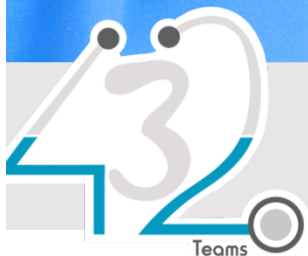


# MEDICINE

432 Team

13

## Investigations of Lung Disease



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COLOR GUIDE: • Females' Notes • Males' Notes • Important • Additional

# Objectives

1. Type of pulmonary diagnostic procedures.
2. Role of various specialized pulmonary procedures in diagnosing lung diseases.
3. When to apply specific tests.

## Pulmonary Diagnostic Procedures

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

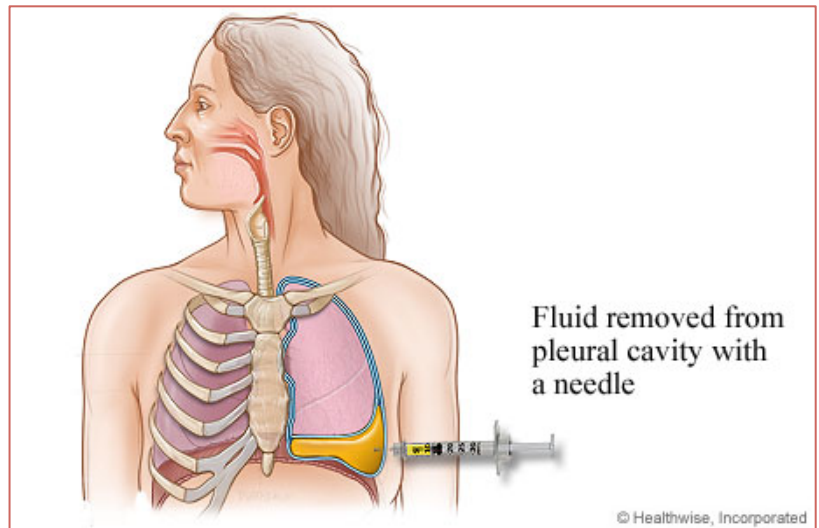
# 1- Thoracentesis:

Thoracentesis is a procedure to remove fluid from the space between the lining of the outside of the lungs (pleura) and the wall of the chest.

Before doing thoracentesis you have to run 3 tests:

1) Platelets count. 2) Coagulation profile. 3) Bleeding time. **(To exclude any blood clotting disorders)**

In thoracentesis, the doctor removes fluid from the space between the lungs and the chest wall (the pleural cavity). The doctor inserts a needle (and sometimes a plastic catheter) through the chest wall to remove and examine the fluid <sup>(1)</sup>.



## Indications of thoracentesis:

Thoracentesis is indicated for the symptomatic treatment of large **Pleural Effusions** (fluid in the pleural cavity) or for treatment of **Empyemas** (pus in the pleural cavity). It is also indicated for pleural effusions of any size that require diagnostic analysis <sup>(2)</sup>.

You have to make sure that the patients have PE by 2 ways:

- 1) **Decubitus Film** (the fluid have to be more than 1cm to do thoracentesis – see next page).
- 2) **Ultrasounds**.

## What do you look for in thoracentesis?

### 1) Appearance:

- Blood → **Hemothorax**.
- Pus → **Empyema**.

### 2) Gram stain, cultures

- If positive → **Complicated parapneumonic effusion (infected Pleura)**

### 3) pH

### 4) Chemistry (glucose, amylase,

- LDH "Lactate dehydrogenase", protein) .(all of them except for amylase exist normally in the pleural cavity in a very few amounts) <sup>(3)</sup>

### 5) Cytology

#### ❖ Separation of Transudates from Exudates:

##### • Pleural fluid analysis:

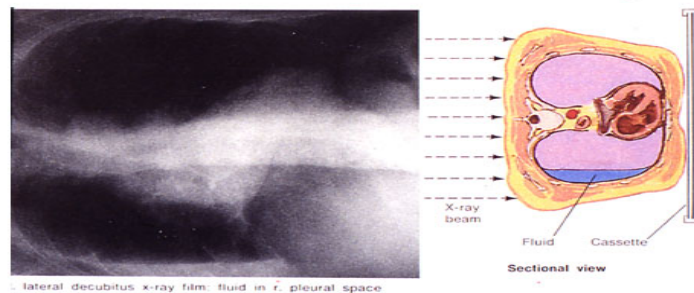
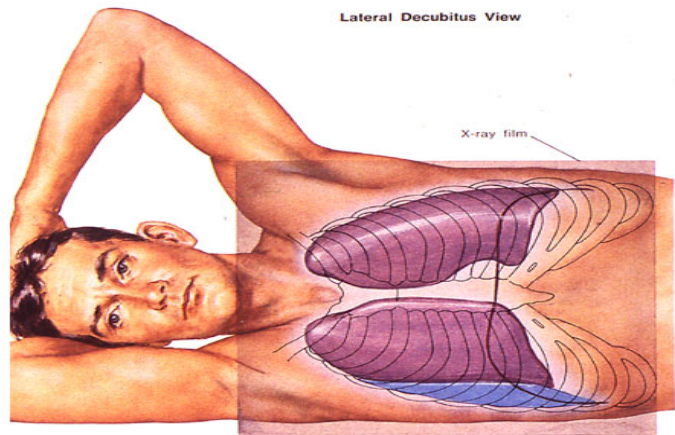
**If it is bloody:** hematocrit (Hct) < 1% = not significant, 1-20% = cancer, pulmonary embolism or trauma, >50% = hemothorax.

**If it is cloudy:** Triglyceride > 100 mg/dl = chylothorax.

**If it has putrid odor:** stain and culture = infection.

Or we can use light criteria: (if one of them is positive, it is exudative)

- Pleural fluid protein to serum protein ratio greater than 0.5
- Pleural fluid LDH to serum LDH ratio greater than 0.6
- Pleural fluid LDH greater than two-thirds of the upper limit of normal for the serum LDH
- If the effusion is pus or blood -gram stain positive- PH below 7.20 → you have to drain it immediately or else it will heal by fibrosis.



### ❖ **Complication of thoracentesis:**

- **Pneumothorax**
  - **Bleeding**
  - **Infection**
  - **Hypotension**
  - **Hypoxemia**
  - **Air embolism**
  - **Splenic laceration**
- If we are dealing with Empyema, Complicated parapneumonic effusion, Symptomatic pleural effusion, Hemothorax or Pneumothorax, **Then we have to insert a chest tube.**

## 2) **Pleural biopsy:**

A procedure in which a sample of the pleura is removed with a special biopsy needle or during surgery to determine if **infection, cancer, or another condition is present.**

- **The biopsy is done on parietal pleura**

### ❖ **Indications of pleural biopsy:**

When there is **exudative effusion** without pus or blood, gram stain and PH is 7.20, recurrent pleural effusions of unknown etiology, plural mass or thickening<sup>(4)</sup>.

## 3) **Bronchoscopy:**

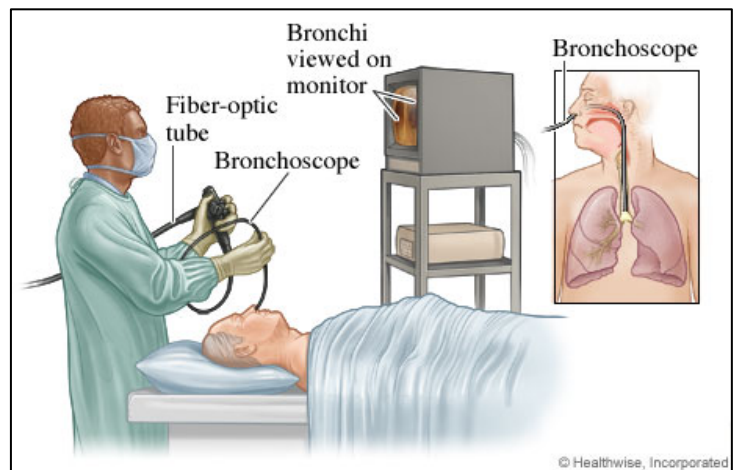
Bronchoscopy is an endoscopic technique of visualizing the inside of the airways for **diagnostic** and **therapeutic** purposes. An instrument (bronchoscope) is inserted into the airways, usually through the nose or mouth, or occasionally through a tracheostomy.

### ❖ Indications of bronchoscopy:

-When looking into an X-ray there will be no air going to the lungs (not Pleural effusion) – mediastinum is pulled in- on examination the percussion will not be stony dullness (**Collapsed lung**).

**Diagnostic indications:** suspected lung cancer, abnormal CXR, hemoptysis, unexplained cough, localized wheeze, positive sputum cytology, mediastinal lymph nodes, refractory cough, unexplained pleural effusion, lung abscess, staging of lung cancer, obtain culture material, airway trauma, tracheoesophageal fistula, and diffuse lung disease). Other **therapeutic** indications: Remove foreign bodies, remove abnormal endobronchial tissue, difficult endotracheal tube intubation, and endobronchial stent placement.

The scope is usually containing US for the assessment of surrounding structure (lymph node – blood vessel ...etc.)



<http://www.webmd.com/lung/bronchoscopy>

## 4) Pulmonary Function Test:

### 4 specific tests:

#### 1) Spirometry:

Spirometry is a common office test used to assess how well your lungs work by measuring how much air you inhale, how much you exhale and how quickly you exhale (5).

- **Indication: Airway lung disease: asthma, COPD**

A) Forced Vital Capacity (FVC) → >90% is normal.

B) Forced Expiratory Volume in the 1<sup>st</sup> sec (FEV<sub>1</sub>) → >90% is normal

FEV<sub>1</sub>/FVC → >75%

- If the ratio is less than 75 then it is **obstruction**, above 75 it is either normal or **suggestive of restrictive lung disease** (we have to do lung volume test)

## 2) Lung volume:

A) Total lung capacity >90% is normal.

B) Residual Volume >90% is normal.

- If the RV is less than 90 then it is **restrictive lung disease**.

The more common lung function values measured with Spirometry are <sup>(6)</sup>:

1. Forced vital capacity (FVC). This measures the amount of air you can exhale with force after you inhale as deeply as possible.
2. Forced expiratory volume (FEV). This measures the amount of air you can exhale with force in one breath. The amount of air you exhale may be measured at 1 second (FEV1), 2 seconds (FEV2), or 3 seconds (FEV3). FEV1 divided by FVC can also be determined.
3. Forced expiratory flow 25% to 75%. This measures the airflow halfway through an exhale.
4. Peak expiratory flow (PEF). This measures how much air you can exhale when you try your hardest. It is usually measured at the same time as your forced vital capacity (FVC).
5. Maximum voluntary ventilation (MVV). This measures the greatest amount of air you can breathe in and out during 1 minute.
6. Slow vital capacity (SVC). This measures the amount of air you can slowly exhale after you inhale as deeply as possible.
7. Total lung capacity (TLC). This measures the amount of air in your lungs after you inhale as deeply as possible.
8. Functional residual capacity (FRC). This measures the amount of air in your lungs at the end of a normal exhaled breath.
9. Residual volume (RV). This measures the amount of air in your lungs after you have exhaled completely. It can be done by breathing in helium or nitrogen gas and seeing how much is exhaled.
10. Expiratory reserve volume (ERV). This measures the difference between the amount of air in your lungs after a normal exhale (FRC) and the amount after you exhale with force (RV).

### 3) Diffusing Capacity (DL)

Measure the ability of gases to diffuse from the alveoli into the pulmonary capillary blood, by giving the patient carbon monoxide that is not present normally in the blood or the lungs. **If the DL is low:**

- 1- Emphysema (Distinguish emphysema from chronic bronchitis or chronic asthma).
- 2- Interstitial lung disease (fibrosis).
- 3- Pulmonary vascular disease. (Thrombo-embolic disease).

### 4) Respiratory muscle strength:

To diagnose the diseases that affects the muscle of respiratory system.

Measured by pressure transducer at the mouth when subject make a maximal inspiratory effort from full expiration or maximal expiratory effort from full inspiration

Respiratory muscle strength can be assessed by measuring the maximal inspiratory pressure (MIP, P<sub>I</sub>max, or negative inspiratory force [NIF]) and the maximal expiratory pressure (MEP or P<sub>E</sub>max). The MIP reflects the strength of the diaphragm and other inspiratory muscles, while the MEP reflects the strength of the abdominal muscles and other expiratory muscles<sup>(7)</sup>.

Neurological disease - metabolic disease - connective tissue disease (myositis) - drugs (corticosteroids for long time).

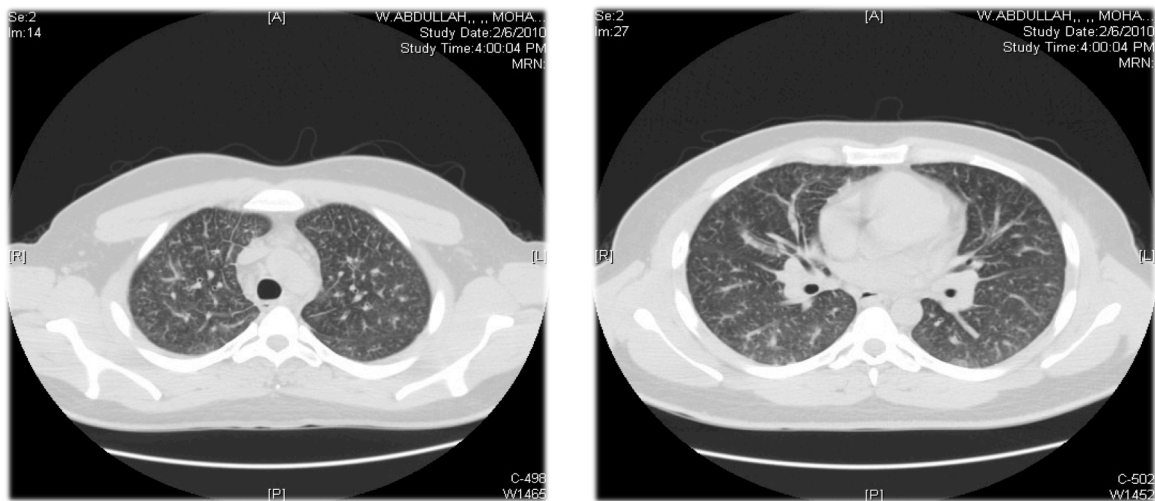


## 5) High Resolution computed Tomography (HRCT):

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

### ❖ Indications:

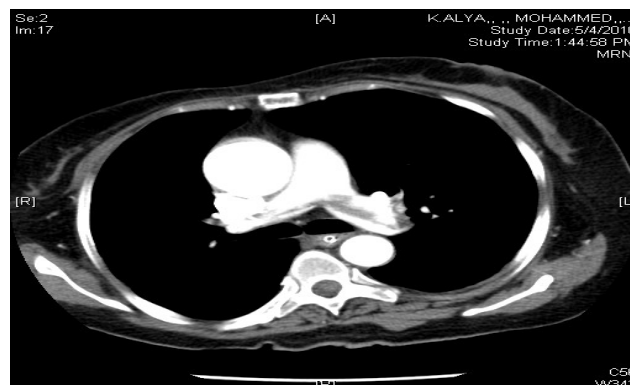
1. Suspected interstitial lung disease
2. Characterization of interstitial lung disease
3. Characterization of solitary pulmonary nodules
4. Diagnosis of bronchiectasis



## 6) CT Angiography:

- We inject the patient with a contrast and a rapid helical CT we call it spiral CT take the image very quickly and reconstruct the mediastinum and you want to see everything white (it takes the contrast) if you see a black spaces that is called filling defect.

If the filling defect is present we diagnose the patient with Pulmonary Embolism.



### ❖ Contraindication of CT Angiography:

1-renal failure 2- allergy to contrast 3- pregnancy

## 7) Lung Scans: V/Q (Ventilation Perfusion Scan)

It is a nuclear scanning test that is most commonly used to detect a blood clot that is preventing normal blood flow to part of a lung (pulmonary embolism) <sup>(8)</sup>.

The nuclear medicine unit does this, they tack the albumin and Technetium then inject it back to the patients via peripheral venues site.

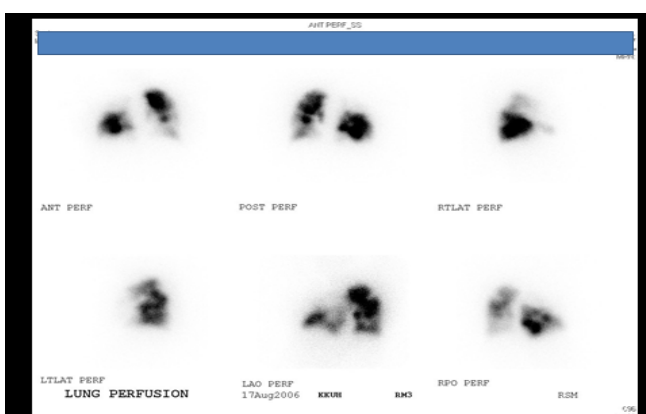
Two types of lung scans are usually done together <sup>(8)</sup>:

**Ventilation scan:** During ventilation scan, a radioactive tracer gas or mist is inhaled into the lungs. Pictures from this scan can show areas of the lungs that are not receiving enough air or that retain too much air. Areas of the lung that retain too much air show up as bright or "hot" spots on the pictures. Areas that are not receiving enough air show up as dark or "cold" spots.

**Perfusion scan:** During a perfusion scan, a radioactive tracer substance is injected into a vein in the arm. It travels through the bloodstream and into the lungs. Pictures from this scan can show areas of the lungs that are not receiving enough blood. The tracer is absorbed evenly in areas of the lung where the blood flow is normal. These areas show up with the tracer distributed evenly. Areas that are not receiving enough blood show up as cold spots.

If the lungs are working normally, blood flow on a perfusion scan matches airflow on ventilation scan. A mismatch between the ventilation and perfusion scans may mean a pulmonary embolism.

- We look to the perfusion of the capillary



Normally the lung appears Black if it is not black then the diagnoses is Pulmonary Embolism.

## **SUMMARY**

1. Thoracentesis: for pleural effusion
2. The effusion is divided based on light's criteria into exudative and transudative.
3. Pleural biopsy is done when suspecting of Malignancies or Granulomatous disease
4. Bronchoscopy is needed in the diagnosis of collapsed lung.
5. Bronchoscopy can be therapeutic and diagnostic procedure.
6. Pulmonary function test compose of 4 different tests (spirometry, lung volume, diffusing capacity, and Respiratory muscle strength).
7. CT Angiography: A lung scan: V/Q is done when investigating for Pleural Embolism.

### **List of References:**

1. <http://www.webmd.com/lung/placement-of-a-thoracentesis-needle>
2. <http://emedicine.medscape.com/article/80640-overview>
3. <http://emedicine.medscape.com/article/299959-workup>
4. <http://emedicine.medscape.com/article/1894279-overview#a3>
5. <http://www.mayoclinic.org/tests-procedures/spirometry/basics/definition/prc-20012673>
6. <http://www.webmd.com/lung/lung-function-tests>
7. <http://www.uptodate.com/contents/tests-of-respiratory-muscle-strength>
8. <http://www.webmd.com/lung/lung-scan>

## Questions

1) Based on the pulmonary function test for this patient what is your differential diagnosis?

- a. sarcoidosis
- b. Emphysema
- c. Chronic bronchitis
- d. empyema

### DIAGNOSIS

SARCOIDOSIS

Date and Time	Baseline		
	03/02/2010	08:41	
<b>SPIROMETRY</b>			
FVC (L)	Pred 5.04	Pre 3.13	%Pred/P 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
<b>BODY PLETHYSMOGRAPH</b>			
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
<b>DIFFUSING CAPACITY</b>			
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

2) Why we have to do the CBC (Platelets- coagulation-bleeding time) before the thoracentesis?

-Because thoracentisi is an invasive procedure's. So, we have to check for any bleeding disorder.

**432 Medicine Team Leaders**

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**Answers:**

1<sup>st</sup> question: a