

The Lungs

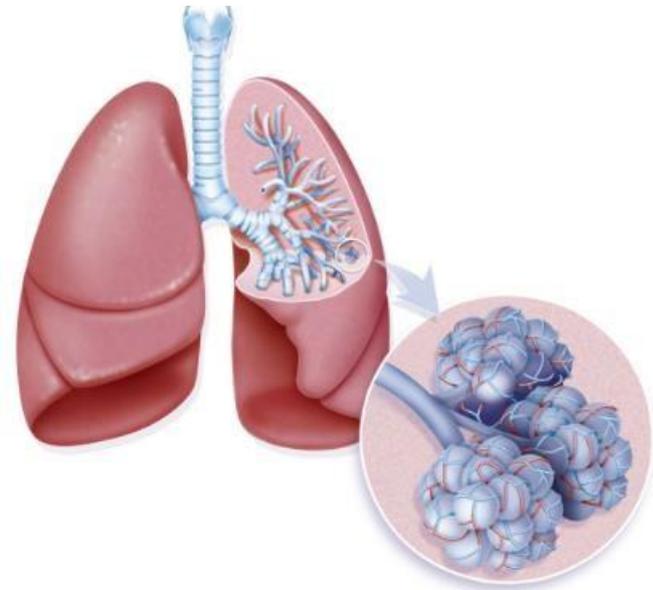
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The lungs

- Their function in the respiratory system is to extract oxygen from the air and transfer it into the bloodstream, and to release carbon dioxide from the bloodstream into the atmosphere, in a process of Gas Exchange.
- Humans have two lungs, a right and left lung. They are situated within the thoracic cavity of the chest.
- The right lung is bigger than the left.
- The lungs are part of the lower respiratory tract that begins at the trachea and branches into the bronchi and bronchioles, then alveolar sacs



The pleural cavity

- Is the potential space between the pleurae of the pleural sac that surrounds each lung. A small amount of serous pleural fluid is maintained in the pleural cavity to enable lubrication between the membranes.
- The serous membrane that covers the surface of the lung is the visceral pleura and is separated from the outer membrane the parietal pleura by just the film of pleural fluid in the pleural cavity.

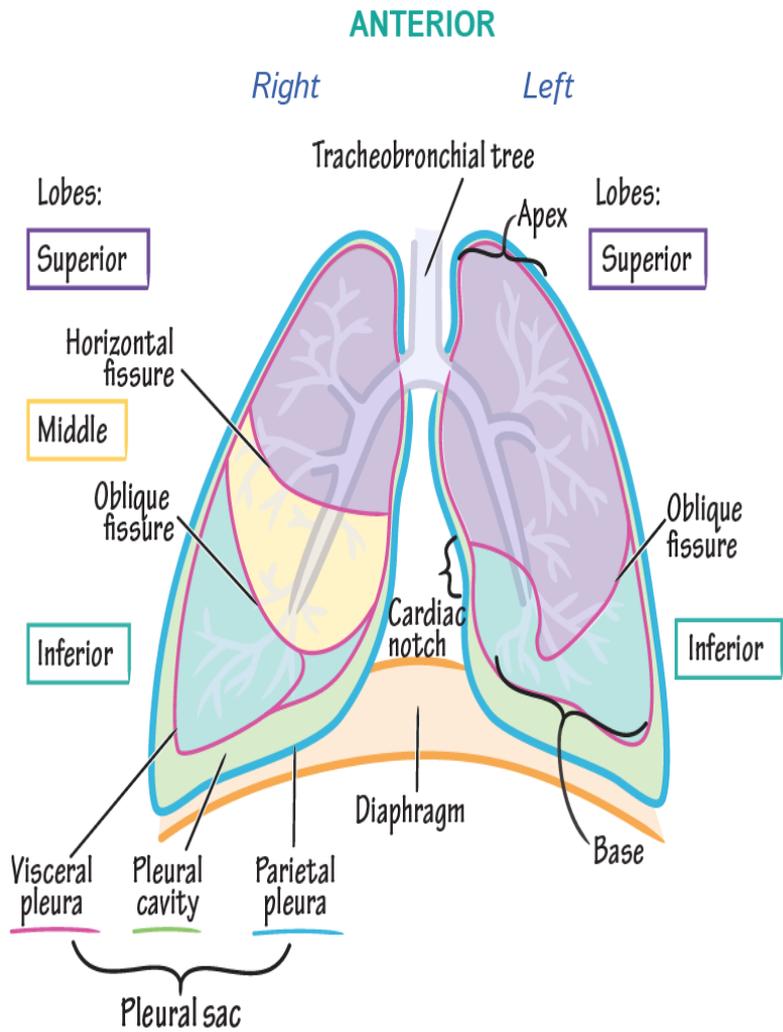
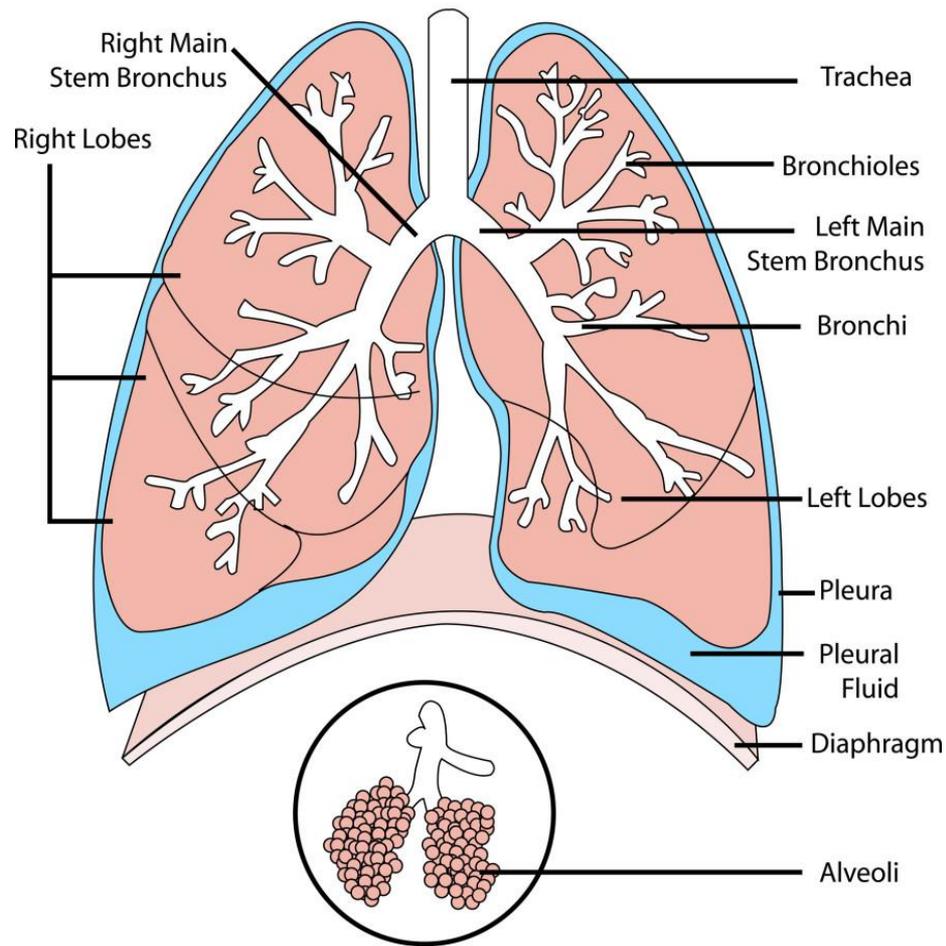
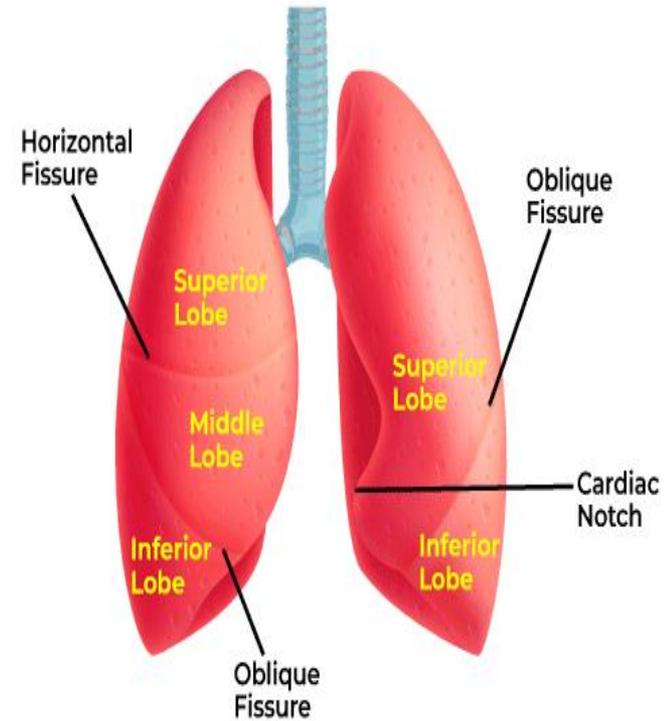


Diagram of the Human Lungs



Fissures

- The fissures are invaginations of the visceral pleura that divide the lobar bronchi, and section the lungs into lobes that helps in their expansion.
- The right lung is divided into three lobes by a **horizontal fissure**, and an **oblique fissure**.
- The left lung is divided into two lobes by an **oblique fissure**.



Pleural Effusion

Pleural Effusion is abnormal accumulation of fluid in the pleural cavity normally 10 to 20 cc of fluid is present , if more than 200 cc can cause blunting by CXR.

Mechanisms:

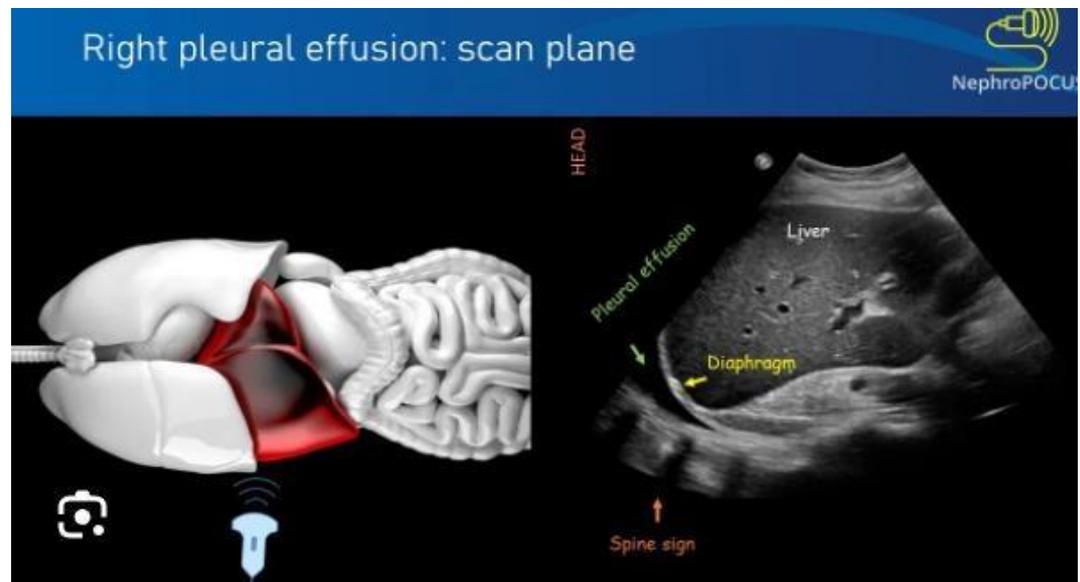
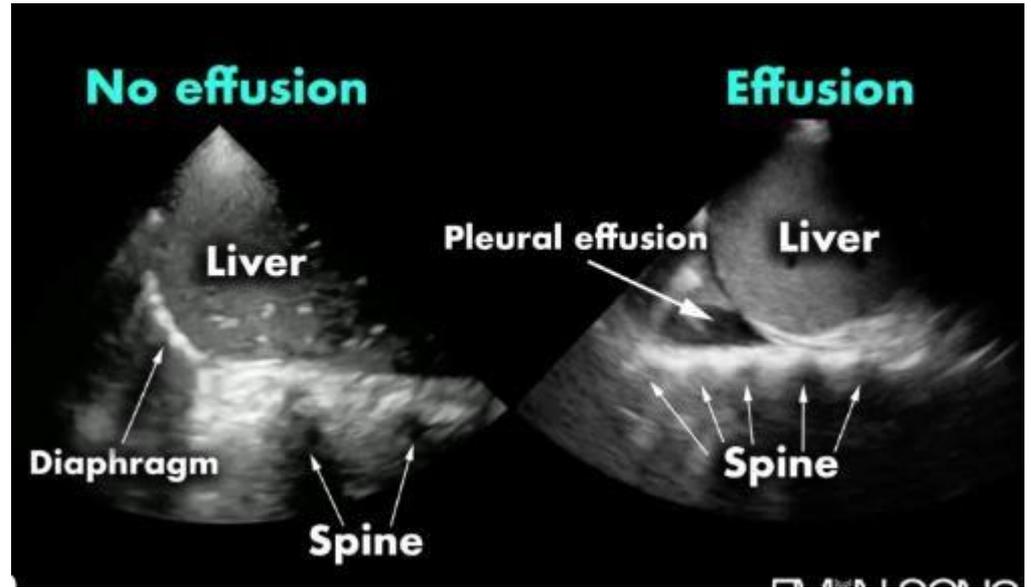
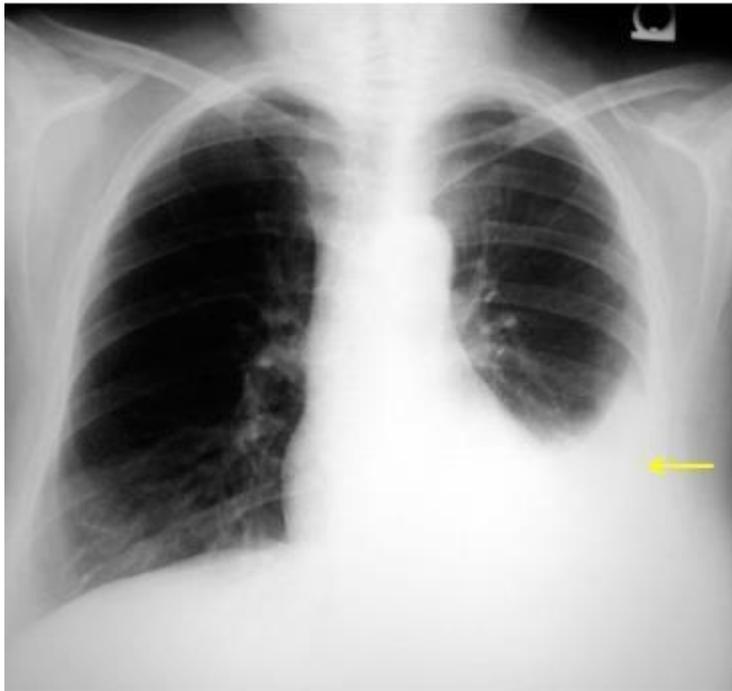
1. [Lymphatic](#) obstruction
2. Increased [capillary](#) permeability
3. Decreased plasma colloid osmotic pressure
4. Increased capillary venous pressure

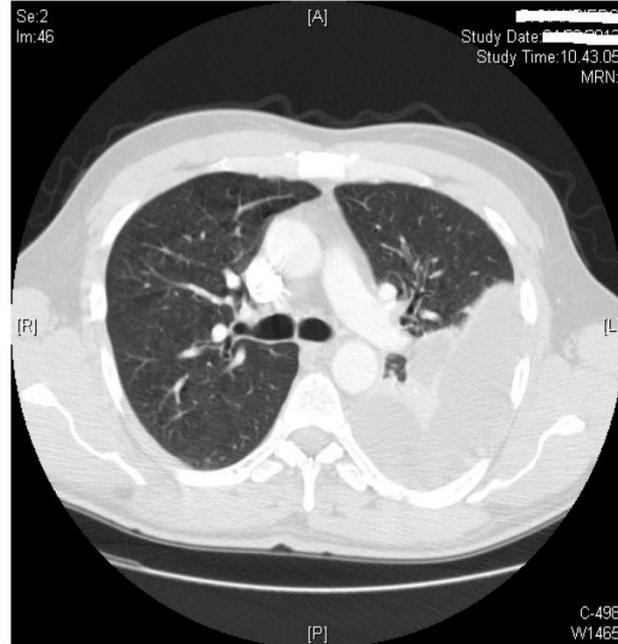
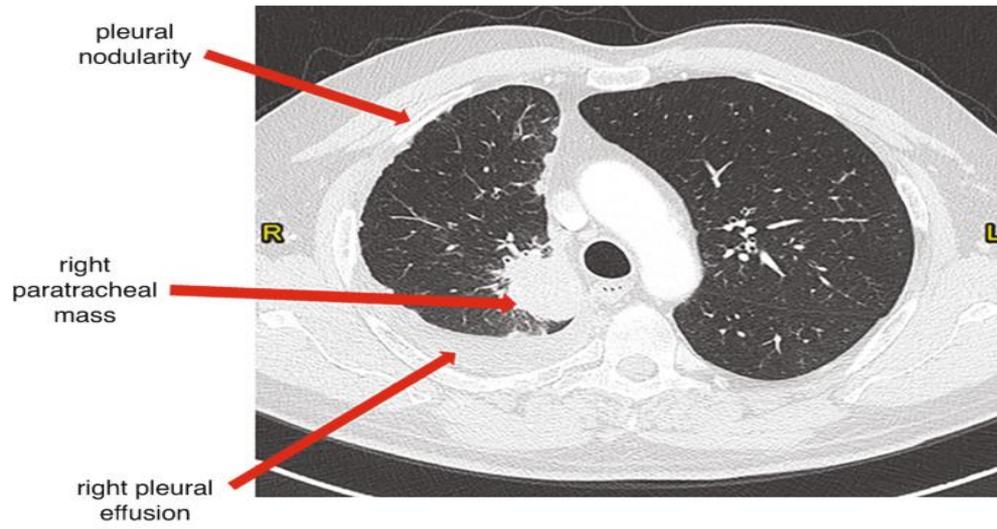
Pleural effusions are classified .

- **Exudative** pleural effusions contains high protein , are generally caused by infections such as pneumonia (parapneumonic pleural effusion), malignancy, granulomatous disease such as tuberculosis, inflammatory states.
- **Transudative** pleural effusions contains low protein occur in congestive heart failure (CHF), cirrhosis or nephrotic syndrome.

Imaging

- Findings on chest radiographs CXR frequently confirm the presence of pleural effusion. chest radiography is limited in evaluating the underlying etiology.
- Ultrasound is also sensitive in diagnosis and assessing the quantity of PE
- CT chest is very sensitive and used to assess the underlying diseases like malignancy.

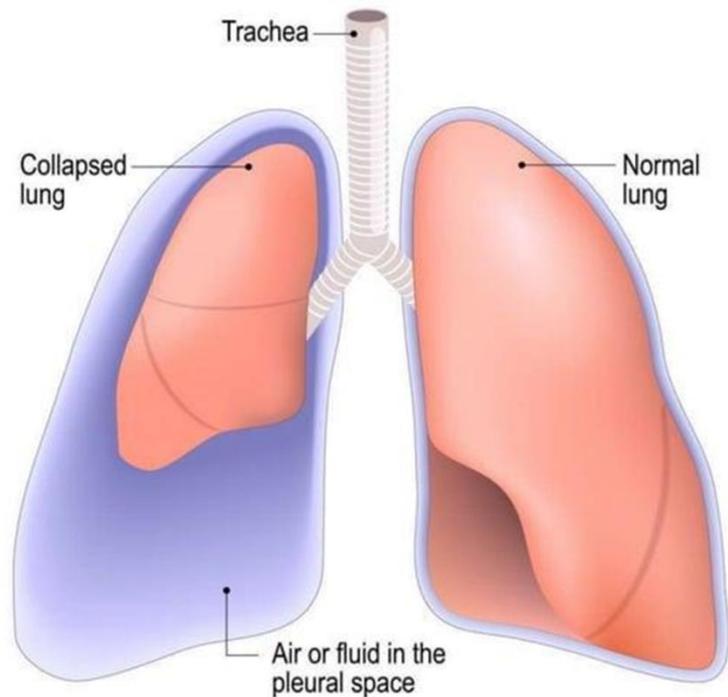




Pneumothorax

Is an abnormal collection of air in the pleural space between the lung and the chest wall.

Symptoms typically include sudden onset of sharp, one-sided chest pain and shortness of breath.

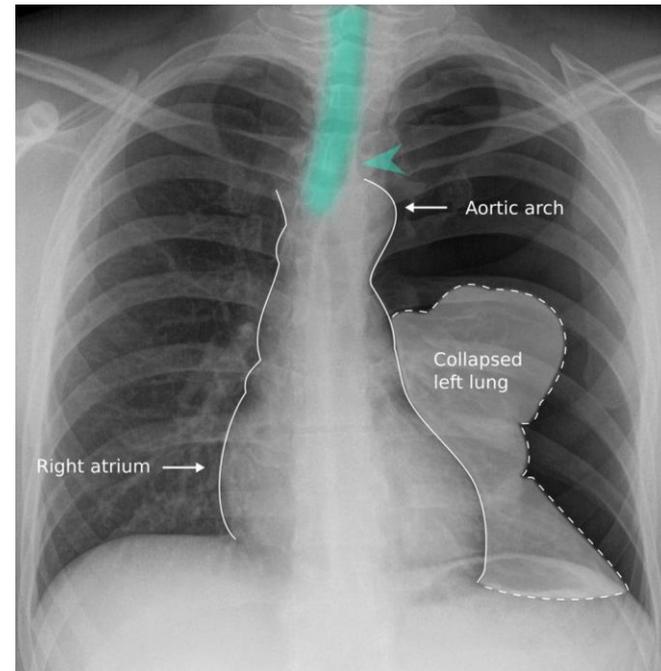
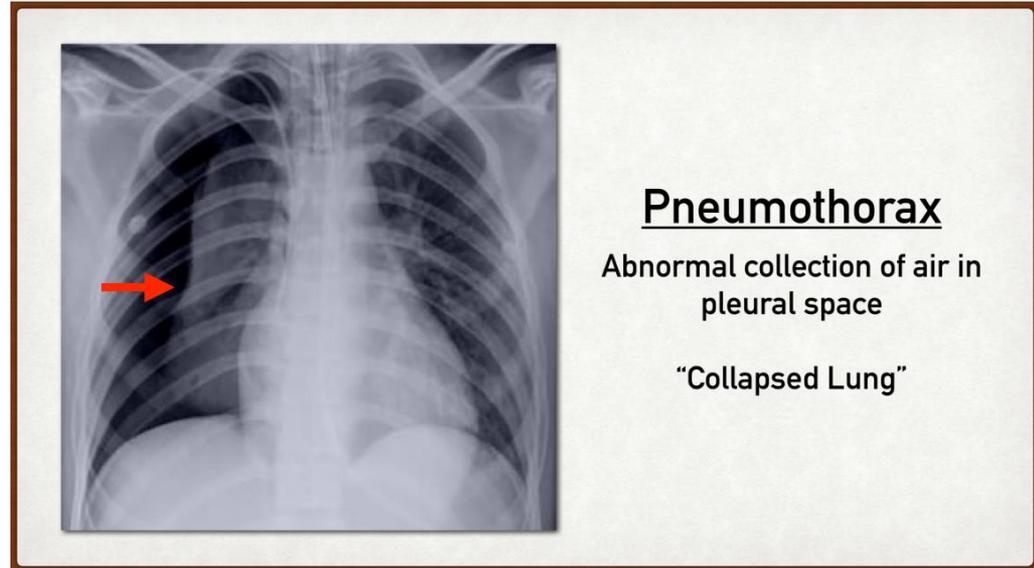


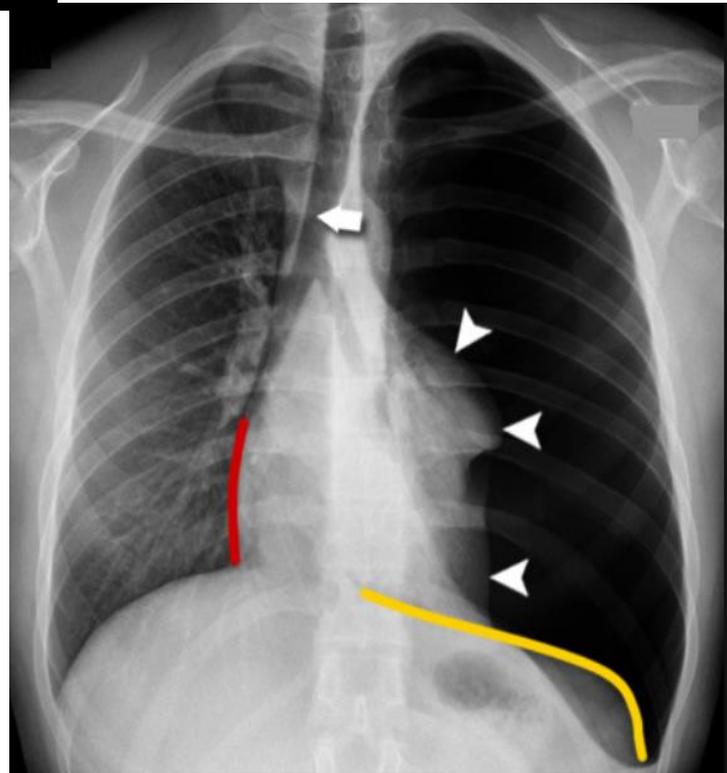
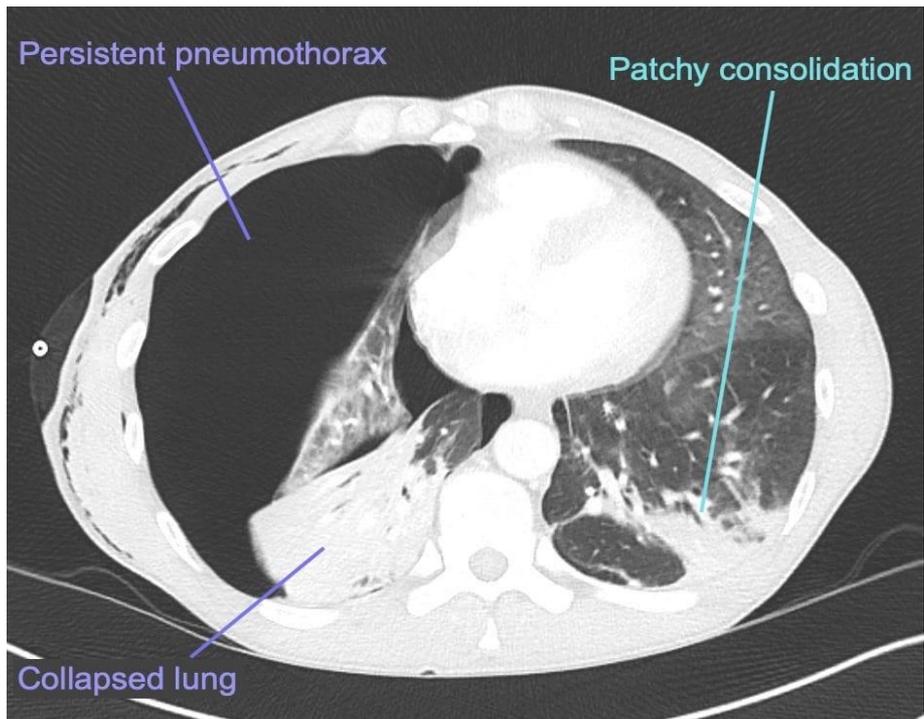
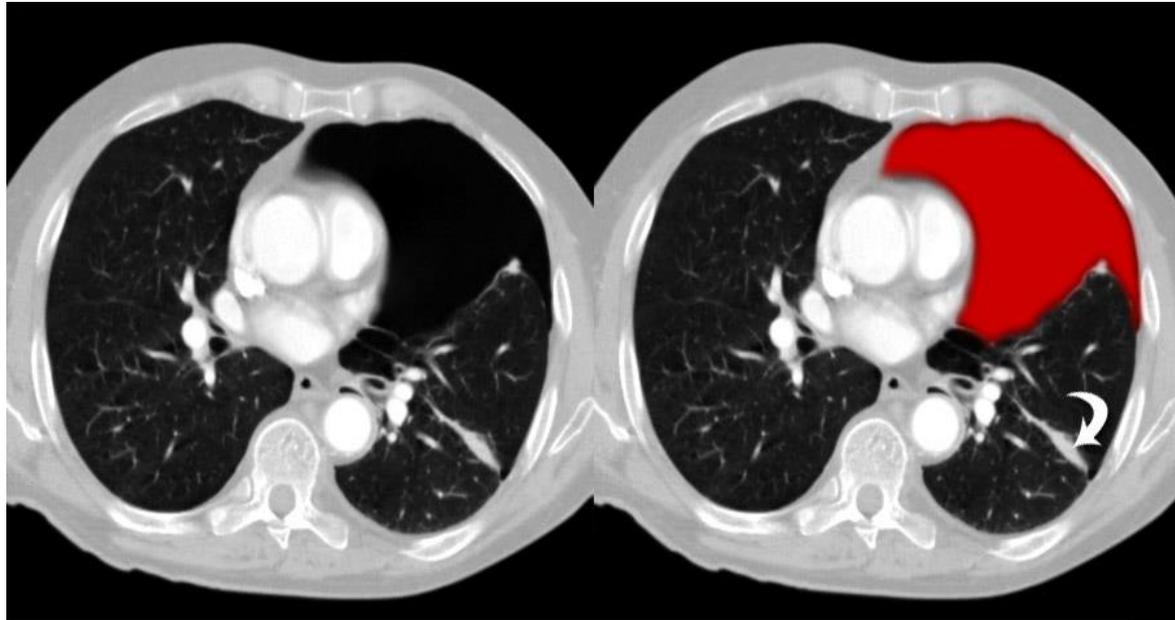
Classification

- **Primary spontaneous pneumothorax** is one that occurs without an apparent cause and in the absence of significant lung disease. Smoking increases the risk of primary spontaneous pneumothorax
- **Secondary spontaneous pneumothorax** occurs in the presence of existing lung disease., the main underlying causes for secondary pneumothorax are COPD, asthma, and tuberculosis.
- **Traumatic pneumothorax** can develop from physical trauma to the chest (including a blast injury) or from a complication of a healthcare intervention like pericardial fluid aspiration or pleural fluid aspiration

Diagnosis

Diagnosis made with chest X-ray, computed tomography (CT) scan, or ultrasound is usually used to confirm its presence





Respiratory tract infections

Are infectious diseases involving the respiratory tract. An infection of this type usually is further classified as an

- **Upper respiratory tract infection** include tonsillitis, pharyngitis, laryngitis, sinusitis, otitis media, certain influenza types, and the common cold.
- **Lower respiratory tract infection**: consists of the trachea , bronchial tubes, bronchioles, and the lungs. Lower respiratory infections, such as bronchitis. Bronchiolitis and pneumonia, tend to be more severe. LRIs are the leading cause of death among all [infectious diseases](#)

- **Acute bronchitis** usually has a cough that lasts around three weeks, In more than 90% of cases the cause is a viral infection
- **Chronic bronchitis** is defined as a productive cough – one that produces sputum – that lasts for three months or more per year for at least two years. Tobacco smoking is the most common cause,
- **Imaging in acute bronchitis is non-specific mainly to exclude pneumonia**

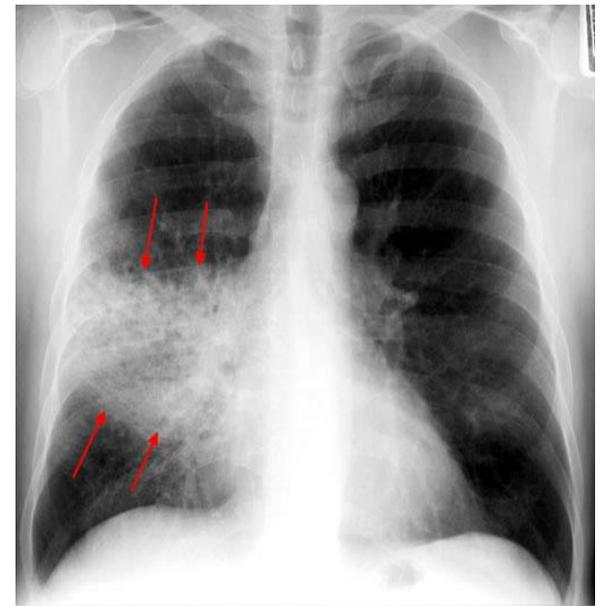
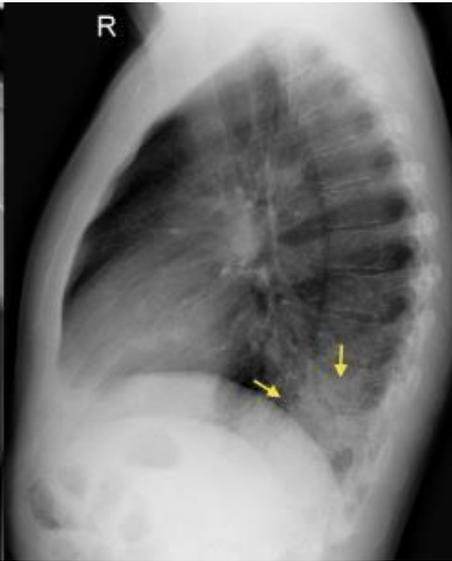
- **Bronchiolitis** is blockage of the small airways in the lungs. Acute bronchiolitis is due to a viral infection usually affecting children younger than two years of age.
- CXR finding is non specific.

Pneumonia

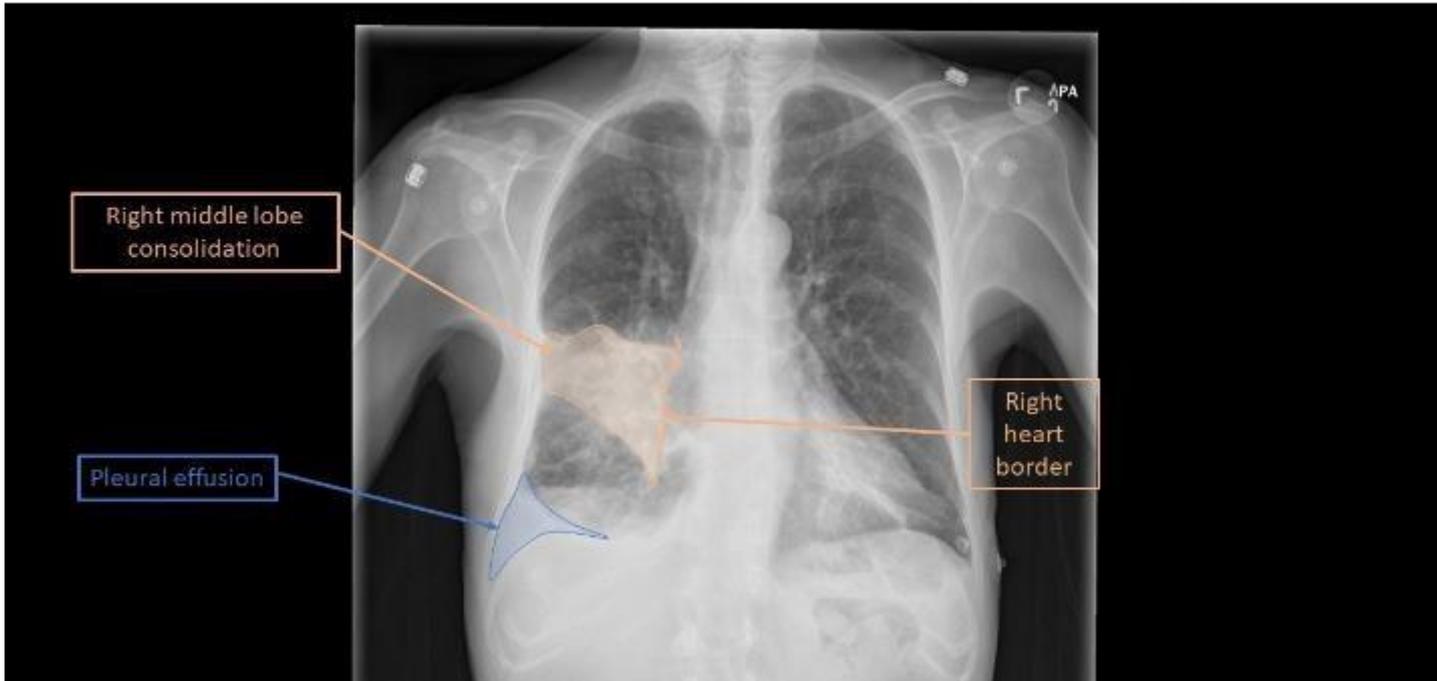
- Is an inflammatory condition of the lung primarily affecting the small air sacs known as alveoli.
- Characterized by inflammatory exudate within the intra-alveolar space resulting in consolidation of the lobe of a lung .
- If severe may threatens life specially in Age extremes or patients with immune deficiency .
- Symptoms typically include some combination of productive or dry cough, chest pain, fever, rigor and difficulty breathing. pneumonia remains a leading cause of death in developing countries
- Pneumonia is usually caused by infection with viruses or bacteria, and less commonly by other microorganisms.

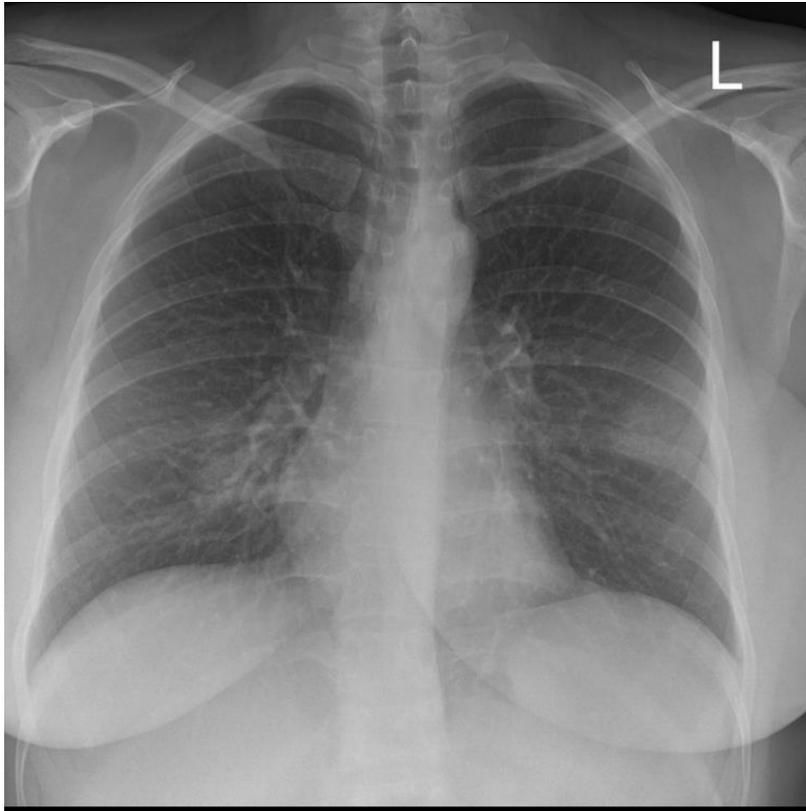
Imaging:

- A chest radiograph is frequently used in patients suspected with pneumonia
- Findings do not always match the severity of disease and do not reliably separate between bacterial and viral infection.
- X-ray presentations of pneumonia may be classified as lobar pneumonia, bronchopneumonia .
- **Lobar pneumonia** Consolidation in lobar pneumonia mainly affects the alveolar air spaces. There is characteristic relative sparing of the bronchi, creating the appearance of air bronchograms.
- **Bronchopneumonia** is a subtype of pneumonia. It is the acute inflammation of the bronchi, accompanied by inflamed patches in the nearby lobules of the lungs



60-year-old-woman with three days of fevers and productive cough.





Hazy consolidations in the left middle lung zone laterally, and around the inferior border of the right hilum. Findings are in line with bronchopneumonia.

Pediatric patient

Fever, Cough
Shortness of
Breath

What is your
diagnosis?

Swipe for answer!

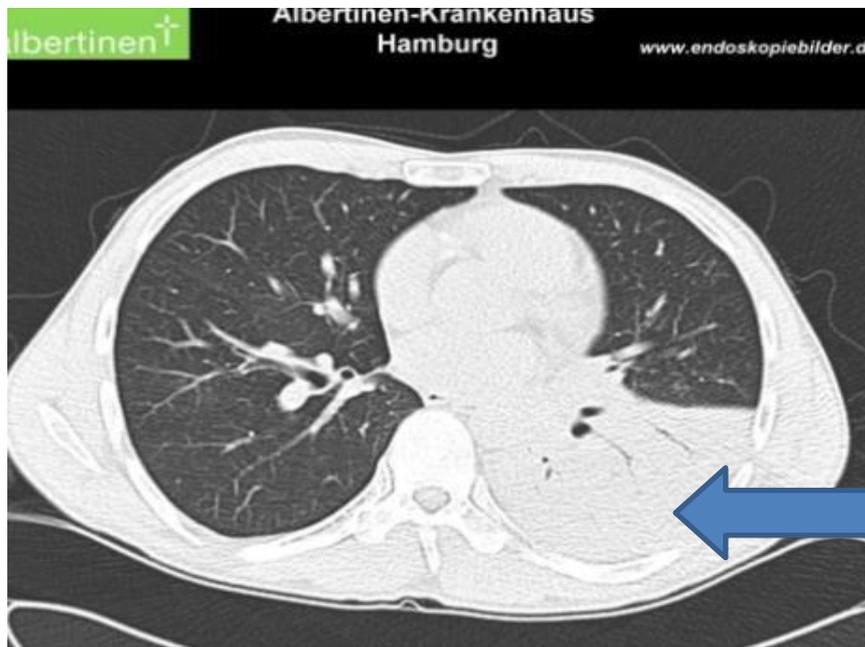
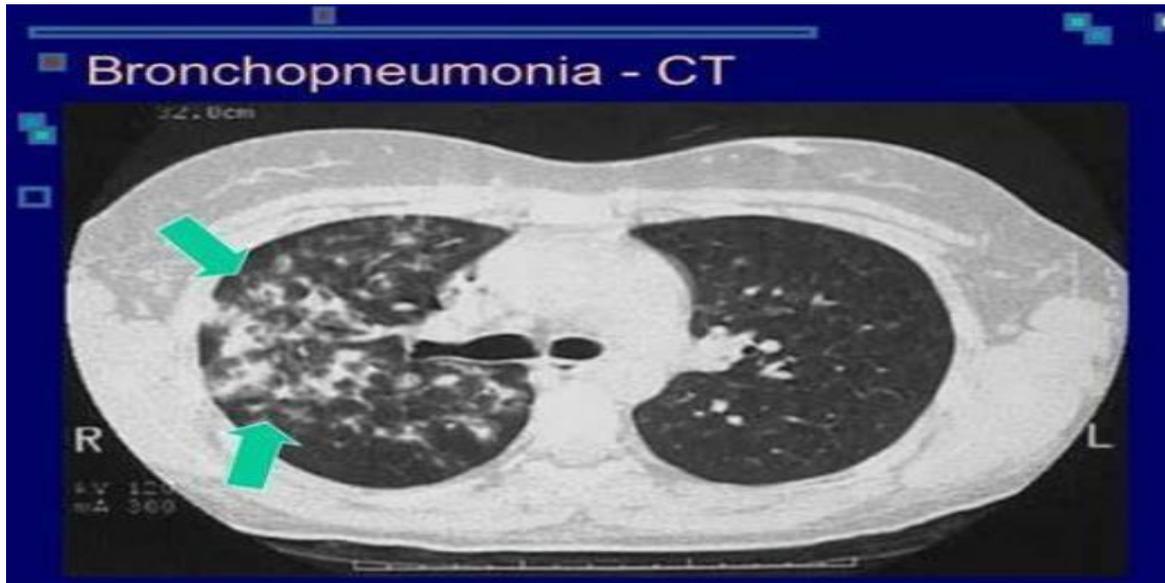
Bronchopneumonia

Patchy consolidation
not limited by fissures

Air Bronchogram

The bronchopneumonia pattern:
Patchy areas of consolidation
that may be initially limited to one
or more pulmonary segments
but it progresses to multifocal
often bilateral, consolidation.

An annotated frontal chest X-ray of a pediatric patient. The image shows patchy consolidations in both lung fields, outlined in orange. Blue arrows point to air bronchograms within the consolidations. A red box at the bottom right contains text describing the bronchopneumonia pattern. The text includes 'The bronchopneumonia pattern: Patchy areas of consolidation that may be initially limited to one or more pulmonary segments but it progresses to multifocal often bilateral, consolidation.' There is also a 'Swipe for answer!' prompt with an orange arrow pointing to the right.



Lobar pneumonia

Pneumonia

Best diagnostic
clue

- Consolidation/ ground-glass opacity in patient with fever

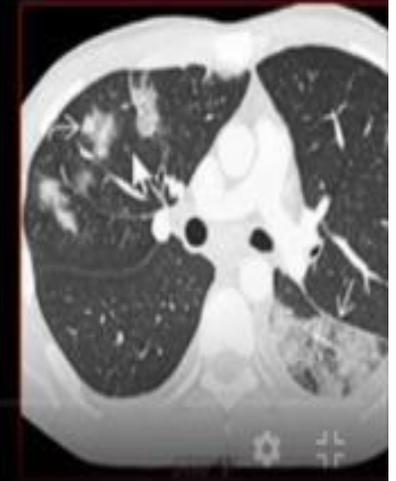
Lobar

Single lobe or multiple lobes
presence of air bronchogram



Bronchopneumonia

Multifocal "lobular"
Absence of air bronchogram



COVID-19

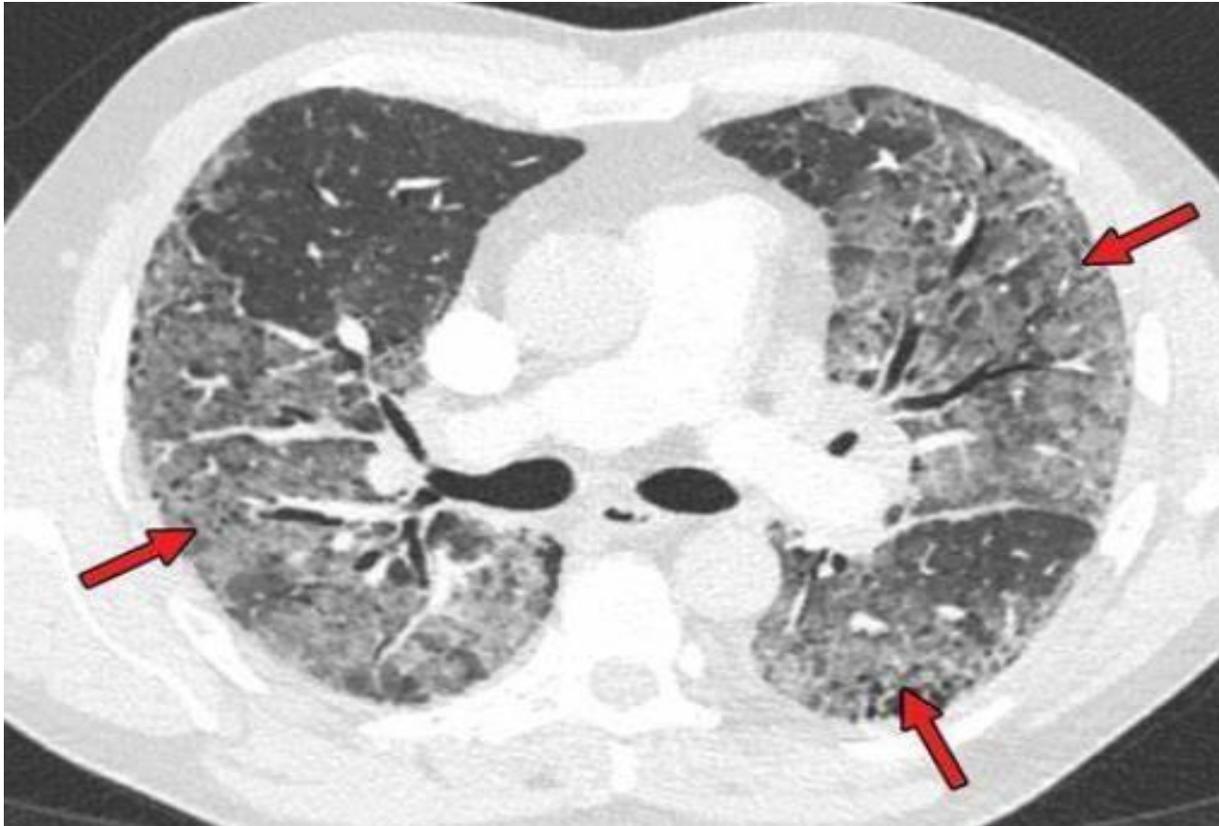
- The most common symptoms of COVID-19 include fever, cough, dyspnea, fatigue, and myalgia, less common symptoms are sputum, hemoptysis, headache, and gastrointestinal symptoms .
- COVID-19 infection is confirmed in many countries by Reverse Transcription Polymerase Chain Reaction (RT-PCR) on nasopharyngeal and throat swabs, with a positive rate of 30–70% .

Imaging for COVID 19

Chest CT scan was found to be more sensitive than RT-PCR in confirming the diagnosis of COVID-19 reaching 98% .

Chest x-ray was found to have limited value in the initial diagnosis of COVID-19 with a sensitivity of about 69% .

Patients with COVID-19 had typical radiological findings on chest imaging including multifocal and bilateral ground glass opacities and consolidations with peripheral and basal predominance.



CT Lung (COVID 19)

Chronic obstructive pulmonary disease (COPD)

- Is a type of progressive lung disease. COPD is characterized by long-term respiratory symptoms and airflow limitation. **The main symptoms** include shortness of breath and a cough, which may or may not produce mucus. COPD progressively worsens with everyday activities such as walking or dressing

The two most common conditions of COPD are emphysema and chronic bronchitis

- **Chronic bronchitis** is marked by mucus hypersecretion and mucins. Excess mucus can narrow the airways, thereby limiting airflow and accelerating the decline in lung function, and result in COPD, those patients usually are obese and called blue bloater and they called blue because of cyanosis.
- **Emphysema** is defined as enlarged airspaces (alveoli) whose walls break down resulting in permanent damage to the lung tissue, those patients are usually are thin and called pink puffer
- COPD develops as a significant and chronic inflammatory response to inhaled irritants (smoke, industrial dusts) which ultimately leads to bronchial and alveolar remodelling in the lung known as small airways disease

Imaging

- an X-ray may reveal bullae. In the lungs, a bullae are a pocket of air that forms near the surface of the lungs. Bullae can get quite large (greater than 1 cm) and take up significant space within the lung.
- other findings include Increased radiolucency of the lung field, Flattening of the diaphragms, Widening of the intercostal spaces, Narrowed and more vertical cardiac silhouette.

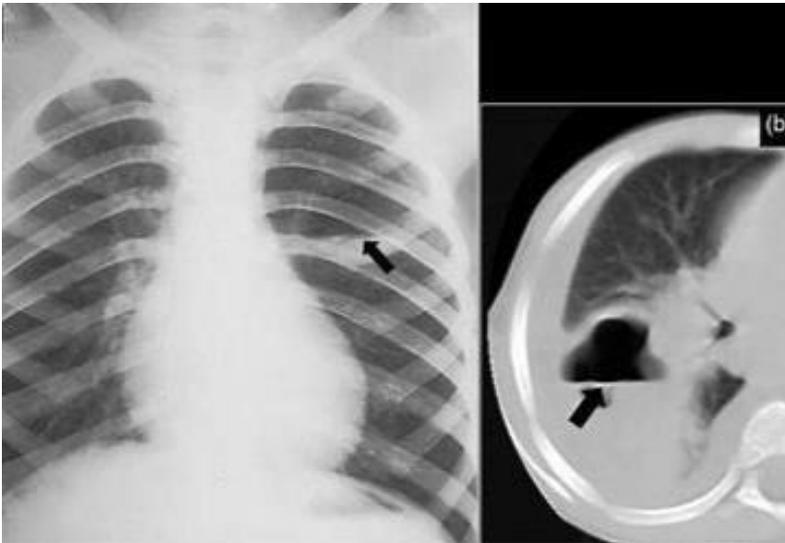
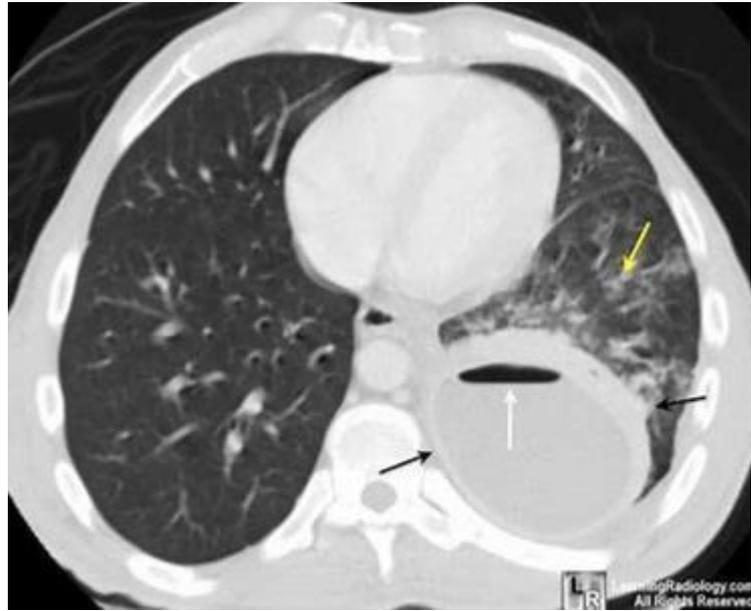


Lung abscess

- Is a type of liquefactive necrosis of the lung tissue and formation of cavities (more than 2 cm) containing necrotic debris or fluid caused by microbial infection
- Onset of symptoms is often gradual, Cough, fever with shivering, and night sweats are often present. Cough can be productive of foul smelling

Imaging studies

- Lung abscesses are often on one side and single involving posterior segments of the upper lobes and the apical segments of the lower lobes as these areas are gravity dependent when lying down.
- CXR are the initial imaging technique that will show a cavitation with air fluid level.
- CT chest also is very important and give details of the lesion, CT with contrast is used to differentiate malignancy from infection



Lung Abscess

Tuberculosis (TB)

- Is an infectious disease usually caused by Mycobacterium tuberculosis (MTB) bacteria.
- Tuberculosis generally affects the lungs, but can also affect other parts of the body.
- Typical symptoms of active TB are a chronic cough with blood-containing mucus, fever, night sweats, and weight loss.
- **Primary pulmonary** TB affect any site of the lung and usually no cavitation occurs mostly in hilum resembling lobar pneumonia
- **Post Primary Pulmonary TB** is Most common site of in the upper lobe causing cavitation

TB Imaging

- CXR IS helpful that in primary Pulmonary TB it may show a patch in any area of lung tissue , in post primary pulmonary TB it occur mainly in the upper lobe and can presented as a cavity
- CT chest may be ordered for more details.



Pulmonary embolism (PE)

Is a blockage of an artery in the lungs by a substance that has moved from elsewhere in the body through the bloodstream (embolism).

Symptoms of a PE may include shortness of breath, chest pain particularly upon breathing in, and coughing up blood.

Symptoms of a blood clot in the leg may also be present, such as a red, warm, swollen, and painful leg.

Signs of a PE include low blood oxygen levels, rapid breathing, rapid heart rate, and sometimes a mild fever.

CT pulmonary angiogram (CTPA)

A **CT pulmonary angiogram (CTPA)** is a medical diagnostic test that employs [computed tomography \(CT\) angiography](#) to obtain an image of the [pulmonary arteries](#).

Its main use is to diagnose [pulmonary embolism](#) (PE).

It is a preferred choice of imaging in the diagnosis of PE due to its minimally invasive nature for the patient, whose only requirement for the scan is an intravenous line.

