

# INVESTIGATIONS OF LUNG DISEASE

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Professor of Medicine

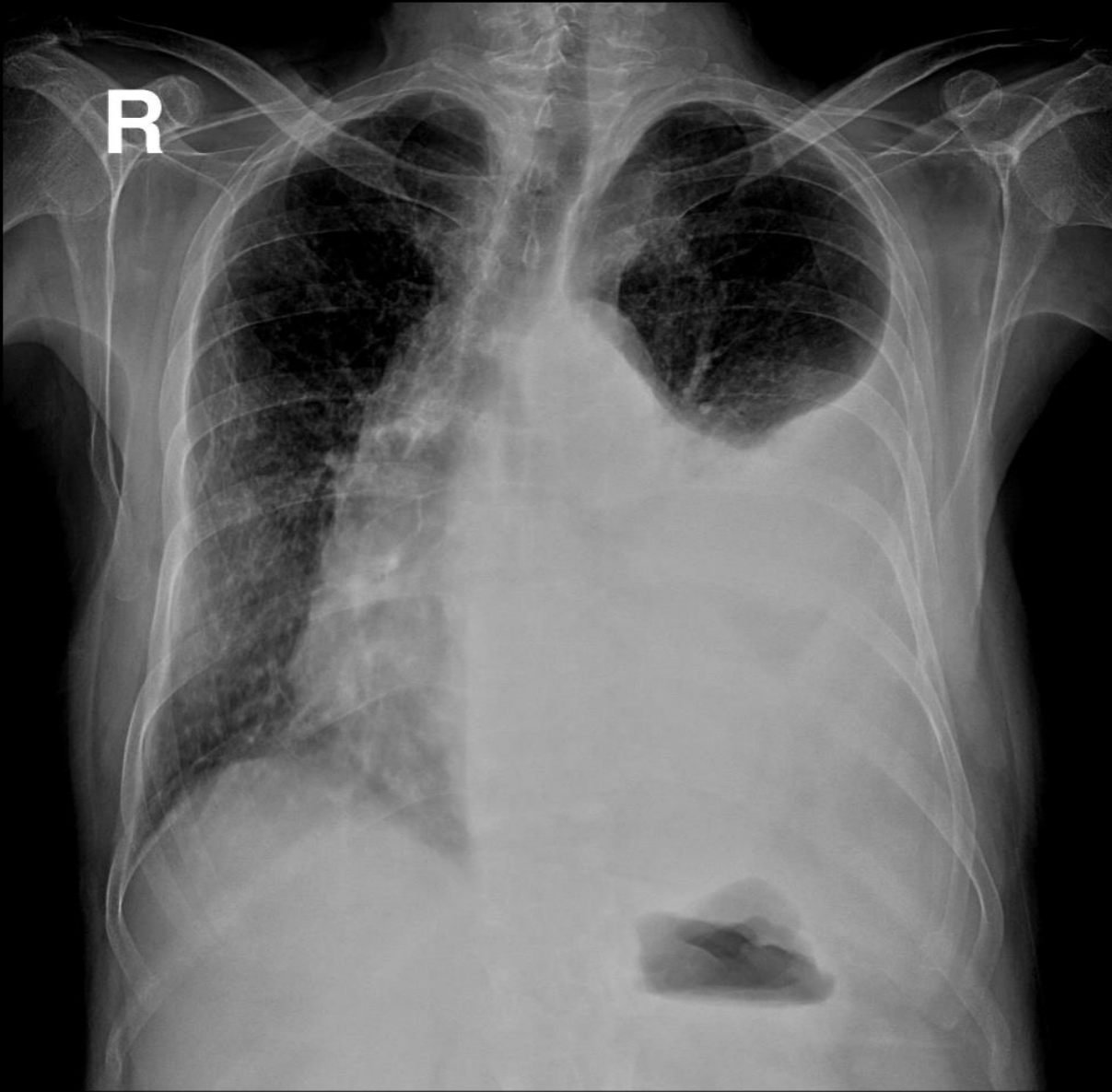
Division of Pulmonary Medicine

# Objectives

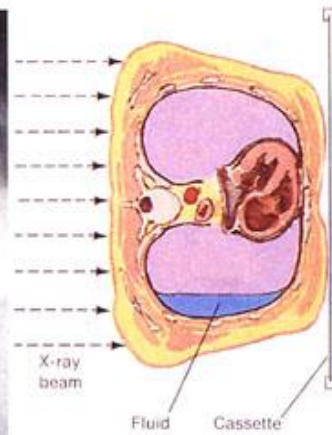
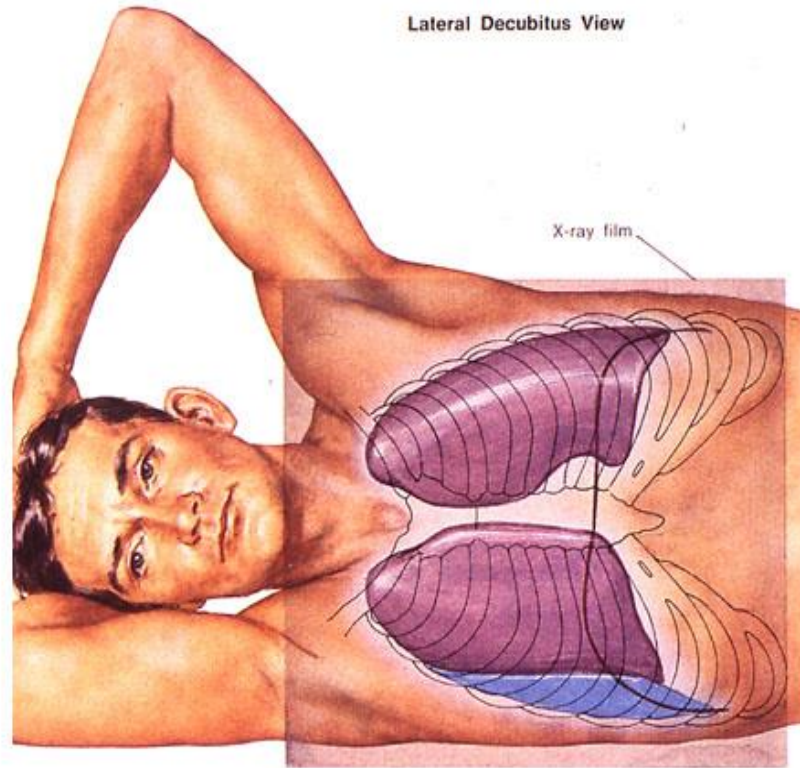
- Type of pulmonary diagnostic procedures
- Role of various specialized pulmonary procedures in diagnosing lung diseases
- When to apply specific tests

# Pulmonary Diagnostic Procedures

- Thoracentesis
- Chest tube
- Pleural biopsy
- Bronchoscopy
- Pulmonary function tests
- Computed tomography
- Lung Scans: V/Q



Lateral Decubitus View



Sectional view

lateral decubitus x-ray film: fluid in r. pleural space

# Thoracentesis

- Appearance
- Gram stain, and cultures
- pH
- Chemistry (glucose, amylase, LDH, protein)
- Cytology

# Separation of Transudates from Exudates

- Pleural fluid protein divided by the serum protein greater than 0.5
- Pleural fluid LDH divided by the serum LDH greater than 0.6
- Pleural fluid LDH greater than two-thirds of the upper limit of normal for the serum LDH

- Gross appearance is pus

or

- Gram stain positive

or

- pH below 7.20



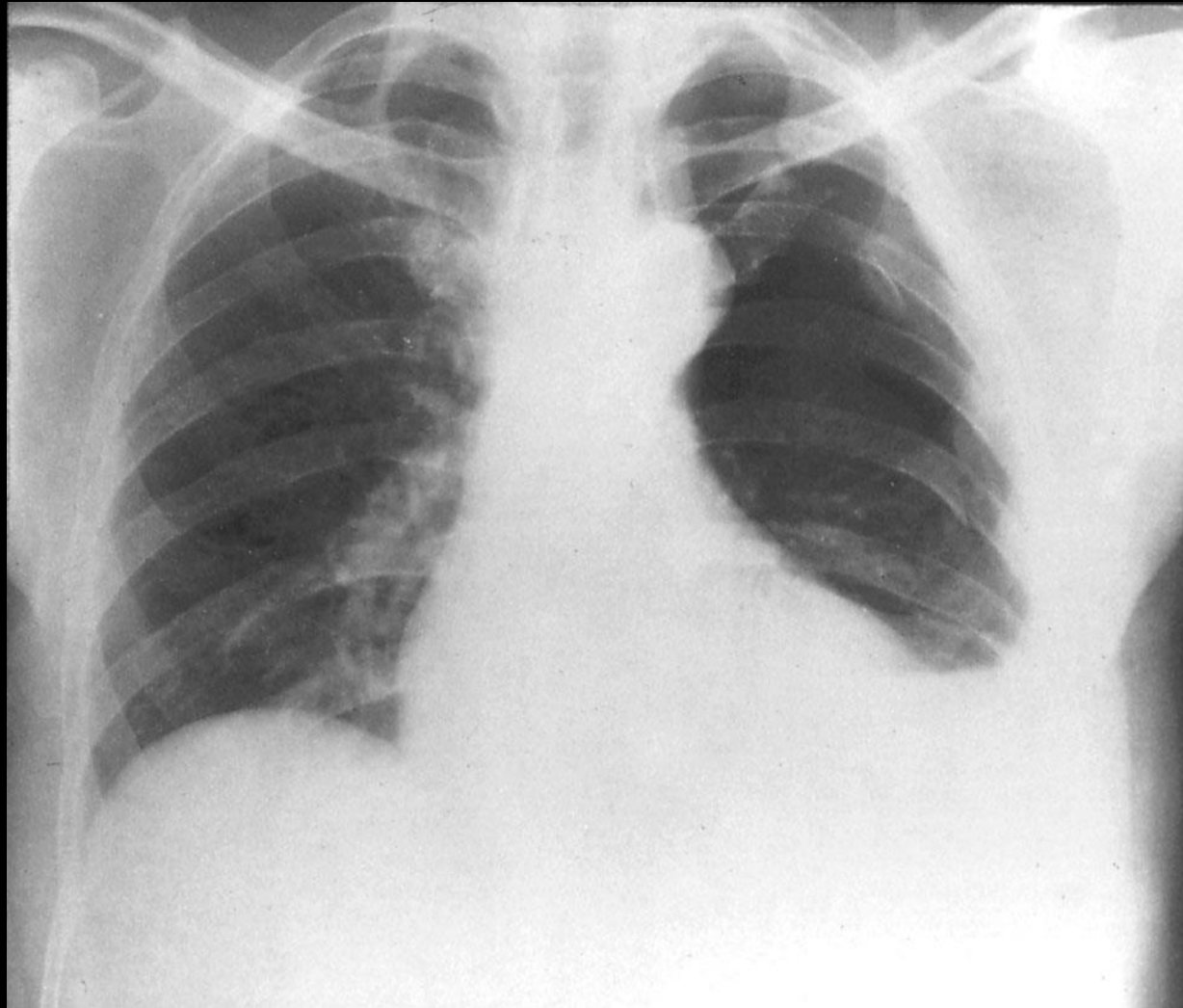
# Chest tube

## Indication for chest tube insertion

- Empyema
- Complicated parapneumonic effusion
- Symptomatic pleural effusion
- Hemothorax
- Pneumothorax

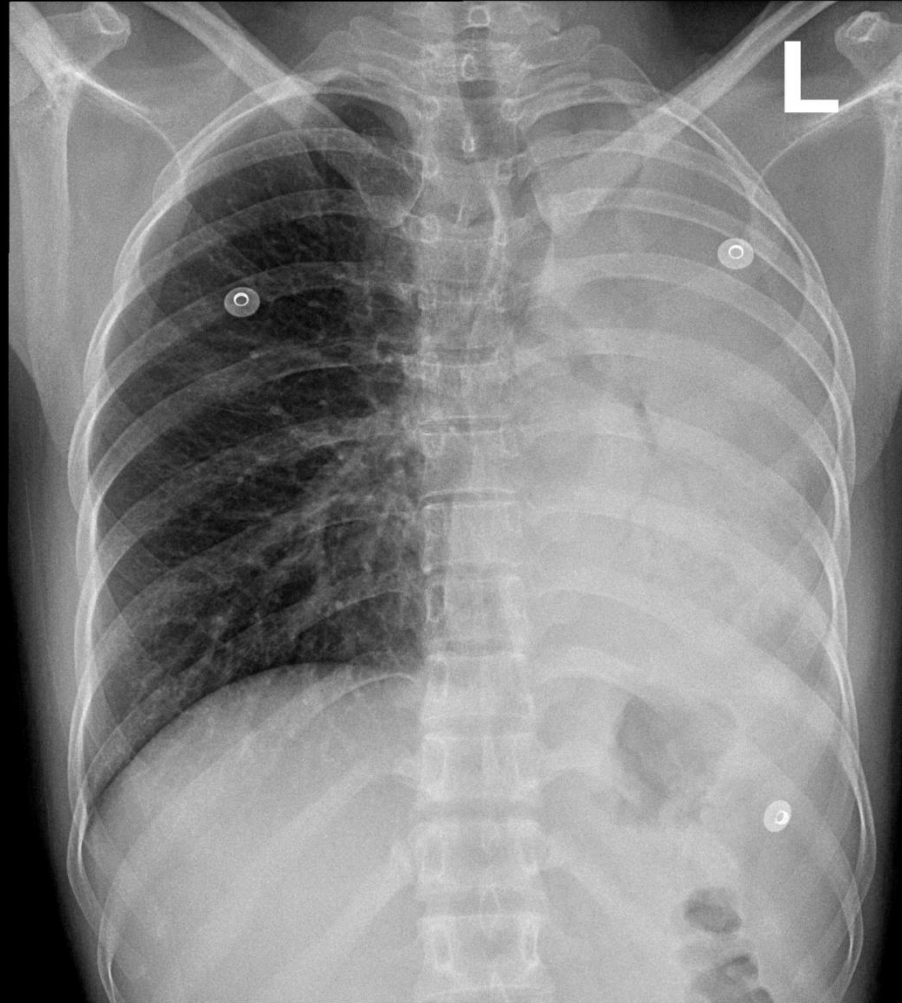
# Complication of Thoracentesis

- Pneumothorax
- Bleeding
- Infection
- Hypotension
- Hypoxemia
- Air embolism
- Splenic laceration

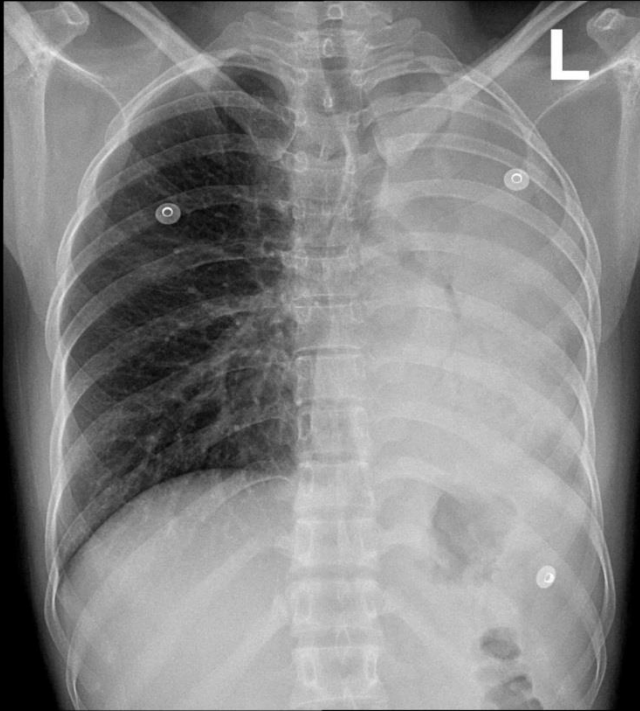


# Pleural biopsy

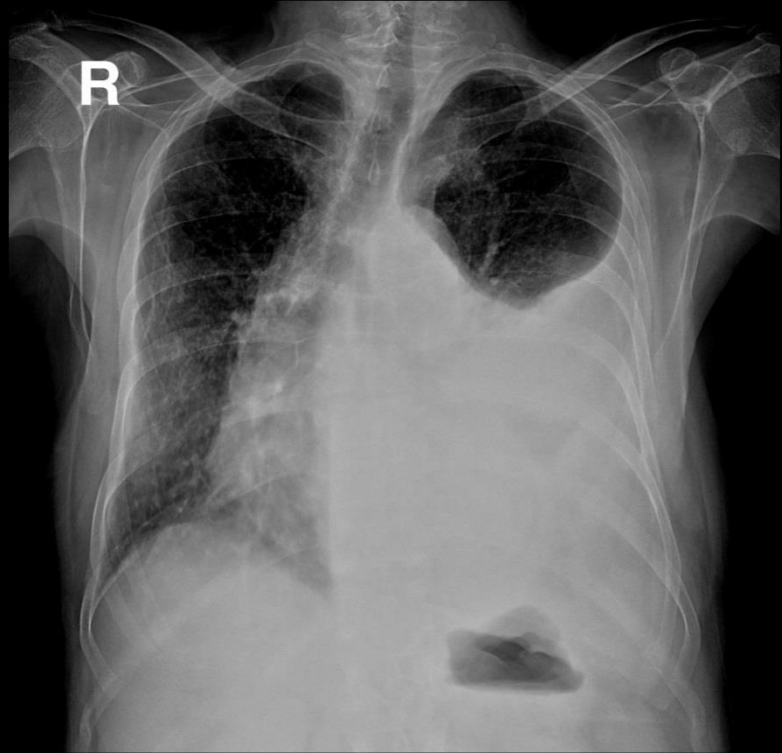
- Granulomatous disease
- Malignancy



# A



# B



# Bronchoscopy

Suspected lung cancer

Abnormal CXR

Hemoptysis

Unexplained cough

Localized wheeze

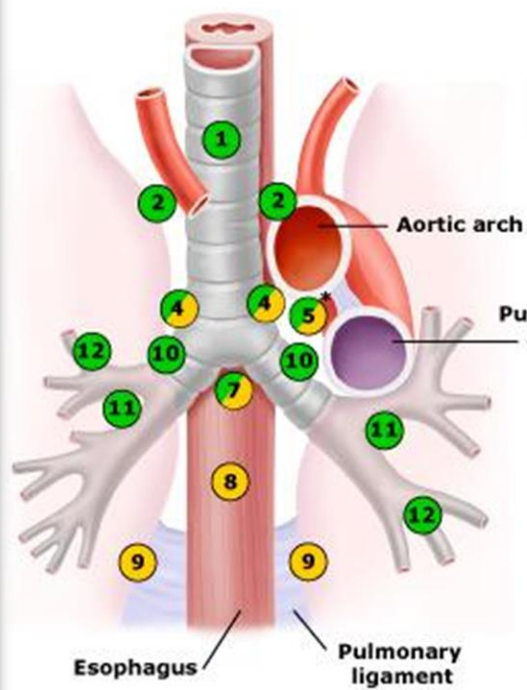
Positive sputum cytology

# Bronchoscopy

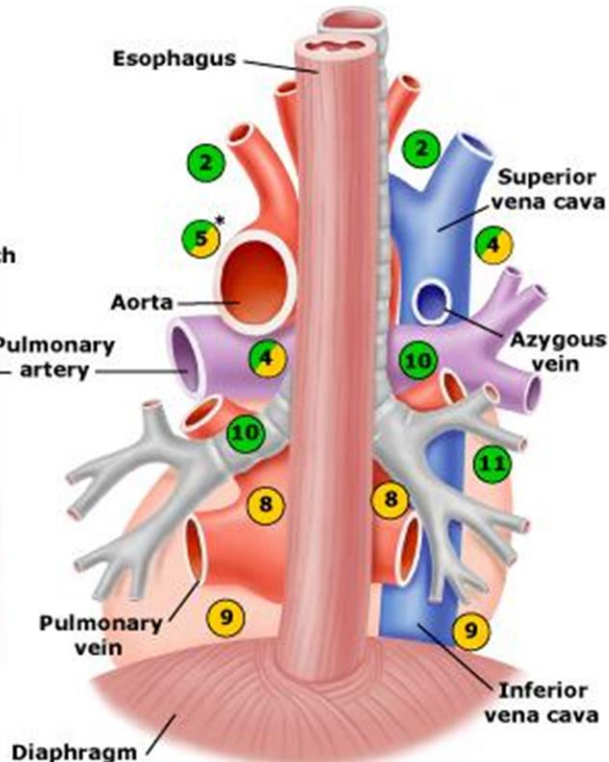
- Mediastinal lymph nodes
- Hemoptysis
- Refractory cough
- Unexplained pleural effusion
- Lung abscess
- Staging of lung cancer
- Obtain culture material
- Airway trauma
- Tracheoesophageal fistula
- Diffuse lung disease



Anterior view



Posterior view



- Endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA)
- Endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA)
- EBUS-TBNA or EUS-FNA
- \* Controversial

**Lymph node stations:** 1 = Supraclavicular, 2 = Upper paratracheal, 3 = Prevascular and retrotracheal (not shown), 4 = Lower paratracheal, 5 = Subaortic, 6 = Para-aortic (not shown), 7 = Subcarinal, 8 = Paraesophageal, 9 = Pulmonary ligament, 10 = Hilar, 11 = Interlobar, 12 = Lobar

# Bronchoscopy

## Therapeutic

- Remove foreign bodies
- Remove abnormal endobronchial tissue
- Difficult endotracheal tube intubation
- Endobronchial stent placement



# Pulmonary function tests

- Spirometry
- Lung volumes
- Diffusion capacity
- Respiratory muscle strength

# Spirometry

- FVC (L) predicted >90%
- FEV1 (L) predicted >90%
- FEV1/FVC > 70
  
- Diagnose obstructive lung disease
- Suggest restrictive lung disease

# Lung volumes

- TLC (L) >90% predicted
- RV (L) > 90% predicted
- Diagnose restrictive lung disease
- Diagnose air trapping

# Diffusing capacity (DL)

- Measure the ability of gases to diffuse from the alveoli into the pulmonary capillary blood
- CO not normally present in lungs or blood
- More soluble in blood than lung tissues
- $D_{lco}$

# ↓ DLco

Reflect loss or damage to the gas exchanging surface of the lung

Emphysema

Distinguish emphysema from chronic bronchitis or chronic asthma

Interstitial lung disease

Pulmonary vascular disease



# Respiratory muscle strength

- P<sub>I</sub>max, P<sub>E</sub>max
- Measured by pressure transducer at the mouth when subject make a maximal inspiratory effort from full expiration or maximal expiratory effort from full inspiration
- P<sub>I</sub> reflect inspiratory muscles (diaphragm)
- P<sub>E</sub> expiratory muscles including abdominal
- Motor neuron disease, Guillian Barre syndrom

**DIAGNOSIS****Date and Time**

03/02/2010

**Baseline**

08:41

**SPIROMETRY**

	Pred	Pre	%Pred/P
FVC (L)	5.04	3.13	62.1
FEV 1 (L)	4.25	2.53	59.5
FEV 1 FVC		80.91	
MMEF 75/25 (L/s)	4.93	2.46	49.9
PEF (L/s)	9.73	7.88	81
FIF (50 (L/s)		4.09	
FEF 50 (L/s)	5.45	4.23	77.6

**BODY PLETHYSMOGRAPH**

VC (L)	5.27	3.13	59.4
TLC (L)	6.9	4.51	65.4
ITGV (L)	3.25	3.58	110.2
ERV (L)	1.59	2.2	138.4
RV (L)	1.66	1.38	83.1
RV % TLC	24.49	30.58	124.9
PI MAX (kPa)	10.96	7.11	64.9
PE MAX (kPa)	14.51	11.55	79.6

**DIFFUSING CAPACITY**

TLCO SB (mmol/min/kPa)	11.63	5.27	45.3
Hb (g/100ml)		16.2	
TLCOc SB (mmol/min/kPa)	11.63	5.06	43.5
KCO (mmol/min/kPa)	1.68	1.54	91.7
TLC-He (L)	6.75	3.42	50.7

- 50 yr old male with SOB and cough >3yrs
- Exam: clubbing and bilat insp crackles
- CXR: reticulation bilateral
- ABG: hypoxic respiratory failure
- PFT: restrictive defect with significant impairment in DLco

# HRCT

- Designed for detailed evaluation of interstitial structures of the lung
- Use narrow slice thickness (1-2 mm) compared with 5-10 mm for routine scans

# HRCT

## Principle indications

- Suspected interstitial lung disease
- Characterization of interstitial lung disease
- Characterization of solitary pulmonary nodules
- Diagnosis of bronchiectasis



Se:2  
Im:11

[A]



Study Time:4:00:04 PM  
MRN:

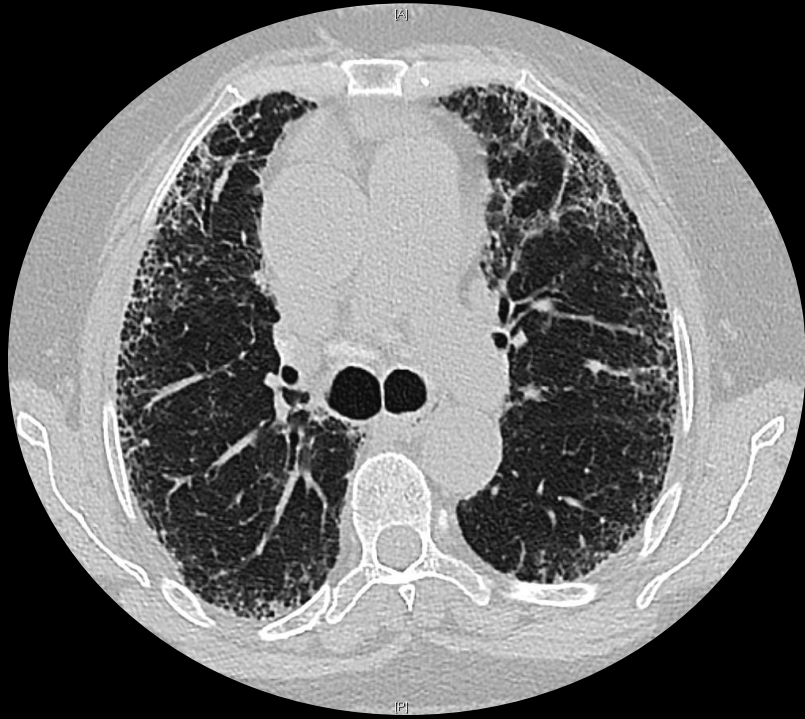


[R]

[L]

[P]

C56  
W342





Se:4  
Im:5

[A]



Study Time: 2:45:11 PM  
MRN:



C-498  
W1465

[R]



[A]

[L]

[P]

Se:7  
Im:7

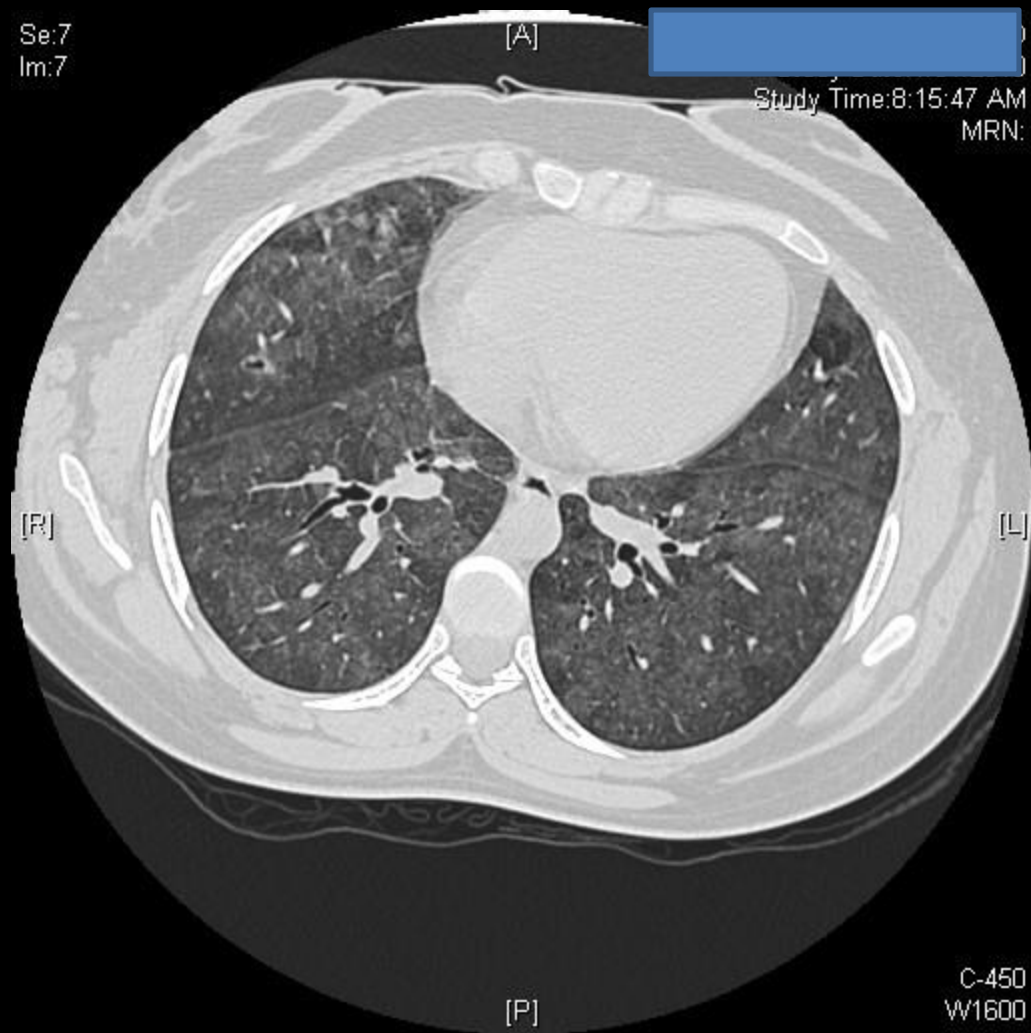
[A]



Study Time:8:15:47 AM  
MRN:

[R]

[L]



[P]

C-450  
W1600

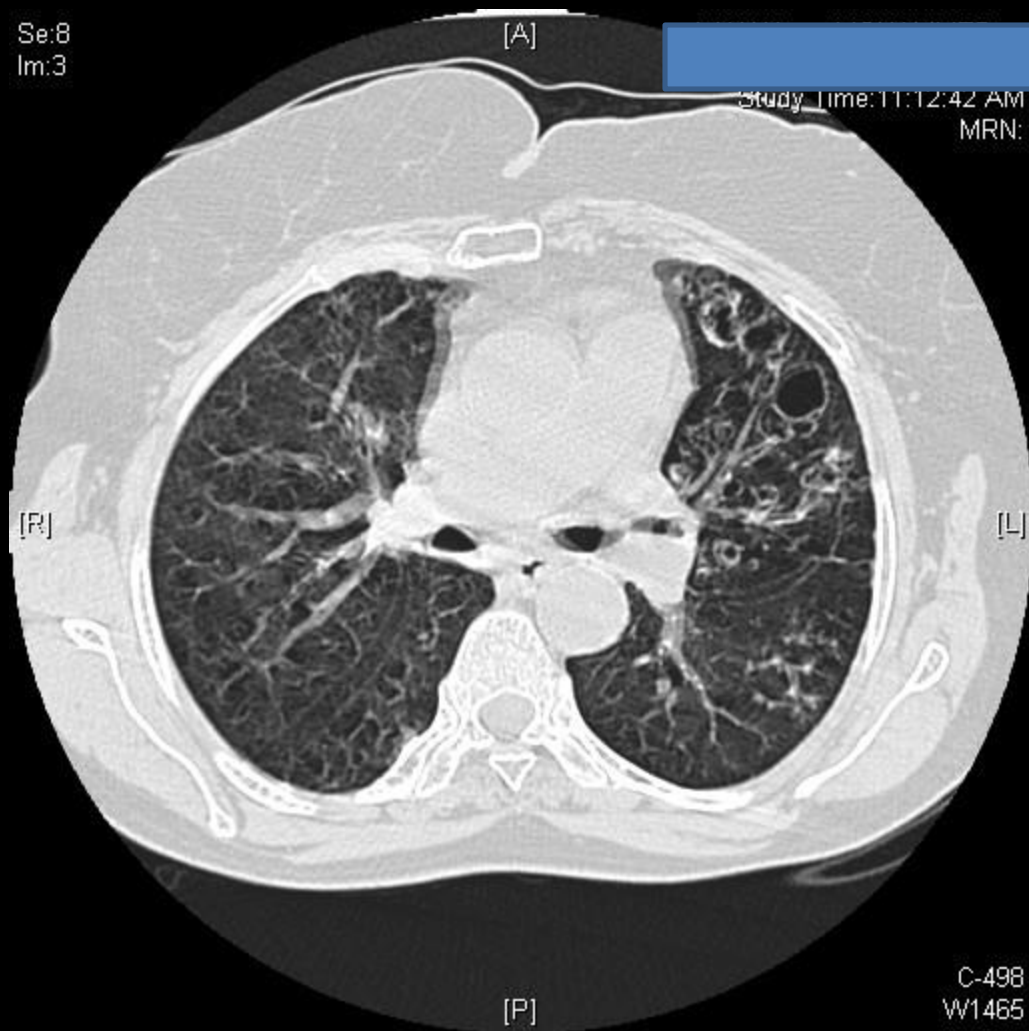
Se:8  
Im:3

[A]



Study Time: 11:12:42 AM  
MRN:

[R]



[L]

[P]

C-498  
W1465

- 45 yrs old female with RT sided chest pain for 1 day

- ABG pH 7.32, PaCO<sub>2</sub> 28, PaO<sub>2</sub> 50, O<sub>2</sub>sat 88%
- EKG sinus tachycardia
- CXR normal
- Spiral CT
- V/Q scan

# CT Angiography

- Image data are acquired continuously as the tube and detector rotate within the gantry and the patient moves continuously through the gantry

## Advantages

- Critically ill patients
- Children
- Less volume of intravenous contrast
- Permits greater processing of the raw data

Se:2  
Im:17

[A]



MRN:



[R]

[L]

[P]

C56  
W342



# Lung Scans: V/Q

- Technetium (Tc) 99 m radionuclide is tagged to macroaggregated albumin to make small radioactive particles
- When Tc decays, it emits a gamma ray detected by the nuclear medicine gamma camera: a nuclear medicine image is formed by detection of many gamma rays

# Lung scan: normal perfusion Q

- When injected via peripheral venous site, the first capillaries encountered are the pulmonary capillaries
- If perfusion is present at the capillary level of the lungs, nuclear medicine perfusion image demonstrate activity in the periphery of the lungs

# Lung scan: perfusion defect Q

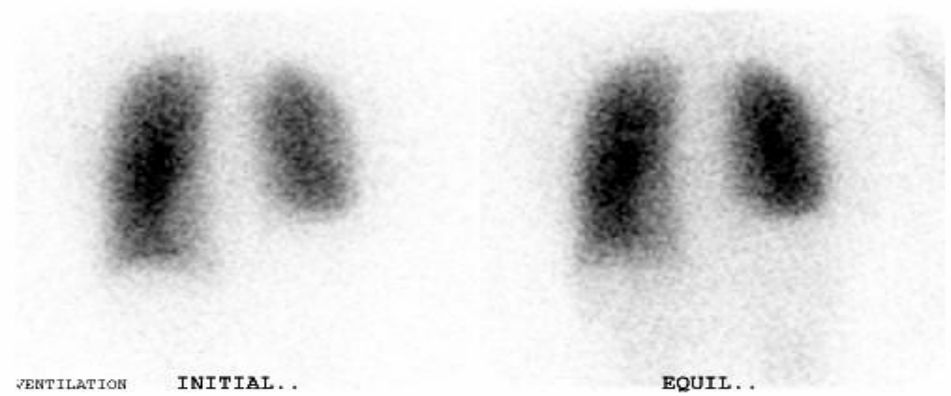
If there is an obstructing vascular lesion in the pulmonary arterial circulation



blocked perfusion to the distal capillary level



nuclear medicine perfusion image demonstrate no activity in the periphery of the lungs



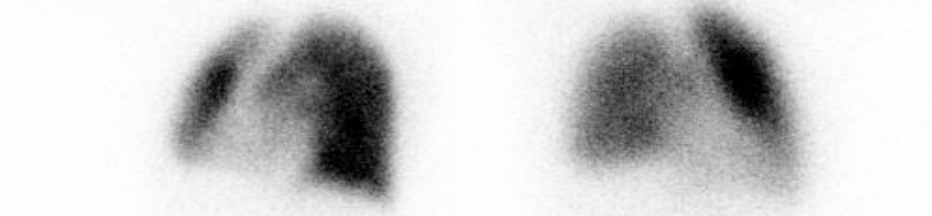
VENTILATION



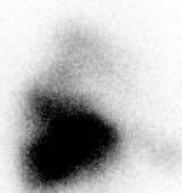
WASHOUT



PERFUSION



V.Q. SCAN



ANT PERF

POST PERF

RTLAT PERF



LTLAT PERF

LAO PERF

RPO PERF

**LUNG PERFUSION**

17Aug2006

KKUH

RM3

RSM

