybrid instrument combining aspects of rigid thoracoscopy and flexible bronchoscopy (figure 12, 13, 14). Its bronchoscope-like handle offers ergonomic familiarity for pulmonologists, making it easier to learn and use.<sup>20</sup> The semi-rigid thoracoscope is a hybrid instrument with a rigid proximal shaft (usually 7 mm) and a flexible distal tip, allowing for active deflection (typically 160°/130°). This design enables operators to examine areas that are often "blind spots" for straight, rigid scopes, such as the apex and deep costophrenic recesses. The instrument's flexible tip is controlled by a lever on the handle, similar to a flexible bronchoscope. It has a 2.8-mm working channel for biopsy forceps, needles, and other accessories.<sup>21,22</sup> Although it's no longer available in the USA, its design has influenced the development of similar instruments.



**Figure 12. Semi-rigid thoracoscope (Olympus®) with design similar to a bronchoscope having rigid shaft and flexible tip introduced through disposable trocar.**



**Figure 13. Semi-rigid thoracoscope maneuvered in pleural space with video image on monitor, mounted on a trolley with light source and processor.**



**Figure 14: Semi-rigid thoracoscope with rigid shaft and flexible tip, similar to a bronchoscope, offering familiar handling and maneuverability for pulmonologists.**

#### **Comparative Dynamics: Rigid vs. Semi-Rigid Thoracoscopy**

To successfully transition between rigid and semi-rigid thoracoscopy,<sup>21,22</sup> the pulmonologist must understand the fundamental differences between the two (table 2).

Key differences:

- Rigid scopes offer better light transmission and larger biopsies, but have limited maneuverability. Although, the rigid thoracoscope gets larger biopsy samples, but both rigid and semi-rigid thoroscopes have similar diagnostic yields.<sup>8</sup>
- Semi-rigid scopes provide active visualization and easier navigation around adhesions, but require more biopsy samples.

Rigid thoracoscopy is preferred for thickened pleura and adhesiolysis in complex disease, while semi-rigid thoracoscopy suits complex anatomy and smaller lesions.

**Table 2: Comparative dynamics of rigid versus semi-rigid thoracoscopy.**

Feature	Rigid Thoracoscopy	Semi-Rigid Thoracoscopy
<b>Maneuverability</b>	The entire instrument acts as a lever against the chest wall; visualization of different areas requires pivoting the scope at the entry site.	The shaft remains relatively stationary while the thumb-lever deflects the tip, allowing dynamic navigation.
<b>Optics and Light Transmission</b>	Superior light transmission via rod-lens system; provides excellent image clarity.	Fiberoptic light transmission; image quality is adequate but comparatively lower resolution.
<b>Field of View</b>	Fixed angle (typically 0° or 30°); limited by the line of sight.	Active visualization afforded by flexible tip deflection; can navigate around simple adhesions that would obstruct a rigid scope.
<b>Navigation Around Adhesions</b>	Limited; simple adhesions may block visualization and access.	Superior; flexible tip allows negotiation around simple, non-obstructive adhesions.
<b>Biopsy Instrumentation</b>	Large, toothed rigid forceps capable of obtaining deep, "chunk" biopsies.	Smaller, flexible "cup" forceps compatible with 2.0–2.8 mm working channel.
<b>Biopsy Sample Characteristics</b>	Large, deep biopsies suitable for thickened, fibrotic pleura.	Smaller, more superficial biopsies.
<b>Number of Biopsies Required</b>	Fewer samples typically sufficient for histopathological diagnosis.	At least 6–10 samples from various suspicious sites recommended to ensure adequate architectural detail for pathological assessment.
<b>Procedural Advantage</b>	Optimal for accessing and sampling dense, fibrotic pleural thickening.	Optimal for exploring pleural cavity, navigating around obstacles, and sampling multiple sites in a single insertion.

## Procedural Sedation and Analgesia

The procedure is done under “conscious sedation”, now more commonly known as “procedural sedation and analgesia (PSA)”. It is defined by the American College of Emergency Physicians (ACEP) as “a technique of administering sedatives or dissociative agents with or without analgesics to induce a state that allows the patient to tolerate unpleasant procedures while maintaining cardio-respiratory function”. PSA is intended to result in a depressed level of consciousness that allows the patient to maintain oxygenation and airway control independently. Sedation’s effect on gas exchange depends on dose and medication type. In high-risk patients (liver/renal disease), using local anesthesia alone can minimize sedation risks, making it a viable option for medical thoracoscopy.

Generally, for PSA, midazolam (1-5mg IV) provides rapid sedation, slight amnesia and anxiolysis. For analgesia, IV morphine or fentanyl (25-100µg) can be used. Alternatively, nalbuphine (0.1-0.2 mg/kg IV) is an option, with repeat boluses as needed; Occasionally, propofol is used instead of a benzodiazepine, requiring the presence of an anesthesiologist or a nurse anesthetist. Thoracoscopy under general anesthesia can be performed with or

without selective bronchial intubation for the ventilation of one lung. The drugs used for procedural sedation and analgesia are enlisted in table 3; the most commonly used agents are midazolam with or without fentanyl or morphine. Commonly used reversal agents and their doses are given in table 4.

Drug	Adult Dose	Onset of Action	Duration of Action	Comments & Clinical Considerations
<b>Midazolam</b>	Initial: 2-2.5 mg (0.5-1 mg in frail/elderly) slow IV, max rate 2 mg/min. Supplemental: 1 mg (0.5-1 mg in frail/elderly) at 2-10 min intervals. Usual Max: 3.5-7 mg (3.5 mg in frail/elderly).	2 min (max effect 5-10 min)	30-120 min	Enhanced sedation and respiratory depression risk when combined with opioids. Opioids should be administered prior to midazolam when used in combination. Reversal agent: Flumazenil.
<b>Fentanyl</b>	Initial: 25 mcg slow IV over 1-3 min. Supplemental: 25 mcg. Usual Max: 50-100 mcg (approx. 1-2 mcg/kg).	A l m o s t immediate (max effect at 5 min)	30-60 min	May cause chest wall rigidity, apnea, bradycardia. Elicits minimal cardiovascular depression. Enhanced sedation when given with benzodiazepines. Administer prior to midazolam. Reversal agent: Naloxone.
<b>Morphine</b>	0.05 to 0.1 mg/kg IV, may repeat dose in 5 min.	5-10 min	20-60 min	Causes histamine release, leading to vasodilation and hypotension; less favored for conscious sedation due to longer duration and side effect profile. Reversal agent: Naloxone.
<b>Nalbuphine</b>	10-20 mg/70 kg IV/IM/SC.	2-3 min (IV)	3-6 hours	Mixed agonist-antagonist opioid. Not to be used in patients with bronchial asthma or those physically dependent on other opioids (may precipitate withdrawal). Can cause respiratory depression.
<b>Propofol</b>	Initial: 0.5-1 mg/kg slow IV loading dose. Maintenance: 0.25-0.5 mg/kg increments q3-5 min as needed.	< 1 min	3-10 min	Can rapidly cause deep sedation, apnea, and dose-dependent cardiovascular depression/hypotension. Should be administered by personnel trained in general anesthesia. May cause pain at injection site.
<b>Etomidate</b>	0.1-0.15 mg/kg slow IV push over 30-60 sec.	< 1 min	3-5 min	Provides hemodynamic stability with minimal cardiovascular depression; useful in patients with hypotension or asthma. Commonly causes myoclonus and pain upon injection. Associated with adrenal suppression, even after single dose.

Reference: British Thoracic Society. BTS Clinical Statement on pulmonary procedures: drugs in bronchoscopy. Thorax. 2024;79(Suppl 4):1-25.

**Table 4. Commonly used reversal agents during thoracoscopy.**

Reversal Agent	Indication	Adult Dose	Onset of Action	Duration of Action	Comments
<b>Naloxone</b>	Opioid reversal (e.g., fentanyl, morphine).	Initial:100-200 mcg IV. Supplemental:100 mcg every 2 min as needed.	2-3 min	45 min – 4 hours	Duration is shorter than many opioids; repeat doses may be required. Rebound sedation and respiratory depression can occur. May precipitate acute withdrawal, pain, hypertension, tachycardia, and pulmonary edema in opioid-dependent patients.
<b>Flumazenil</b>	Benzodiazepine reversal (e.g., midazolam).	Initial:200 mcg IV over 15 sec.  Supplemental: 100 mcg every 60 sec if inadequate response.  Maximum Total Dose:1mg.	1 min	1-4 hours	Duration is shorter than midazolam observe for recurrence of sedation. May precipitate acute withdrawal and seizures in benzodiazepine-dependent patients. If combined sedation was used, it is recommended to administer flumazenil first unless a large dose of opioid has been given.

Reference: O'Keefe D, Joshi GP. UpToDate: Reversal of opioids (naloxone) and benzodiazepines (flumazenil) in procedural sedation. Wolters Kluwer; 2024.

# Medical Thoracoscopy: The Procedure Technique

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MT is performed using standard surgical sterile technique and drapes, gowns, and gloves. Thoracoscopic procedures typically performed under local anesthesia are inspection of the pleural space, removal of pleural fluid, biopsy of parietal pleura, and talc pleurodesis. The complete procedure is explained step by step below with illustrations (figure 15). Optimal patient selection and preparation are key to safe thoracoscopy. Check vitals, give premeds (if needed), oxygen (if needed, keep SpO<sub>2</sub> >90%), and review chest imaging before starting. Following section describes the steps of medical thoracoscopy.

## 1. Patient's Positioning

The patient is positioned in lateral decubitus with the diseased side up. A soft cotton roll protects the brachial plexus under the dependent axilla, and the upper arm is abducted over the head to widen intercostal spaces. A pillow under the chest can help arch the vertebral column, spreading the ribs and easing trocar insertion. Keep the patient comfortable and confirm positioning with TUS imaging.

## 2. Entry Site

One of the main reasons of inability to perform a good thoracoscopy is failure to select the safest site of entry into the pleural space. This can be secondary to pleural adhesions, minimal pleural effusion or prior pleurodesis. Thoracic ultrasound (see ultrasound section above) use prior to thoracoscopy allows to identify the safe access site, apprehend any procedural difficulties, reduce the risk of complications and length of hospital stay.<sup>10</sup> For pleural inspection, the mid-axillary line at the 4th or 5th intercostal space is preferred for optimal pleura visualization. Watch out for the lateral thoracic artery high up in the axilla. Mid-axillary line is not always the safest. Safety triangle is based on fixed anatomy, while the fluid moves. Ultrasound helps to select the safest and optimal entry site avoiding vascular adhesions and viscera. Mark the site of entry when the patient is in lateral decubitus position with the affected side up.

## 3. Skin Preparation

Prepare patient's skin by disinfecting a large area to include from the sternum to the clavicle and across the axilla past the scapula to the spinous processes, and down to the base of the thorax. The area is cleaned with iodine, alcohol or chlorhexidine-based solutions. Give adequate aseptic drying time (3 – 5 minutes for povidone-iodine). A sterile drape shall be placed over the patient, having a small uncovered area through which procedure can be performed.

## 4. Local Anesthesia

At the specified site of entry local anesthesia is administered using 10–20 ml of lidocaine 1–2% (maximum dose 3mg/kg body weight). Lidocaine can be combined with 1:100,000 adrenaline, preventing oozing of blood at the incision site and onto thoracoscope tip hampering vision. Administer local intercostal anesthesia (using lignocaine 1-2%, 10-20 ml) to anesthetize the skin, subcutaneous tissue, intercostal muscle, parietal pleura, caudal rim

of the upper and the cranial rim of the lower rib to anesthetize the intercostal nerve as well as the periosteum of the ribs. Following local anesthesia, sedation is administered (see above).

### 5. Aspiration of Pleural Fluid

Confirming pleural effusion involves checking for fluid flow into the syringe and ensuring proper needle depth and position (figure 16).

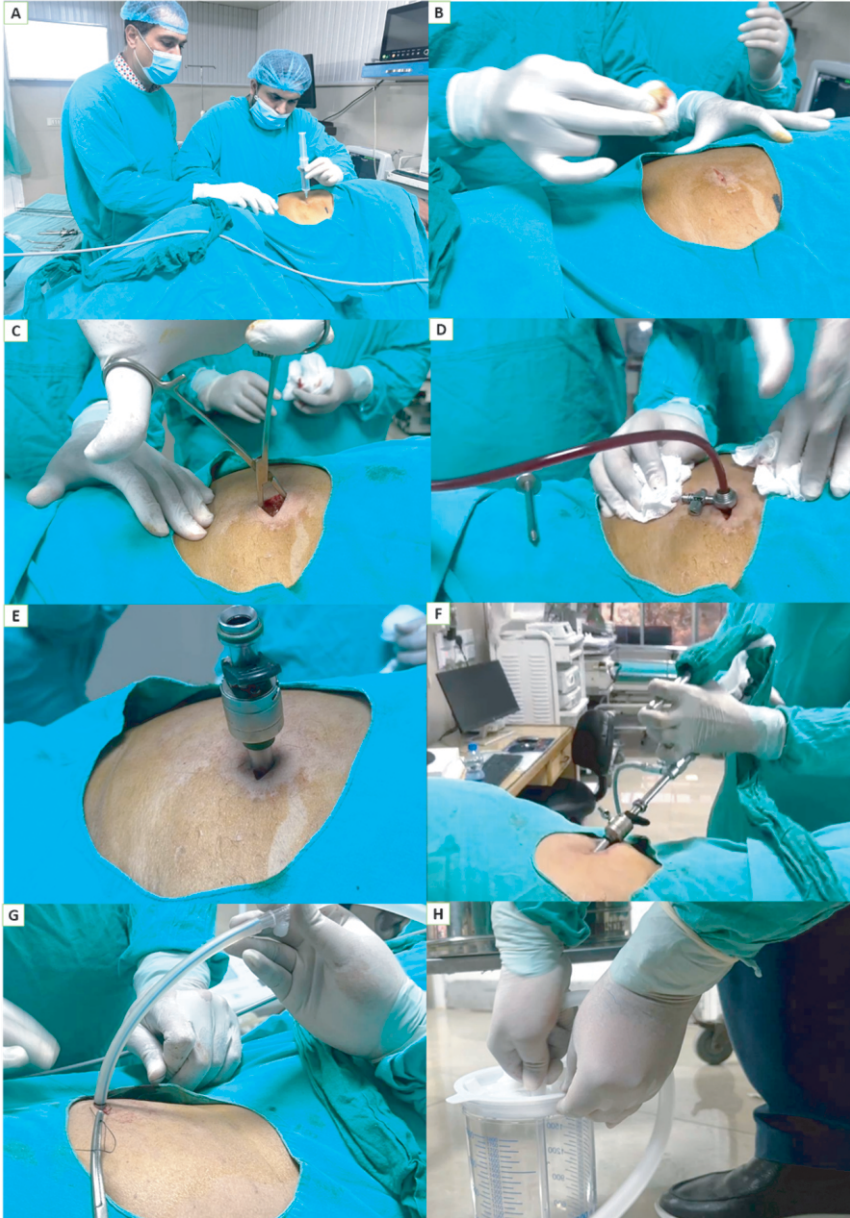
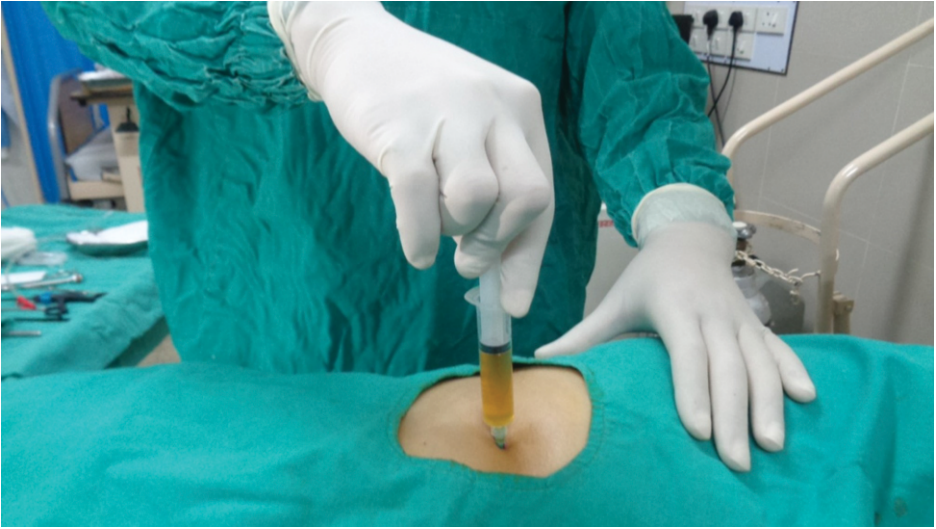


Figure.15. Top left to bottom right: After povidone iodine antiseptic painting the affected hemithorax in a patient placed in lateral decubitus position, hole sheet placed over the

chest leaving a small area to be operated, (A) local anesthesia is administered using lidocaine (B) followed by a one inch incision over the skin (C) blunt intercostal dissection using hemostat, (D) hemorrhagic fluid is suctioned via a small (5mm) trocar (E) then a large (11mm) trocar is inserted (F) rigid thoracoscope insertion for pleural evaluation and biopsy (G) post-procedure, a chest tube is placed through the insertion site, and (H) and attached to an underwater seal drainage bottle.



**Figure 16.** Aspirate to confirm pleural fluid using same syringe after intercostal anesthesia.

### **6. Intercostal Dissection**

At the selected point of entry an incision is made with the scalpel through the skin and subcutaneous tissue, appropriate to the size of the trocar (usually approximately 10 mm), parallel with and in the middle of the selected intercostal space. This follows blunt dissection through the soft tissues and intercostal muscles using artery forceps (hemostat). Blunt dissection with artery forceps is used to carefully separate tissue layers, advancing to the pleura. The forceps is inserted closed, opened to separate tissue, then withdrawn and repeated. Slight pressure is placed on the hemostat and it is slowly moved through the intercostal space until it 'gives way' through the intercostal muscle-parietal pleura complex followed by emergence of pleural fluid. It is safer to create an opening using index finger and passing it into the pleural space to check for adherence of lung with the chest wall. A probing finger can check for adhesions and allow air in, causing the lung to slightly deflate. Once at the pleura, the trocar with sheath is introduced gently with controlled pressure.

### **7. Draining Pleural Fluid**

If pleural fluid is present, it should be removed using a suction catheter or directly through the working channel of the pleuroscope. In cases of large pleural effusion, complete aspiration prior to thoracoscope insertion is recommended to prevent fluid spillage or splashing, especially during patients' coughing. As fluid is aspirated, allow air to enter the pleural space to replace the aspirated fluid volume and minimize the risk of re-expansion pulmonary edema.

## 8. Induction of Artificial Pneumothorax (For Dry Pleura/Minimal Effusion)

Safe thoracoscopy requires space between the visceral and parietal pleura. If the pleural space is dry, or have minimal effusion, some experts may induce pneumothorax before intercostal dissection to minimize lung puncture risk. In such a situation, an artificial pneumothorax can be created using a Boutin needle (2-3 mm diameter) (figure 17). To do this, insert the needle perpendicular to the chest wall, above the lower rib's superior border, until a "pop" indicates pleural traversal. Remove the stylet and allow air to enter the pleural space, either passively with patient breathing or using a 50 mL syringe. Typically, 400-600 mL of air creates sufficient space for safe trocar entry. Exercise caution in patients with underlying lung disease.



**Figure 17. Boutin's needle for pneumothorax induction.**

Alternatively (to the unavailable Boutin needle), in our setup, we induce a pneumothorax using either an angiocatheter (open to air) or a 12-14 Fr suction catheter. Our technique involves careful intercostal dissection with a hemostat, blunt parietal pleura puncture with the index finger, and suction catheter insertion. Air entry is verified by hissing sounds during breathing, and partial lung deflation creates space for introducing the blunt-tip trocar and pleuroscope, enabling safe pleural inspection.<sup>23</sup>

## 9. Introducing Trocar and Thoracoscope

The trocar is inserted under direct vision in a corkscrew motion until the sudden release of resistance (on passing the costal pleura) is felt, while holding the handle of the trocar firmly in the palm of the hand, as the extended index finger, for safety's sake, limits the depth of insertion needed to reach the pleural space. While the trocar is in the pleural cavity, the obturator is removed and the cannula should lie 1-3 cm within the pleural cavity. Thoracoscope is then advanced into the pleural cavity under direct vision through the cannula.<sup>24</sup> Trocar path shall be made as perpendicular to the chest wall as possible. When the trocar insertion path is made in an oblique direction with respect to the chest wall, orientation of the thoracoscope will be restricted. In patients with significant pooling of pleural effusion, the fluid may overflow as the pleura gets punctured, so hold some gauze against the trocar entry site.

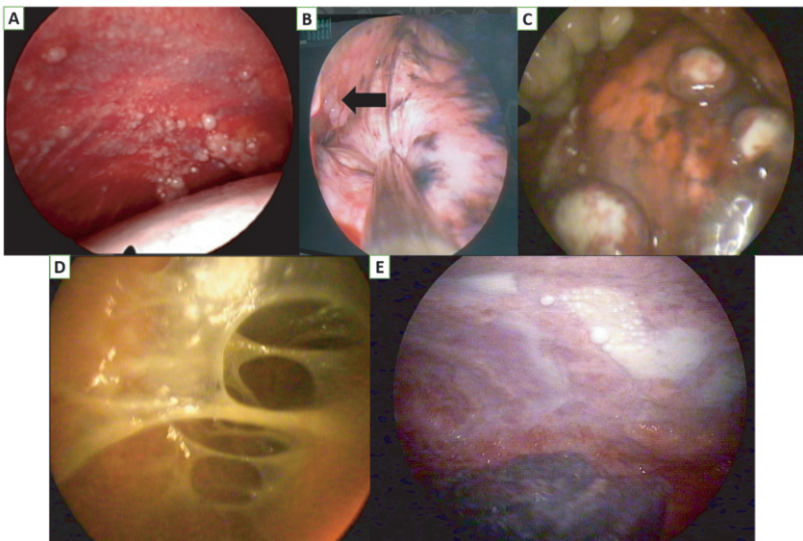
## 10. Inspection of Pleural Cavity (Pleuroscopy)

Upon insertion of the thoracoscope, systematic examination of the pleural cavity is

performed, visualizing parietal and visceral pleura. The scope is maneuvered methodically from apex to diaphragm and medially towards the hilum, examining the entire parietal pleural surface and visceral pleura for any abnormalities (figure 18). Key targets include fibrin membranes, loculations, neoplastic nodules, and intrapleural bubbling. Smooth, controlled movements prevent iatrogenic trauma, with minimal scope length inside the cavity ensuring safety. The semi-rigid thoracoscope's flexibility aids navigation and examination. Instruments like probes, aspiration needles, or biopsy forceps can be introduced through the working channel.

### 11. Taking Pleural Biopsies

When using a flexi-rigid pleuroscope for biopsy, positioning the scope close to the lesion is key. This allows better visualization and support for the biopsy forceps, reducing the risk of the forceps bending and making it easier to catch the pleura. Parietal pleural biopsies are taken over a rib to avoid neurovascular injury. While using the rigid instrument, the technique involves palpating the rib with the 5-7 mm rigid biopsy forceps, then grasping and removing the overlying pleura with a long tearing motion ("pinch and peel" for flat lesions like TB inflammation) (figure 19a) or "grab and pull" (punch biopsy) for raised malignant lesions. Take 2-6 biopsy pieces routinely; avoid visceral pleura/lung biopsy unless abnormalities are localized there. Pleural biopsy may also be obtained using diathermy knife or cryobiopsy. Biopsy sites may be sprayed with 2% lignocaine using atomizer to reduce pain. Send samples in saline for microbiology and formalin for histopathology, especially in TB-endemic areas like Pakistan. Rapid onsite evaluation can guide management, like pleurodesis in malignancy.<sup>25,26</sup> Recognizing normal variations and pleural disease patterns helps guide biopsy site selection. If no visible abnormalities are seen, taking multiple biopsies from different sites increases diagnostic yield.



**Figure 18.** Pleuroscopic images illustrate various pleural pathologies: soft nodules in pleural TB (A), occult nodules (adenocarcinoma) in the left oblique fissure (black arrow) of an elderly patient with a small left pleural effusion (B), pleural metastasis from renal cell carcinoma in a 40-year-old male (C), fibrinous pleural septations in a 30-year-old male with pleural TB (D), and hard pleural plaques in an elderly patient with mesothelioma (E).

## **12. Adhesiolysis**

Fibrous adhesions in pleural infections, inflammation, or malignancy can be lysed using suction, biopsy forceps, or the thoracoscope to improve visualization. Vascular adhesions may be left alone or cauterized by experienced operators. Once the parietal pleura is exposed, biopsies should be taken.

## **13. Saline Flushes/Lavage**

In patients with thoracic empyema flushing the pleural space with saline is done to clear pus, debris, and clots. This helps improve visualization and facilitates a more thorough examination and intervention.

## **14. Talc Poudrage/Pleurodesis (Optional)**

Different delivery devices like spray atomizers, bulb syringes, or spray catheters can be used for talc administration via the working channel or cannula. Thoracoscopic talc pleurodesis is considered for malignant pleural effusion (if malignancy suspected) and selected cases of recurrent non-malignant effusion or secondary spontaneous pneumothorax. Pre-insufflation, all pleural fluid is removed and the lung should expand to the chest wall. Talc, a sterile asbestos-free hydrated magnesium silicate with particles  $<50\ \mu\text{m}$ , is used for pleurodesis. The recommended dose is 4-8g (typically ~5g) for malignant effusion and 2-3g for pneumothorax. Talc poudrage can be performed safely through a single portal MT with direct visualization of pleural surfaces being sprayed using spray catheter attached with atomizer (figure 20). Alternatively, talc can be sprayed from a second port or the same port followed by reinsertion of the telescope to ensure that all pleural surfaces are sufficiently coated with talc. The goal is to obtain a light coating of talc on all pleural surfaces, both parietal and visceral, using a dedicated device and avoid mass collection of talc which may make the procedure inefficient. There is snow storm appearance during talc spray and pleura post talcage resembles the first light fall of snow (figure 19b). To manage pain, administer systemic analgesics and intrapleural lidocaine before talc application.<sup>27</sup>

## **15. Second Port of Entry (Optional/Conditional)**

The clinician should decide in advance (looking at ultrasound or CT images) whether a single point or two points of entry will be required during a particular procedure. The second site of entry is created under direct video guidance (i.e., with the telescope inside the pleural cavity) to simplify visualization or sampling of difficult to reach areas such as the costovertebral angle, mediastinal pleural surfaces, and the lung apex. When using ports, one is used for the thoracoscope, and the second port is used to introduce accessory instruments (figure 21). Double-port thoracoscopy is used in specific cases, like draining complex loculated fluid, larger biopsies, "pinch" lung biopsy, sampling lesions near the first port, or controlling bleeding. The second port is placed 1-2 intercostal spaces away, in line with the first port.<sup>28</sup>

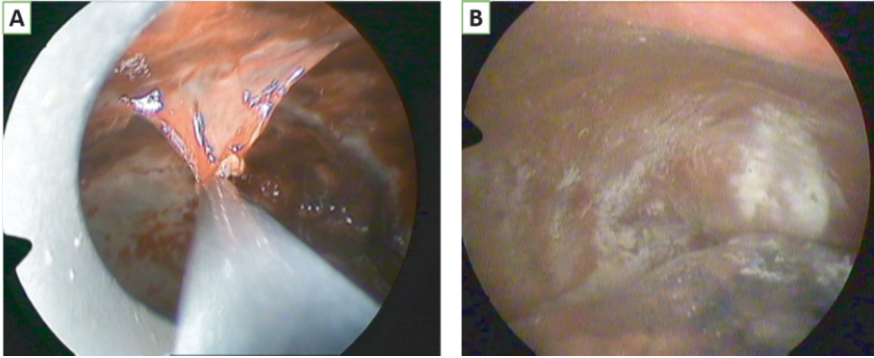


Figure.19. (A) Pinch and peel rigid forceps biopsy in a patient with TB pleuritis and (B) post talc poudrage image showing dispersed talc particles on the parietal pleural surface.



Figure 20. The spray catheter is attached to an atomizer pump and inserted through the thoracoscope.

#### 16. Other Procedures

Less frequently performed procedures include visceral pleural and lung biopsy, blebectomy, and sympathectomy.<sup>[4]</sup>



**Figure 21.** The second port (for instrumentation) is positioned in line with the first port, spaced about 1-2 intercostal spaces apart.

#### **17. Post-Thoracoscopic Chest Drain Insertion**

After inspection, sampling, and treatment, the thoracoscope and trocar are removed and a chest tube (>24 Fr) is inserted to facilitate lung re-expansion and evacuation of residual air, pleural fluid, and debris. The tube is connected to an underwater seal drainage system and secured with sutures and sterile dressing to ensure proper fixation and minimize infection risk.

# Post-Procedure Care

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Patients should be encouraged regarding early mobility and physiotherapy but if the patient is immobile due to any reason, venous thromboembolism (VTE) prophylaxis should be given.

### Post-Procedure Monitoring

Vitals sign, oxygen saturation and drain output shall be recorded every 15 min in 1st hour. Chest radiograph may be routinely performed following MT to document lung expansion, confirm the position of chest tube.

### Drain Management

In case of collapsed lung, gentle step by step suction (up to -20 cmH<sub>2</sub>O) should be applied to the chest drain post procedure for gradual lung re-expansion. Daily drain output should be recorded precisely. Chest tube removal should be considered when clear fluid (not pus/blood) drainage falls below 150 ml/day, there is no evidence of air leak and the lung is fully expanded to the chest wall.<sup>4, 16, 29</sup> Tubes sometimes require saline irrigation or intrapleural fibrinolytics to address smaller post-procedural collections and removal of debris. In such circumstances, tubes should not be disconnected from under water seal bottles, rather interconnecting valves with injection ports should be placed between chest tube and underwater seal bottle. This helps to prevent post-procedural pleural infection/empyema.

### Post-Thoracoscopy Pain Management

Depending on patient's pain threshold, pain is common following MT. It can be controlled in most cases with the use of oral paracetamol, opioids or nonsteroidal anti-inflammatory drugs (NSAIDs). In patients where the pain is inadequately controlled by mild analgesics, other methods should be used, for example, intravenous analgesics (NSAIDs/opioids).

### Post-Procedure Physiotherapy

Patients should be encouraged to be mobilized before thoracoscopy and avoid excessive bed rest to reduce the onset of deconditioning and physical dependence. Post-procedural physiotherapy is frequently needed in patients with thoracic empyema in the presence of collapsed/folded lung. Mobilize the patient (corridor walking) and start physiotherapy (incentive spirometry, breathing exercises and stationary cycling) preferably on the day of thoracoscopy to facilitate lung expansion, improve configuration of diaphragm & avoidance of secretions accumulation & tube obstruction. Benefits include facilitation in re-expansion of the lung and clearing of the fluid, cardiovascular stability, wound healing, regaining the arm and trunk movement, maintenance of good posture and conditioning of muscles with improved exercise tolerance and confidence.<sup>30</sup>



**Figure 22. Post-pleuroscopy cycling in a stationary position can help promote lung expansion.**

# Patients' Follow Up

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Follow-up visits vary based on the underlying lung condition and complexities of the procedure. Empyema patients are seen within 1-2 weeks to check for fluid recurrence, while malignant pleural disease patients are followed up after 2-4 weeks to assess pleurodesis success. Symptomatic patients should return immediately.

## Indications of Medical Thoracoscopy

Medical thoracoscopy is typically a second-line tool for diagnosing or treating pleural disorders, and shouldn't replace initial approaches like thoracentesis for evaluating pleural effusion. However, if thoracoscopy isn't available or TB is likely, Abrams needle biopsy or image-guided needle aspiration might be preferred. Interestingly, while cryobiopsy gets larger samples than flexible or rigid forceps biopsy, they yield similar diagnostic results.<sup>31,32</sup>

### Diagnostic Indications:

1. **Diagnostic Evaluation of An Exudative Pleural Effusion of Unknown Cause:** Medical thoracoscopy is usually done when multiple thoracentesis attempts (typically two) fail to diagnose a recurrent exudative pleural effusion.<sup>12</sup> The choice between medical thoracoscopy and VATS depends on procedure complexity, need for additional surgery (like lung biopsy or decortication), and institutional expertise.<sup>33</sup> Thoracoscopic biopsy has high diagnostic accuracy (90%) in this situation compared with closed needle or image-guided biopsy.<sup>34,35</sup>
2. **Suspected Malignant Pleural Effusion:** Although any malignancy can metastasize to pleura, various malignancies, particularly those originating from the lung, breast, and thyroid, exhibit a propensity for pleural metastasis.<sup>36</sup> The parietal pleura may be involved in a random and diffuse pattern, rendering Abrams needle biopsy prone to sampling error and potentially inaccessible. In contrast, thoracoscopic biopsy enables direct visualization and targeted tissue sampling, resulting in a diagnostic yield of up to 98% in cases of pleural carcinomatosis secondary to metastatic disease.<sup>4</sup> Thoracoscopic characteristics of pleural malignancy may include nodules, polypoid lesions, candle wax drops like lesions and yellowish/whitish flat deposits due to malignant infiltration of lymphatics (figure 23 a and b). Medical thoracoscopy provides a comprehensive management approach for patients with malignant pleural disease, offering a 'one-stop shop' solution. In addition to its high diagnostic yield, the procedure facilitates therapeutic pleurocentesis, enabling complete drainage of pleural fluid, and allows for simultaneous talc pleurodesis, thereby reducing the likelihood of recurrence.<sup>4,36</sup>
3. **Suspected Malignant Pleural Disease (Without Pleural Effusion/Dry Pleura):** In rare instances, patients may present with pleural metastatic disease in the absence of pleural effusion, potentially leading to underdiagnosis in clinical practice, particularly in

cases of metastatic disease.<sup>37</sup> The pleura can be effectively visualized through the creation of an on-site artificial pneumothorax (using Boutin's needle, angiocatheter or suction catheter), facilitating insertion of a pleuroscope and enabling targeted biopsies of metastatic lesions (figure 24a and b).<sup>23</sup> However, in patients with minimal or absent pleural effusion, the induction of an artificial pneumothorax via filtered air injection is not a requisite procedural step prior to medical thoracoscopy.<sup>38</sup>

4. **Diagnosis and Staging of Lung Cancer:** Pleural effusions due to lung cancer (usually non-small cell lung cancer (NSCLC) represent unresectable (M1a) disease. Repeated thoracentesis is nondiagnostic in about one-third of individuals with NSCLC, thereby necessitating pleural biopsy. Thoracoscopic biopsy is preferred since it has a higher diagnostic sensitivity (up to 98 percent).<sup>4,39,40</sup>
5. **Diagnosis of Malignant Pleural Mesothelioma:** Medical thoracoscopy is increasingly used to diagnose mesothelioma, as it's more accurate than repeated thoracentesis or closed needle biopsy, allowing direct visualization and targeted biopsy, though diagnostic accuracy can still be challenging due to factors like adhesions or nonspecific lesion appearance. Thoracoscopic diagnosis of mesothelioma has been achieved in 60-75% of patients, but studies with larger specimens (using 5-7mm rigid forceps) suggest accuracy may reach 90%, comparable to open biopsy.<sup>41</sup> Newer tools like insulated tip knives and cryobiopsy forceps are being explored for thoracoscopy, with uncertain accuracy, and confocal laser endomicroscopy is being studied for real-time biopsy guidance.<sup>42,43</sup>
6. **Suspected Pleural Tuberculosis:** Grossly TB pleuritis is characterized by extensive grayish-white granulomas involving the parietal pleura or there may be simple patchy inflammation (figure 25). Medical thoracoscopy, has the highest diagnostic rate for tuberculous pleuritis, 100% compared with 79% for Abrams' pleural biopsy.<sup>44, 45</sup> It is specifically useful when Abrams closed pleural biopsy is negative or when adhesiolysis is required or if larger pleural tissue is needed for histopathology and drug sensitivity testing in a patient suspected of MDR pleural TB.<sup>46</sup>
7. **Other Benign Pleural Disorders:** If appropriate pleural fluid studies are non-diagnostic, thoracoscopic biopsy may help establish the diagnosis of benign diseases (e.g. asbestos plaques in asbestos associated pleural disease and granulomatous inflammation in rheumatoid pleuritis) and, more importantly, helps to exclude malignancy or tuberculosis in such situations.<sup>47</sup>
8. **Lung Biopsy for Parenchymal Disease or Peripheral Nodules Biopsy:** Yield of up to 75% has been reported from centers experienced in performing such procedures utilizing

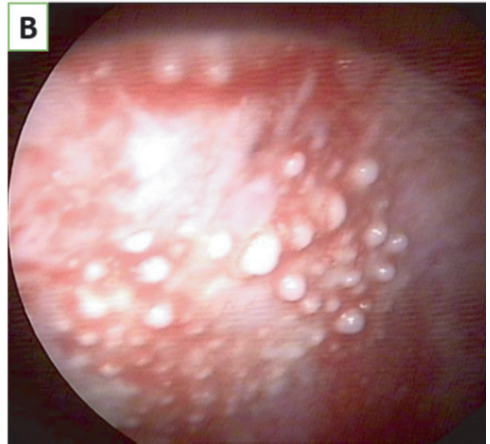
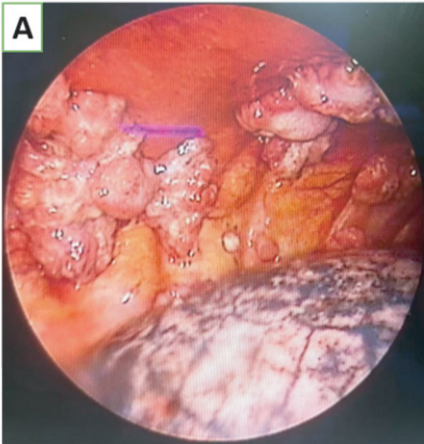


Figure 23 (A) rounded and polypoidal metastatic pleural nodules in a patient with renal carcinoma and (B) whitish (candle wax like) nodules in a patient with malignant mesothelioma.

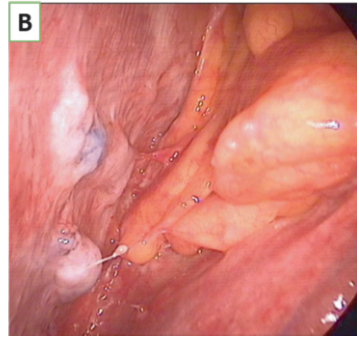
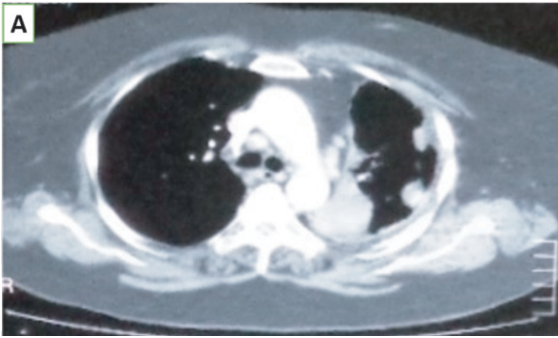


Figure 24 (A) Contrast enhanced CT scan chest in a 65-year-old lady showing left sided pleural nodules and thickening and (B) thoracoscopic visualization of nodules at costophrenic location- confirmed as adenocarcinoma on biopsy.

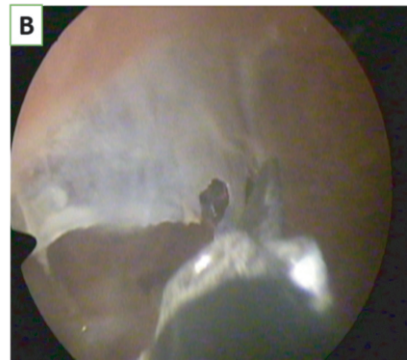


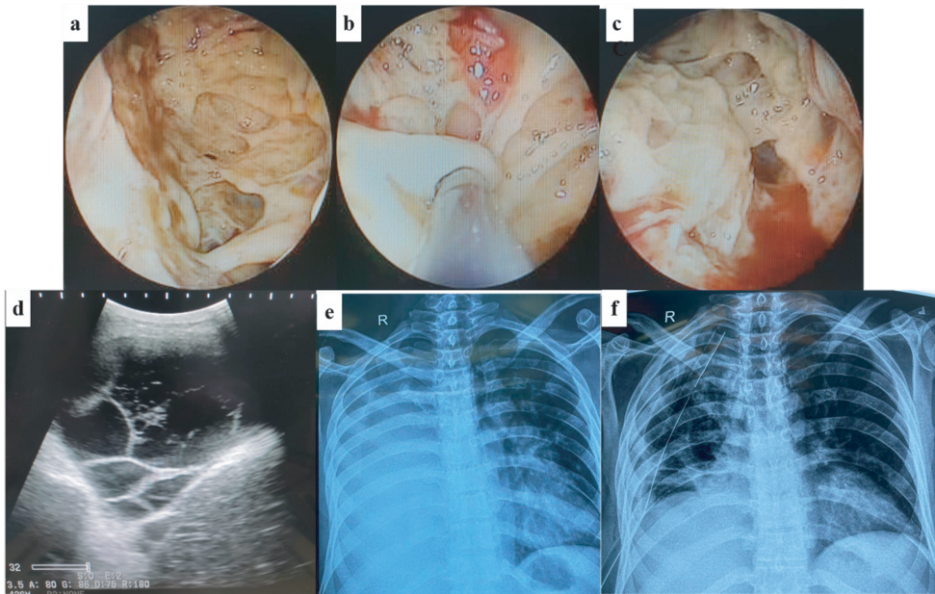
Figure 25. Thoracoscopic findings: (a) Nodular deposits on parietal pleura in a patient with hepatitis C-related liver cirrhosis and pleural TB (b) Tuberculous pleuritis with extensive adhesions in a middle-aged man; thoracoscopy allowed adhesiolysis and facilitated drainage and biopsy.

staples or cautery or cryoprobe to seal biopsy site.<sup>48,49</sup> However, thoracoscopic lung biopsy is a rare option, typically considered only when less invasive methods (bronchoscopy, fine needle aspiration, cryo-biopsy) fail to diagnose. With CT imaging advancements, these biopsies are now uncommon, and VATS is often the preferred surgical approach when needed.

**9. Diagnostic Evaluation of A Transudative Pleural Effusion:** Parietal pleural biopsy is rarely needed for transudative effusions of unclear etiology but may be considered on a case-by-case basis (e.g., borderline exudative effusions). In patients with malignant pleural disease, comorbidities like heart or renal failure can lead to transudative pleural fluid accumulation, diluting the exudative biochemistry. Even with transudative chemistry, cytological examination of pleural fluid and or thoracoscopic pleural biopsy is crucial to rule out underlying malignancy, especially in unexplained effusions.<sup>50</sup>

### **Therapeutic Indications:**

- 1. Chemical Pleurodesis:** Most often with talc (poudrage), primarily for recurrent malignant pleural effusions or pneumothoraxes and rarely for refractory selected cases of benign pleural effusions.<sup>4,40</sup>
- 2. Management of Complicated Parapneumonic Effusion (PPE) and Empyema:** Interventional procedure post-chest-tube is frequently indicated in patients with complicated PPE and empyema. The role of MT is controversial since reports are mixed and lysis of adhesions can sometimes be challenging (figure 26). Success rate of 79-91% have been reported with MT with or without fibrinolytics in patients with free-flowing or multiloculated PPEs/empyema.<sup>28, 51, 52</sup> A small randomized trial comparing medical thoracoscopy to intrapleural tPA/DNase found thoracoscopy resulted in significantly shorter hospital stays post-procedure, with comparable rates of treatment failure and complications.<sup>53</sup> In our experience, rigid medical thoracoscopy under local anesthesia is a viable option for managing multiloculated, exudative, and fibrinopurulent empyema.<sup>54</sup>
- 3. Adhesiolysis:** Other than patients with thoracic empyema, adhesiolysis using rigid medical thoracoscopy may also be required in pleural space complicated by adhesions due to TB pleuritis (figure 25b), uremic pleurisy and malignant pleural disease.<sup>47</sup>



**Figure 26.** Thoracoscopic images of a 32-year-old male with thoracic amoebic empyema secondary to a ruptured liver abscess. The images depict: thick pleural adhesions and loculations (a, c), adhesiolysis performed using biopsy forceps (b) ultrasound image showing multiseptated pleural effusion (d) pre-procedure chest radiograph with opaque right hemithorax and contralateral mediastinal shift (e) post-medical thoracoscopic chest X-ray showing significant radiological resolution and chest tube in-situ (f).

4. **Sympathectomy for Palmer Hyperhidrosis:** Difficult procedure usually done under general anesthesia in specialized centers having full thoracic surgery support.<sup>55,56</sup>
5. **Foreign Body (FB) Removal:** Intrapleural FB is an uncommon condition, usually encountered in the setting of thoracic trauma, but can rarely complicate procedures like diagnostic pleurocentesis. Although surgical extraction using thoracotomy or VATS remains the preferable management approach, intrapleural FB, although challenging, may also be removed utilizing MT.<sup>25</sup>
6. **Blebectomy and/or Pleurodesis for Pneumothorax:** In pneumothorax patients, VATS is preferred for detecting and treating blebs and bullae. However, medical thoracoscopy is sometimes used, where small (<2 cm) blebs can be treated with argon beam coagulation, Nd:YAG laser, or electrocautery, followed by pleurodesis.<sup>57</sup>

# Contraindications

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## Absolute:

- Complete pleural symphysis (extensive adhesions/unavailable pleural space)
- Hemodynamic instability (not due to large pleural effusion)
- Uncorrectable coagulopathy
- Severe hypoxia (can't tolerate single-lung ventilation)
- Recent myocardial ischemia, heart failure, or severe cardiovascular issues
- Uncontrolled hypercapnia or respiratory distress<sup>4,13,56</sup>

## Relative Contraindications:

- Severe cardiopulmonary disease
- Active infection or systemic sepsis
- Large bullae
- Previous extensive thoracic surgery/pleurodesis
- Hypocoagulability (INR > 1.5, platelets < 50 x 10<sup>9</sup> cells/ml)
- Intractable cough
- Hypoxemia
- Morbid obesity
- Inability to lay supine or lateral decubitus position (if it is because of large pleural fluid collection, a therapeutic pleurocentesis may be considered to alleviate orthopnea/trepopnea before performing pleuroscopy)<sup>4,13,56</sup>

# Complications

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Procedure-related complications are mostly minor and range from 2 to 6 percent.<sup>14,56,59</sup>

## 1. Sedation and analgesia-related complications:

- Hypotension (SAP < 90 mmHg or MAP < 60 mmHg)
- Hypoxemia (SpO<sub>2</sub> < 90%)
- Respiratory depression or arrest (RR < 8 breaths/min or apnea)
- Arrhythmias (e.g., bradycardia, tachycardia, AF)

## 2. Procedure-related complications (incidence < 1%):

- Pain: Mild to severe, pleural pain, cough, and dyspnea
- Vasovagal syncope: Associated with pain or rapid fluid suctioning
- Pleural trauma: Pneumothorax, or hemothorax
- Persistent air leak: > 7 days, often due to visceral pleural injury
- Subcutaneous emphysema: Due to trocar insertion or excessive coughing

## 3. Hemorrhage:

- Pleural hemorrhage (incidence: < 1%), often self-limiting, but may require surgical intervention
- Laceration of the lung may occur during insertion of the trocar or scope if lung is adherent to chest wall.

## 4. Infections:

- Wound infection, pneumonia, and empyema are unusual

## 5. Inflammation:

- Fever is not infrequent particularly after talc pleurodesis and usually resolves within 48 hours.

## 6. Other Complications:

- Pleural-cutaneous fistula or broncho-pleural fistula (rare)
- Air embolism (extremely rare, but potentially life-threatening)
- Re-expansion pulmonary edema (REPE)- Although large volumes of fluid can be removed, REPE is rare, possibly due to the equilibration of pleural pressures when the pleural space is open to air.

## 7. Mortality:

- Procedure-related mortality: 0.09-0.34%<sup>16,60,61</sup>

# Complications and Management

Medical thoracoscopy is generally a safe procedure. However, as with other interventions, it also has associated complications. Following table 5 highlights minor and major complications along with their management.<sup>18,27,62,63,64</sup>

**Table 5. Potential thoracoscopy complications and their management.**

Complication	Management
<b>Pre-procedure</b>	
Air embolism	Immediately stop pneumothorax induction. Place patient in left lateral decubitus and Trendelenburg position. High flow oxygen. IV fluids and vasopressors
Pain during induction of pneumothorax	Good analgesia and anesthesia. Reassure patient. If pain persists check position of needle
Dyspnea after induction of pneumothorax	Don't introduce trocar till patient is stabilized. Check SpO <sub>2</sub> . Auscultate both lungs. High flow oxygen. If severe dyspnea aspirate air. Check for air embolism
Hypersensitivity reaction to local anesthetic	Stop administering the drug. Administer adrenaline, antihistamine, corticosteroid, bronchodilators, IV fluids
<b>During procedure</b>	
Pain	Analgesics, intra-pleural lidocaine
Hypoxia	Oxygenate
Hypotension	IV fluids/ inotropes
Hypoventilation	Stop procedure. Check cause of hypoventilation (pneumothorax, over-sedation etc.) and manage accordingly
Arrhythmia	Monitor electrolytes and oxygenation. Most cases resolve as inflammation subsides.
Cardiac arrest	Manage as per ACLS protocol
Hemorrhage	Apply direct pressure with the rigid scope/forceps; use electrocautery or argon plasma coagulation (APC) if available. For major bleeding, pack the area with gauze through the cannula and consider for urgent VATS or thoracotomy
Lung laceration	Withdraw trocar. Insert large bore chest tube. Consider surgical intervention/VATS
Diaphragmatic perforation	If the injury is small and abdominal viscera are not herniated, observe closely. For larger tears or suspected bowel injury, immediate surgical repair via laparotomy or thoracotomy is mandatory
<b>Post-procedure</b>	
Pain	Analgesics
Fever	Paracetamol. Rule out infection

Wound infection	Antibiotics
Pneumonia	Antibiotics
Empyema	Drainage & antibiotics
Deep venous thrombosis	Anticoagulation
Subcutaneous emphysema	Ensure the chest tube is patent and correctly positioned within the pleural space. Most cases resolve with adequate drainage.
Persistent air leak	Maintain underwater seal drainage with low-pressure suction (-10 to -20cm H <sub>2</sub> O). If the leak persists >5 days, consider surgical intervention/VATS
Myocardial infarction	Manage as per ACS protocol
Re-expansion pulmonary edema	Diuretics, oxygen
ARDS	Provide supportive care in an ICU setting, including high-flow oxygen or mechanical ventilation. To prevent ARDS, use large-particle talc
Seeding of chest wall by malignant cells	Get oncology advise
Cardiac arrest	Manage as per ACLS protocol

## Prevention of Complications

### Pre-Procedure:

- Use thoracic ultrasound for safe access site
- Postpone the procedure if severe cough is present
- Measure blood gases, monitor cardiac status, and oxygenate during procedure

### Intra-Procedure:

- Avoid biopsy from internal parts of fissures or mediastinum
- Coagulate and ensure hemostasis if hemorrhage occurs

### Post-Procedure:

- Insert chest tube (at least till lung expands)
- Mobilize patient and start physiotherapy (incentive spirometry, breathing exercises)
- Apply external suction if lung is collapsed (-10 to -20 cmH<sub>2</sub>O)
- Daily PA chest radiograph to monitor lung expansion and complications
- Remove drain if lung remains collapsed after 3 days of suction and physiotherapy
- Liaise with thoracic surgery team for early referral in case of complications

### Additional Measures:

- Consider radiation therapy for malignant mesothelioma to prevent track invasion

# Quality Assurance

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The aim of quality assurance in rigid medical thoracoscopy is to ensure procedural safety and efficacy.

## Competency, Training, and Credentialing

Trained pulmonologists should perform thoracoscopy, following guidelines for better outcomes. Thoracoscopy requires skill and training, involving a learning curve. Using pre-procedure ultrasound and experience with pleural procedures like pleural tap and chest drain helps ensure safety. Strict ASNT is crucial due to the sterile pleural space. Training is part of respiratory medicine and interventional pulmonology, with competencies categorized into Level 1-3, ranging from basic diagnostics to advanced VATS techniques. A pulmonary specialty trainee registrar should do at least 20 supervised medical thorascopies to become competent, and then perform around 10 per year to stay competent. It's crucial to assess their skills formally through log books, efficacy, and complication rates. However, being truly proficient means being able to handle anatomical variations, getting accurate diagnoses, and managing complications - some achieve this in 15 cases, others need more. Institutions should have a credentialing process in place, with proper mentorship, especially in centers offering this procedure.<sup>8,12,59</sup>

## Procedural Safety and Standardization

Pre-procedure Checklist ("Time-Out"):

Like surgical safety checklist, implement a "time-out" just before the procedure. Before starting procedure confirm following crucial information.<sup>65</sup>

1. Is this the right patient?
2. Is this the right site?
3. Is this the right procedure?

# Sterility and Infection Control

Observe strict sterile techniques as per institutional policies. Following are the main components of infection control (table 6) at the thoracoscopy suite.<sup>9</sup>

**Table 6. Sterility and infection control for medical thoracoscopy.**

<b>Environment</b>	Easy to clean surfaces. Minimal foot traffic during procedure
<b>Hand Hygiene</b>	Surgical scrub (3–5 minutes) by all team members. Use personal protective equipment (sterile surgical gowns, sterile gloves, surgical masks ± eye protection, hair covers)
<b>Skin Prep</b>	Chlorhexidine/Alcohol (preferred) or Povidone-iodine. Large, sterile fenestrated drapes over the site of entry
<b>Instrument Cleaning</b>	Follow manufacturer’s guidelines. Forceps, trocars must undergo full autoclaving (if not single use). Light cables and cameras shall be covered with sterile plastic sheaths or sterilized according to the manufacturer’s validated instructions.
<b>Procedural infection control</b>	Use aseptic technique while connecting thoracostomy tube to under water seal to prevent retrograde infection. If empyema or high risk of infection, may use a single dose of prophylactic antibiotic like second/third generation cephalosporin 60 min before procedure. Sterile, occlusive for 24–48 hours post-op

## Equipment Maintenance

Immediate post-procedure cleaning and sterilization of equipment is necessary to prevent the drying of blood, pleural fluid etc. which may form biofilms. Follow manufacturer’s guidelines and infection-control protocols to regularly maintain and sterilize the rigid thoroscopes, forceps, and accessories. Maintain a record of equipment use, disinfection, and storage.

## Monitoring Outcomes and Reporting

Monitor efficacy of procedure by keeping proper record. Periodically audit diagnostic yield.

## Complication Tracking

Define major and minor complications. Keep a record of complications. May use some classification scheme for uniform documentation, like Clavien-Dindo scale to grade severity of complication.<sup>66</sup>

**Table 7. Medical thoracoscopy complications tracking.**

Grade	Description	Thoracoscopy Example
Grade I	Any deviation from the normal course; no need for drugs or surgery.	Mild subcutaneous emphysema.
Grade II	Requiring pharmacological treatment (e.g., antibiotics).	Wound infection or post-procedure pneumonia.
Grade III	Requiring surgical, endoscopic, or radiological intervention.	Failed lung expansion necessitating intervention again.
Grade IV	Life-threatening complication requiring ICU care.	Massive hemorrhage or respiratory failure.
Grade V	Death of the patient.	Procedural-related mortality.

Complications of procedure are discussed above in this document.

## Patient Feedback and Satisfaction

Patients' feedback is key. Use structured questionnaires to assess post-procedural pain, functional status, etc. Have a departmental follow-up protocol in place, including vitals, drain output, and chest X-rays at set intervals. Monitor patients for at least 01-hour post-procedure, checking vitals and pleural drain every 15 minutes initially.

## Morbidity and Mortality (M&M) Meetings

Hold periodic (e.g., quarterly) review meetings to discuss complications, near misses, unexpected outcomes. Review all grade III to V complications. Use root-cause analysis to identify system issues (training gaps, equipment failure, and procedural technique) and institute corrective actions.

## Governance and Policy Integration

Include the national thoracoscopy guidelines into hospital's standard operating procedures. Hospital policy must include standardized, written protocols for every stage of the procedure.

## Limitations of Medical Thoracoscopy

The approach to uncommon thoracoscopy applications like blebectomy, adhesiolysis in empyema, sympathectomy, parenchymal lung biopsies and pleural FB removal varies widely among clinicians and regions, influenced by factors like expertise, training, and access to thoracic surgical support. Meanwhile, VATS is the established standard for these indications including other procedures like resectional surgeries (lobectomy or pneumonectomy), decortication, pleurectomy, resection of pulmonary nodules, bronchopleural fistula repair, pericardial window creation, transthoracic vagotomy, and evaluation of mediastinal lymphadenopathy or tumors.

## Recent Advances in Medical Thoracoscopy

Recent advancements in pleuroscopy have enhanced the safety and efficacy of medical thoracoscopy. The development of thinner, more flexible pleuroscopes (mini thoracoscope, 5.5mm diameter, 3.5mm working channel) has reduced chest trauma, bleeding, and complications, improving patient tolerance and procedure efficiency. Key technological enhancements include **auto-fluorescent video-thoracoscopy**, which utilizes fluorescence to differentiate malignant tissue, and 3D imaging pleuroscopes offering improved spatial visualization. Emerging technologies like narrow-band imaging and confocal laser endomicroscopy may further enhance diagnostic precision<sup>67,68</sup>. The **next-generation flexi-rigid Thoracoscope LTF-H290** offers advanced capabilities, including a larger 3.0mm working channel, 180° upward angulation, and enhanced imaging modalities (RDI, TEI, NBI) with EVIS-X1, contributing to improved diagnostic and therapeutic outcomes with reduced morbidity.

## Conclusion

Medical thoracoscopy is a minimally invasive, safe, and effective procedure for the diagnosis and management of pleural diseases, offering high diagnostic yield and therapeutic benefits. Adherence to standardized guidelines and proficiency-based training protocols is essential to optimize outcomes and minimize complications. As expertise and experience grow among pulmonologists in Pakistan, medical thoracoscopy is poised to play an increasingly integral role in the management of pleural disorders.

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### **Further Reading:**

- Pakistan Chest Society Guidelines for Medical Thoracoscopy (Pleuroscopy) 2018. (<https://pakistanchestsociety.pk/pcs-guidelines/>)
- Pakistan Chest Society Guidelines for diagnosis of unilateral pleural effusion 2018. (<https://www.pakistanchestsociety.pk/wp-content/uploads/2018/03/Pleural-usageguidelines>)
- WABIP textbook of Interventional Pulmonology. Ali Musani, Levent Dalar. 2025 ([https://www.wabip.com/wp-content/uploads/institute/ipi\\_textbook.pdf](https://www.wabip.com/wp-content/uploads/institute/ipi_textbook.pdf))
- British Thoracic Society Guideline for pleural disease 2023 (<https://doi.org/10.1136/thorax-2022-219784>)
- BTS Clinical Statement on Pleural Procedures July 2023 (<https://www.brit-thoracic.org.uk/clinical-resources/clinical-statements/pleuralprocedures/>)
- Innovative pleuroscopic retrieval of an intrathoracic metallic foreign body- a case report, Talha Mahmud, Namra Khalid, Muhammad Shah Nawaz and Kashif Ali Tarar. The Egyptian Journal of Bronchology. 2025; 19:117. (<https://doi.org/10.1186/s43168-025-00484-1>)
- Prof Dr Talha Mahmud's Interventional Pulmonology (<https://www.youtube.com/shorts/U543MFC7nY0:UCPSaTFeNF8UXyoYNMDYII9g>)

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