

Diagnosis and Management of Pleural Disease

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What Is Pleural Disease?

How does it differ
from lung disease?



Lung Parenchyma vs Pleura

Pleural disease affects the pleural membranes and the pleural space.

Feature	Pulmonary parenchymal disease	Pleural disease
Primary Site	Alveoli and interstitium	Pleural membranes and space
Main Impact	Impaired gas exchange	Altered lung expansion and respiratory mechanics
Diagnostic Focus	Assess parenchymal changes and their cause	Evaluate pleural fluid, air and pleural tissue
Treatment Focus	Treat the underlying disease	Treat the cause and manage the pleural space when indicated

Pulmonary and pleural disease may coexist. Heart failure can also cause pleural effusion.

A simplified comparison. Both can cause dyspnea and hypoxemia.

The Spectrum of Pleural Disease

Pneumothorax

- Spontaneous
Primary / secondary
- Traumatic / iatrogenic
- Catamenial

Infection-related disease

- Parapneumonic effusion
Uncomplicated / complicated
- Empyema
- Pleuritis (Tuberculous)

Systemic & inflammatory effusions

- Heart failure / cirrhosis
- Malignant pleural effusion
- Other pleuritis

Pleural tumors

- Metastatic pleural disease
- Mesothelioma
- Solitary fibrous tumor

Special pleural collections

- Hemothorax
- Chylothorax
- Pseudochylothorax

Fibrosing pleural disorders

- Pleural plaques / diffuse thickening
- Fibrothorax / trapped lung



Pleural Anatomy

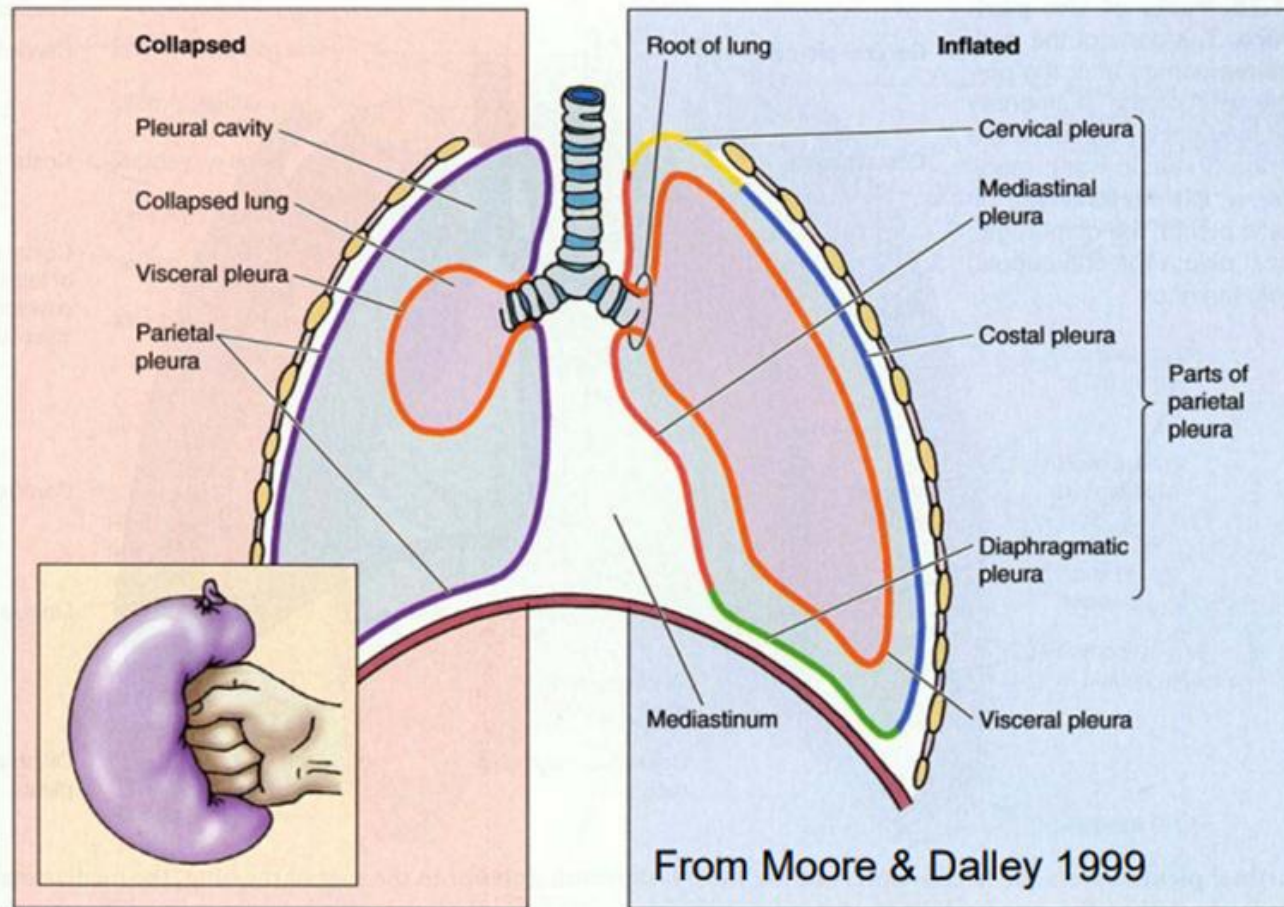
Structure and Clinical Relevance



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Pleura and Pleural Cavity

A mesothelial membrane surrounding each lung



Visceral pleura

Covers the lung surface and interlobar fissures

Parietal pleura

Lines the thoracic cavity

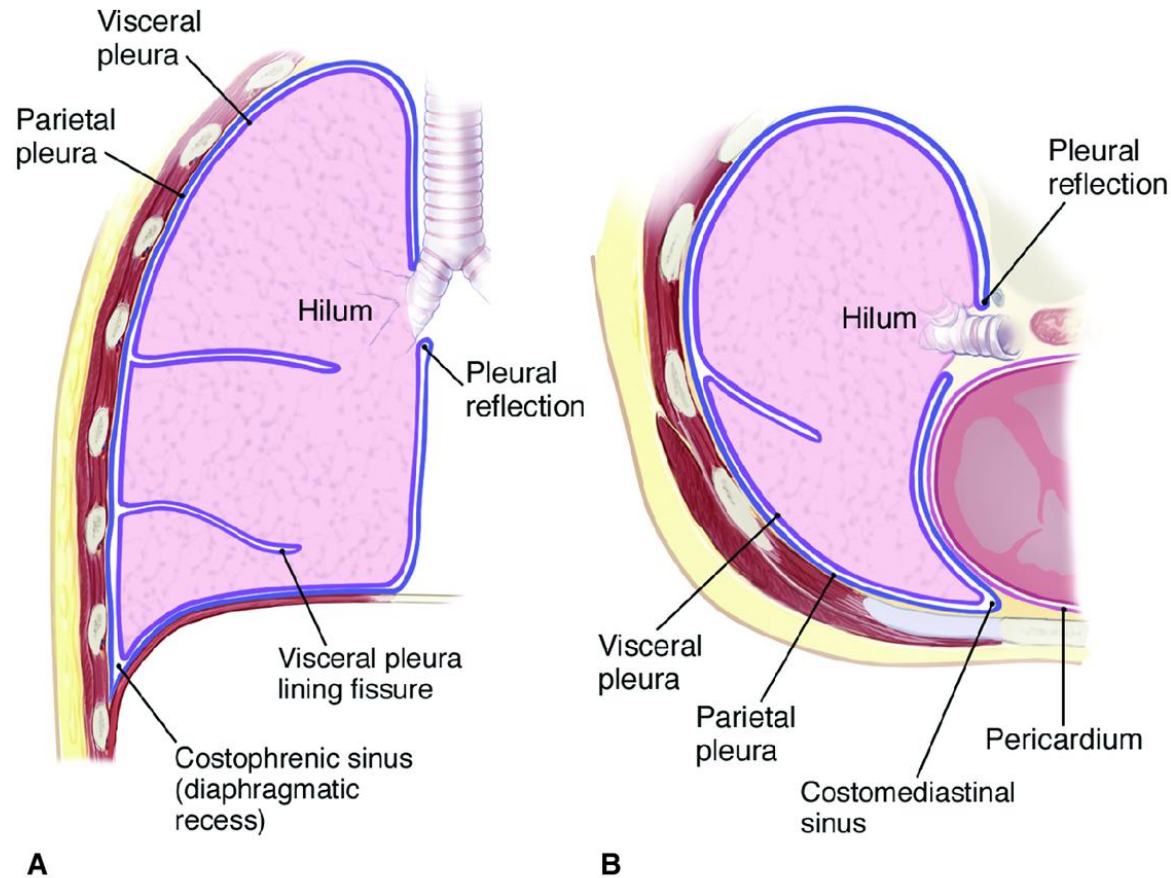
Costal, diaphragmatic, mediastinal and cervical

Pleural cavity

Potential space between visceral and parietal pleura

A thin fluid film reduces friction and helps couple the lung to the chest wall.

Visceral Pleura



Continuity at the hilum

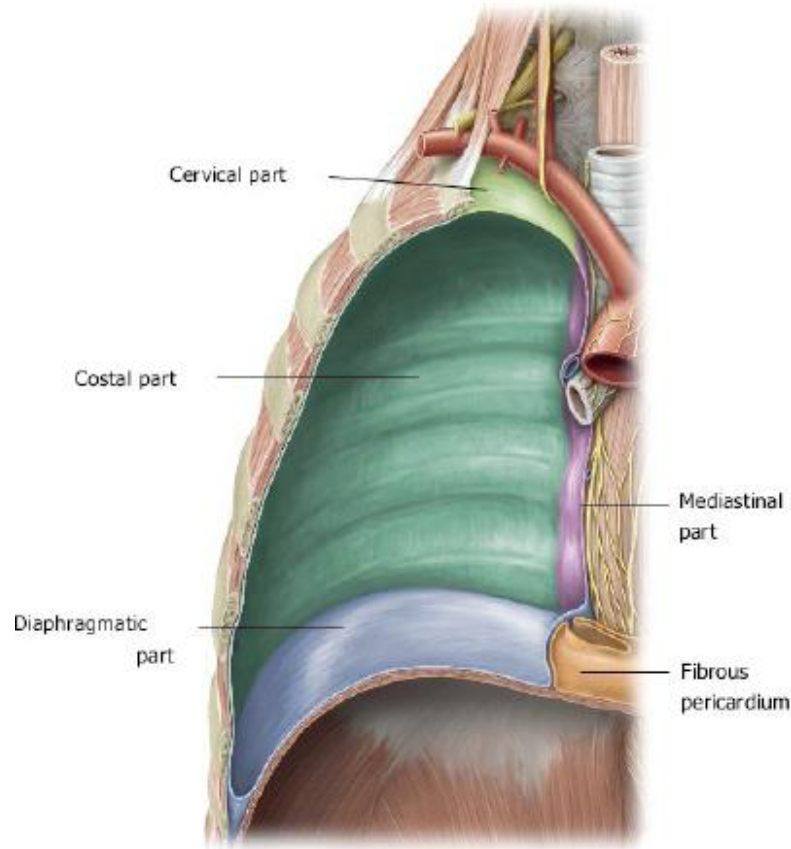
Reflects into parietal pleura around the lung root

Firm attachment

Mesothelium faces the cavity
Fibroelastic tissue anchors the pleura to the lung

Disruption of the lung surface can allow air to enter the pleural space.

Parietal Pleura



Cervical

Extends above the first rib

Costal

Lines the inner chest wall

Mediastinal

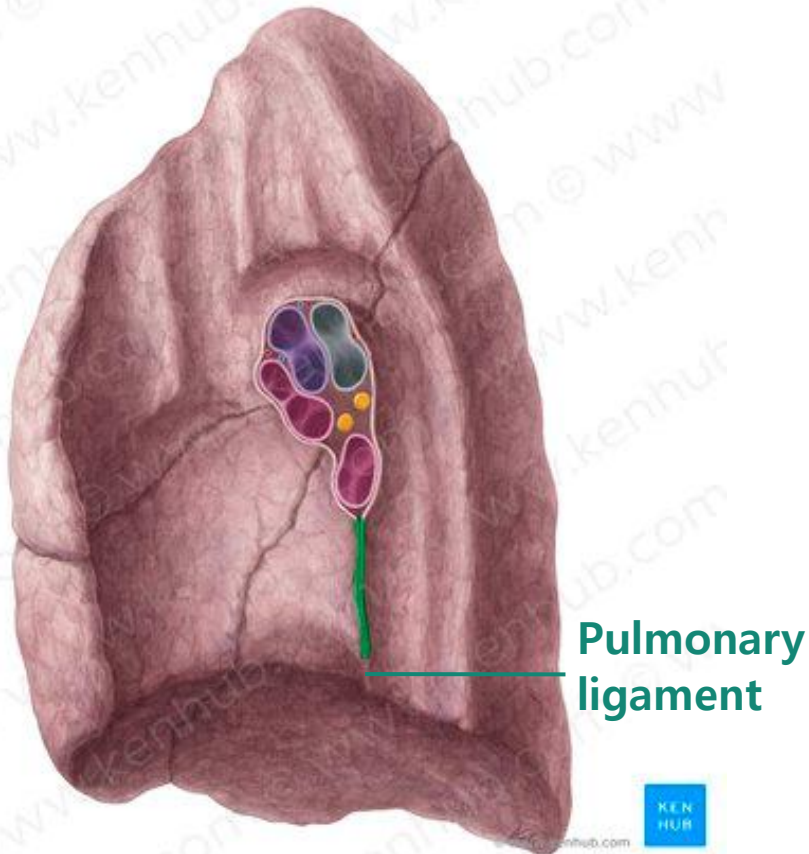
Faces the mediastinum

Diaphragmatic

Covers the superior diaphragm

Parietal pleura is a major source of pleuritic pain and a target for pleural biopsy.

Pleural Reflections



Around the lung root

Visceral and mediastinal parietal pleura become continuous

Visceral pleura



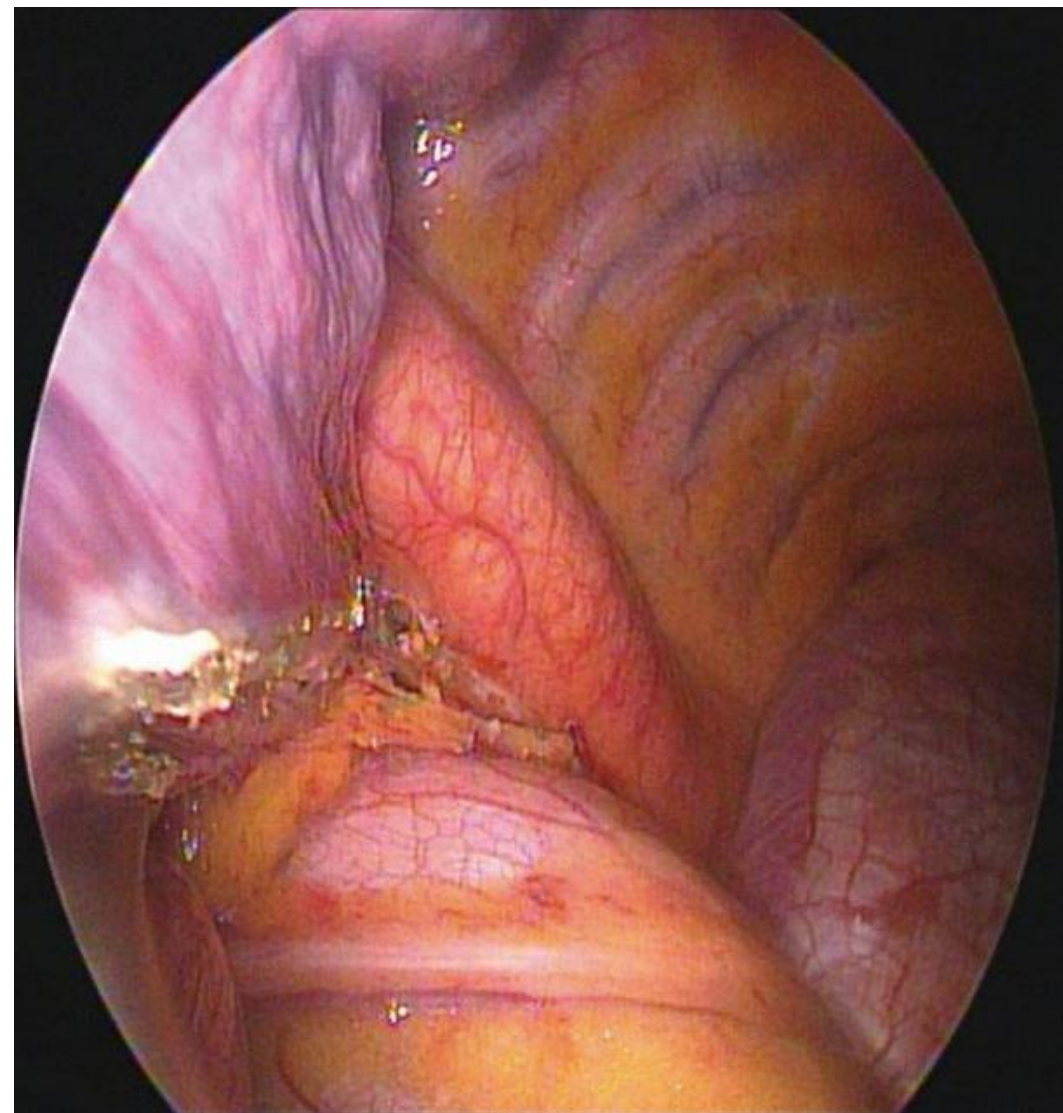
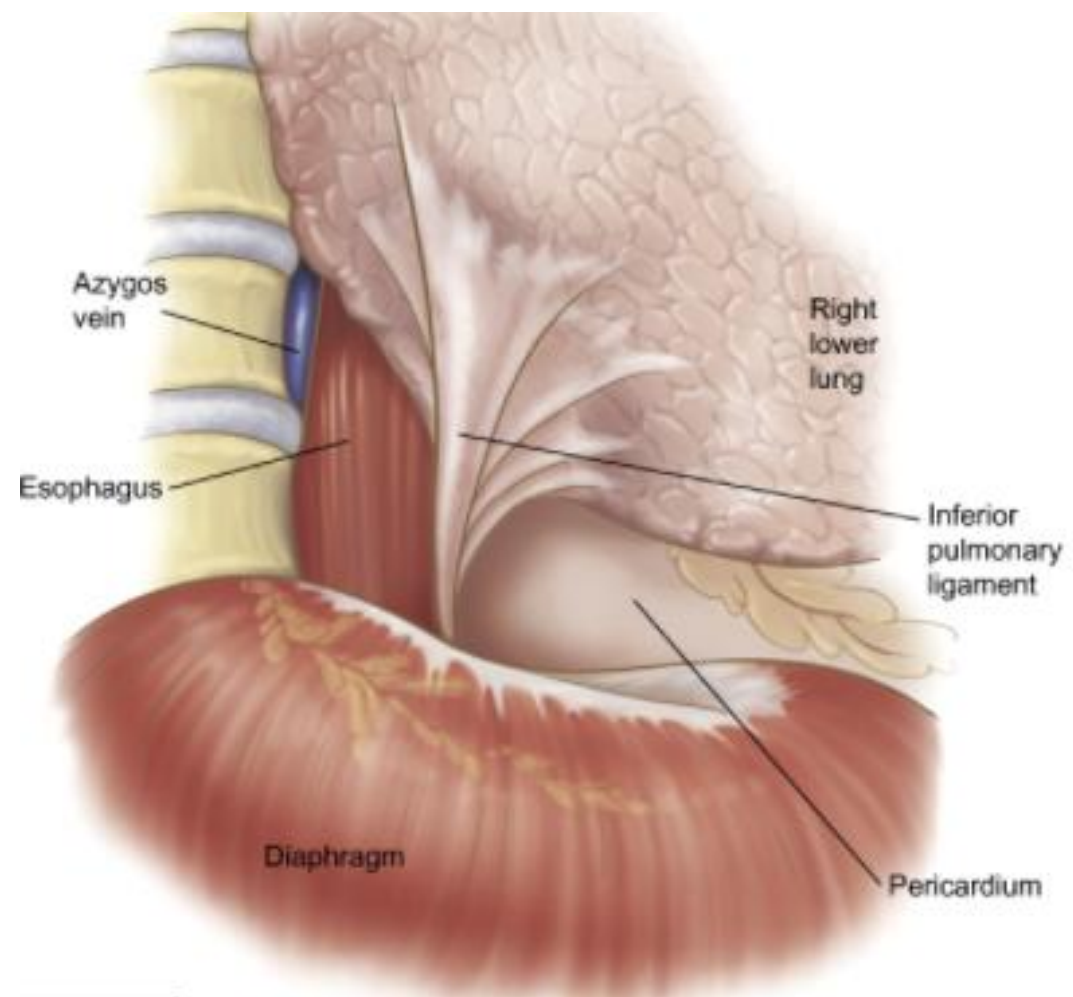
Parietal pleura

Hilar reflection

Pulmonary ligament

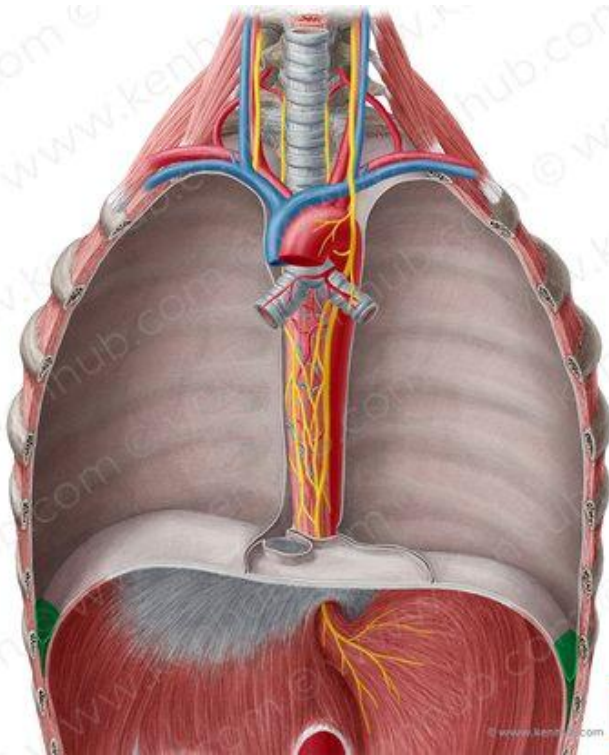
A double pleural fold extending inferiorly from the lung root

The pulmonary ligament provides an anatomic landmark during lower-lobe mobilization.



Pleural Recesses

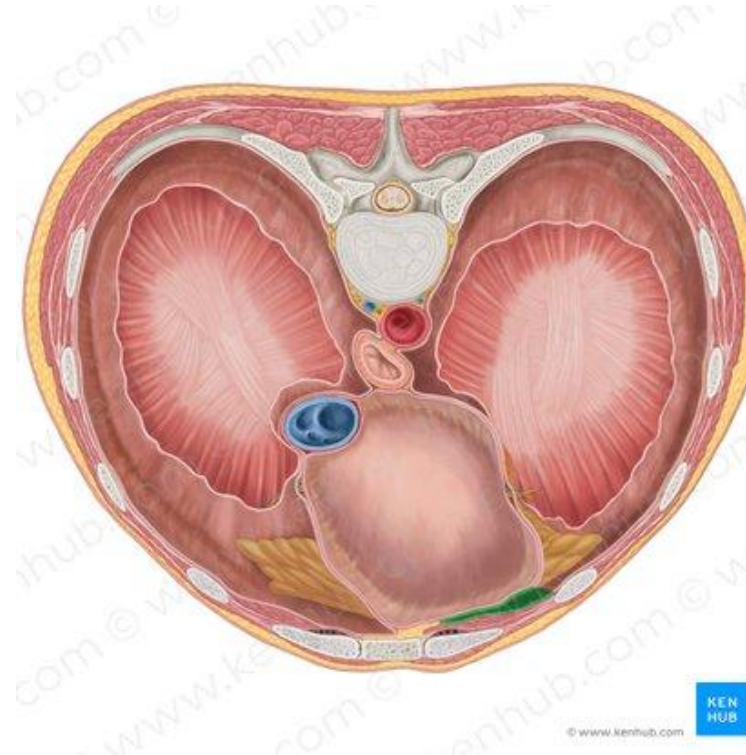
Costodiaphragmatic recess



Frontal view

Costal pleura
meets
diaphragmatic
pleura

Costomediastinal recess



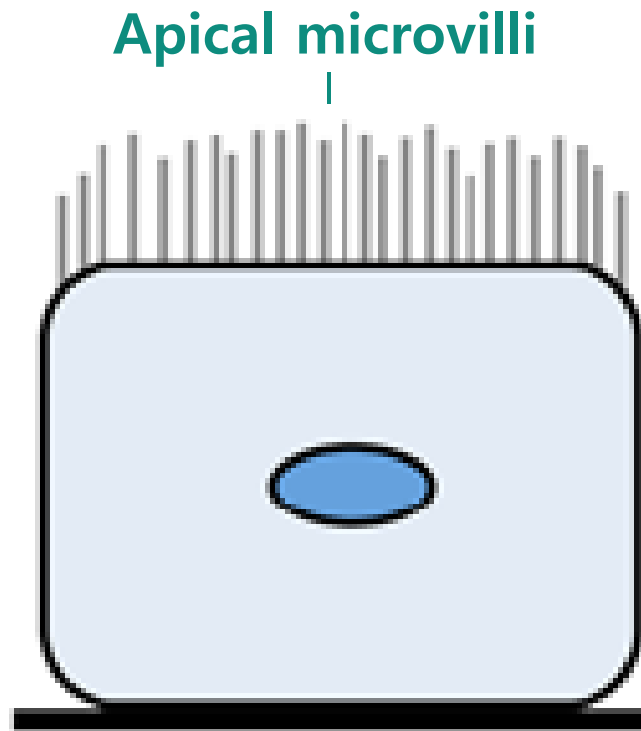
Axial view

Anterior
space beside
the heart

Dependent fluid collects in recesses. Ultrasound confirms the fluid pocket and diaphragm.

Mesothelial Cells

Cuboidal form and microvilli



Cuboidal morphology during activation or repair

Cell shape

Flattened to cuboidal cells
forming a single mesothelial layer

Apical microvilli

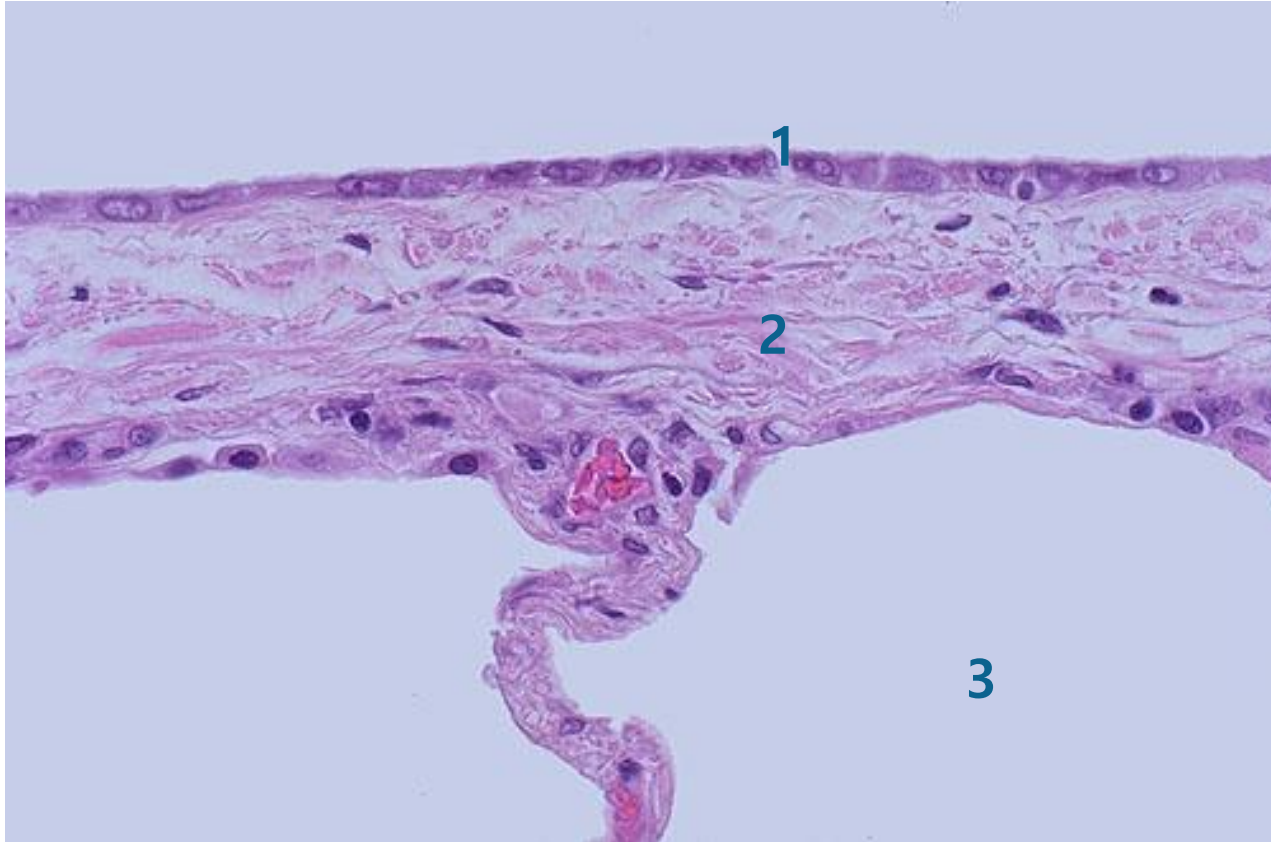
Project into the pleural cavity
Surface coat supports lubrication

Cell junctions

Maintain continuity of the lining
and contribute to barrier function

Other pleural cells Fibroblasts, macrophages, lymphatic endothelial cells

Pleural Microstructure



1 Mesothelium

A single surface layer of flattened or low cuboidal cells

2 Fibroelastic tissue

Collagen, elastin and stromal cells with blood and lymphatic vessels

3 Lung parenchyma

Alveoli beneath the visceral pleural connective tissue

The surface barrier and underlying stroma both contribute to pleural repair and fibrosis.

Pleural Blood Supply

Parietal pleura

Costal pleura
Intercostal arteries

Mediastinal pleura
Pericardiacophrenic artery

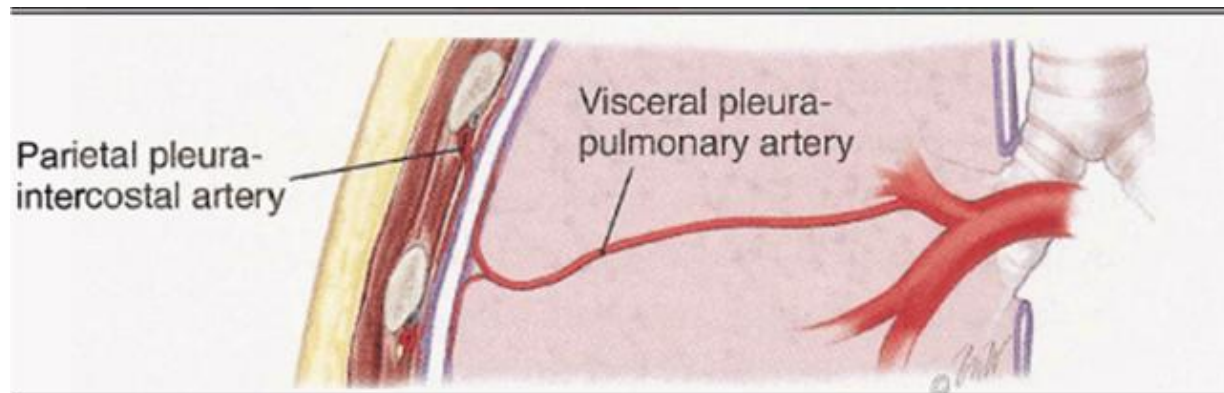
Diaphragmatic pleura
Superior phrenic + musculophrenic arteries

Visceral pleura

Bronchial arteries

Mediastinal and interlobar surfaces
Part of the diaphragmatic surface

Pulmonary arteries
Contribution to other pleural regions*

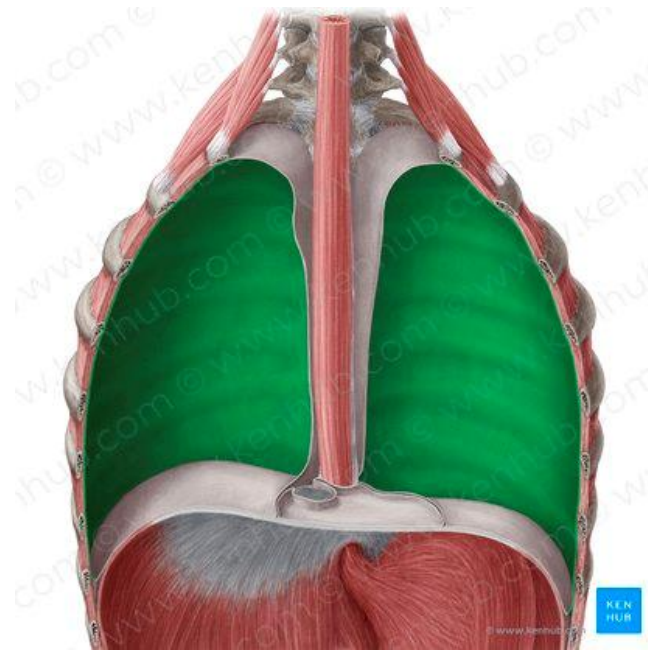


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*The regional extent of pulmonary arterial supply is less certain.

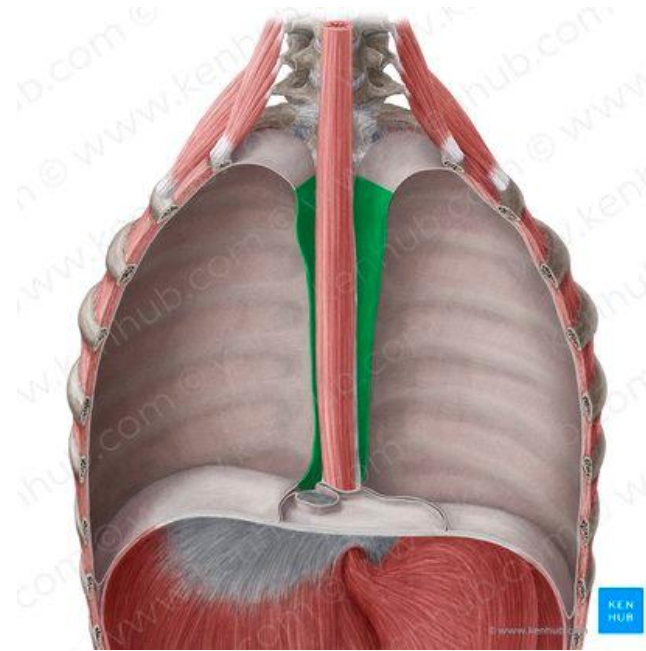
Pleural Innervation

Intercostal nerves



Costal + peripheral diaphragm
Chest / upper abdominal pain

Phrenic nerve (C3–C5)



Mediastinal + central diaphragm
Referred shoulder-tip pain

Visceral pleura

Pulmonary plexus

Autonomic fibers and
visceral afferents

Relatively insensitive
to ordinary somatic
pain stimuli

Pleuritic pain mainly reflects parietal irritation. Central diaphragmatic pain may refer to the shoulder.

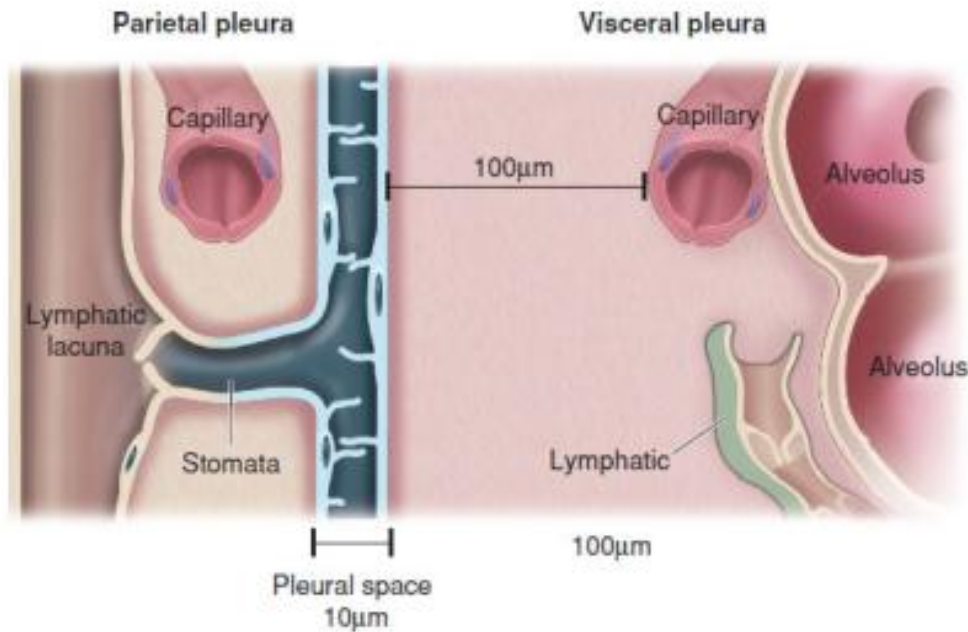
Pleural Physiology

Mechanics and Pleural Dynamics



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The Pleural Fluid Compartment



Schematic dimensions from the textbook

Small resting volume

A thin layer of low-protein fluid

Continuous turnover

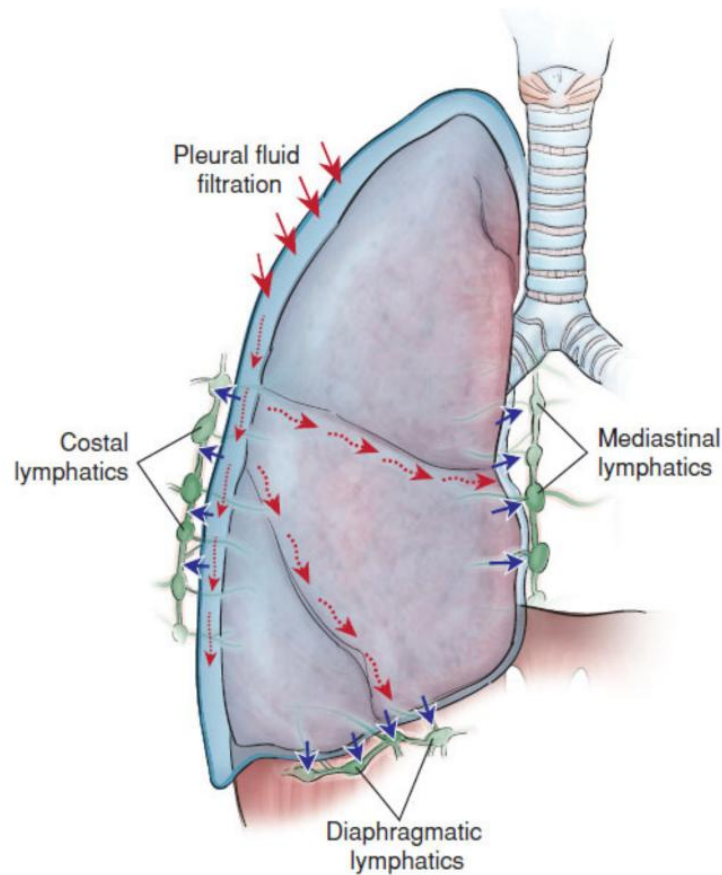
Fluid enters and leaves while volume remains small.

An active mesothelial layer

Barrier function and transport contribute to fluid regulation.

Small volume and continuous turnover coexist in the normal pleural space.

Pleural Fluid Formation and Clearance



Formation

Mainly from parietal microvessels
in less dependent regions

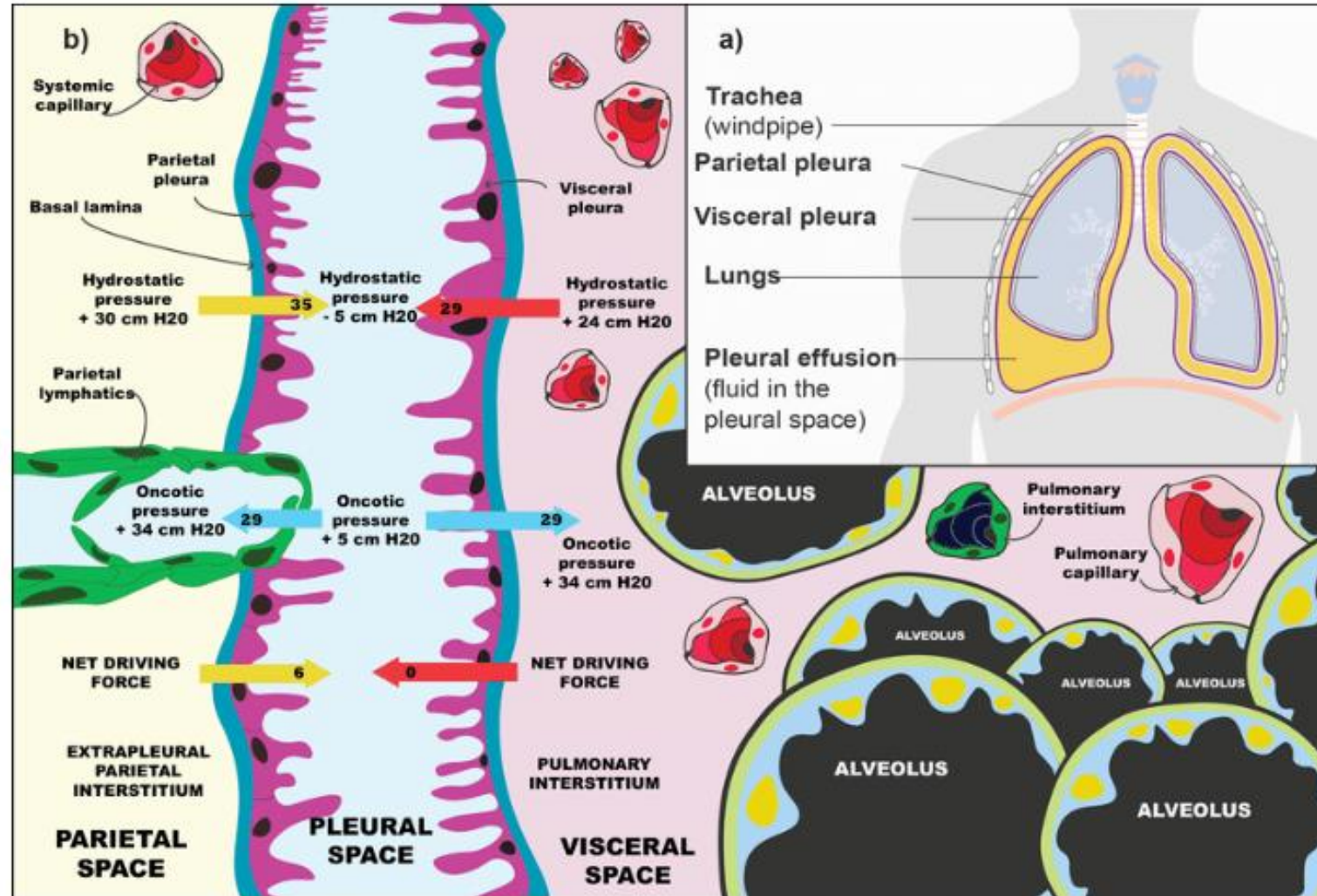
Clearance

Parietal lymphatic stomata
Diaphragmatic, costal and
mediastinal drainage pathways

Visceral lymphatics

Drain the pulmonary interstitium

Normal pleural fluid turnover primarily uses parietal entry and lymphatic exit.



Mechanisms of Pleural Effusion

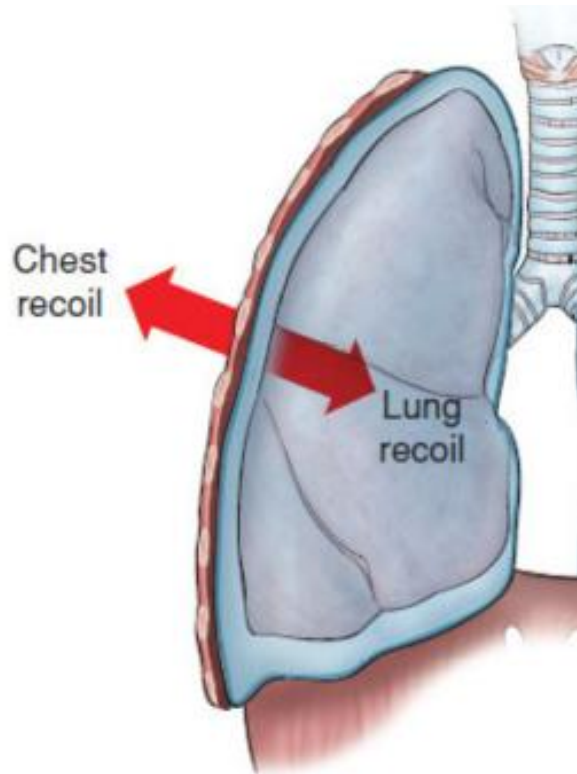
Net accumulation = fluid entry – fluid removal

Mechanism	Functional change	Typical setting
Greater hydrostatic drive	Increased filtration	Heart failure
Increased permeability	More fluid and protein entry	Inflammation or malignancy
Impaired lymphatic outflow	Reduced clearance capacity	Lymphatic obstruction
Additional fluid sources	Entry through another route	Ascites, chyle or blood

Resolution requires fluid removal to exceed ongoing entry.

Pleural effusion reflects a sustained mismatch between entry and removal.

Mechanical Coupling of Lung and Chest Wall



Opposing elastic recoil

The lung recoils inward.
The chest wall tends outward
at resting end-expiration.

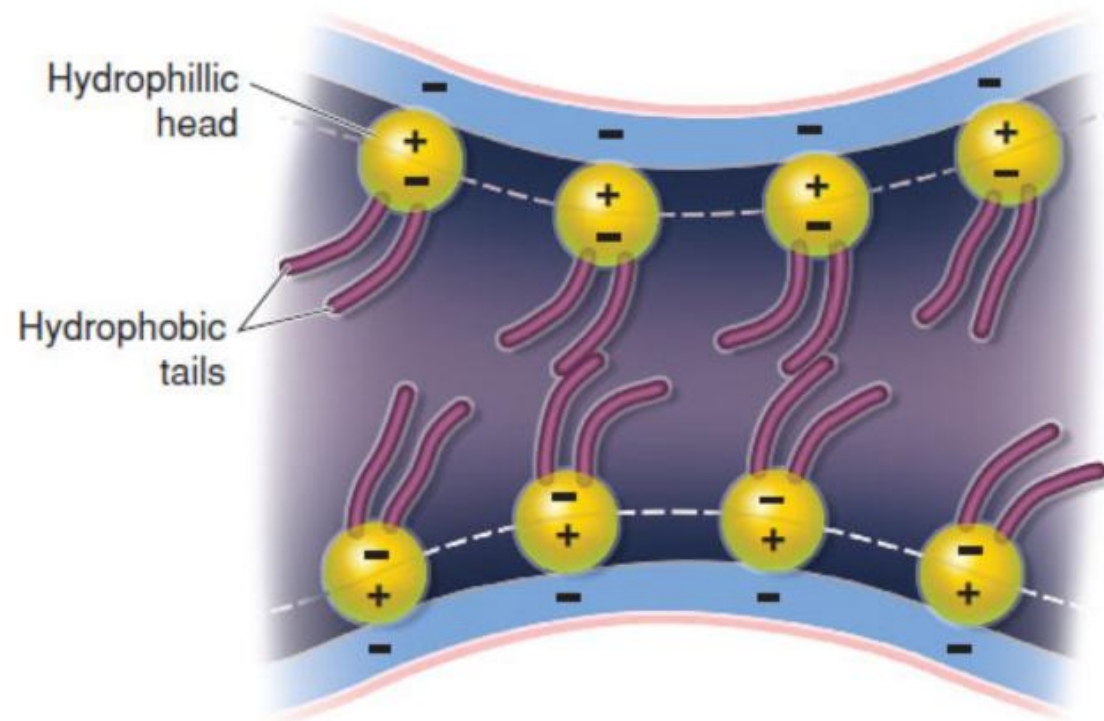
Transmission of movement

The pleural interface transmits
chest-wall motion to the lung.

Apposition supports coordinated motion.

The pleural interface couples lung expansion to chest-wall movement.

Pleural Lubrication and Sliding



Surface phospholipid model

A thin liquid film

Supports sliding during breathing

Surface macromolecules

Glycocalyx, hyaluronan and glycoproteins contribute to boundary lubrication.

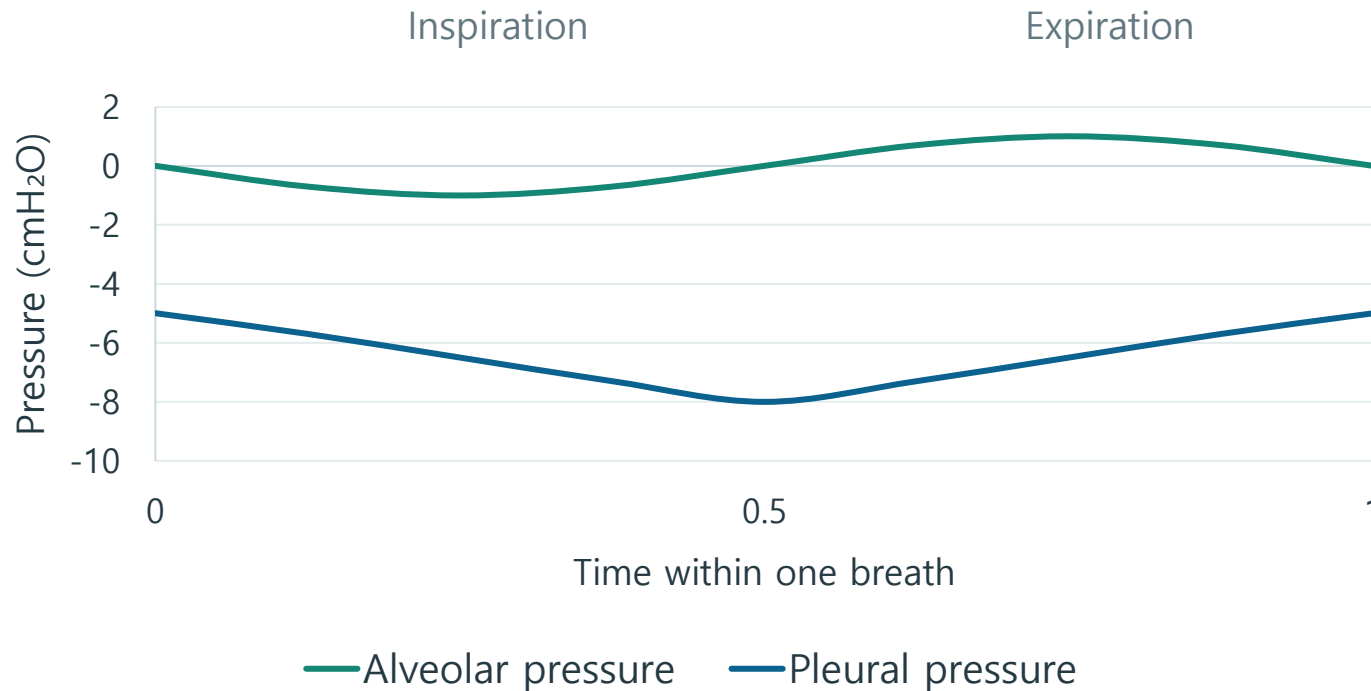
Surface phospholipids

A proposed contributing mechanism

Pleural surfaces remain closely apposed while sliding with little friction.

Pleural Pressure and Lung Expansion

Quiet spontaneous breathing



Illustrative values relative to atmospheric pressure

Transpulmonary pressure

$$P_l = P_{alv} - P_{pl}$$

At resting end-expiration

$$P_{alv} \approx 0, P_{pl} \approx -5$$

$$P_l \approx +5 \text{ cmH}_2\text{O}$$

Inspiration makes pleural pressure more negative and increases lung distension.

Lung expansion depends on the pressure difference across the lung.

Pneumothorax

Diagnosis and Management



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Types of Pneumothorax

Air in the pleural space: classification by clinical context

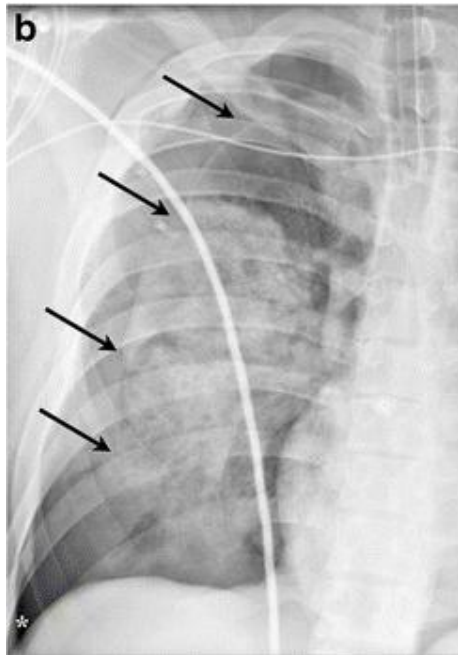
Type	Typical context
Primary spontaneous (PSP)	No clinically apparent underlying lung disease
Secondary spontaneous (SSP)	Established underlying lung disease
Iatrogenic	A medical procedure or mechanical ventilation
Traumatic	Blunt or penetrating chest injury
Catamenial (spontaneous)	Recurrent episodes around menstruation

Tension pneumothorax

A life-threatening state that can complicate any type of pneumothorax

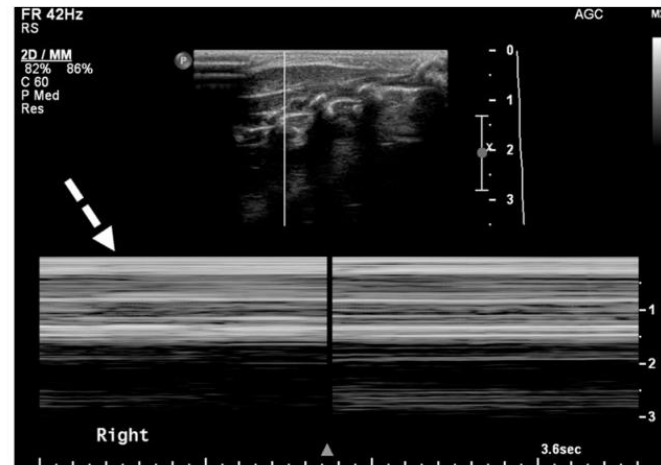
Imaging Diagnosis

Chest radiograph



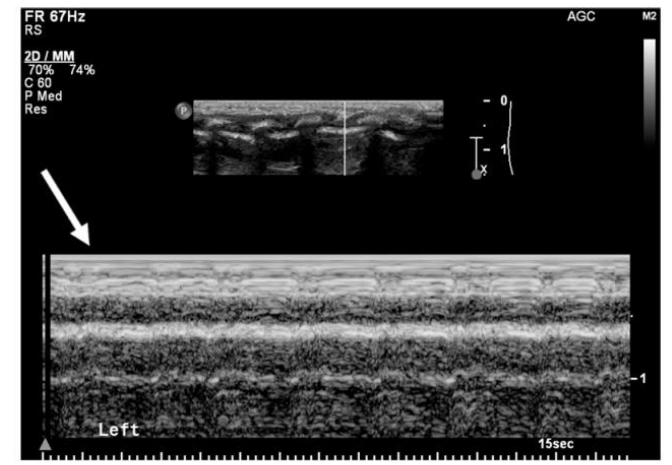
Visceral pleural line
Absent peripheral markings

Ultrasound



Barcode pattern

Absent sliding alone
is nonspecific



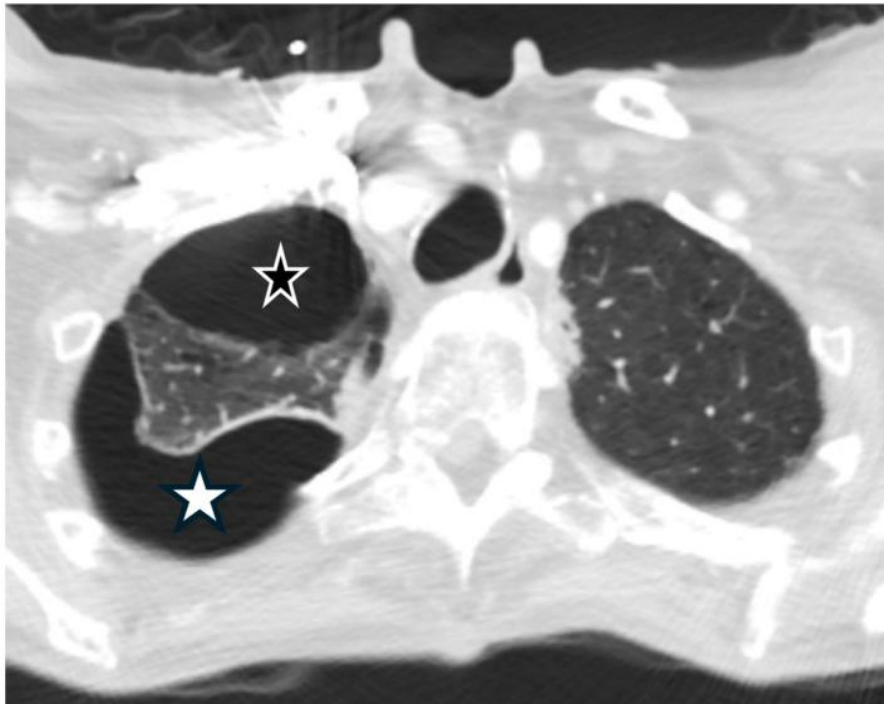
Seashore pattern

Normal motion at
the examined pleural site

CXR remains central in stable spontaneous pneumothorax. Ultrasound adds bedside information.

CT and Underlying Lung Disease

Bulla and pleural air can coexist



Anterior: bulla Posterior: loculated pneumothorax

Resolve uncertainty

Pleural air versus bullae
Loculated or persistent pneumothorax

Identify the substrate

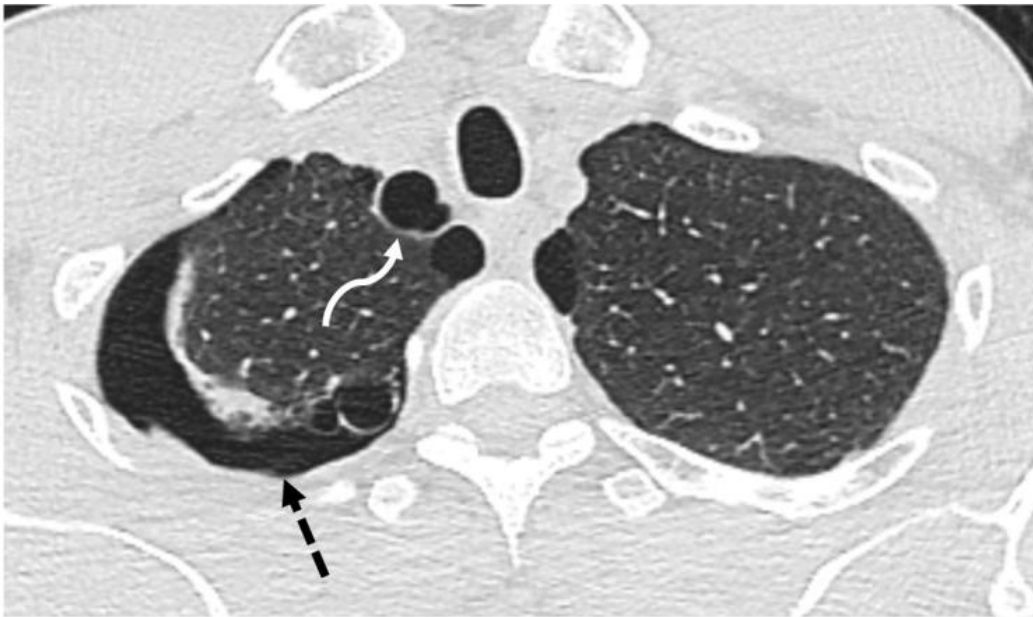
Emphysema, fibrosis or diffuse cysts

Investigate atypical cases

Recurrent / bilateral disease
Family history or menstrual association

CT clarifies anatomy and cause when clinical assessment and CXR are insufficient.

PSP: Pathogenesis and Clinical Features



(a)

Apical blebs with adjacent pleural air

Typical clinical profile

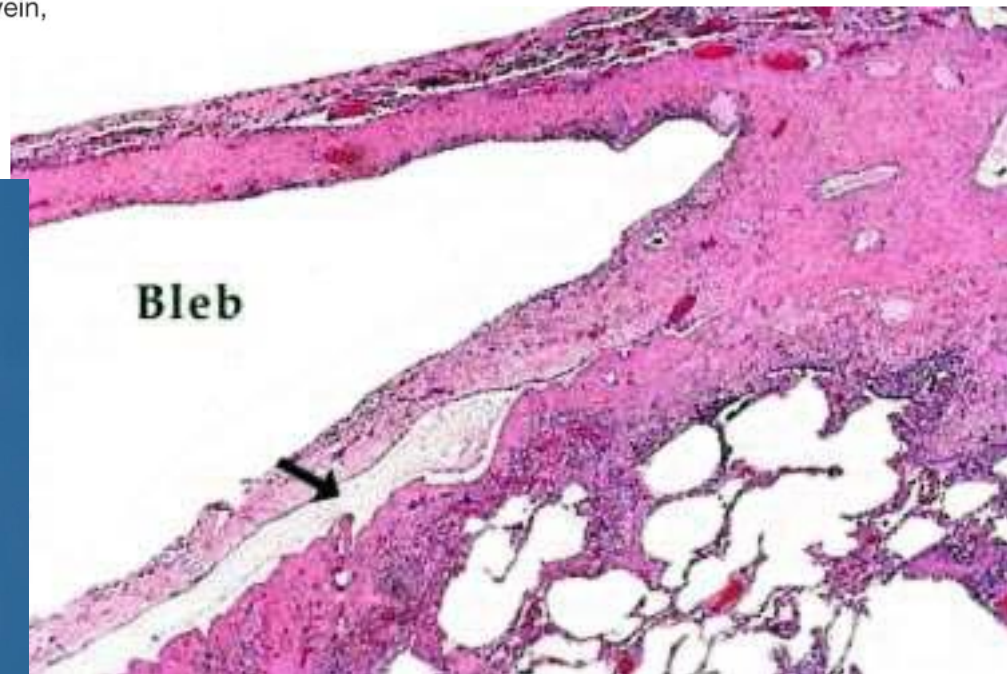
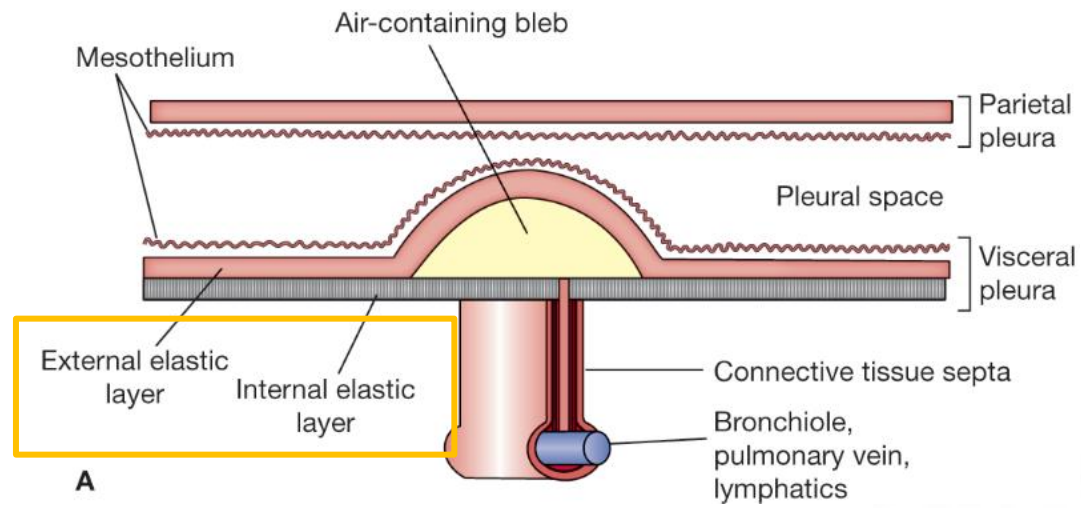
Often young adults
Smoking and family history
Tall, slender body habitus

Potential leak mechanisms

Subpleural blebs or bullae
Distal airway and pleural abnormalities

**Atypical cysts or family history
may indicate a specific disorder.**

PSP means no clinically apparent underlying lung disease. Blebs may still be present.



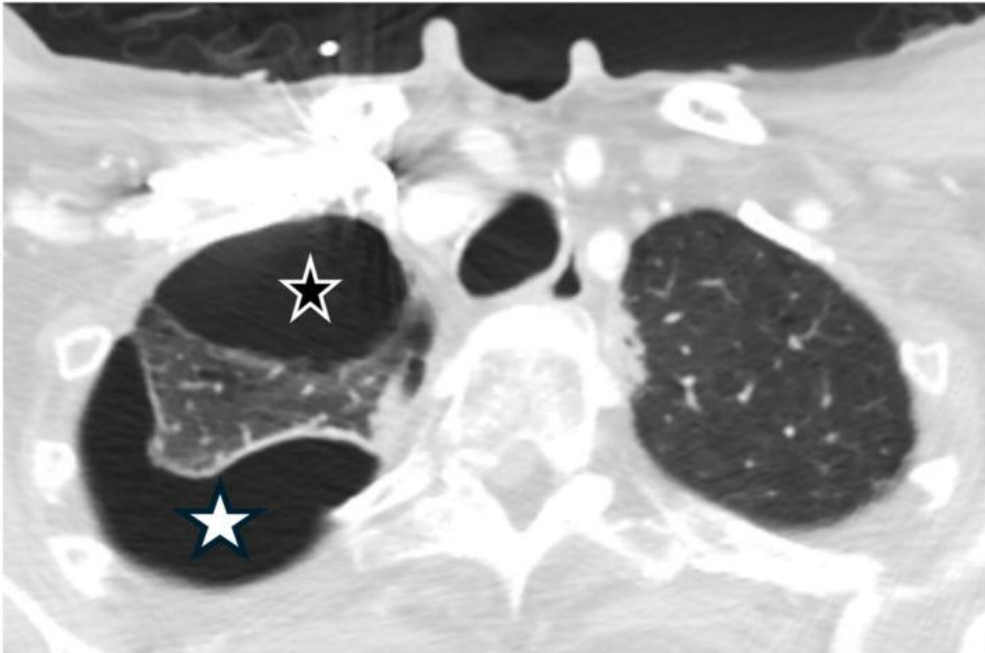
PSP: Initial Management

Symptoms, stability and follow-up access

Option	Clinical setting
Conservative care	Minimal symptoms, clinical stability Reliable follow-up and return access
Needle aspiration	Intervention is needed in a stable patient ERS 2024 favors aspiration over an initial chest tube
Ambulatory drainage	Selected patients with an established ambulatory service and close review
Chest tube drainage	Failed aspiration, ongoing leak or a need for continued pleural drainage

Selected stable PSP can be observed even when the pneumothorax is large.

SSP: Underlying Disease and Clinical Impact



Bullous emphysema with pleural air

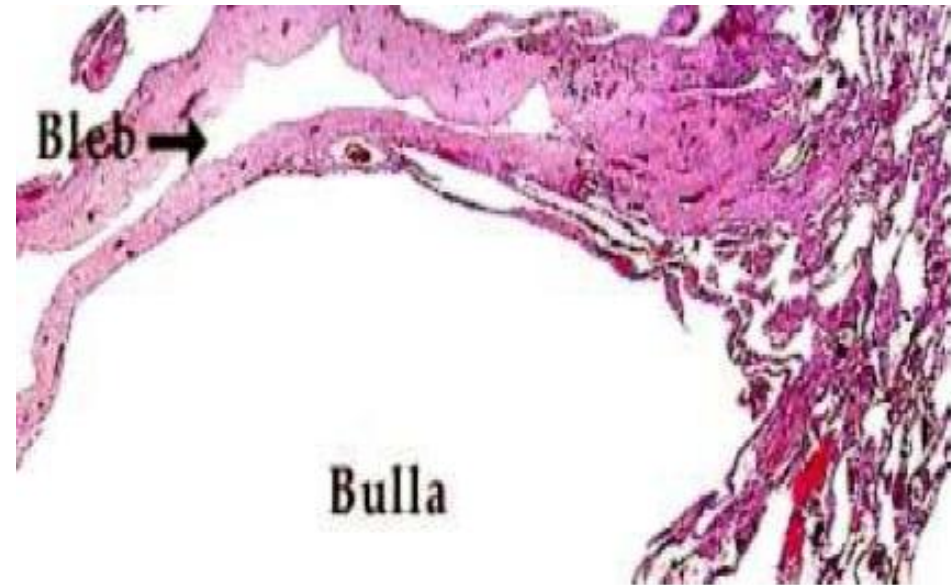
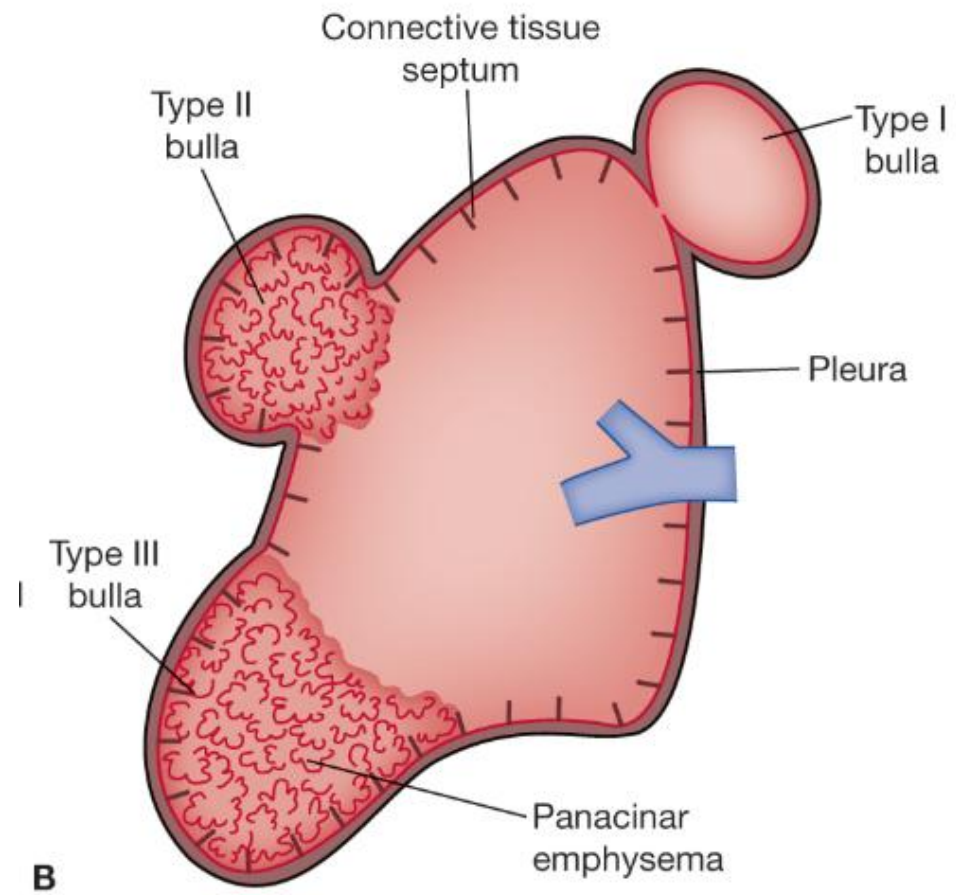
Underlying disease

COPD / emphysema
Interstitial lung disease
Infection and post-tuberculosis change
Cystic lung disease, including LAM

Greater clinical impact

Reduced respiratory reserve
More hypoxemia and persistent air leak
Higher treatment risk

The underlying lung determines how much physiological reserve remains.



SSP: How Management Differs

Decision	PSP	SSP
Conservative care	An option in selected stable, minimally symptomatic patients	Evidence is limited Do not simply transfer PSP criteria
Initial setting	Outpatient pathways may be appropriate	Usually inpatient assessment Lower threshold for drainage
Recurrence prevention	Recurrence, leak persistence and patient priorities	Also consider the harm of another episode

Persistent air leak Early surgical assessment. If surgery is unsuitable, consider an autologous blood patch in selected patients.

In SSP, balance the need for reliable drainage against the risks of intervention.

Surgery and Recurrence Prevention

When to discuss surgery

- Ipsilateral recurrence
- First contralateral pneumothorax
- Persistent leak or failed re-expansion
- Bilateral pneumothoraces
- High-risk occupations

What surgery aims to achieve

Air leak control

VATS bleb / bulla resection

Recurrence prevention

Pleurodesis and/or selected staple-line reinforcement

Selected first episodes: discuss early surgery when recurrence prevention is a priority.

The surgical strategy should reflect recurrence risk, operative burden and patient preference.

Iatrogenic Pneumothorax

A complication of a medical procedure or mechanical ventilation

Common settings

Lung biopsy

Thoracentesis or pleural procedures

Central venous catheter placement

Positive-pressure ventilation

Key features

Symptoms may occur during a procedure or develop later.

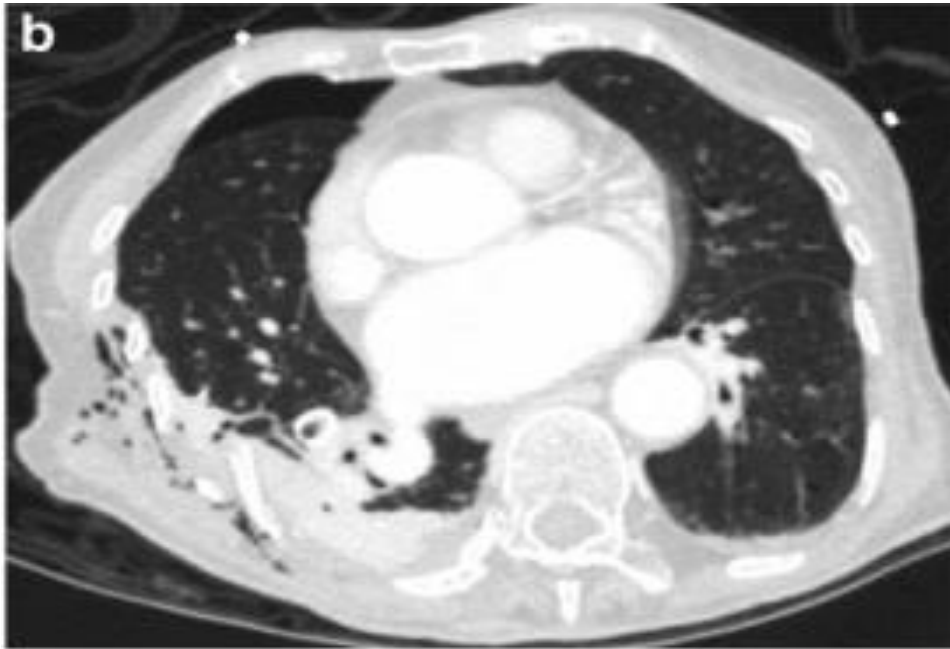
Some patients initially have few symptoms.

Clinical significance

Treatment depends on clinical stability and whether the pneumothorax progresses. Prompt reassessment is essential.

New breathlessness or falling SpO₂ after a procedure needs prompt assessment.

Traumatic Pneumothorax



Rib fracture, lung injury and pleural air

Diagnosis

Blunt or penetrating chest injury
eFAST / CXR, with CT in stable patients
Look for hemothorax and associated injury.

Treatment

Small and stable: monitored observation
Compromise or progression: chest drainage
Positive-pressure ventilation favors drainage.

**Open injury: wound seal, pleural drainage
and definitive chest-wall repair**

Treat the patient and associated injuries as well as the pleural air.

Catamenial Pneumothorax



Diaphragmatic fenestrations

Recognition

Pneumothorax around menstruation
Often right-sided and recurrent
Assess for thoracic endometriosis.

Treatment and prevention

Treat the acute pneumothorax.
Inspect and treat diaphragmatic lesions.
Select pleurodesis and lesion resection.
Discuss hormonal suppression with gynecology.

Menstrual history and diaphragmatic assessment are central to diagnosis and recurrence prevention.

Approach to Pleural Effusion

Initial Assessment and Differential Diagnosis



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Initial Assessment and Clinical Clues

Respiratory or circulatory compromise requires urgent assessment and stabilization

Clinical clues

Orthopnea, edema, organ dysfunction

Fever, pleuritic pain, recent pneumonia

Weight loss, cancer history, recurrent fluid

Recent surgery, trauma or thrombotic risk

Working differential

Cardiac, hepatic or renal disease

Parapneumonic effusion / infection

Malignancy or tuberculosis

Postoperative fluid, blood, chyle or embolism

The clinical context establishes probability before pleural fluid results are available.

Imaging Evaluation

Chest radiograph



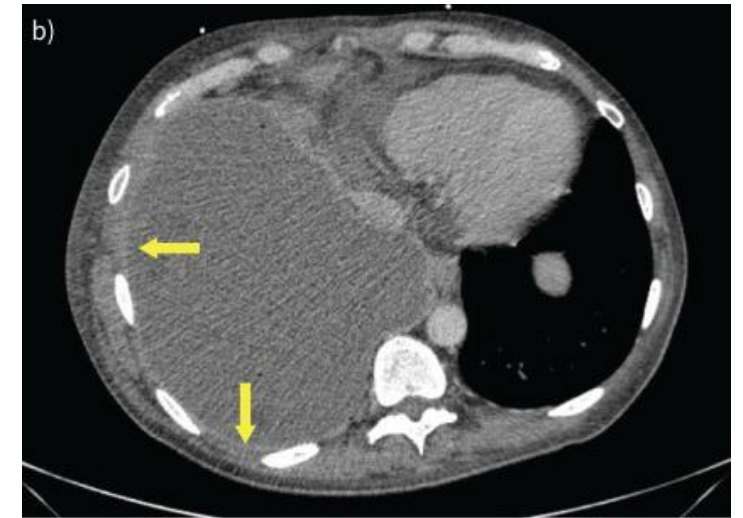
Distribution and size
Free-flowing effusion

Ultrasound



Septations and access
A safe procedural target

Contrast-enhanced CT



Pleura and underlying lung
Enhancement and nodularity

Ultrasound guides fluid procedures. Contrast CT helps investigate unexplained pleural disease.

Indications for Diagnostic Thoracentesis

After assessment of urgency and procedural safety

Diagnostic sampling

Unexplained or atypical effusion
Suspected infection or malignancy
Poor response to appropriate treatment



Ultrasound-guided thoracentesis
If a safe fluid pocket is accessible

Initial treatment and reassessment

Typical bilateral effusions
A convincing systemic cause
No clinical features suggesting another cause



Treat the underlying disorder
Sample if the course is atypical or unresponsive

Diagnostic thoracentesis and therapeutic drainage have different indications.

Pleural Fluid Analysis

Clinical question	Pleural fluid tests	Collection priorities
Transudate or exudate?	Protein and LDH	Paired serum protein and LDH
Inflammatory pattern?	Cell count / differential Glucose	Interpret with clinical context
Pleural infection?	pH, Gram stain and culture	Blood gas syringe for pH Plain + blood culture bottles
Suspected malignancy?	Cytology	Based on clinical and imaging findings

pH: prompt blood gas analysis, without air or local anesthetic contamination

Correct sampling and processing determine the value of the pleural fluid result.

Transudates and Exudates

Light's criteria

An exudate meets at least one criterion

Measurement	Threshold
Pleural / serum protein ratio	> 0.5
Pleural / serum LDH ratio	> 0.6
Pleural fluid LDH	> $\frac{2}{3}$ of serum LDH upper reference limit

Transudative causes

Heart failure
Hepatic hydrothorax
Renal / volume-related disorders

Exudative causes

Infection and tuberculosis
Malignancy
Inflammation or pulmonary embolism

Light's criteria classify the fluid and guide the differential diagnosis.

Cell Differential and Targeted Testing

Fluid pattern / clue	Diagnostic direction	Selected tests
Neutrophil predominance	Acute inflammation Often parapneumonic	pH, glucose and microbiology when infection is suspected
Lymphocyte predominance	TB, malignancy or other chronic processes	ADA and mycobacterial testing Further tests as indicated
Milky appearance / lymphatic risk	Chylothorax or pseudochylothorax	Triglycerides, cholesterol Chylomicrons when needed
Bloody fluid	Hemorrhagic effusion Possible hemothorax	Pleural and peripheral blood hematocrit

Cell predominance and appearance narrow the differential but are not diagnostic alone.

Target additional tests to a clinical hypothesis.

Pleural Biopsy

Tissue diagnosis when the cause of pleural disease remains unclear

When is it considered?

Unexplained exudative effusion
after fluid tests and imaging

Suspected pleural malignancy
or tuberculosis

Clinical significance

Negative fluid cytology does not exclude malignancy.

Before biopsy Confirm the anticoagulant plan and specimen containers.

How is tissue obtained?

Image-guided core biopsy

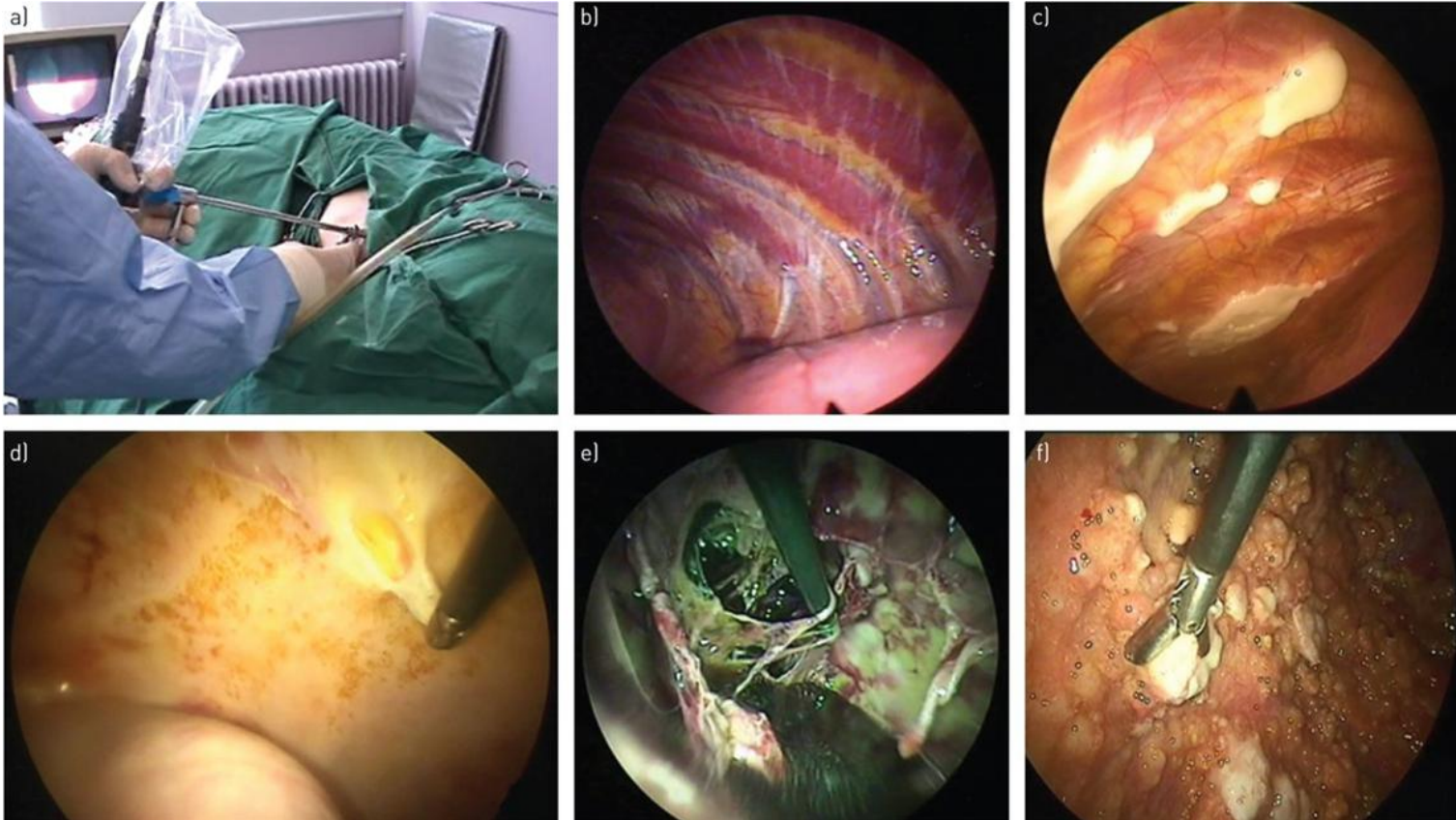
Ultrasound or CT guides the needle

Thoracoscopic biopsy

Direct inspection and targeted sampling

Thoracoscopic Pleural Biopsy

Direct pleural inspection and targeted tissue sampling



Procedure, pleural appearances and biopsy

After the procedure

Monitor breathing and SpO₂
Reassess pain and vital signs
Check the wound and drain

Prompt reassessment

New breathlessness
Falling SpO₂ or hypotension
Increasing bloody drainage

Malignant Pleural Effusion

Diagnosis and Individualized Management



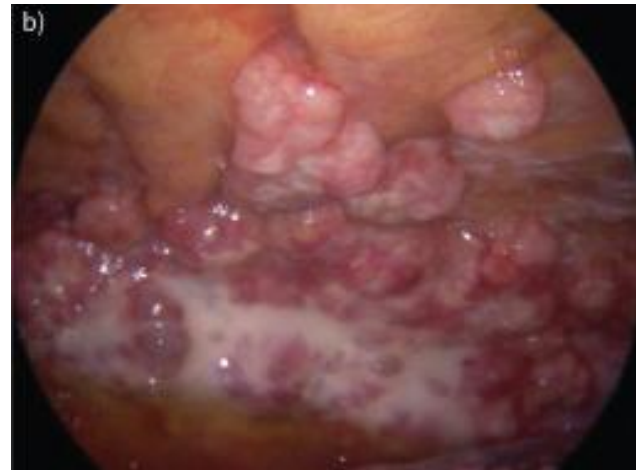
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Diagnosing Malignant Pleural Effusion

Pleural abnormalities



Pleural thickening on CT



Thoracoscopic nodularity

Diagnostic pathway

Cytology and cell block
25–50 mL when feasible

↓ If insufficient or suspicion persists

Image-guided biopsy
or thoracoscopy



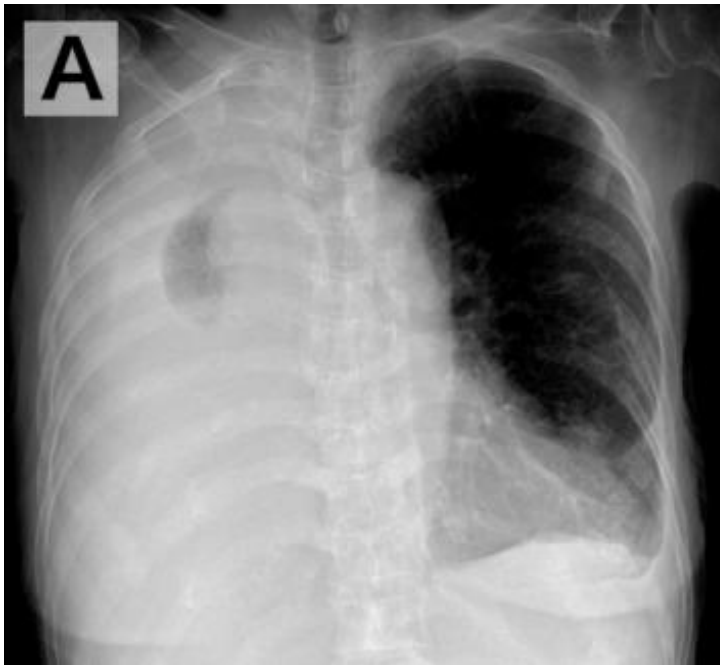
Histology, IHC and
needed molecular tests

A negative CT or cytology result does not exclude pleural malignancy.

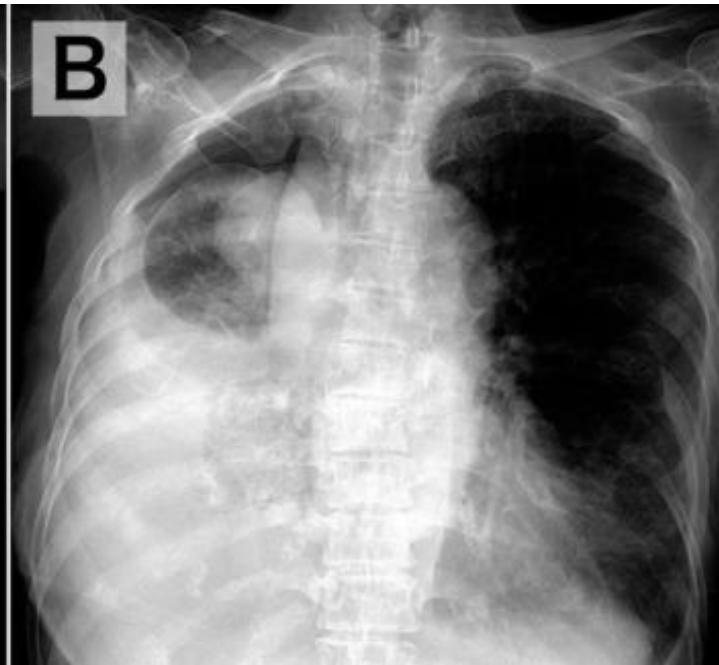
Plan sampling to obtain enough material for diagnosis and treatment selection.

Assessing Symptoms and Lung Expansion

A Before thoracentesis



B After thoracentesis



Malignant effusion with persistent non-expansion after drainage

Two assessments

- 1 Does breathlessness improve?
- 2 Does the lung re-expand?

Symptoms guide benefit

Pleural apposition guides
pleurodesis feasibility

Assess symptom response and lung expansion before choosing durable control.

IPC or Pleurodesis?

Decision factor	Indwelling pleural catheter (IPC)	Talc pleurodesis
Lung expansion	Suitable for expandable lung Significant NEL: often favored	Needs pleural apposition
Initial care	Usually ambulatory insertion	Usually a short inpatient pathway
Ongoing burden	Home drainage and support	Catheter-free if successful
Patient preference	Less initial hospital time Accepts an indwelling catheter	Prefers catheter-free control Accepts an initial admission
Failure / limitations	Blockage, loculation, infection May remain for months	Recurrence / pleurodesis failure Limited role in significant NEL

Expandable lung: offer either option through shared decision-making.

Both approaches can improve dyspnea. Match the care pathway to the patient.

Talc Pleurodesis

Fluid drainage and adequate lung expansion



Sufficient pleural apposition



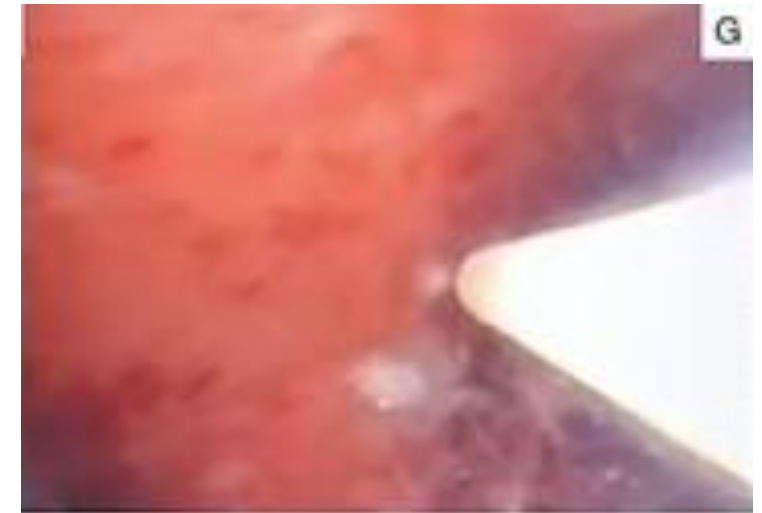
Talc slurry
Via a chest tube



Talc poudrage
During thoracoscopy

Analgesia and graded talc
Reassess symptoms, drainage and lung expansion

Thoracoscopic insufflation



Biopsy and pleurodesis may be combined in selected patients.

Slurry and poudrage are both reasonable. Effective apposition is central to success.

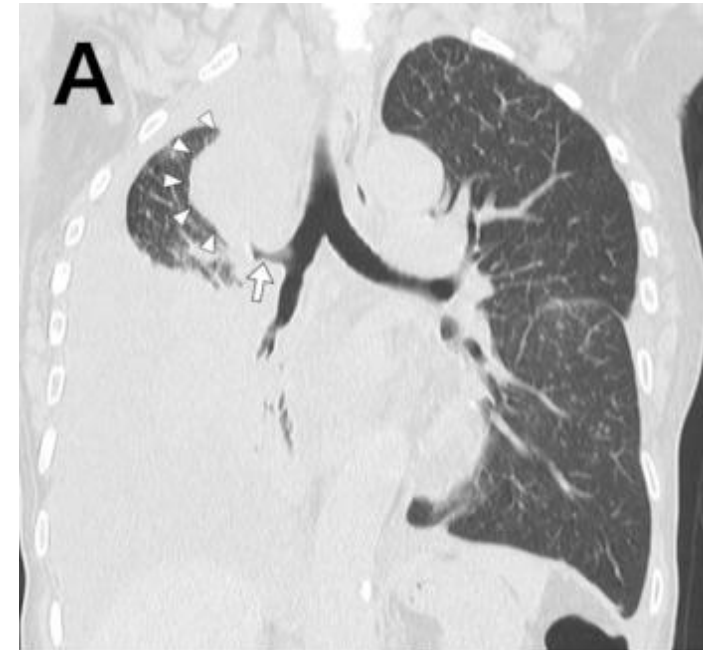
Non-Expandable Lung

Mechanisms

Visceral pleural restriction
Endobronchial obstruction
Chronic atelectasis

Management implications

IPC for symptomatic recurrent fluid
Limited role for routine pleurodesis
Surgery only in highly selected patients



Obstructing right hilar tumor
Same patient as the earlier CXR

Stable pneumothorax ex vacuo usually requires observation after careful assessment.

An aerial photograph of the Pusan National University Yangsan Hospital complex, featuring several large, modern medical buildings with orange and grey facades. The hospital is situated in a densely populated urban area with numerous residential apartment buildings in the background. A large, dark, forested mountain rises behind the city. The foreground shows extensive parking lots filled with cars and some green spaces.

Infectious Pleural Disease

Diagnosis and Source Control



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The Spectrum of Pleural Infection

Parapneumonic effusion: fluid associated with pneumonia

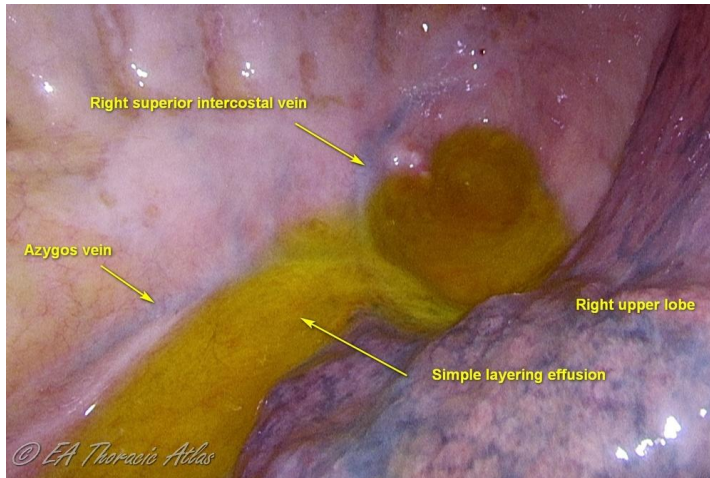
Category	Defining feature	Usual management
Uncomplicated PPE	Often sterile and free-flowing	Antibiotics for pneumonia Clinical reassessment
Complicated PPE	Infected / biochemically complicated May remain non-purulent	Antibiotics and pleural drainage
Empyema	Frank pus in the pleural space	Antibiotics and pleural drainage

Other infectious settings Postoperative / procedural infection, tuberculosis and rare fungal infection

Pleural infection includes complicated PPE and empyema. Visible pus is not required.

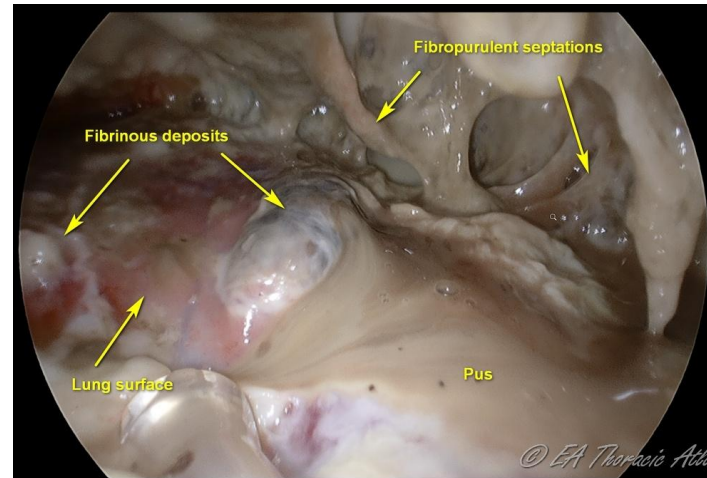
From Exudation to Organization

I Exudative



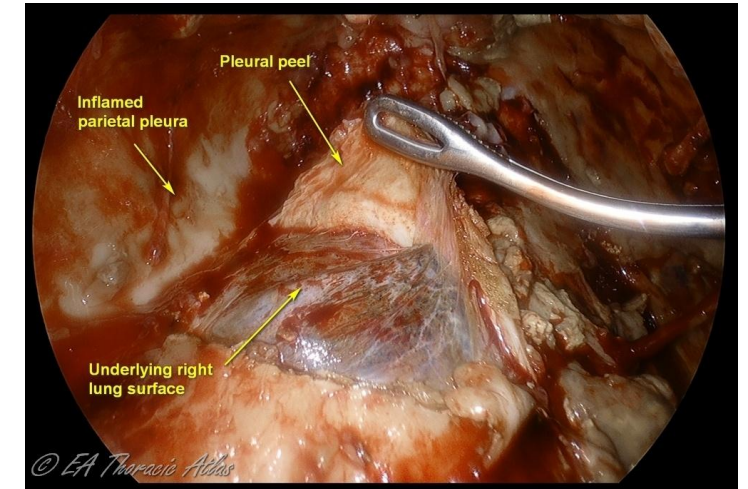
Free-flowing fluid
Limited structural change

II Fibrinopurulent



Fibrin and loculations
Viscous infected fluid

III Organizing



Fibrous pleural peel
Restricted lung expansion

Stages overlap. Anatomy and clinical response determine the next treatment.

Recognizing Pleural Infection

Clinical and fluid findings

Fever, pleuritic pain or sepsis

Pus, pH and microbiology

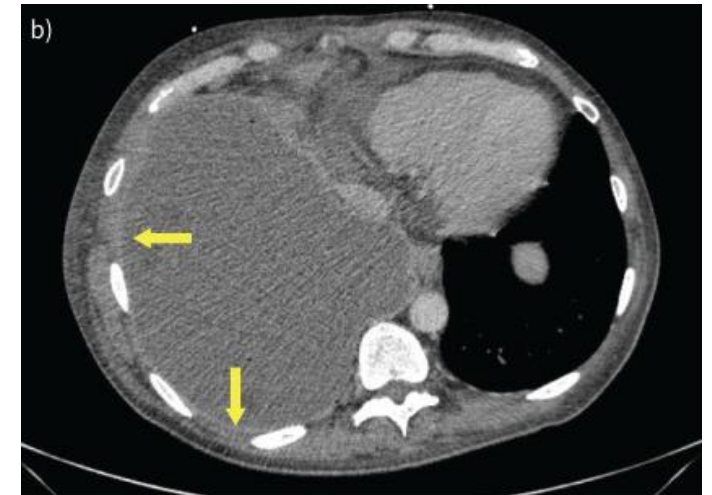
Culture-negative infection
remains possible

Ultrasound



Echogenic fluid / septations
A safe drainage target

Contrast CT



Pleural enhancement
Extent and other sources

RAPID estimates prognosis: renal function, age, purulence, infection source and albumin

Combine clinical, fluid and imaging findings. RAPID supports prognostic discussion.

Who Needs Pleural Drainage?

Frank pus or positive Gram stain / culture: arrange pleural drainage

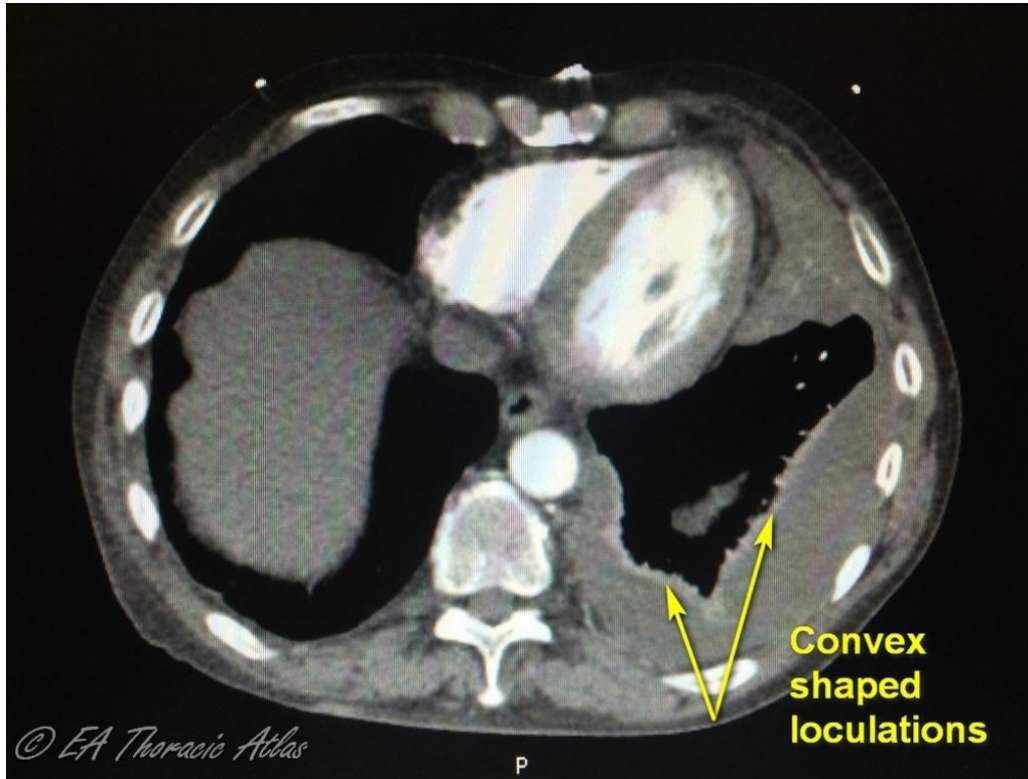
Non-purulent fluid with suspected pleural infection

Pleural fluid pH	Risk	Drainage decision
≤ 7.2	High	Drain if a safe fluid pocket is accessible
> 7.2 and < 7.4	Intermediate	Consider drainage if LDH > 900 IU/L and supporting clinical / imaging findings
≥ 7.4	Low	No immediate infection-driven drain Reassess if the course changes

Supporting findings: persistent fever, large volume, low glucose, septations or pleural enhancement

Pus establishes empyema. In non-purulent fluid, interpret pH in the clinical context.

Getting the Drainage Right



Initial image-guided drainage

Drain for most
initial adult pleural infections

Position and patency

Target the infected collection
Keep side holes within the cavity
Flush according to protocol

Separate undrained locules may need
an additional targeted drain

Effective drainage depends on access, position and patency as well as tube size.

Intrapleural Therapy or Surgery?

Decision factor	tPA / DNase	Surgical source control
Main role	Improve drainage of residual infected fluid	Direct clearance of loculations and organized material
Factors favoring discussion	Residual loculated collection A functioning drain Acceptable bleeding risk	Persistent or worsening infection Organized peel / poor expansion Fistula or other surgical source
Patient assessment	Bleeding risk and anticoagulation Response during treatment	Operative fitness and anatomy Anesthesia and lung reserve

BTS 2023: initial medical drainage for most patients

AATS 2017: a more proactive VATS approach for stage II acute empyema

Discuss both options early. tPA/DNase is not a mandatory step before surgery.

Surgical Source Control

Drainage

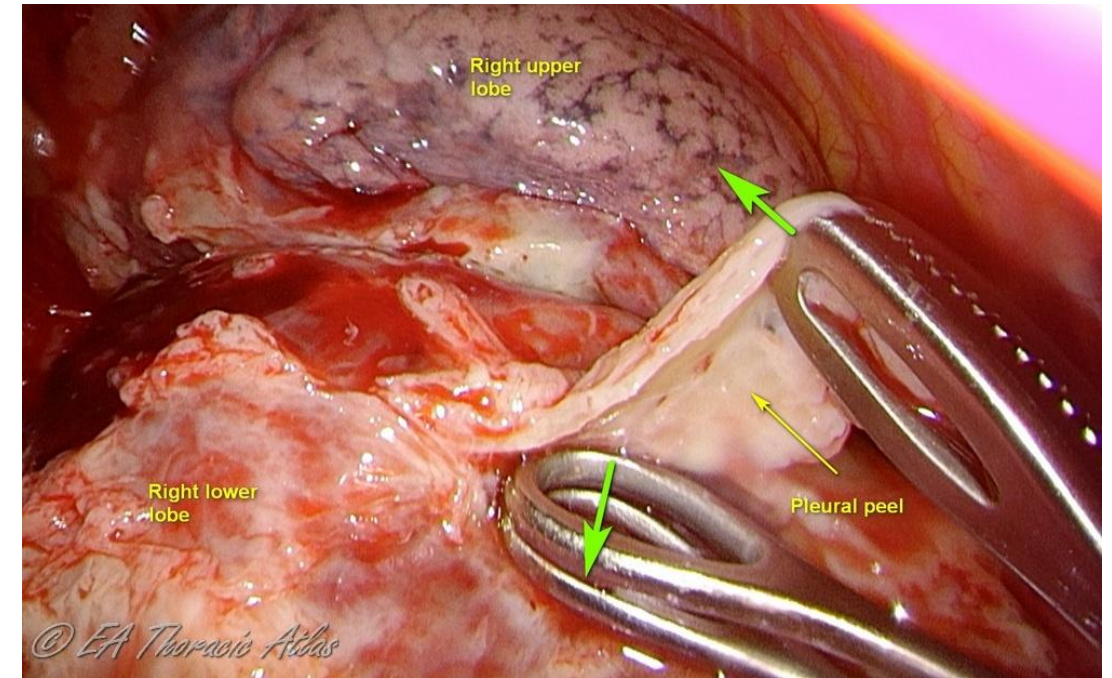
Evacuate infected fluid
Open inaccessible locules

Debridement

Remove fibrin, pus and
non-viable material

Decortication

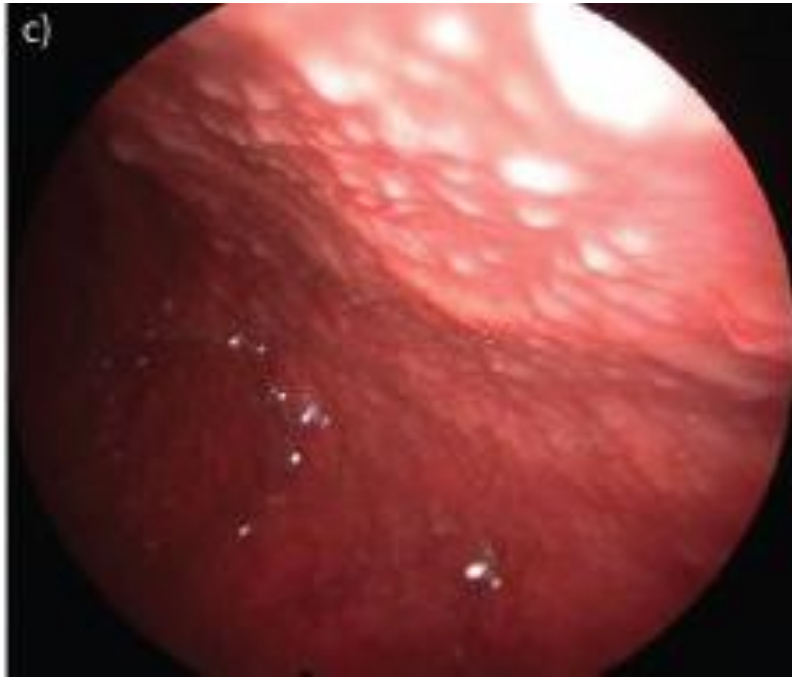
Release a restrictive pleural peel
when lung re-expansion is needed



VATS when adequate and safe
Open access when necessary

Tailor the extent of surgery to infection clearance, lung expansion and patient fitness.

Tuberculous Pleural Disease



Pleural tuberculosis on thoracoscopy
Appearance supports targeted biopsy

Tuberculous pleuritis

Often a lymphocyte-predominant exudate
ADA supports the diagnosis in context
Seek microbiological / tissue confirmation

Treatment and a key distinction

Systemic anti-tuberculosis treatment
Drain selectively for symptoms or complications

TB empyema: chronic infected space, sometimes
with a fistula, requiring a separate source-control plan

ADA and visual appearance are supportive. Obtain material for culture and susceptibility.

Pleural Neoplasm

Diagnosis and Management



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The Spectrum of Pleural Tumors

Primary pleural tumors

Pleural mesothelioma

Mesothelial malignancy
Often diffuse pleural disease

Solitary fibrous tumor

Mesenchymal tumor
A localized mass with variable risk

Secondary pleural involvement

Metastatic malignancy

Lung and breast cancer
Lymphoma and other primaries

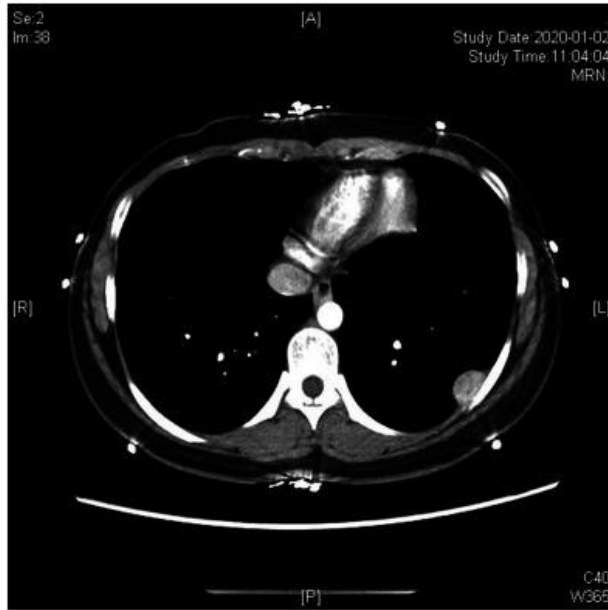
Clinical presentations

Pleural nodules or thickening
Effusion, sometimes with little visible tumor

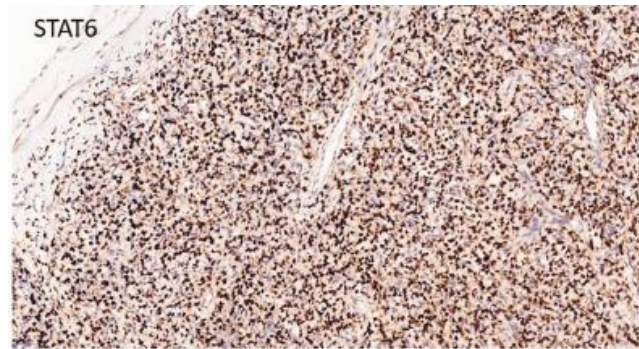
Malignant pleural effusion (MPE) can accompany several tumor types.

Identify the tumor type and the pleural problem that requires treatment.

Solitary Fibrous Tumor of the Pleura



Localized pleural mass



Nuclear STAT6 staining

Clinical relevance

Mesenchymal origin
NAB2–STAT6 association

Complete resection when feasible

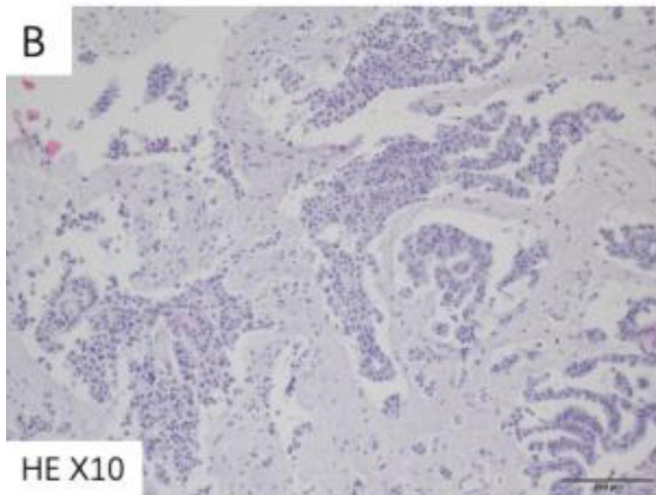
Risk assessment after pathology
Long-term surveillance

Risk features include tumor size, mitotic activity and necrosis.

SFT can recur late, including after apparently complete resection.

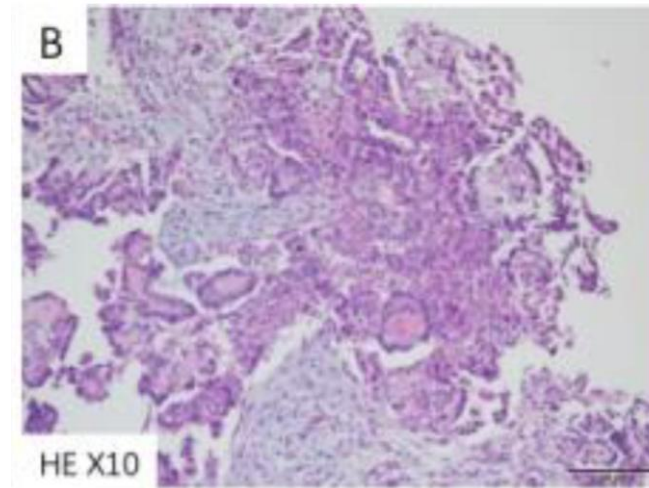
Pleural Mesothelioma: Diagnosis and Classification

Epithelioid



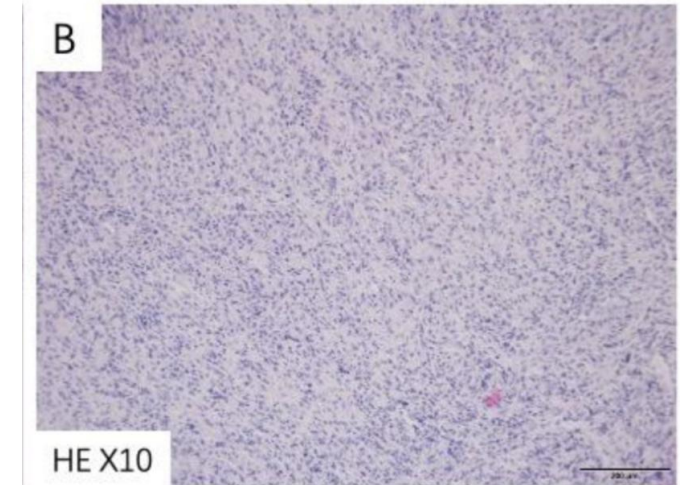
Epithelial morphology

Biphasic



Epithelioid and
sarcomatoid components

Sarcomatoid



Spindle-cell morphology

Adequate tissue and an IHC panel establish lineage and support classification.

Histology, stage and patient fitness influence the treatment plan.

Systemic Therapy for Pleural Mesothelioma

Main first-line options for unresectable disease

Regimen	Where it fits	Key considerations
Nivolumab + ipilimumab	Epithelioid and nonepithelioid Strong relevance in nonepithelioid disease	Immune-related toxicity Autoimmune / transplant history
Pembrolizumab + platinum–pemetrexed	Chemoimmunotherapy option Across histologic subtypes	Fitness for chemotherapy and immunotherapy
Platinum–pemetrexed	Chemotherapy option When immunotherapy is unsuitable	Renal function and tolerance Supportive supplementation

Select with oncology using histology, fitness, disease burden and patient preference.

Treatment choice requires an individualized discussion of benefit and toxicity.

The Role of Surgery in Mesothelioma

Procedure	Extent
P/D	Parietal and visceral pleurectomy, preserving the lung
Extended P/D	P/D plus diaphragm and/or pericardial resection
EPP	En bloc resection including the ipsilateral lung

MARS 2, 2024

Extended P/D + chemotherapy
vs chemotherapy alone

Worse survival to 2 years
and more serious adverse events

ASCO, 2025

Highly selected early-stage
epithelioid disease (T1–3N0)

Expert MDT, comprehensive staging
and fitness for multimodality care

Anatomic resectability alone is insufficient to justify cytoreductive surgery.

An aerial photograph of the Pusan National University Yangsan Hospital complex, featuring several large, modern medical buildings with orange and grey facades. The hospital is situated in a densely populated urban area with numerous residential apartment buildings in the background. A large, dark, forested mountain rises behind the city. In the foreground, there are large parking lots filled with cars and some green spaces with trees.

Summary

Clinical Priorities in Pleural Disease

Take-Home Messages

01 Is the patient clinically stable?

Symptoms and physiological compromise determine urgency.

02 Is the diagnosis sufficiently established?

Persistent suspicion after negative cytology may require pleural biopsy.

03 Will the proposed treatment benefit this patient?

Consider symptom benefit, lung expansion and the patient's goals.

04 Has the intervention achieved its goal?

Reassess symptoms, drainage and lung expansion, then plan follow-up.

The next step depends on the patient's clinical response.

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Thank You

for your attention



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