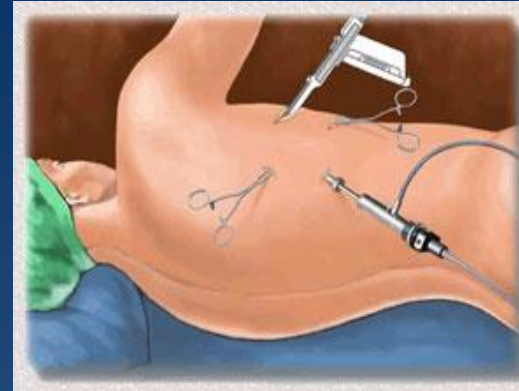


Thoracoscopy



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MD Pulmonology



History

- Thoracoscopy was introduced together with laparoscopy in 1910 by **Hans-Christian Jacobaeus**.
- Jacobaeus initiated the therapeutic application of thoracoscopy for lysis of pleural adhesions by means of thoracocautery to facilitate pneumothorax treatment of tuberculosis (**Jacobaeus operation**).
- With the advent of anti-tuberculosis drugs, thoracoscopy was abandoned for several decades. Recent technologic advances such as improved optical and video technology have revitalized the use of this procedure as a diagnostic and therapeutic tool.

History

- The excellent results of laparoscopic surgery and the tremendous advances in endoscopic technology stimulated many thoracic surgeons to develop minimally invasive techniques, which were termed therapeutic or surgical thoracoscopy, as well as video-controlled or video-thoracoscopic surgery, or video-assisted thoracic surgery (VATS).
- Today, pleuroscopy (medical thoracoscopy) is considered as a part of the field of interventional pulmonology.

MT vs. VATS

	MT	VATS
Main Indications	Diagnosis of pleural diseases	Treatment
Anaesthesia	LA/Sedation	GA
Intubation	No	Yes
Procedure site	Suite/Room	OT
Ports of entry	Single-Double	Multiple(>3)
Instruments	Non-disposable	Disposable
Invasiveness	+	++
Safety	++	+
Cost	+	++

MEDICAL THORACOSCOPY (PLEUROSCOPY)



Indications

Pleuroscopy	Pleuroscopy or VATS
Pleural effusions ✓ Pleural effusions of unknown etiology ✓ Staging of lung cancer ✓ Staging of diffuse malignant mesothelioma ✓ Pleurodesis by talc poudrage	1. Spontaneous pneumothorax ✓ Staging ✓ Pleurodesis by talc poudrage 2. Empyema (stage I/II) ✓ Drainage 3. Diffuse pulmonary diseases ✓ Biopsy 4. Localized lesions ✓ Chest wall, diaphragm

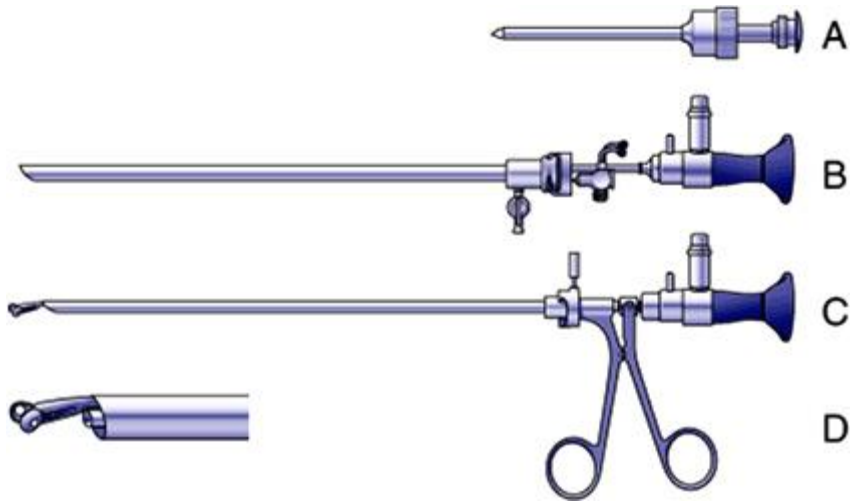
Techniques

- Pleuroscopy is an invasive technique that should be used only when other, simpler methods do not provide the diagnosis.
- The technique is actually very similar to chest tube insertion by means of a trocar.
- There are two different techniques of diagnostic and therapeutic pleuroscopy, as performed by the pulmonary physician.

Techniques

1. The first method uses a single entry site, usually with a 9-mm trocar, for a thoracoscope with a working channel for accessory instruments and optical biopsy forceps that is employed under local anesthesia.
2. In the other technique, as used by Jacobaeus for lysis of adhesions, two entry sites are used: one with a 7-mm trocar for the examination telescope and the other with a 5-mm trocar for accessory instruments, including the biopsy forceps. For this technique, neuroleptic or general anesthesia is preferred.

Equipment



- A, Trocar and cannula with valve.
- B, Single-incision thoracoscope (9 mm diameter).
- C, Biopsy forceps with straight optical device.
- D, Magnified view of optical device and forceps in the thoracoscope shaft ready for biopsy.

- The single-entry-site technique is usually done with a 9-mm diameter trocar and a cannula with valve.
- The two-entry-site technique uses a 7-mm trocar for the first site of entry, with appropriate telescopes and forceps, and similar accessory instruments. For the second site of entry, a 5-mm trocar is used.

Equipment



Semirigid pleuroscope with biopsy forceps

- It has the advantage that the skills involved in operating the instrument are already familiar to the practicing bronchoscopist.
- Its disadvantages compared to rigid thoracoscopic instruments are the smaller biopsy specimens. However, the flexible tip allows very homogeneous distribution of talc on all pleural surfaces.

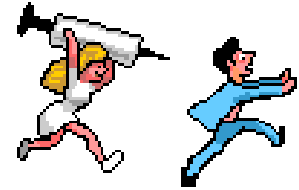
Equipment

- The procedure suite should be equipped with monopolar and, if possible, bipolar electrocoagulation as well as equipment for resuscitation and assisted ventilation, electrocardiography, blood pressure monitoring, defibrillator and as well as oxygen and vacuum generators.

Patient Preparation

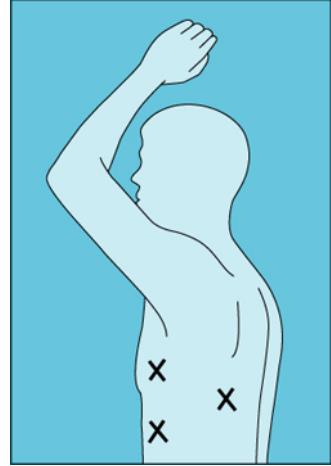
- Radiologic evaluation include
 - P-A and lateral chest radiograph.
 - Ultrasound for localization of the pleural fluid and for diagnosis of fibrinous membranes or adhesions in the pleural space.
 - CT scan is not mandatory, but can be helpful in certain situations such as loculated empyema and localized lesions (tumors) of the chest wall or diaphragm.
- ABG
- ECG
- Clinical laboratory tests
- Informed consent

Anesthesia



- Pleuroscopy by the single-entry-site technique is usually done under local anesthesia with premedication, using an antianxiolytic, a narcotic, or both (e.g., midazolam and hydrocodone). If necessary, additional pain medication should be given during the procedure, as required.
- An excellent alternative is sedation by propofol with or without premedication. General anesthesia with intratracheal intubation and ventilation is not necessary for pleuroscopy

Access to the Pleural Space



- Create a pneumothorax before introducing the trocar. The pneumothorax is induced under fluoroscopic control with the patient in the lateral decubitus position and the hemithorax to be studied facing upward.
- A pneumothorax apparatus is not necessary in the case of a preexisting large pleural effusion or a pneumothorax.
- In case of difficulties creating a pneumothorax because of adhesions, the blunt dissection technique (extended thoracoscopy) is recommended. This involves blunt dissection of the subcutaneous tissues and intercostal muscles in order to advance the pleuroscope into the pleural space.

Pleuroscopic Technique

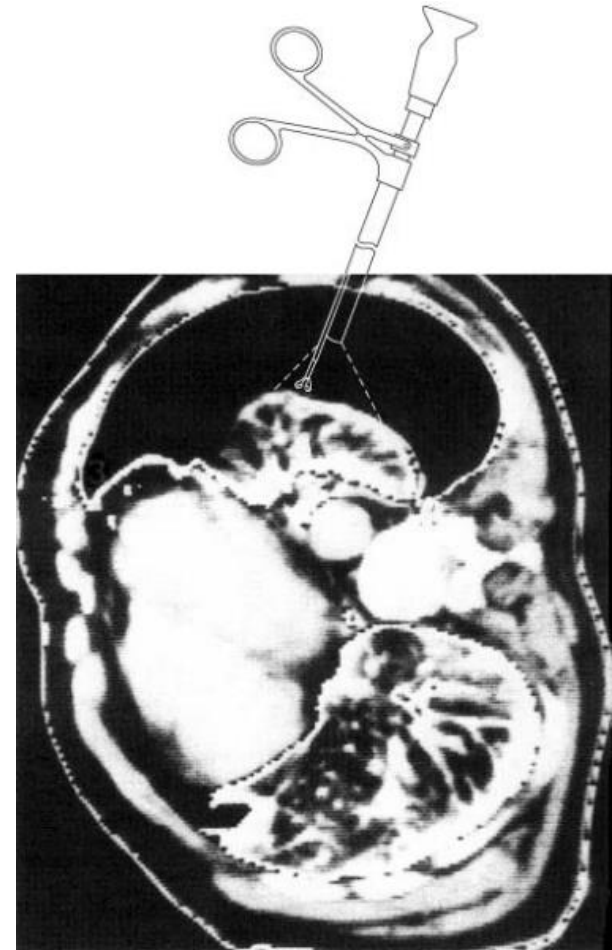
- The site of introduction of the pleuroscope depends in part on the location of abnormalities to access and the location of potentially hazardous areas to avoid.
- The region of the diaphragm is unsuitable.
- The trocar is generally introduced in the lateral thoracic region between the mid- and anterior axillary line in the fourth to seventh intercostal space.
- Following preparation with a surgical cleansing agent, local anesthesia is administered and after making a small skin incision, the trocar is advanced with a fairly forceful corkscrew motion until the detectable resistance of the internal thoracic fascia has been overcome. The cannula of the trocar should lie at least 0.5 cm within the pleural space.

Pleuroscopic Technique

- Pleural effusions should be removed completely by using a suction tube that does not fully occlude the cannula, so that air may rapidly enter the pleural space to provide pressure equilibration.
- After complete removal of the effusion, or in cases without effusion, the optical device is introduced through the cannula, and the pleural space is then inspected.
- Biopsies of the pleura and, if needed, of the lungs, can be carried out most easily and safely by means of the lung biopsy forceps. If no macroscopic abnormalities are visible, several biopsies should be taken from different sites of the parietal pleura.

Technique

- Although a single site of entry is generally sufficient, a second site may be useful for biopsies or to perform coagulation.
- The position of the second site of entry is determined by viewing through the 50-degree scope, while depressing the possible entry site with the index finger.
- After administration of a local anesthetic, a 5-mm incision is made and the 5-mm trocar is inserted directly. Its cannula will accommodate many instruments designed for its smaller bore.



CT representation of pleuroscopy in the right thoracic cavity with the patient in the left lateral decubitus position.

Talc Pleurodesis

Indications:

- Malignant or recurrent pleural effusions and pneumothorax.

Prerequisites:

- Removal of all pleural fluid before spraying with talc.
- Complete collapse of the lung.
- Following distribution of the talc, a complete lung expansion is necessary.

Dose:

- 5g (8 to 12 mL) for malignant or recurrent effusions.
- 2g for pneumothorax.



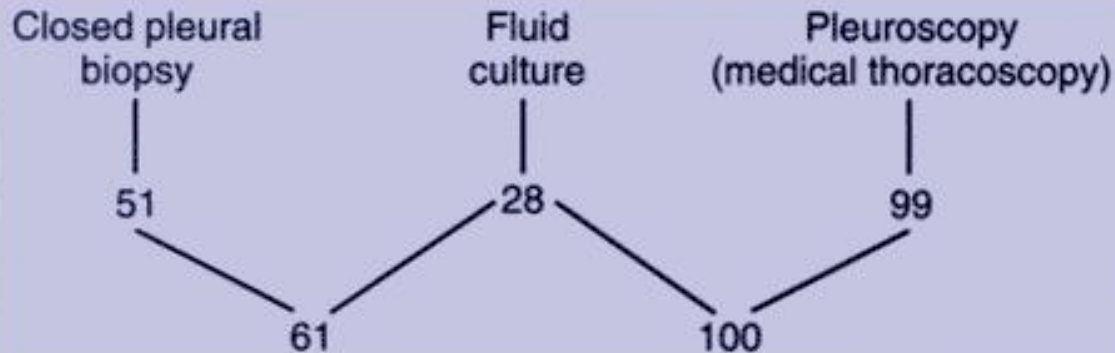
Talc Pleurodesis

- After talc poudrage, an 8- to 11-mm chest tube should always be inserted to drain residual fluid. The chest tube can be removed when the daily amount of fluid production is less than 100 ml or when an air leak associated with a pneumothorax has stopped.
- Advantages over thoracostomy tube pleurodesis:
 - Simultaneous drainage of pleural fluid and pleurodesis.
 - Visualization of the visceral pleura to ensure that the lung is not encased by pleural thickening or tumor, and thereby evaluating the re-expansion potential of the lung.
 - Guidance of chest tube placement.
- Adverse effects of talc:
 - Fever and pain (most common short-term).
 - ARDS, acute pneumonitis and respiratory failure (rarely).

Tubercular Pleural Effusion

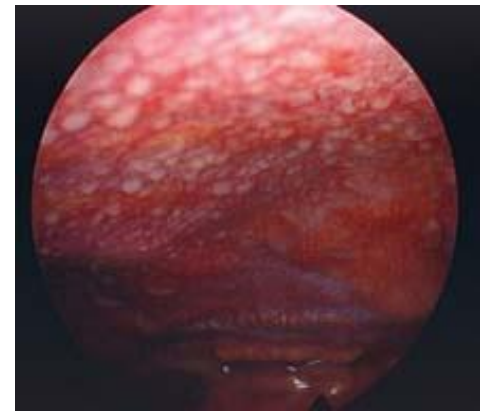
- The diagnostic accuracy of pleuroscopy is almost 100% because the pathologist is provided with multiple, selected biopsies and because the cultural proof of tubercle bacilli growth is more frequent.
- Advantages of MT:
 - Visualization of grayish-white granuloma (parietal & diaphragmatic pleura).
 - Multiple biopsies from selected sites.
 - TB cultures more frequently positive.
 - Complete drainage of pleural effusion during MT→ greater symptomatic improvement.
- Indications of MT – when requirement for :
 - Large amounts of tissue both for diagnosis and testing for drug resistance and susceptibility.
 - Lysis of adhesions.

Tubercular Pleural Effusion



Sensitivity of different biopsy methods (histologic and bacteriologic results combined) for the diagnosis of *M. Tb* infection.

Note the numerous small whitish nodules on the parietal (chest wall) pleura. The histology revealed florid exudative tuberculous. *M. Tb* cultures from the biopsies were positive, whereas those from the effusion were negative.



Malignant Pleural Effusions

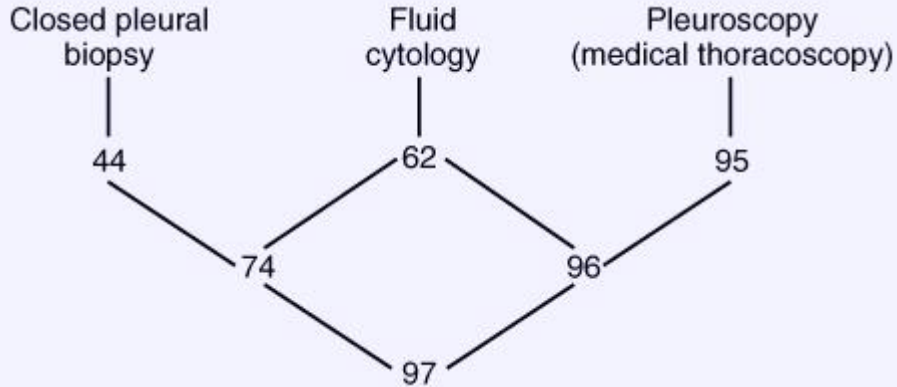
Advantages of MT:

- Complete evacuation of pleural fluid.
- Maximization of lung expandability by removing adhesions.
- Talc poudrage pleurodesis.

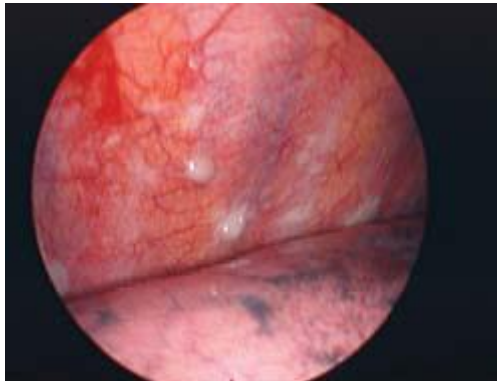
Indications of MT:

- Staging lung cancer
- Diffuse malignant mesothelioma.
- Metastatic cancer.

Malignant Pleural Effusions

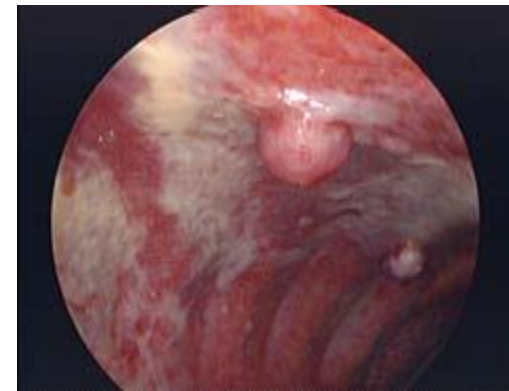


Sensitivity of different biopsy methods (cytologic and histologic results combined) for the diagnosis of malignant pleural effusions.



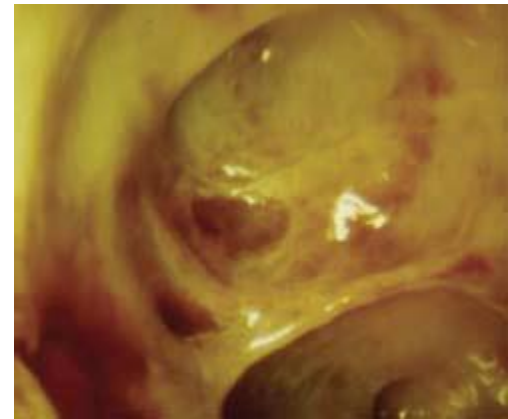
A patient with a malignant pleural effusion due to breast cancer. Small whitish tumor nodules on the parietal (chest wall) pleura are seen. The lung surface (lower part of photo) demonstrates some anthracosis

A patient with diffuse malignant mesothelioma following occupational asbestos exposure. Tumor nodules and whitish areas with pleural thickening on the parietal (chest wall) pleura are seen.



Empyema

- Pleuroscopy can be used in the management of early empyema.
- In cases with multiple loculations, it is possible to open these spaces, to remove the fibrinopurulent membranes by forceps, and to create a single cavity, which can then be successfully drained and irrigated. This treatment should be carried out early in the course of empyema before the adhesions become too fibrous and adherent to perform pleuroscopy.
- Pleuroscopy is a procedure similar to chest tube placement, but enables the creation of a single pleural cavity, allowing much better local treatment.



Pleural effusion of unknown etiology

- >20–25% of pleural effusion remain undiagnosed even after extensive diagnostic work-up of pleural fluid.
- In cases with effusions that are neither malignant nor tuberculous, pleuroscopy may give visual clues to the etiology (e.g., thick white fibrin deposits in rheumatoid effusions, calcifications in effusions following pancreatitis, dilated veins in liver cirrhosis).
- In some cases of recurrent pleural effusions of nonmalignant etiology, such as hepatic and renal hydrothorax, chylothorax and SLE that do not respond appropriately to medical therapy, the recurrent effusion can be treated successfully by talc pleurodesis.
- By medical thoracoscopy → The proportion of idiopathic pleural effusions usually falls below 10%.

Mesothelioma

Advantage of Medical Thoracoscopy:

1. Specimens large & full-thickness from several areas (no need for open pleural biopsy) → Early diagnosis (accuracy by HPE upto 98%) and better H/P classification.
2. If intrapleural CT or surgical treatment not under consideration, diagnosis and pleurodesis done simultaneously.
3. Benign asbestos-related Pleural effusion (Diagnosis of exclusion):
 - Fibrohyaline/calcified, thick, pearly white pleural plaques.
 - Pleural and pulmonary biopsy→ demonstration of asbestos fibres.

Mesothelioma

- Diagnosis by cytologic examination → <20% (4–77%).
- Most common cause of false negative cytology – Early malignant mesothelioma.
- Closed needle biopsy – specimens small (size & no.) → inadequate for all immunohistochemical stains & electronmicroscopy examination needed for definitive diagnosis.
- Limitations of thoracoscopy:
 1. Inadequate visualization (extensive adhesions).
 2. Tumor growth through thoracoscopic incision sites.
 3. Inherent difficulties in pathologic identification.

Spontaneous Pneumothorax

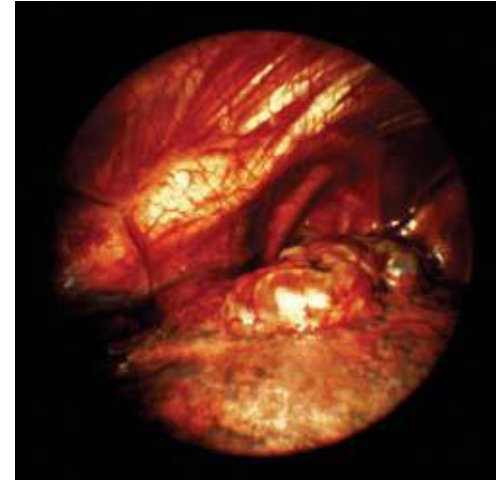
Advantages of Pleuroscopy:

- Precise assessment of underlying lesions under direct visual control.
- Choice of best (conservative or surgical) treatment measures.
- Direct treatment by electrocautery of blebs and bullae.
- Severing of adhesions, if necessary followed by talc poudrage.
- Selection of the best location for chest tube placement.

Spontaneous Pneumothorax

Thoracoscopic findings in PSP:

- Type I (Normal appearance)
- Type II (Pleural-Pulmonary adhesions)
- Type III (Small blebs or bullae < 2cm)
- Type IV (Large bullae >2 cm)



Talc poudrage in spontaneous pneumothorax:

- 2 to 4 mL of talc is sufficient for effective pleurodesis.
- No long-term sequelae are observed 22 to 35 years after talc poudrage.
- Talc poudrage achieves excellent results, with recurrence rates below 10%.

Diffuse pulmonary diseases

- Indications for thoracoscopy:
 1. Evaluation of single/multiple peripheral pulmonary opacities where TBLB/Percutaneous lung biopsy non-diagnostic.
 2. Biopsy of visceral pleura and lung surface in patients with proven or suspected pleural malignancy (metastasis/ malignant mesothelioma) for staging.
- Sensitivity + Invasiveness → Open Lung Biopsy > MT/VATS > TBLB.

Diffuse pulmonary Diseases

- Advantage over TBLB:
 1. Ability to choose biopsy site (direct visualization).
 2. Larger biopsy size.
 3. Bleeding can be controlled with electrocoagulation /laser.
- Sensitivity – overall $> 90\%$:
 1. Sarcoidosis stage II/III $\rightarrow \sim 98\%$
 2. Diffuse malignant lung diseases $\rightarrow \sim 90\%$
 3. Fibrotic lung disease $\rightarrow \sim 85\%$

Localized Diseases

- Localized diseases in the region of the chest wall, diaphragm, thoracic spine, and lung, and pathologic changes in the chest cage close to the pleura provide a good indication for pleuroscopy if the pleural space is not obliterated.
- Currently, the application of pleuroscopy has decreased substantially for these indications due to better imaging techniques such as CT, magnetic resonance imaging, and ultrasound, which allow the diagnosis of pleural plaques, lipomas, and cysts, usually without difficulty.

Contraindications

Absolute:

- Size of free pleural space <6-10 cm usually due to extensive adhesions.
- Respiratory insufficiency requiring ventilatory support.
- Pulmonary arterial hypertension
- Uncorrectable bleeding disorders.

Relative:

- Intractable cough.
- Hypoxemia.
- Bleeding and coagulation disorders.
- Unstable cardiovascular status.

Contraindications

Contraindications for pulmonary biopsy:

1. Suspicion of arteriovenous pulmonary aneurysm.
2. Vascular tumors.
3. Hydatid cysts.
4. End stage pulmonary fibrosis with extensive honeycombing.

Relative contraindications

- previous systemic steroid or immunosuppressive therapy.

Complications

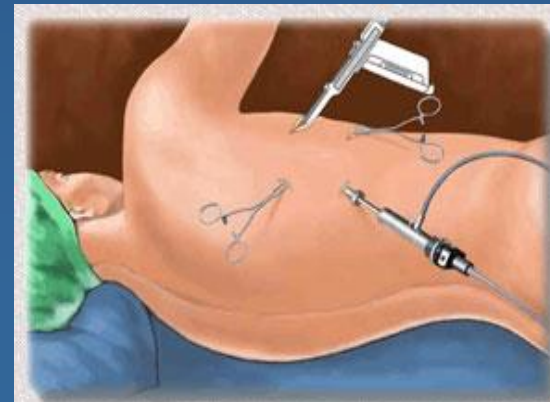
Mortality - 0.01-0.25 %

Morbidity:

- Desaturation during procedure ($\downarrow$ LA) – $<2\%$
- Persistent post-operative air leak ($>7d$) – $<2\%$ (pts with spontaneous pneumothorax).
- Subcutaneous emphysema $\sim 0.5\%$
- Rare – benign cardiac arrhythmias, transient hypotension and seeding of pathology in patients with malignant mesothelioma.

SURGICAL THORACOSCOPY

(VIDEO-ASSISTED THORACIC SURGERY)



Video-assisted Thoracic Surgery(VATS)

- VATS uses small incisions to perform therapeutic interventions in the chest without spreading the ribs.
- VATS requires an operating room, general anesthesia with single-lung ventilation, more than two (usually three) entry sites, and complex instruments.
- Overall, it is a more invasive and expensive technique with a higher risk than pleuroscopy; however, in experienced hands and in the proper setting, VATS is less invasive, is less expensive, and has a lower risk than open procedures.

Indications

Lung biopsy

- Lobectomy
- Decortication
- Lung volume reduction surgery

Pleura procedures

- Pleurectomy (pneumothorax)
- Drainage/decortication (empyema stage III)

Mediastinal procedures

- Resection of mediastinal mass
- Thoracic lymphadenectomy
- Thoracic duct ligation
- Pericardial window
- Sympathectomy

Esophageal procedures

- Excision of cyst, benign tumors
- Esophagectomy
- Anti-reflux procedures

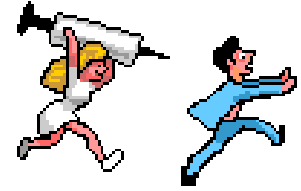
General Procedure

- The trocar and the camera are placed in the midaxillary line in approximately the eighth intercostal space.
- Most of the surgeons use a reusable 5-mm trocar and a 30-degree, 5-mm thoracoscope.
- A 2-cm incision is made in about the sixth intercostal space in the mid-clavicular line.
- An additional incision is made in the fourth intercostal space in the midaxillary line.
- A variety of equipment is available for VATS procedures.

Basic instrumentation for VATS

- “Three-chip” endoscopic video camera and high-definition television monitor
- Operating thoracoscope (with 5-mm biopsy channel)
- Three standard-length ringed forceps
- Suction-irrigation system 10 mm diameter
- Endoscopic hook cautery (5 mm) with trumpeted suction
- Standard electrocautery unit with extended tip for application through intercostal access site
- Landreneau “Masher” set
- Bulbed syringe (60 ml)
- Standard Metzenbaum scissors (10–12 in.)
- Standard University of Michigan Mixner clamp (10–12 in.)
- Standard-sized and pediatric Yankour metal suckers
- Standard 28-French chest tubes (straight and right angled) and closed drainage system

Anesthesia



- VATS is usually performed under general anesthesia, although simple procedures, such as pleural biopsy and pleurodesis, can be performed with local anesthesia.
- With VATS, the surgeon depends upon single-lung ventilation and excellent collapse of the lung for exposure, as compared to thoracotomy which depends on manual compression and retraction of the lung provide good exposure.
- Single-lung ventilation for VATS is facilitated by the use of a double-lumen tube.
- Carbon dioxide insufflation into the pleural space and endobronchial suction with a bronchoscope help collapse the lung.

Lung Biopsy/Wedge Resection

- A lung biopsy is the most common procedure performed by VATS.
- Preoperative chest CT scan allows the surgeon to know where the mass is located.
- Preoperative wire localization of a mass may be advisable.
- An endoscopic stapler is used to resect the appropriate area of lung parenchyma.
- Patients are usually discharged on the first or second postoperative day.

Lobectomy

- The procedure should involve a standard anatomic dissection and removal of lymph nodes.
- This generally requires three sites of entry.
- A 5-mm trocar and 30-degree thoracoscope are placed in the eighth intercostal space in the midaxillary line.
- A 2-cm incision is placed in the sixth intercostal space in the mid-clavicular line.
- The utility thoracotomy incision is a 4- to 5-cm incision in the fourth or fifth intercostal space in the midaxillary line.
- Standard instruments are used to dissect and transect the artery, vein, and bronchus of the lobe to be removed.

Lobectomy

- Advantages over thoracotomy:-
 - the mortality rate is less than 1%, lower complication rate, lower cost, less impairment of shoulder function, less impact on the postoperative vital capacity and 6-minute walk, and less pain.
- Limitations of VATS:-
 - Concern about dissection of pulmonary vessels and controlling bleeding. Tumor seeding of the incisions has occurred following VATS procedures, but the risk of this also appears to be very low (<1%).

Lung Volume Reduction Surgery

- Lung volume reduction surgery (LVRS) has now been shown to be an effective treatment that is better than medical management for selected patients with emphysema (upper lobe emphysema and low exercise tolerance).
- The typical patient for LVRS has upper lobe emphysema.
- The exact location and amount of lung tissue to be resected are determined by the preoperative CT and lung perfusion scans.

Diagnosis and Treatment of Pulmonary Metastases

- VATS can be used for either diagnosis or treatment of pulmonary metastases.
- The procedure is performed with the standard technique for a wedge resection.

Treatment of Pneumothorax

- VATS is an ideal approach for the treatment of spontaneous pneumothorax.
- Indications for an operation include prolonged air leak, bilateral pneumothorax, and recurrent spontaneous pneumothorax.
- The bleb and a margin of normal lung tissue are excised with staples.
- A mechanical pleurodesis is performed with a ring forceps that holds a gauze pad.

Pleural Procedures

Treatment of Empyema –

- Generally, the effusion is drained percutaneously by chest thoracostomy tubes. If the effusion cannot be drained and the patient remains febrile, VATS is performed within the next few days.

Decortication –

- If the lung does not expand fully after the effusion has been drained completely, pulmonary decortication may be needed.
- If there is a thick peel, an incision is made through the peel to the surface of the lung. An Allis clamp holds the peel off the pleural surface so that blunt dissection can separate the peel from the lung.

Summary

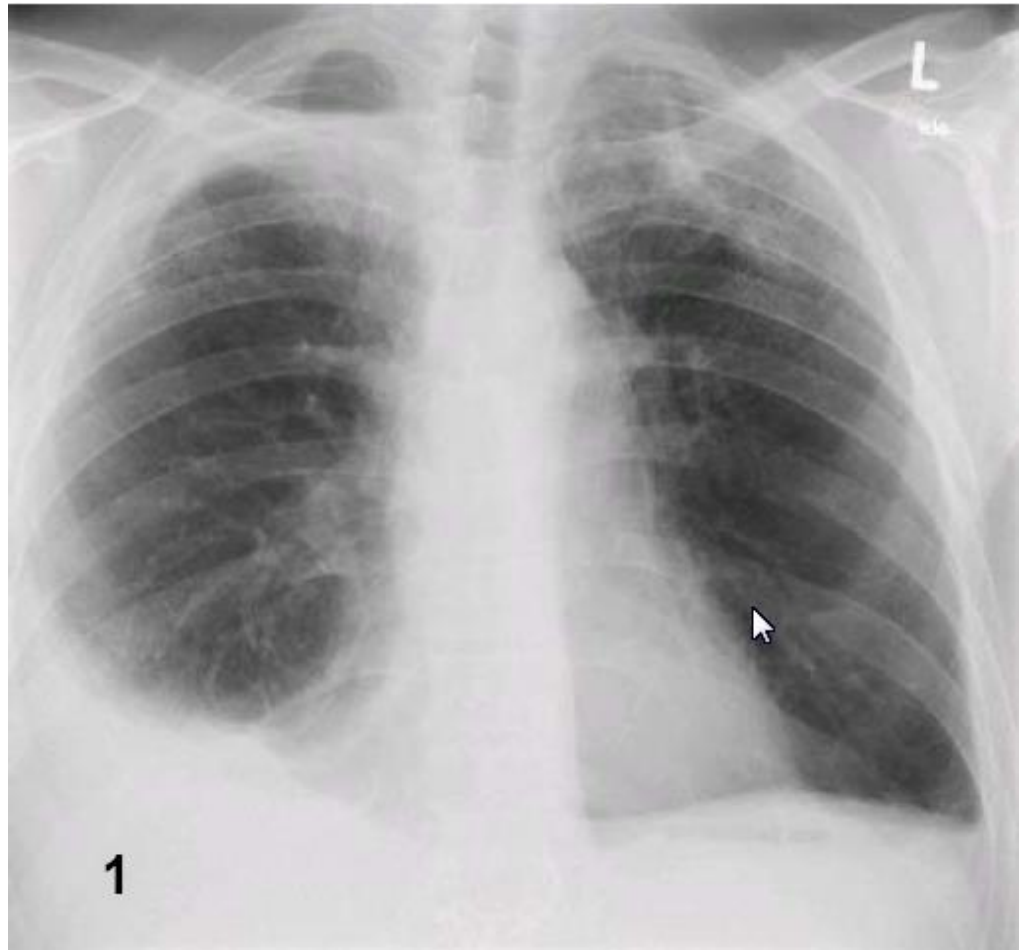
- The advances in endoscopic technology, with sophisticated endoscopic instruments and endoscopic telescopes, allow the replacement of standard management with thoracoscopy in many indications.
- Just as there is an overlap between pleuroscopy and VATS procedures, there is also an overlap between VATS and open surgical procedures, and the decision between these procedures depends on the particular situation, on the performance status and prognosis of the patient, and on the expertise of the thoracic surgeon.



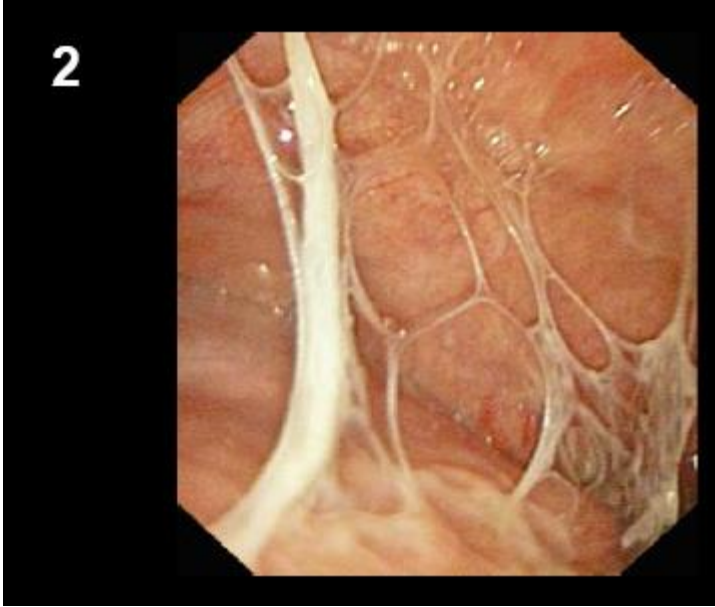
CASES

Case - 1

- 46 Yr old male
- Pleural fluid was exudative, but no tumor cells.



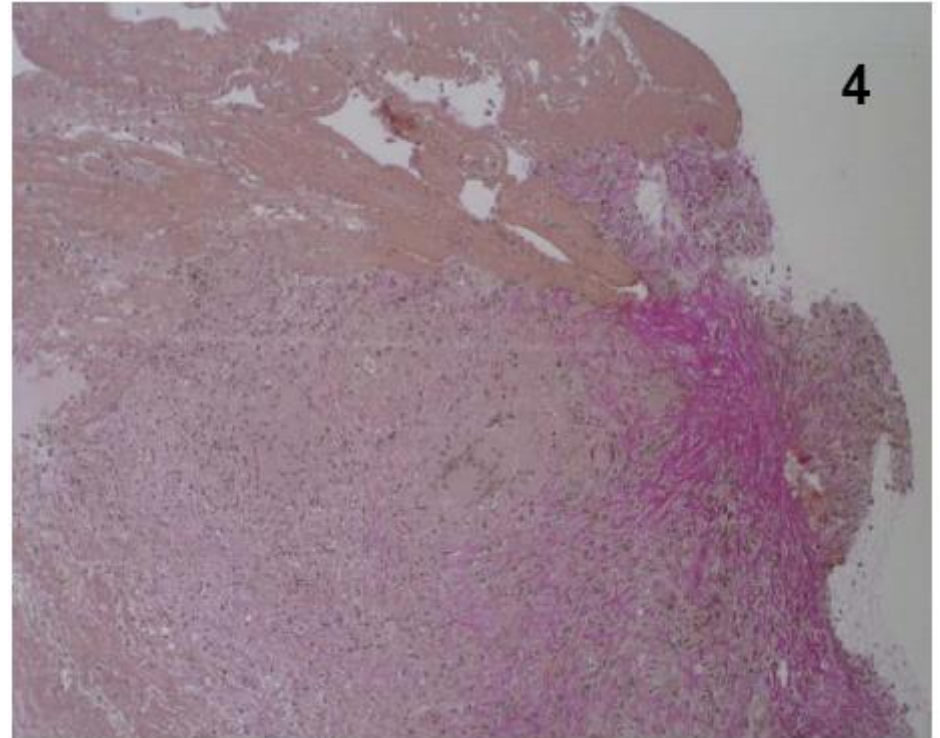
Case - 1



Finding- acute inflammatory pleural changes and fibrin.
Location- posterior chest wall

Case - 1

**Diagnosis :
Tuberculous
pleurisy**

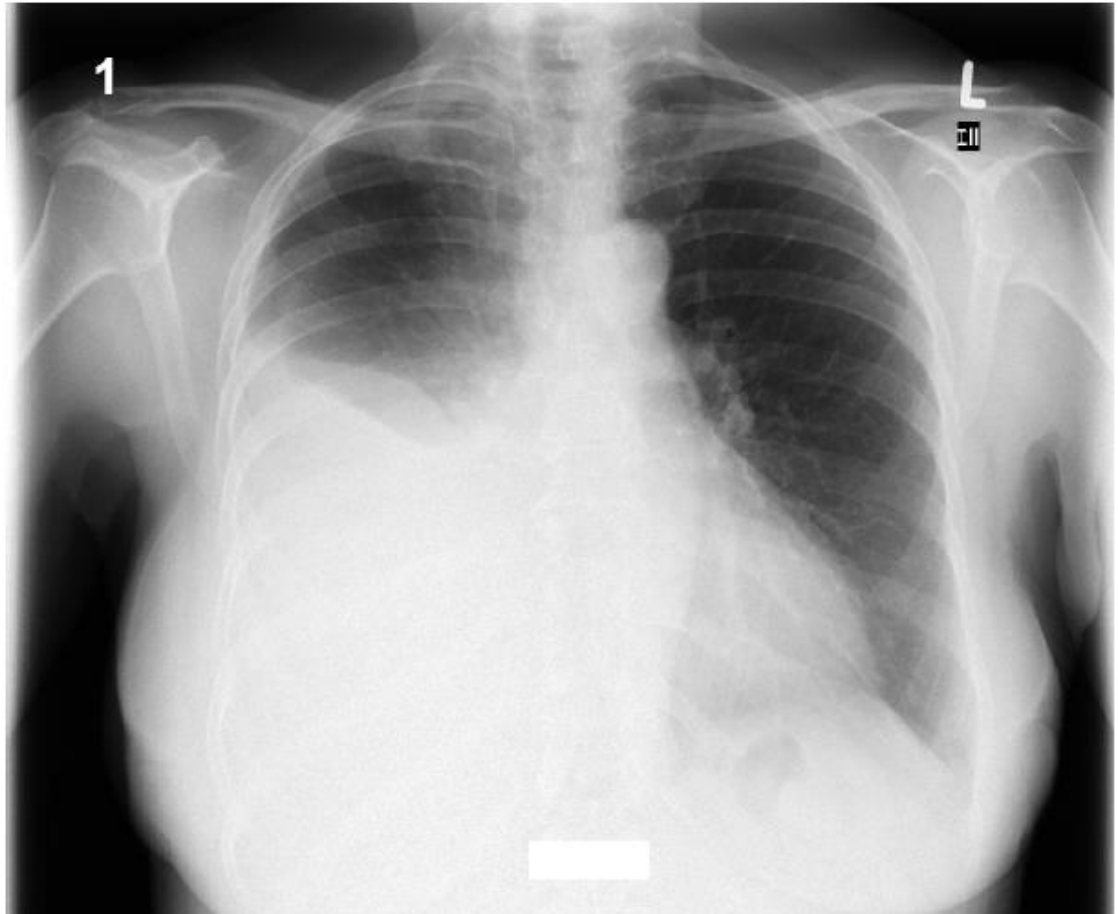


Histology / Bacteriology

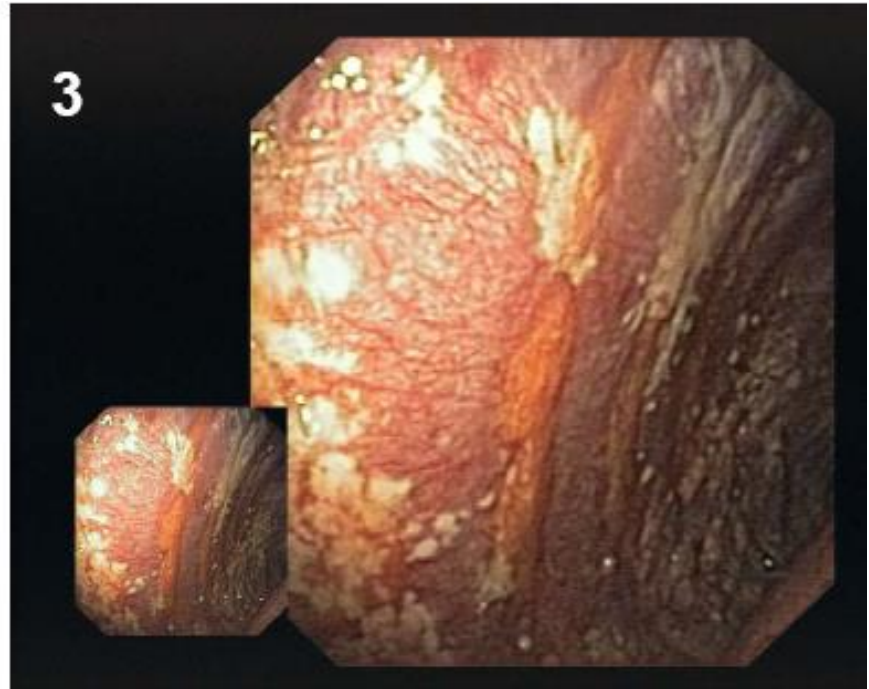
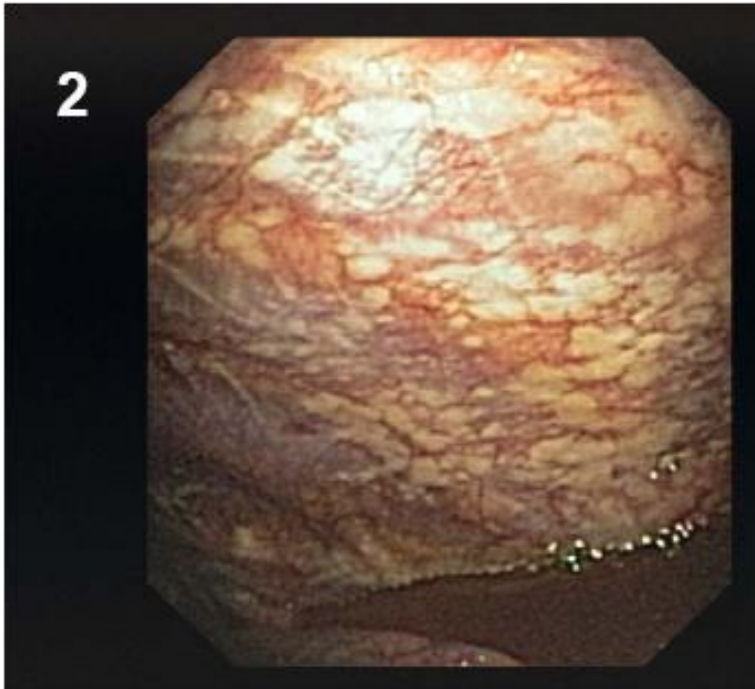
Finding: Histology (image 4) revealed granulomata with epithelioid cells and necrosis. After ten days, fluid cultures were positive (M. tuberculosis).

Case - 2

- 65 yr female
- History: 2003 diagnosed to have breast cancer and received breast sparing surgery, chemo and radiotherapy and hormonal tx.
- Pleural fluid exudate, cytology negative



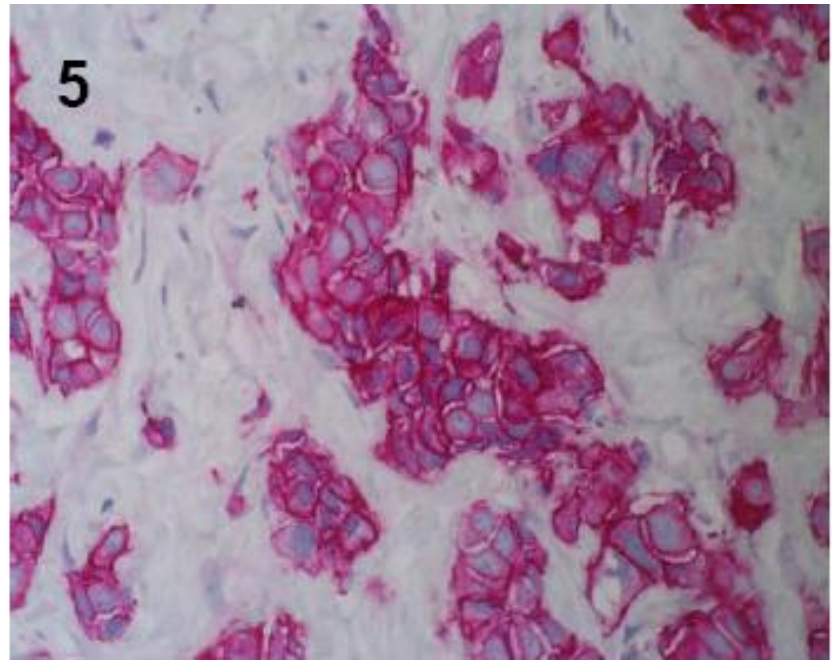
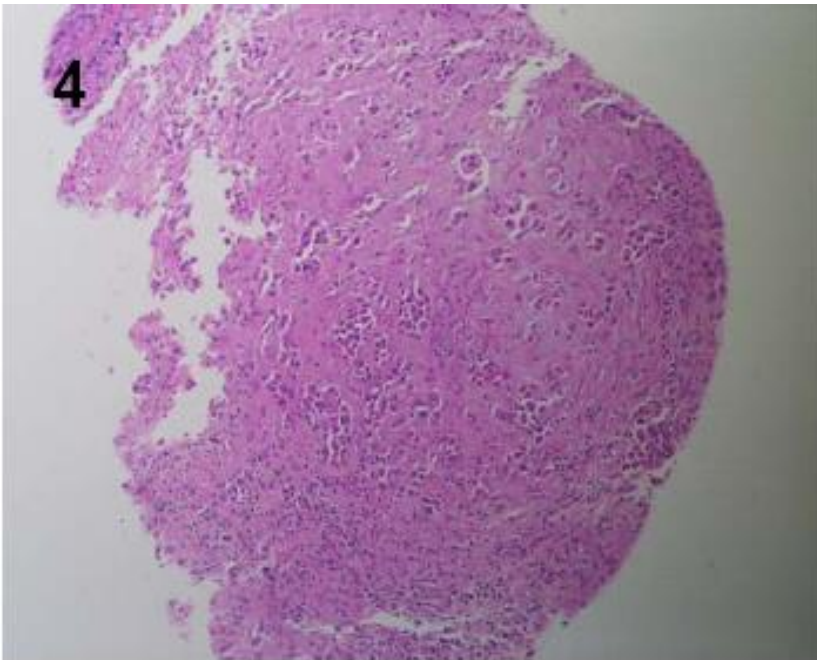
Case - 2



Finding: Multiple white confluent tumorous lesions, frequently seen especially in metastatic breast cancer.

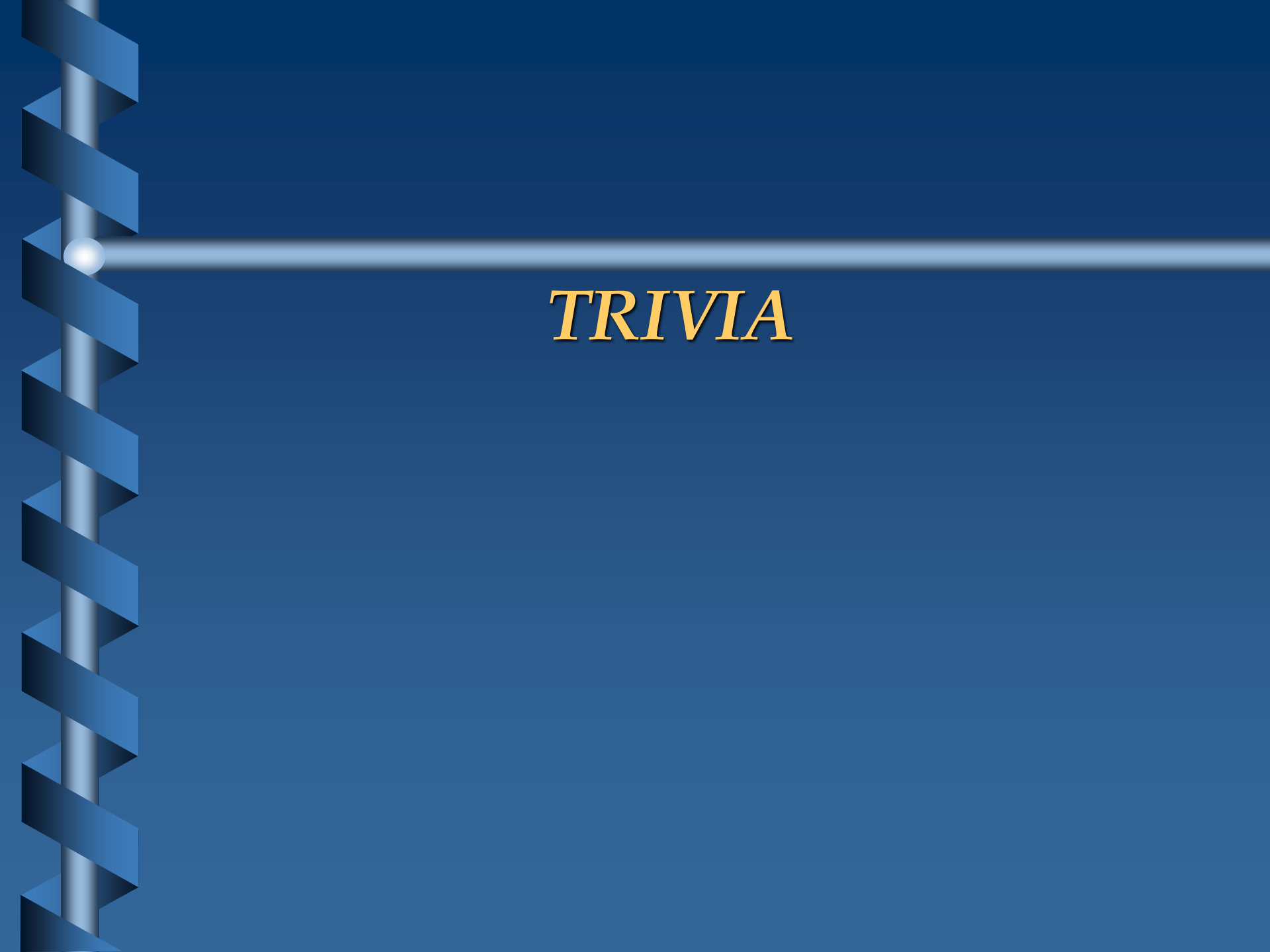
Location: Posterior chest wall

Case - 2



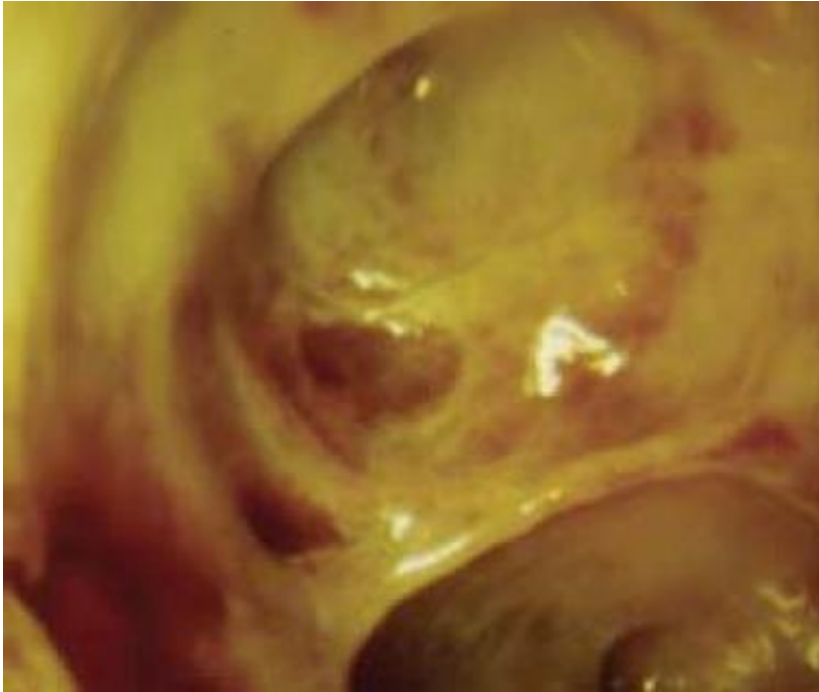
Histology (image 4) confirmed malignant involvement of the pleura. Immunohistochemistry revealed positivity for HER-2 (image 5).

Diagnosis: Malignant pleural involvement due to breast cancer

A decorative vertical bar on the left side of the slide, featuring a blue and white spiral pattern. A horizontal line with a glowing effect extends from the bar across the top of the slide.

TRIVIA

Case-1



Typical empyema
loculations

Case-2



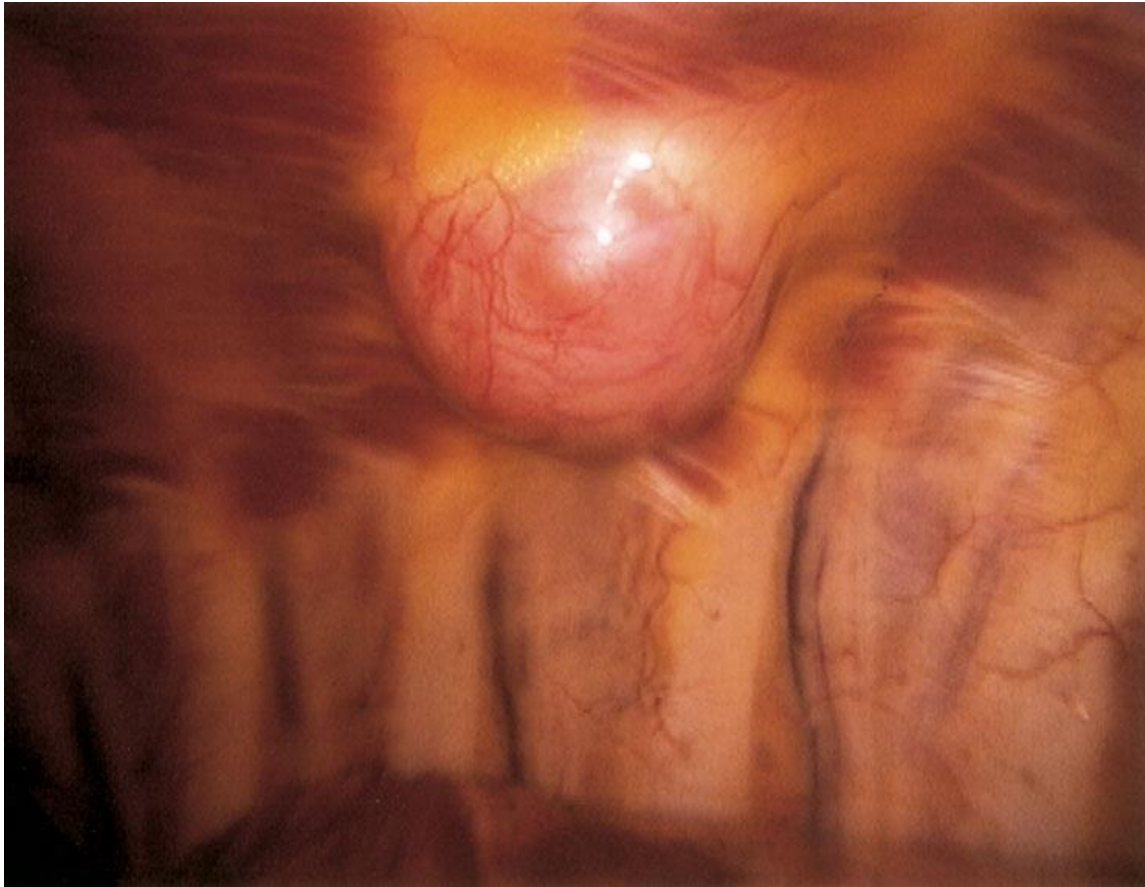
Thoracoscopic appearance of a typical apical bleb responsible for a spontaneous pneumothorax, usually in a young person.

Case-3



A giant bulla occurring as an isolated finding, resulting in compression of adjacent lung parenchyma. Excision usually offers significant relief of symptoms.

Case-4



A benign schwannoma arising from the parietal pleural surface—a lesion that is easily amenable to thoracoscopic excision.

References

- ❑ Mason: Murray & Nadel's Textbook of Respiratory Medicine, 5th ed.
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- ❑ Advanced techniques in medical thoracoscopy: *G.F. Tassi, R.J.O. Davies and M. Noppen*(*Eur Respir J* 2006; 28: 1051–1059).
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Thank you

m s thakkar

