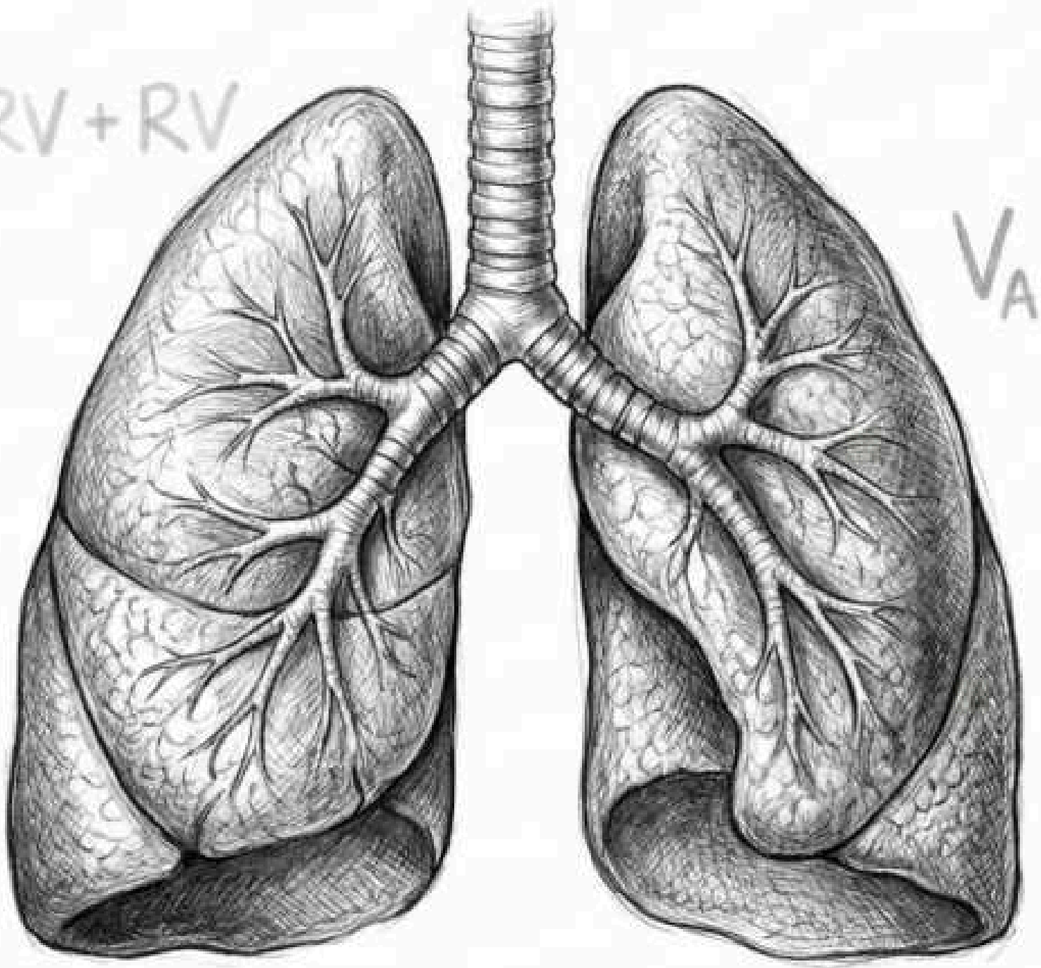
Restrictive & Interstitial Lung Disease

Visual Companion to MED 522 B – Lecture 4

Exploring interstitial, occupational, neuromuscular, and pleural mechanisms of respiratory restriction.

$TLC = IRV + V_T + ERV + RV$

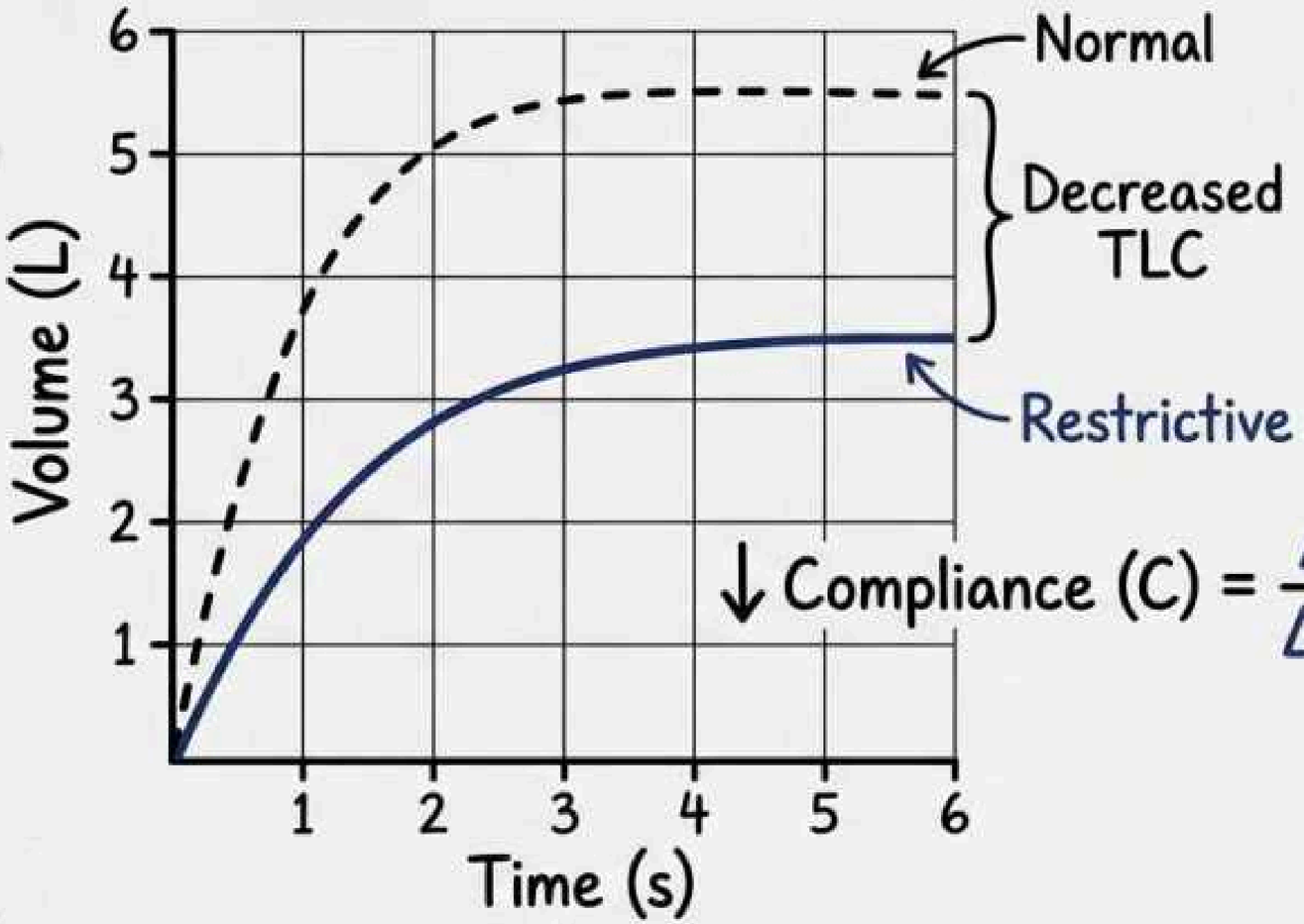


$V_A = (V_T - V_D) \times f$

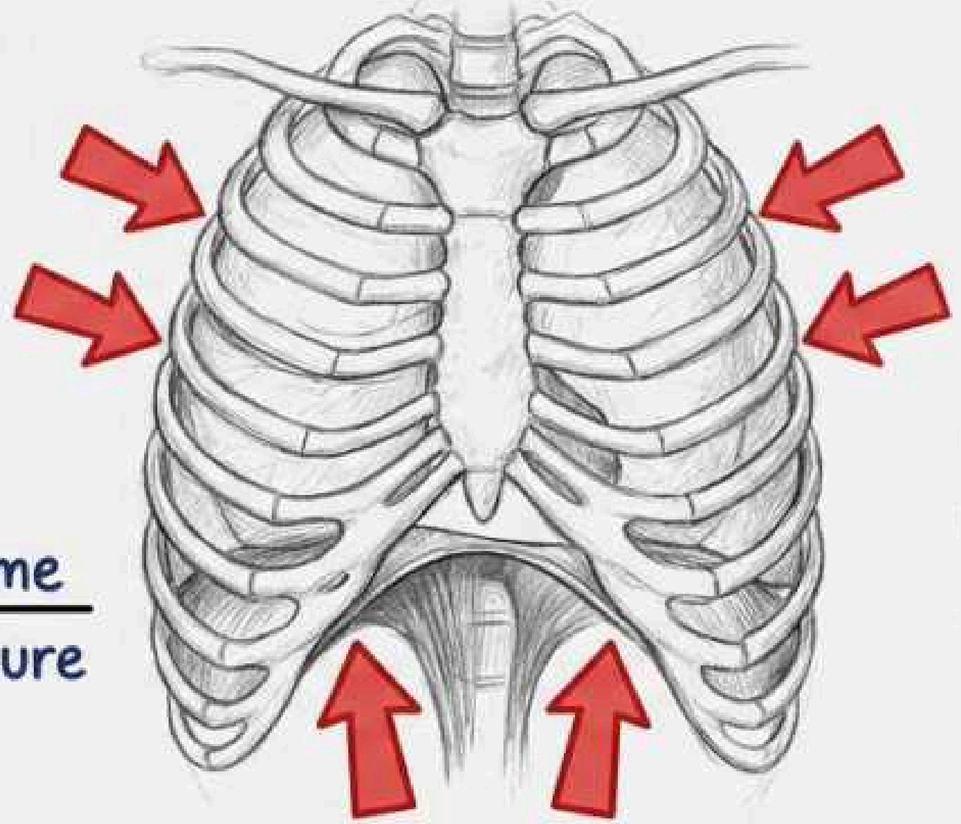
FVC

¶ 4.1

Volume–Time Spirometry Graph



$$\downarrow \text{Compliance (C)} = \frac{\Delta \text{Volume}}{\Delta \text{Pressure}}$$

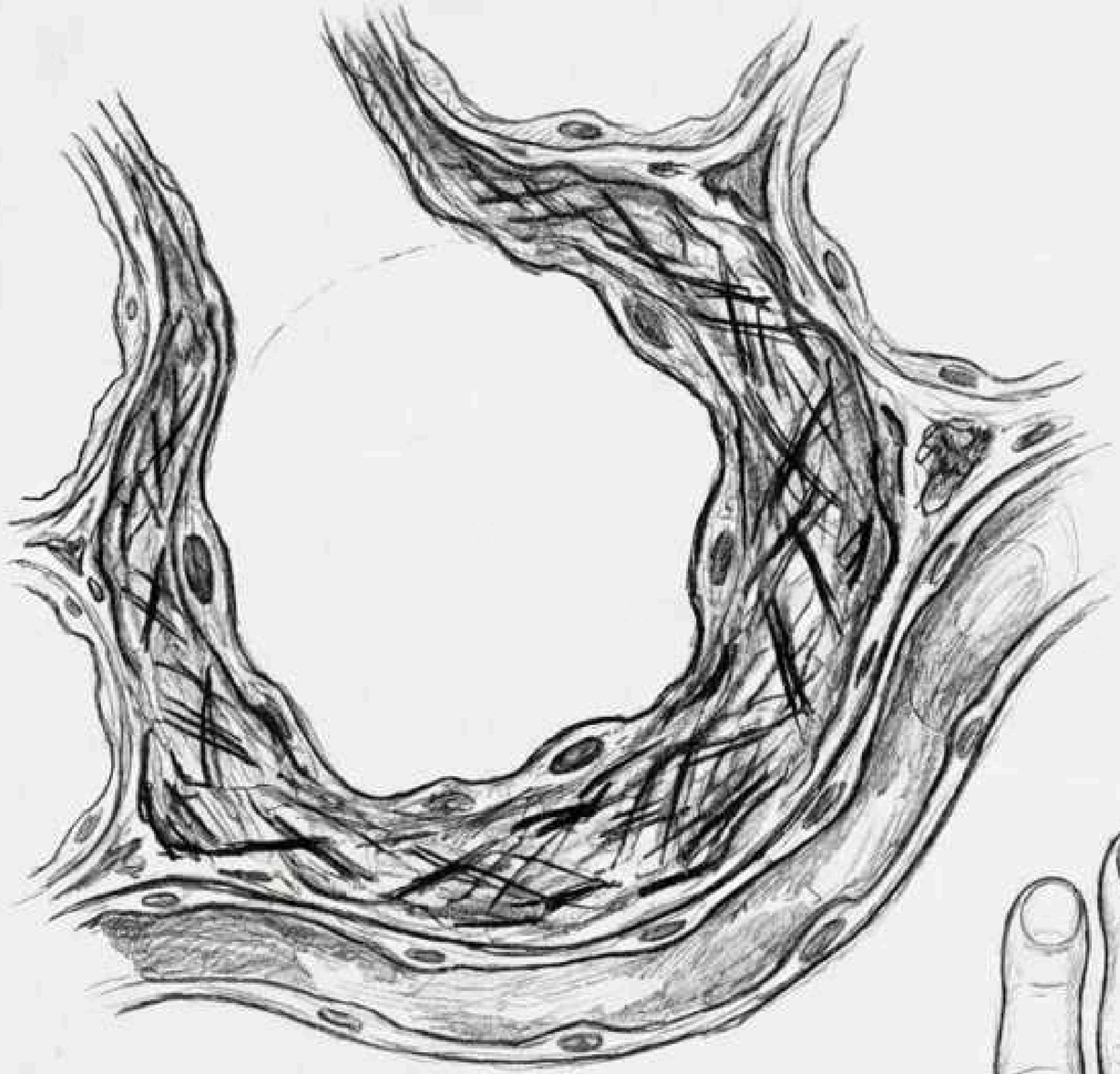


Key Symptoms:

- Breathlessness on exertion
- Dry cough

Three Buckets of Restriction:

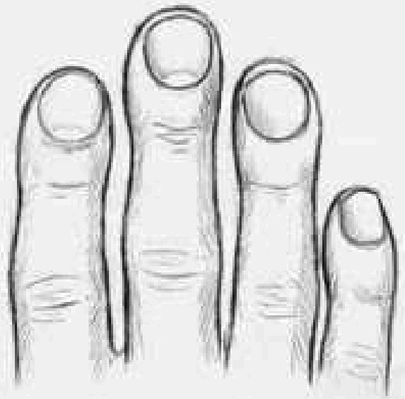
1) Stiff lung tissue
2) Chest wall and breathing muscles
3) The pleura



$$\text{Rate of Diffusion} \propto \left(\frac{\text{Surface Area}}{\text{Thickness (T)}}\right) \times \Delta P$$

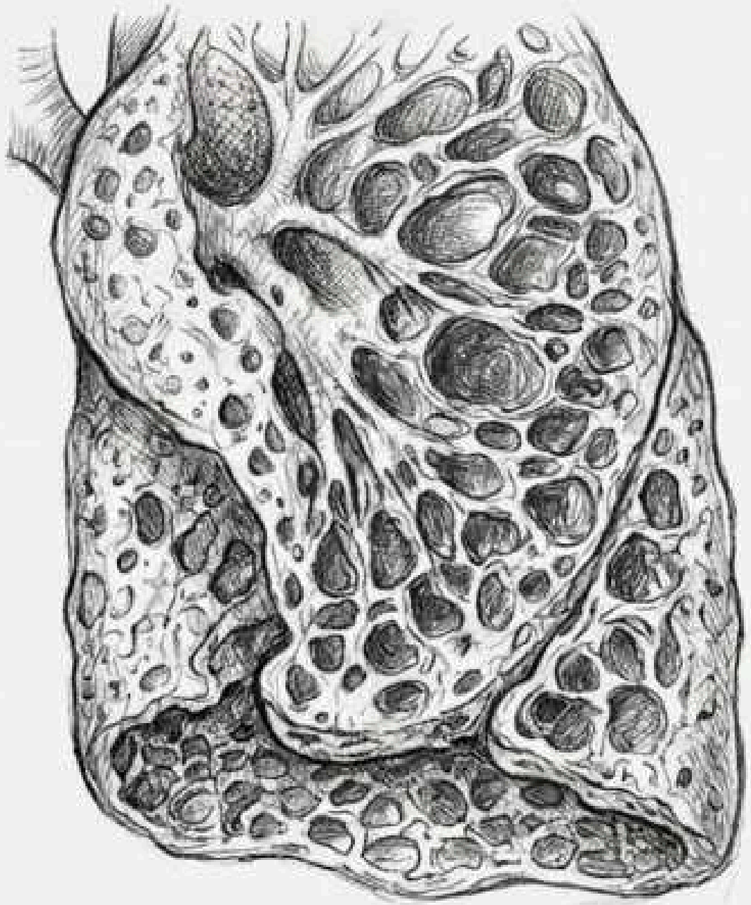
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Pathology: Interstitial lung disease affects the delicate framework around the alveoli, stiffening the lung and slowing oxygen diffusion into the blood.



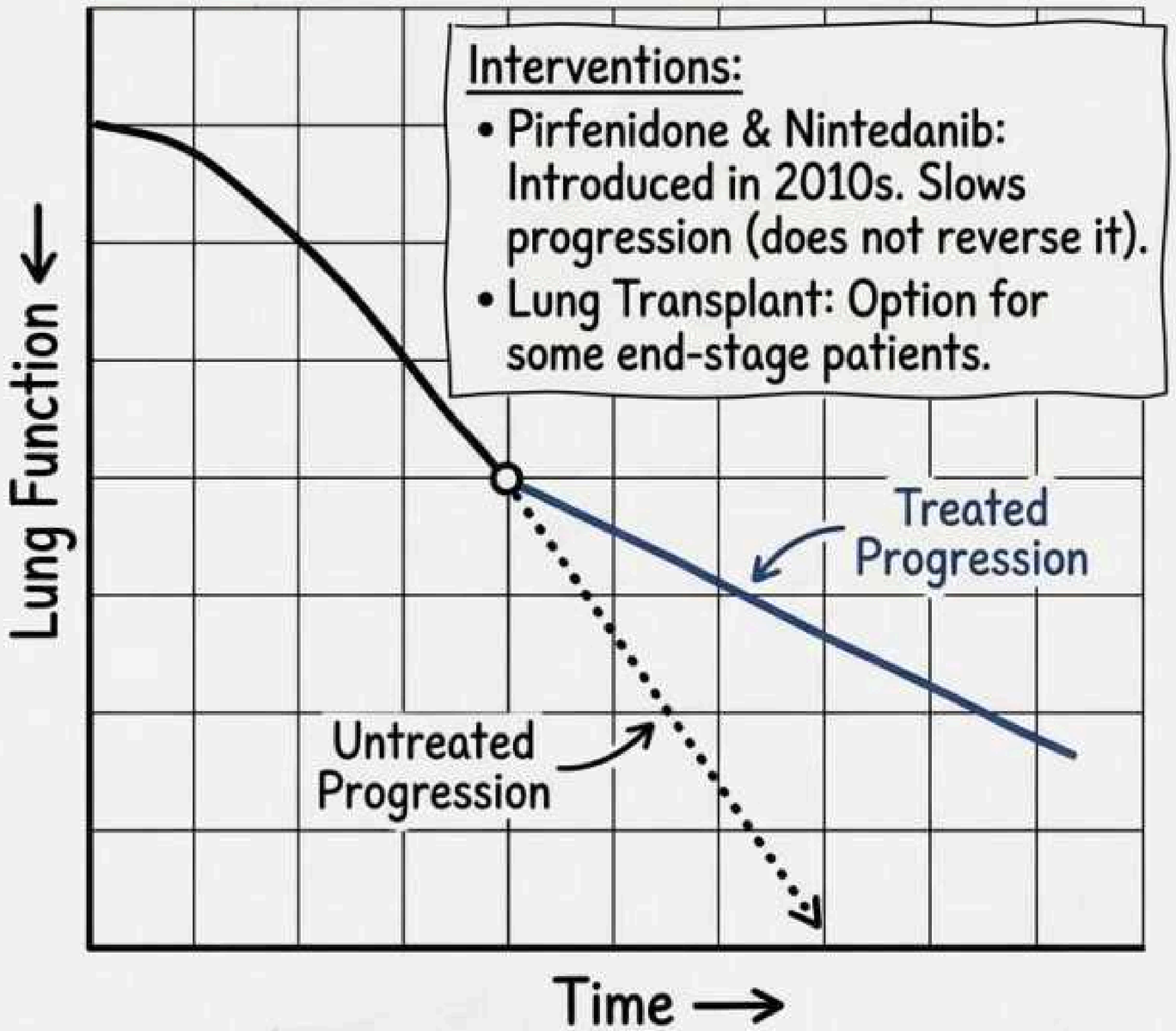
Clinical Signs:

- Auscultation: Fine crackles at lung bases
- Observation: Digital clubbing



Patient Profile:

- Older adults; especially former smokers
- Etiology: Idiopathic (Unknown cause)
- Progression: Relentless scarring causing steady reduction in lung function



Interventions:

- Pirfenidone & Nintedanib: Introduced in 2010s. Slows progression (does not reverse it).
- Lung Transplant: Option for some end-stage patients.

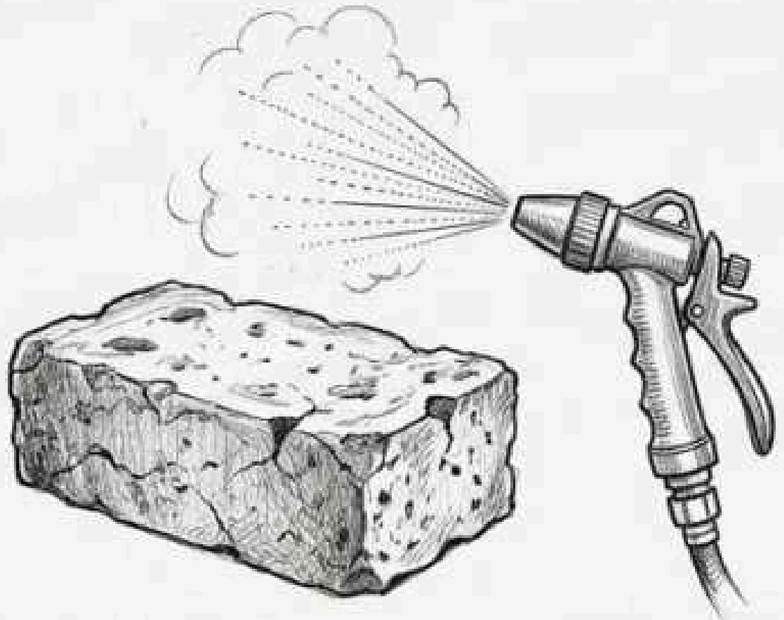
Occupational Lung Diseases

Caused by workplace inhalation. Appears many years after exposure.
Key to prevention: Dust Control.



Disease: Asbestosis

Exposure: Asbestos fibres



Disease: Silicosis

Exposure: Silica dust (mining, stone cutting, sandblasting)

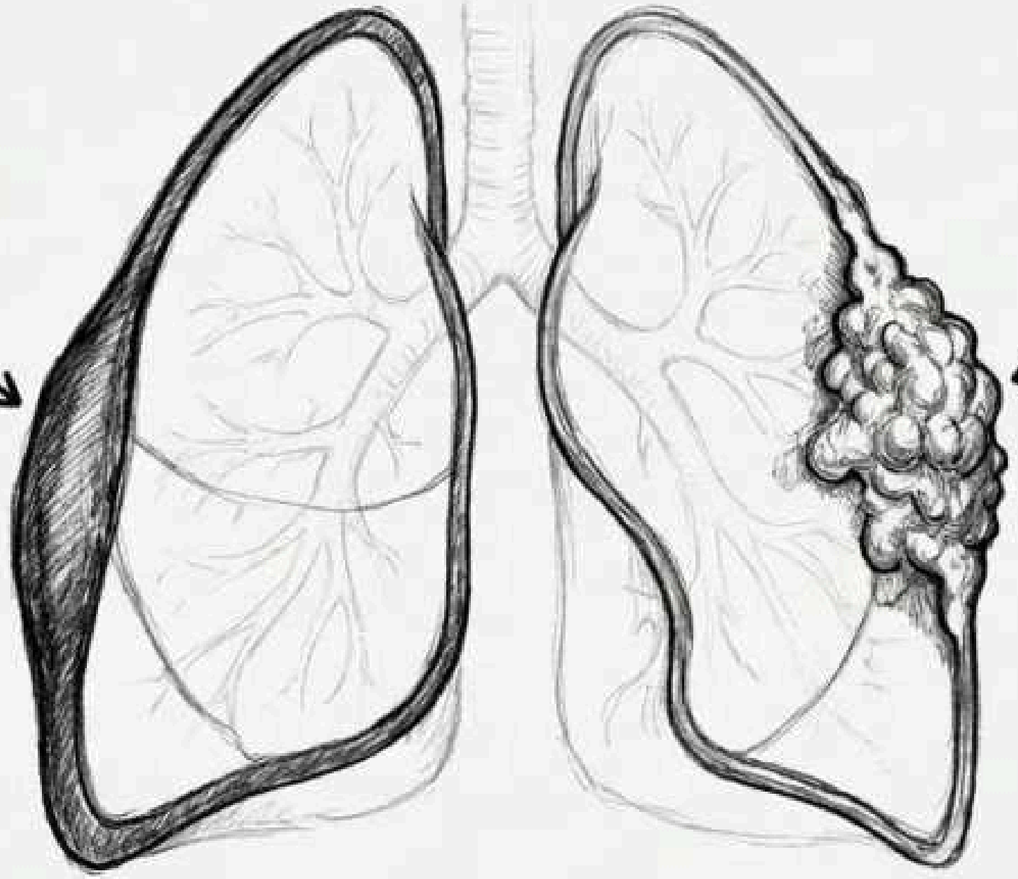


Disease: Coal workers' lung disease

Exposure: Coal dust

Exposure (t=0) → Latency (Δ t = Decades) → Pathology

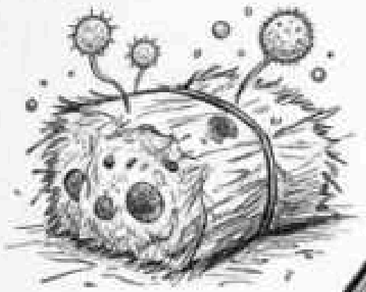
Thickening of the pleura



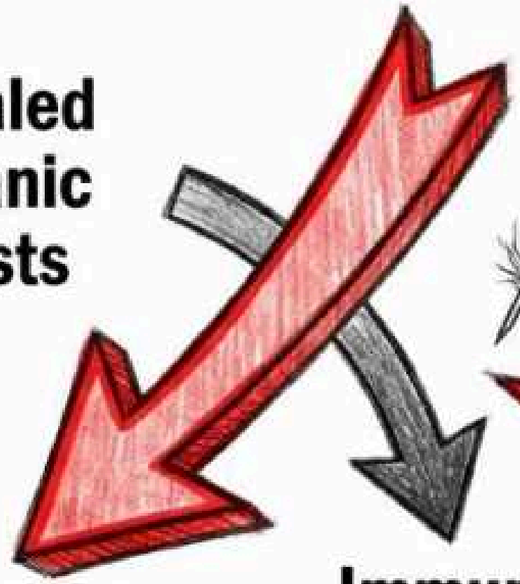
Mesothelioma: A cancer of the pleura appearing decades post-exposure.

Public Health Context: Recognition of harms led to bans in many countries, though legacy buildings persist and usage continues globally.

Hypersensitivity Pneumonitis



Inhaled Organic Dusts





Immune Reaction

Inflammation

Permanent Scarring
(If exposure continues)

Classic Examples:

- **Farmer's Lung:** Mouldy hay spores
- **Bird Fancier's Lung:** Proteins from bird droppings

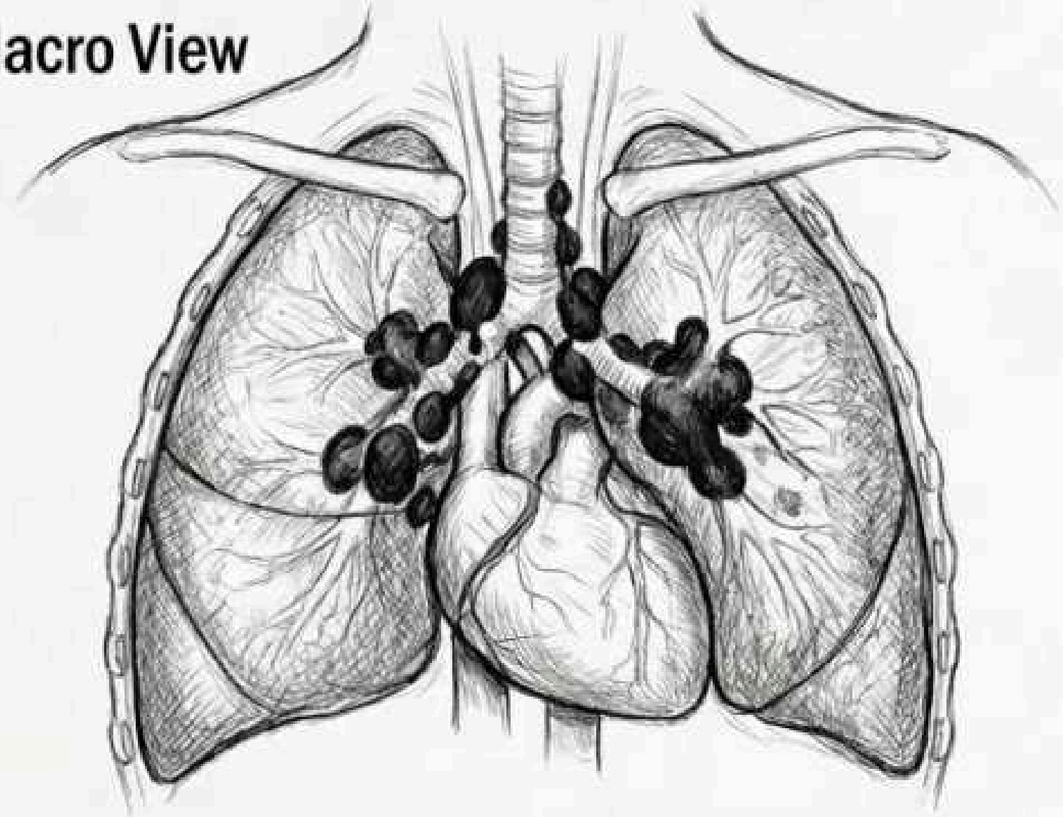
Primary Directive:

Identify and REMOVE the exposure.

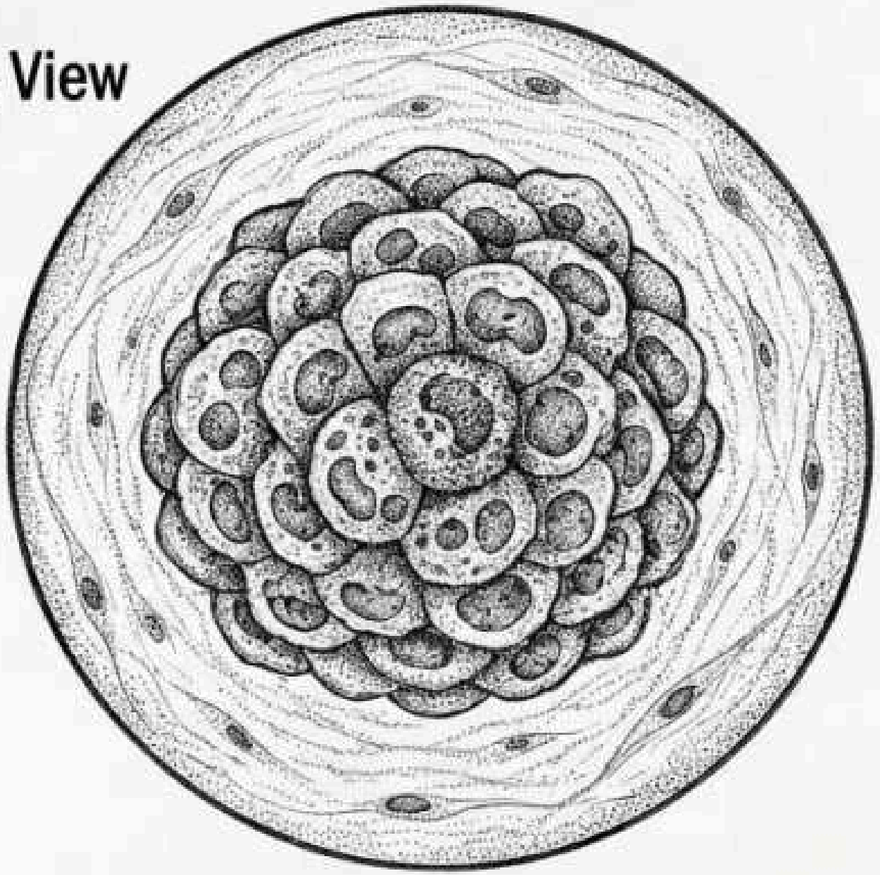
Sarcoidosis

Condition of unknown cause.

Macro View



Micro View



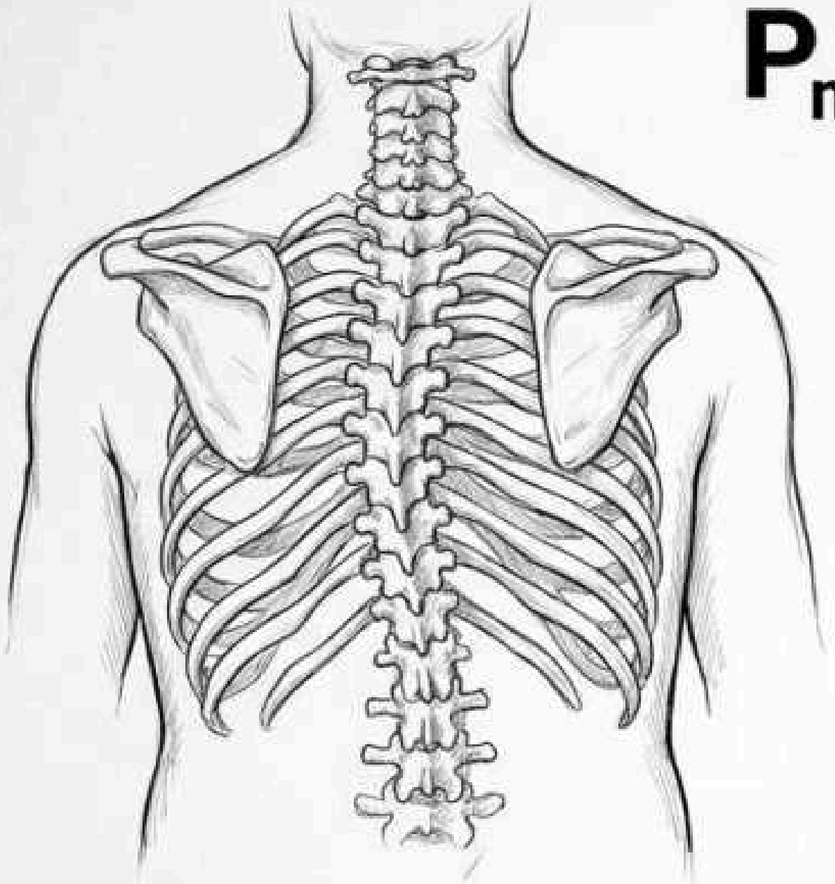
Demographic: Frequently affects young and middle-aged adults.

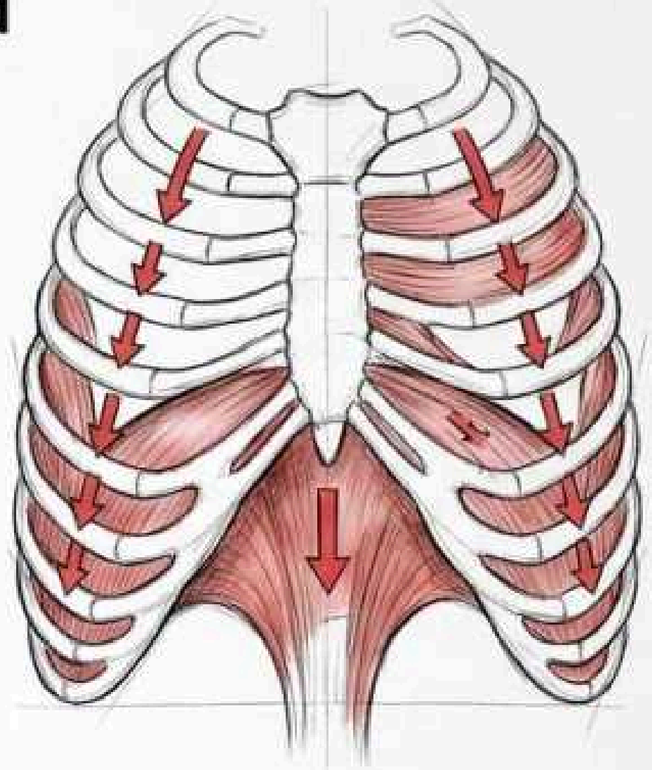
Pathology: Formation of granulomas (immune cell clusters) in multiple organs. Most common: Lungs + Chest Lymph Nodes.

Prognosis & Treatment:

- Many cases resolve on their own.
- Severe cases require drugs that suppress the immune response.

$P_{muscle} < P_{load}$





Structural Limits:

- Severe curvature of the spine (Kyphoscoliosis)
- Severe obesity

Both mechanics physically limit chest expansion.

Neuromuscular Limits:

Diseases that weaken breathing muscles:

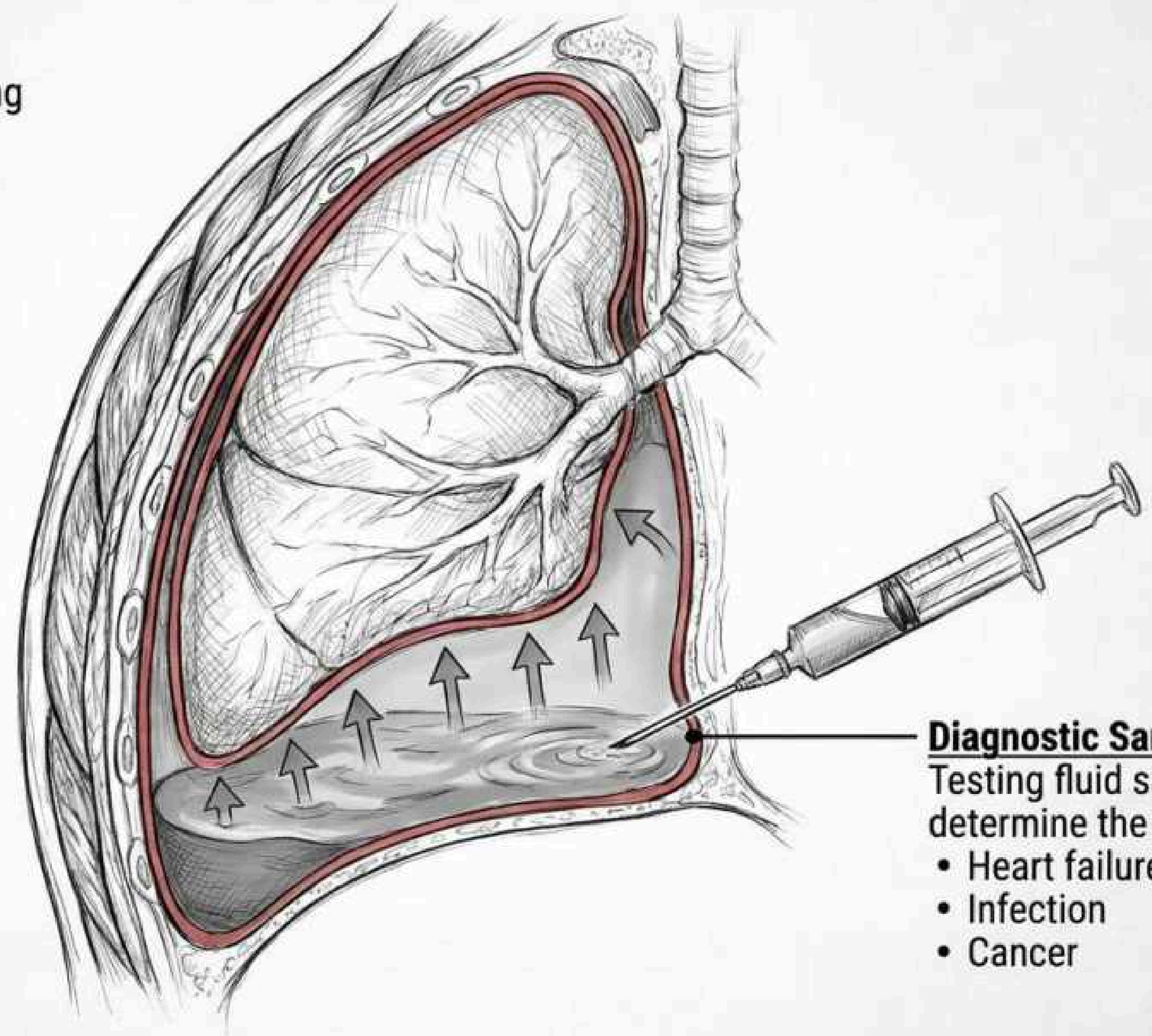
- Motor neurone disease
- Muscular dystrophies

Clinical Consequence:

Inability to take a deep breath → eventual respiratory failure in advanced stages.

Anatomical Definition:
Pleura = Double membrane lining lungs and inside of chest wall, normally with a thin layer of fluid between.

Pathology:
Pleural Effusion: Build-up of extra fluid in this space, compressing the lung.



Diagnostic Sampling:
Testing fluid samples helps determine the cause:

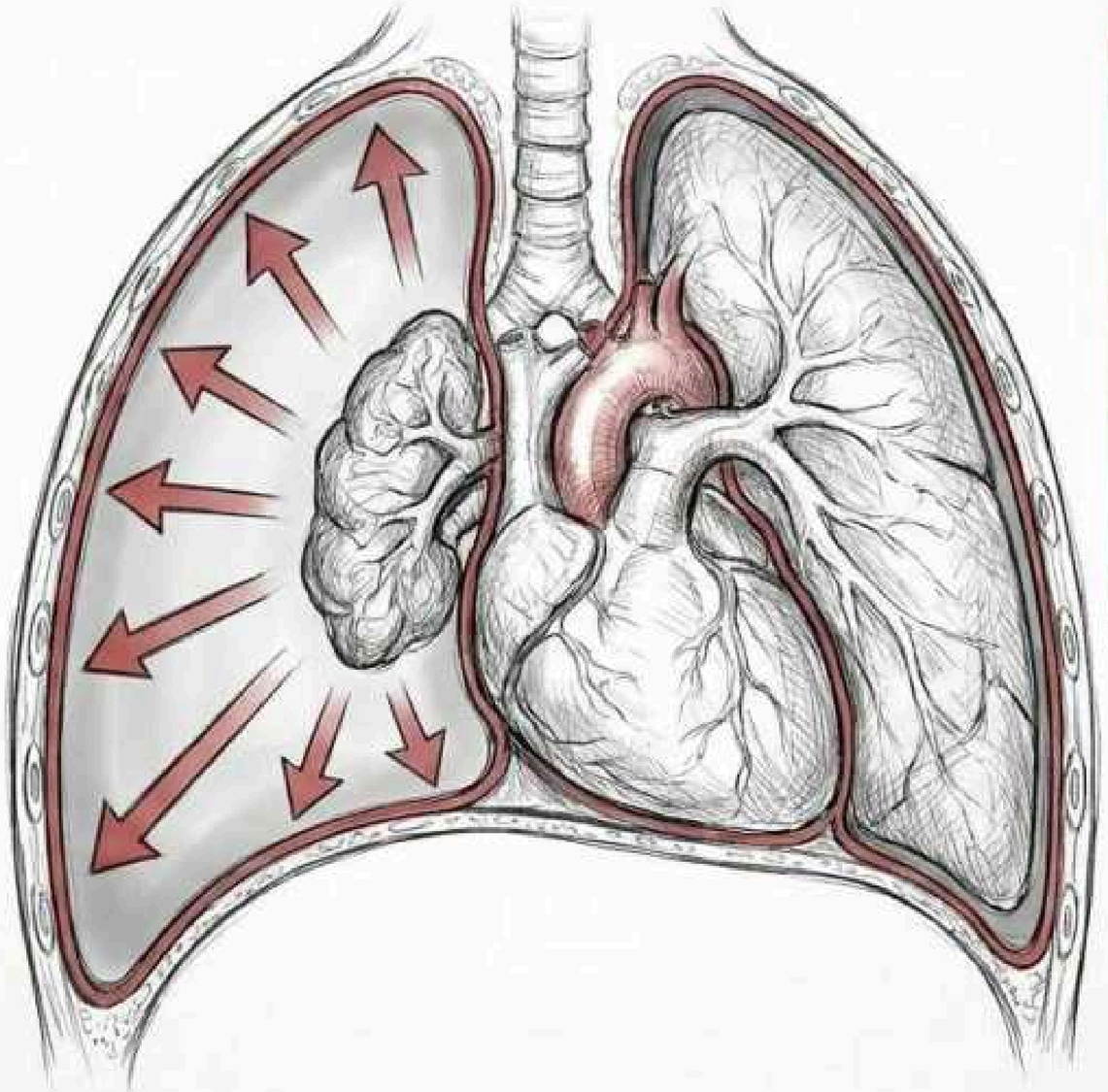
- Heart failure
- Infection
- Cancer

Pathology:
Pneumothorax:
Pneumothorax: Air in the pleural space, letting the lung collapse.

Etiology:

- Spontaneous (often in tall, thin, young men)
- Secondary to lung disease or injury

$$P_{pleural} > P_{atm}$$



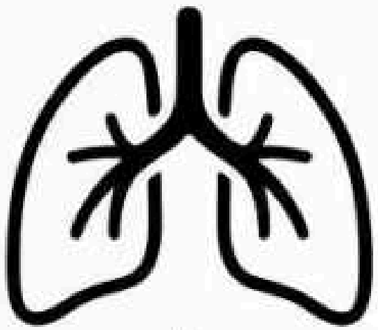
EMERGENCY WARNING:
Tension Pneumothorax

A one-way **valve** effect where air keeps entering and pressure builds, dangerously compressing the heart and great vessels.

Treatment Paradigms (Matched to Restrictive Cause)

Mechanism / Cause	Intervention
Exposure (Organic/Occupational)	Remove triggers and dusts.
Immune / Inflammation (e.g., Sarcoidosis)	Suppress inflammation.
Fibrosis (IPF)	Slow fibrosis with anti-fibrotics.
Pleural (Effusion / Pneumothorax)	Drain excess fluid or air.
Neuromuscular	Support weak muscles with nocturnal breathing machines.
End-Stage Disease	Lung transplantation.

Core Concept:
Restrictive disease fundamentally limits lung expansion.



Branch 1

1. Inside the Lung (Tissue)

Scarring, dusts, immune reactions.

Branch 2

2. The Engine (Muscles/Wall)

Chest wall problems and muscle weakness.

Branch 3

3. The Casing (Pleura)

Pleural problems (fluid and air).

Next Lecture:
Blood Vessels of the Lungs →