

Radiology of the Chest

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Characteristics of good diagnostic tests:

- 1. Sensitive**
- 2. Specific**
- 3. Harmless**
- 4. Inexpensive**
- 5. Not uncomfortable**



pneumoencephalography, technique of diagnostic radiology that produces X-ray films of the head after injection of air or gas between the membranes lining the brain and spinal cord to sharpen the outlines of various brain structures



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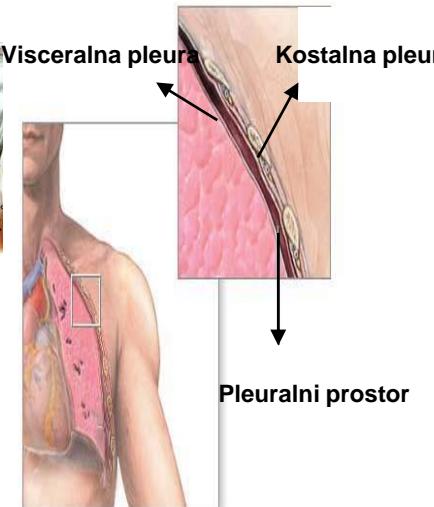
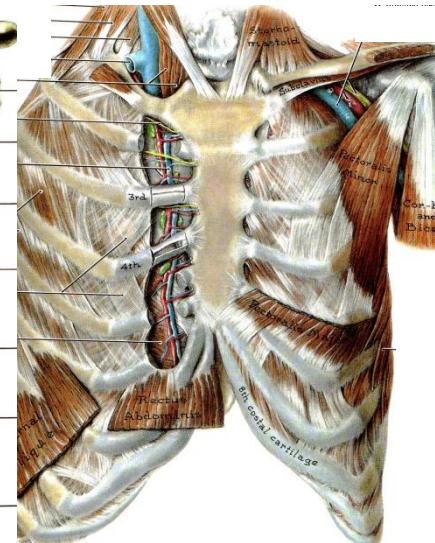
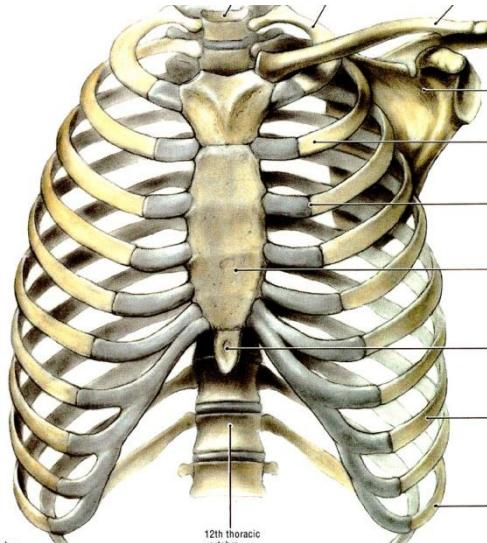
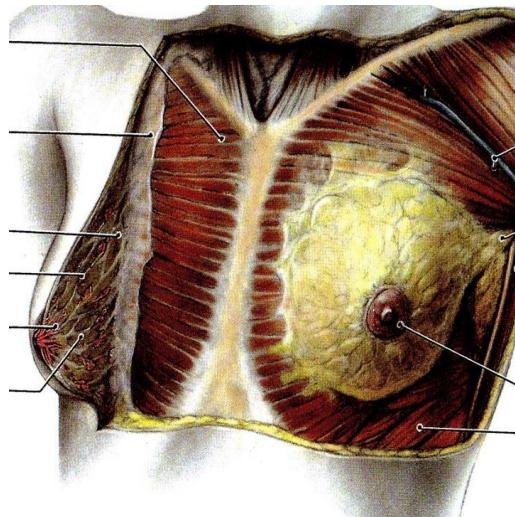


For now, no UNIQUE diagnostic tests for analyzing changes in the thorax!

Problem of inability to perform just a single diagnostic procedure of the Chest -

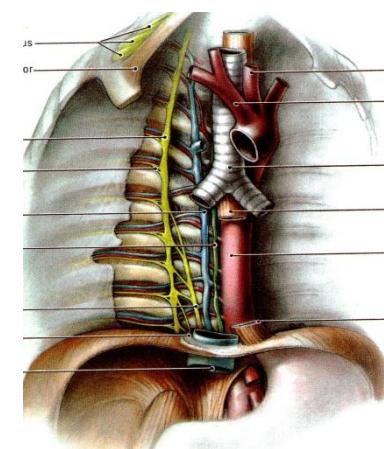
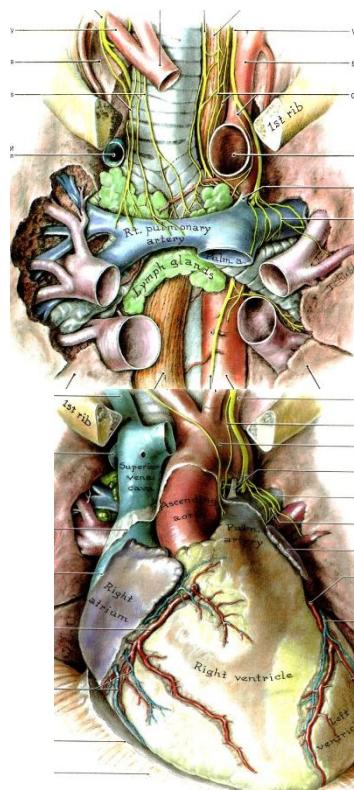
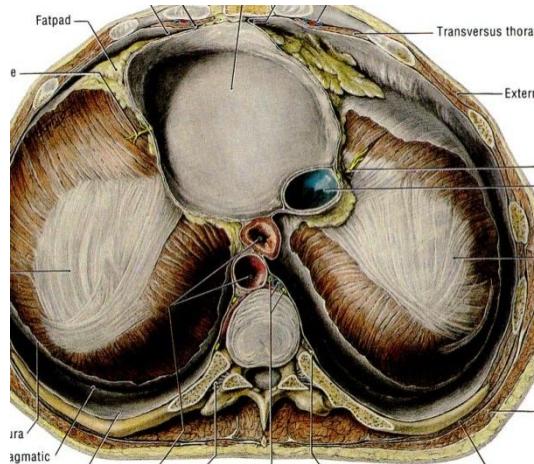
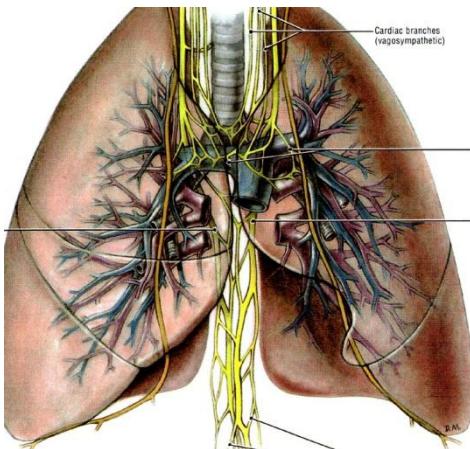
ANATOMY

1. **“Soft tissue”**- skin, subcutaneus tissue, muscles, breast
2. **Bone structures** – ribs, sternum, collarbone, spine
3. **Pleura**



Problem of inability to perform just a single diagnostic procedure of the Chest - **ANATOMY**

- 4. Lung parenchyma** - bronchus, interstitium, lymph vessels, arteries,
- 5. Mediastinum**- heart, large blood vessel, trachea, esophagus, lymph nodes
- 6. Diaphragm**



Radiological methods of examination of the Chest

I. Conventional procedures

1. **Chest X-ray in two projection: PA and lateral projection**
2. **Lateral chest X-ray imaging with contrast media in the esophagus**
3. **Chest X-ray in expiration**
4. **The images in the supine position with horizontal X-ray beam**
5. **Fluoroscopy**
6. **Tomography**
7. **Target imaging – for example, X-ray of the hemitoraxs**

Radiological methods of examination of the Chest

II. RECENT IMAGING METHODS

- 1. Multi-slice Computer tomography - MSCT**
- 2. Magnetic resonance - MR**
- 3. Ultrasound – US**
- 4. PET/CT**

III. INTERVENTIONAL METHODS

I. Conventional Radiography

1. Chest radiograph



The two views (posteroanterior and left lateral view) of a chest radiograph are taken in projections at 90 degrees to each other with the patient's breath held at the end of a maximum inspiration.

Exceptions:

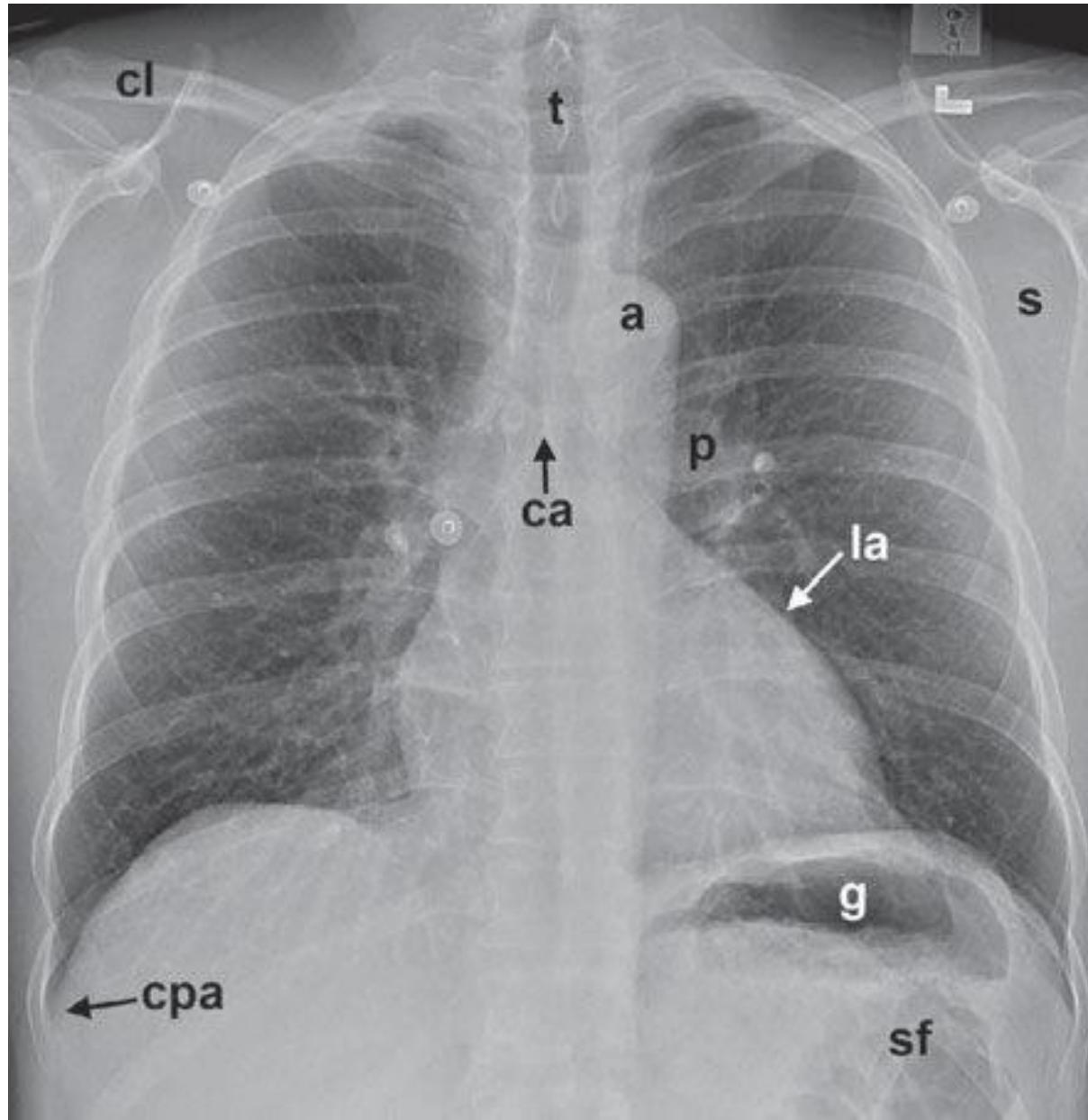
AP (anteroposterior view) - in some clinical situations, patients may not be able to stand or sit upright for the conventional PA and lateral radiographs

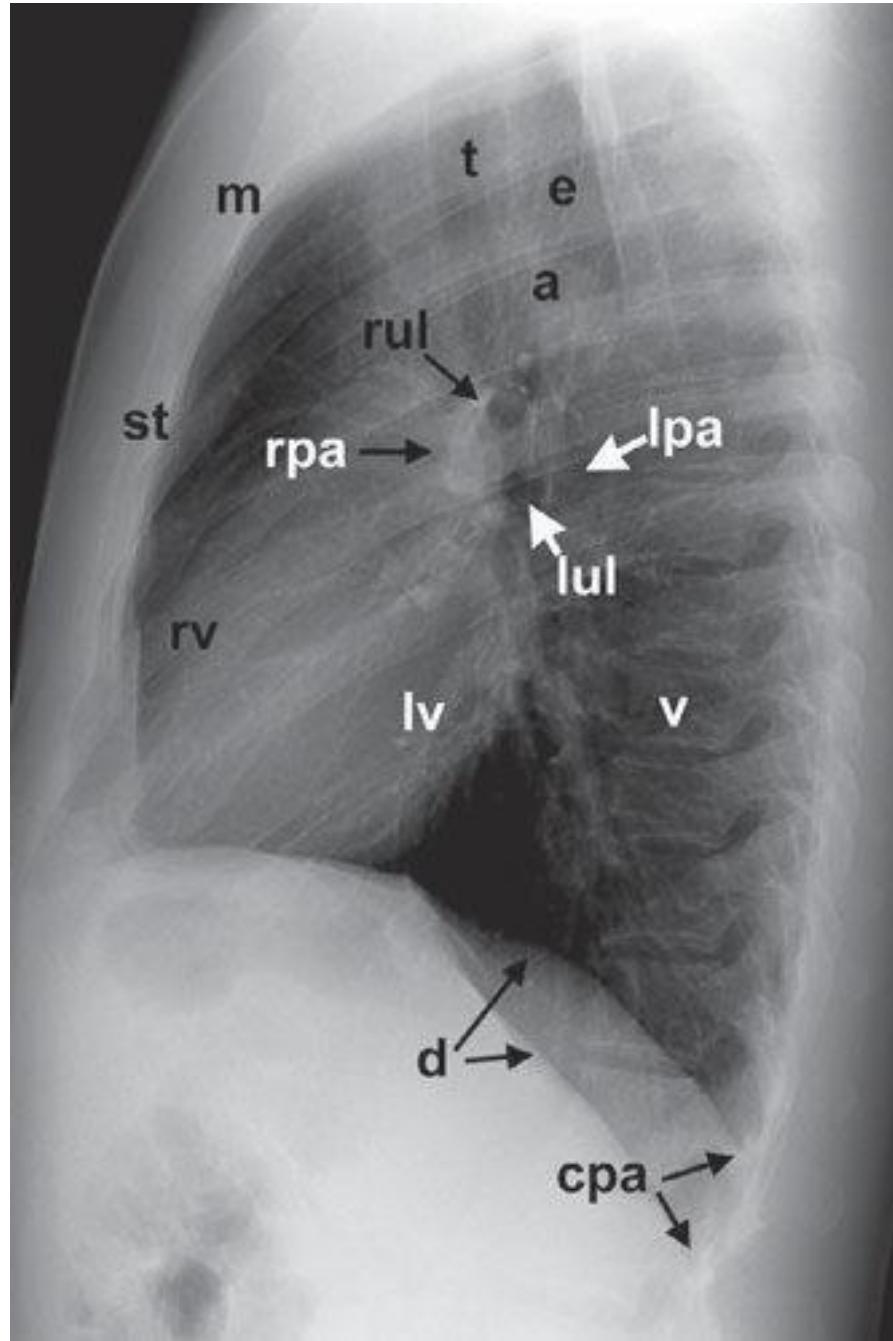
1. Chest radiograph

Disadvantages

- Irradiation
- Low specificity
- Low sensitivity – important pathological processes may not be (low amount of pleural effusion, small metastases ...)
- Some part of chest is not available to adequate analysis
- 20-30% of lesion are overlooked by an experienced radiologist (Felson B. 1979.g)







1. Chest radiograph

Indications

- 1. General symptoms** – nausea, fatigue, fever
- 2. Altered laboratory findings** (SE, L, tuberculin test)
- 3. Preoperative preparation in the elderly patients**
- 4. Extra thoracic disease:** septic conditions, malignant neoplasm
- 5. Monitoring of possible complications of various therapeutic procedures:** hemodialysis, radiation therapy
- 6. Detection and monitoring of the disease thoracic organs**
- 7. Trauma of the chest**

2. Oblique radiograph

Indication

1. Further analysis of pleura
2. Detection and analysis of lung parenchyma covered by other thoracic structures



2. Fluoroscopy

Indication

1. Provides real-time imaging of the chest
2. May be used to evaluate the motion of the diaphragm in a patient with suspected diaphragmatic paralysis (A paralyzed hemidiaphragm has sluggish motion as the patient breathes, and as the patient takes in a quick breath of air, it moves paradoxically upward as the normal hemidiaphragm moves downward ("sniff test").
3. Fluoroscopy and fluoroscopically positioned spot images are also useful for identification of calcification within a pulmonary nodule, within coronary arteries, or within cardiac valves.
4. Fluoroscopic guidance can also be used for percutaneous transthoracic needle biopsy of lung masses.

II. RECENT IMAGING METHODS

1. Computer tomography (CT)

Advantages: higher sensitivities than chest radiograph (able to detect changes <1cm), CT provides images without structures overlap (it is frequently used to clarify confusing shadows identified on conventional radiographs)

Disadvantages: higher irradiation dose

II. RECENT IMAGING METHODS

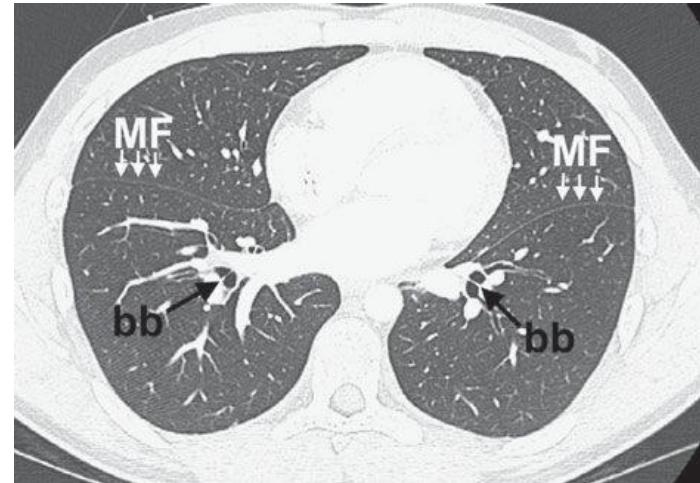
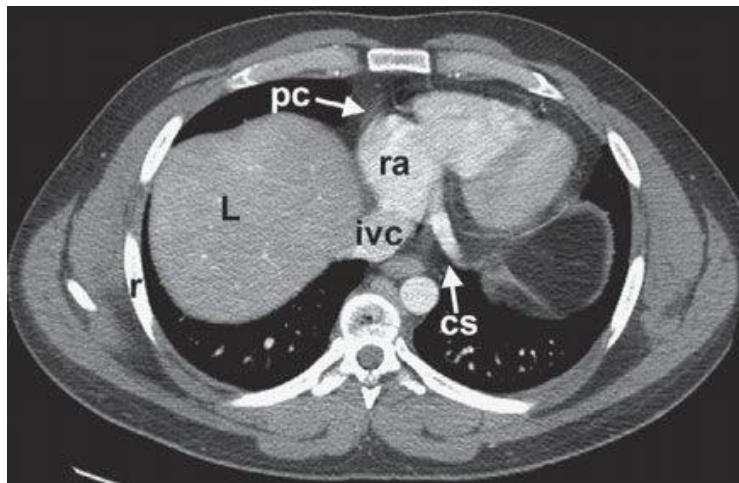
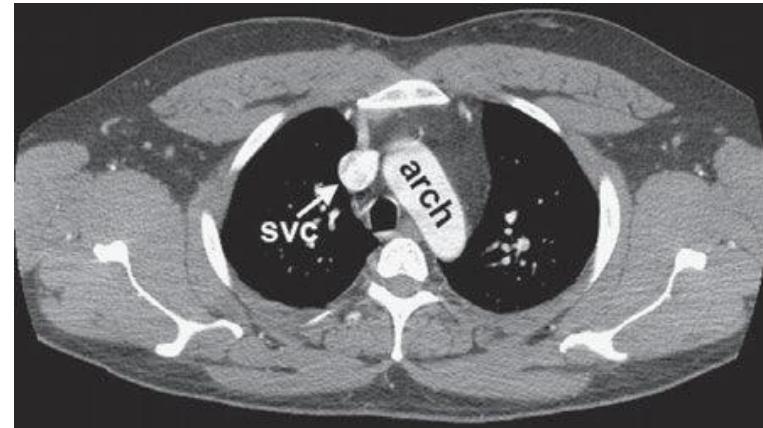
1. Computer tomography (CT)

Major Indications for CT of the Chest:

- Clarification of abnormal chest radiograph findings
- Staging of lung cancer and esophageal cancer
- Detecting metastatic disease from extra thoracic malignancy
- Evaluation of a solitary pulmonary nodule
- Suspected mediastinal or hilar mass
- Suspected pleural tumor or empyema
- Determining source of hemoptysis (eg, bronchiectasis)
- CT-guided percutaneous needle aspiration of lung and mediastinal masses
- CT-guided pleural drainage

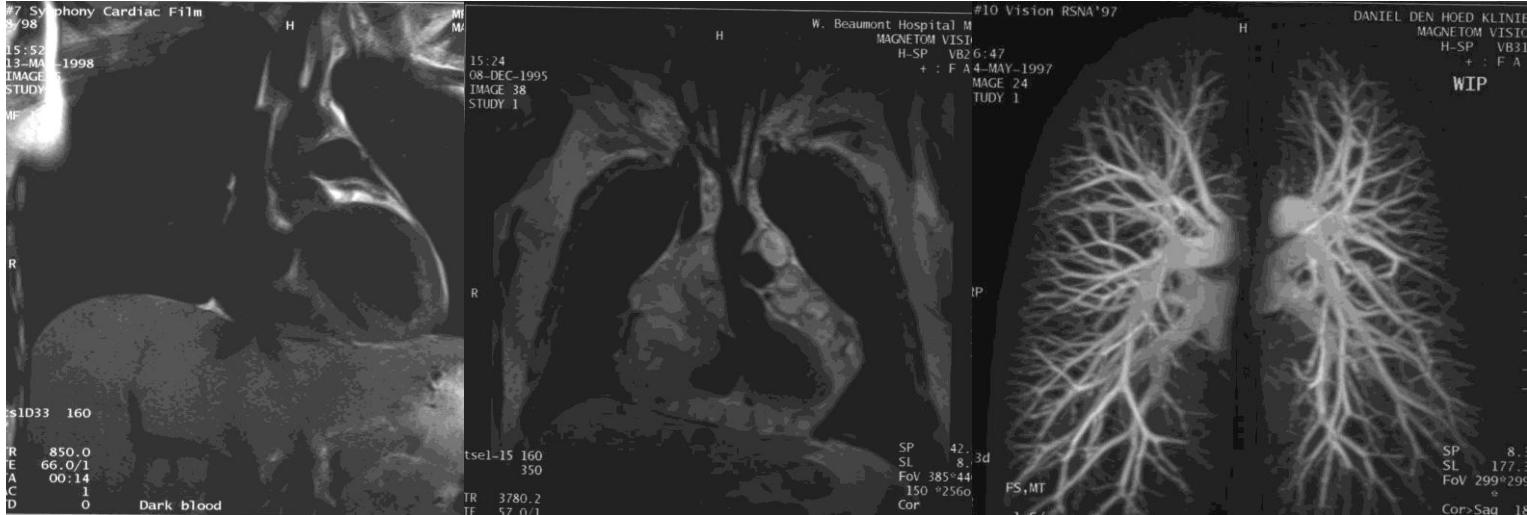
II. RECENT IMAGING METHODS

1. Computer tomography (CT)



II. RECENT IMAGING METHODS

Magnetic resonance (MR)



MR imaging of the thorax is most commonly used for cardiovascular imaging, but there are indications for MR imaging in mediastinal and pulmonary parenchymal imaging as well. MR is helpful when bronchogenic carcinoma is suspected of invading vascular structures.



II. RECENT IMAGING METHODS

Magnetic resonance (MR)

Major Indications for MR of the Chest:

- Evaluation of a mediastinal mass
- Suspected Pancoast (superior sulcus) tumor
- Superior vena cava syndrome
- Staging of lung cancer, when CT suggests invasion of the heart, great vessel, chest wall, diaphragm
- Suspected aortic dissection
- Evaluation for central pulmonary embolus in patients with allergy to iodinated contrast media or renal failure
- Evaluation of the mediastinum and hilum in patients with allergy to iodinated contrast media or renal failure
- Congenital and acquired heart disease



II. RECENT IMAGING METHODS

ULTRASOUND (US)

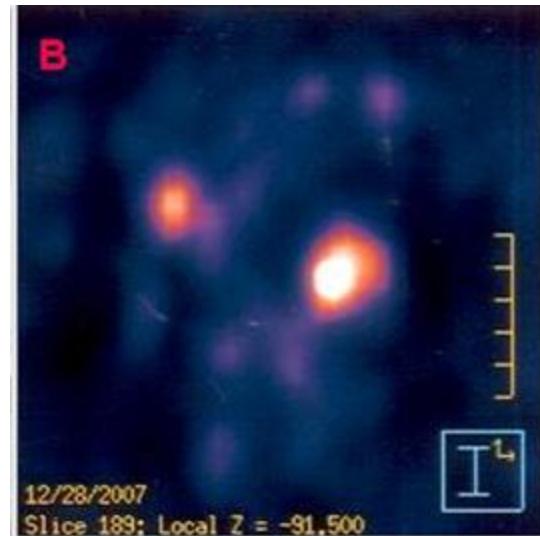
- Ultrasonography is useful for imaging the soft tissues of the chest wall, heart, and pericardium, as well as fluid collections within the pleural space.
- Ultrasonography has been used for guidance for biopsy of peripheral lung lesions, aspiration of pleural fluid.



II. RECENT IMAGING METHODS

PET/CT (MR)

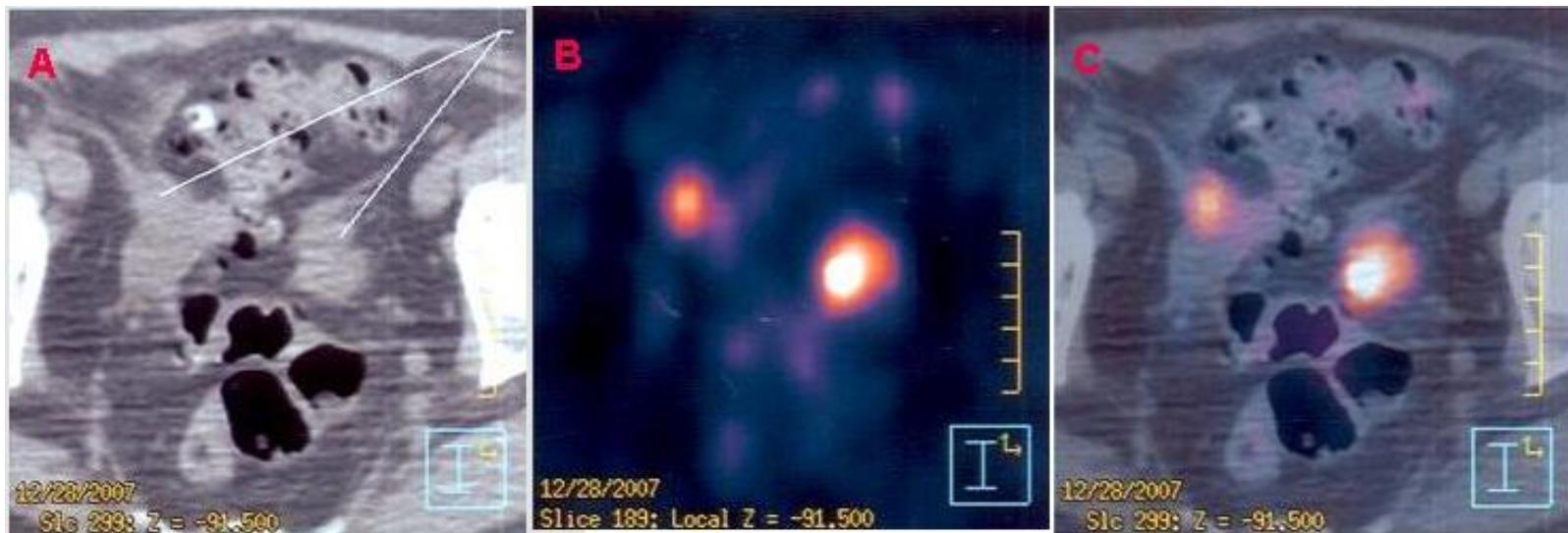
- PET shows metabolic activity of tissue and allows differentiation of malignant from benign tumors.
- the most widely used positron emitter is F-18-fluorodeoxyglucose (FDG), which is used as a metabolic tracer.
- The raised metabolic rate can be used to distinguish neoplasm and inflammation from normal tissue.



II. RECENT IMAGING METHODS

PET/CT (MR)

- PET provides tomographic images, the spatial resolution (0.7 to 1.0 cm) is somewhat inferior to that of CT.
- This spatial resolution is improved by utilizing PET/CT fusion imaging in which a patient receives both a PET scan with F-18 FDG as well as a CT with or without contrast. These images can then be overlaid, or fused, to combine the spatial resolution of CT



CHEST RADIOGRAPH

ANALYSIS

- The chest radiograph is the most frequently performed radiographic study in the United States.
- It should almost **always be the first** radiologic study ordered for evaluation of diseases of the thorax.
- The natural contrast of the aerated lungs provides a window into the body to evaluate the patient for diseases involving the heart, lungs, pleurae, tracheobronchial tree, esophagus, thoracic lymph nodes, thoracic skeleton, chest wall, and upper abdomen.
- In both acute and chronic illnesses, the chest radiograph allows one to detect a disease and monitor its response to therapy. For many disease processes (eg, pneumonia and congestive heart failure) the diagnosis can be established and the disease followed to resolution **with no further imaging studies**.

CHEST RADIOGRAPH

ANALASYS

It May Prove Quite Right
(but)

—
ANALYSIS OF
TECHNICAL
PARAMETERS

**Stop And Be Certain How
Lungs Appear**

—
ANALYSIS OF
MORPHOLOGICAL
CHANGES OF THE
THORAX

CHEST RADIOGRAPH

ANALYSIS

1. ANALYSIS OF TECHNICAL PARAMETERS

It May Prove Quite right

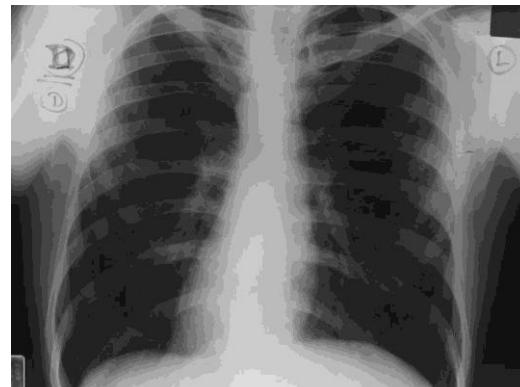
I = Identification (name, age, sex, indication for X-ray) by mas

M = Markers (differentiate left from right - diagnose dextrocardia)

P = Position - the spinous process of T4 should be between the heads of the clavicle (if it isn't the body is rotated)

Q = Quality - is the film penetrated properly. In a properly penetrated film the vertebral interspaces should be visible behind the central (cardiac) shadow

R = Respiration - chest X-rays are typically done with full inspiration

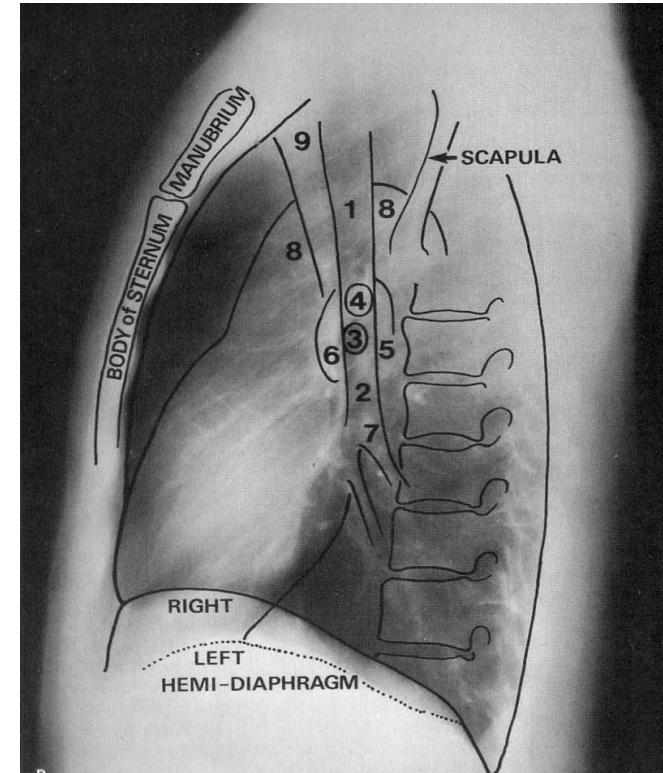
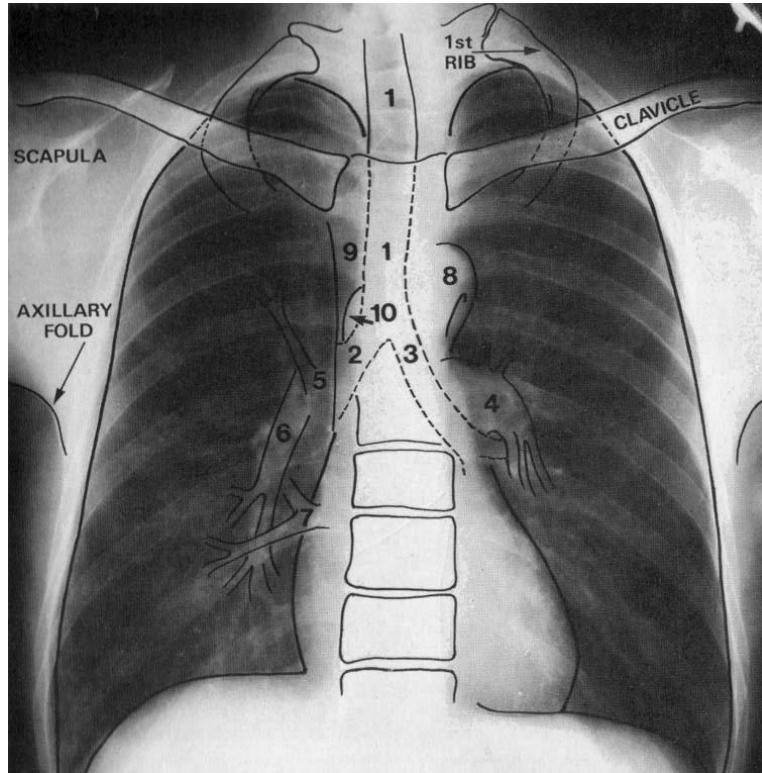


CHEST RADIOGRAPH

ANALYSIS

2. ANALYSIS OF MORPHOLOGICAL CHANGES OF THE THORAX

The key to recognizing pathology is knowledge of normal radiological anatomy of the healthy thorax



CHEST RADIOGRAPH

ANALYSIS

2. ANALYSIS OF MORPHOLOGICAL CHANGES OF THE THORAX

Stop And Be Certain How Lungs Appear

S- Soft tissue

A = Abdomen

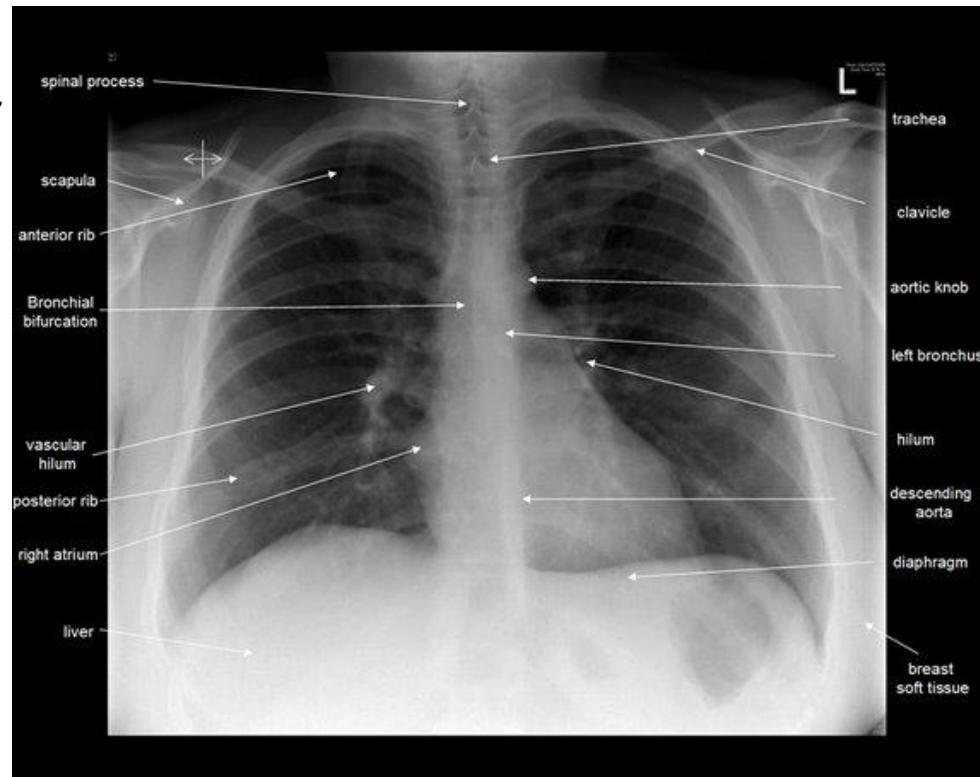
B = Bone

C = Central shadow (cardiac silhouette and mediastinum)

H = Hila (of the lungs)

L = Lungs

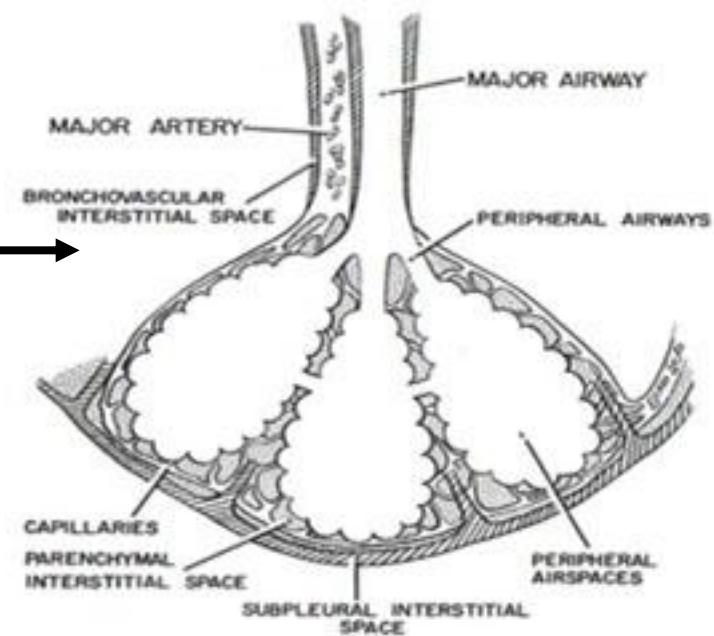
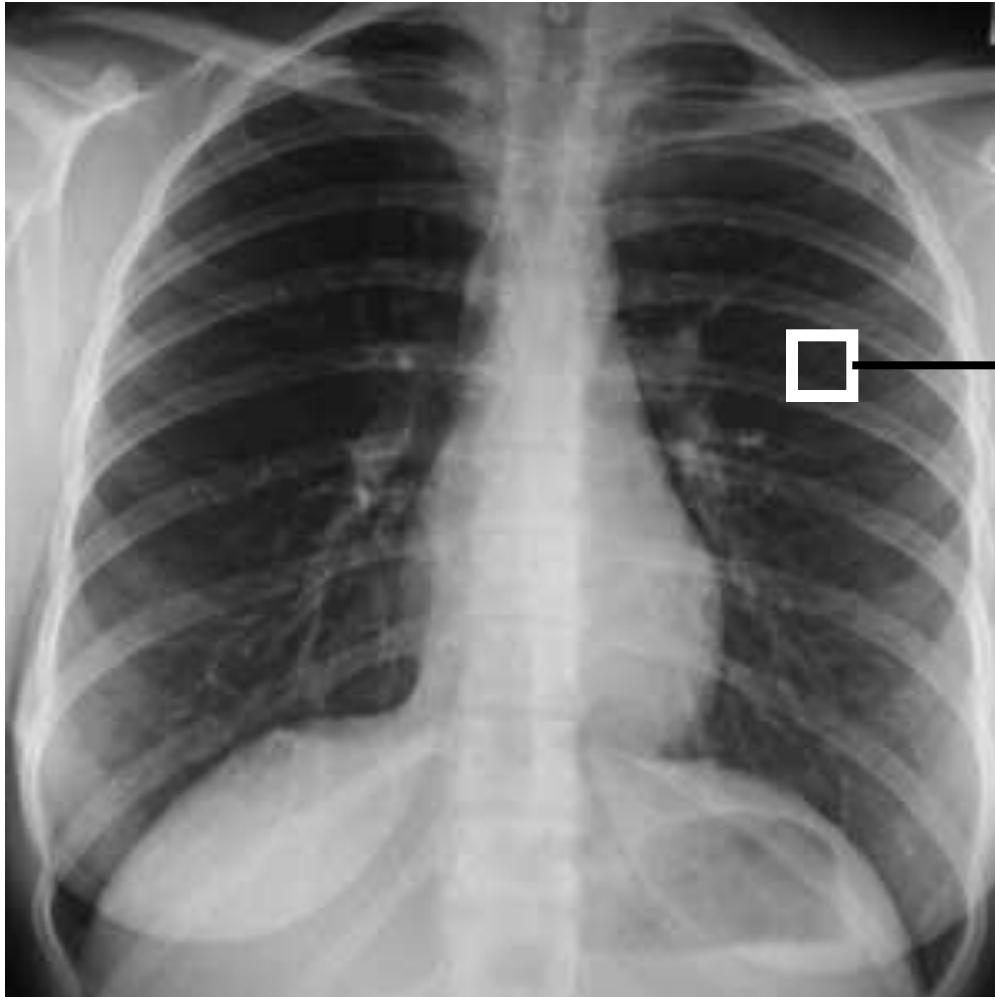
A = Absent structures/Apices of the lung (pneumotorax)



CHEST RADIOGRAPH

ANALYSIS

Interpretation of pathological changes of the LUNG

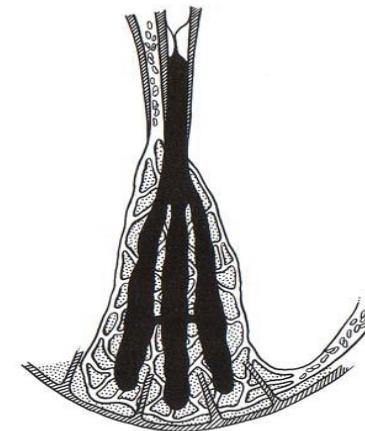
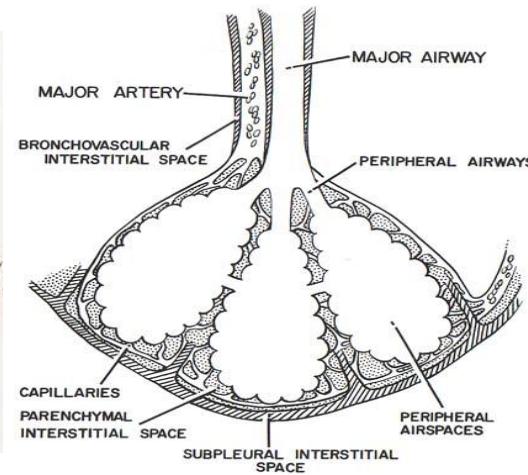
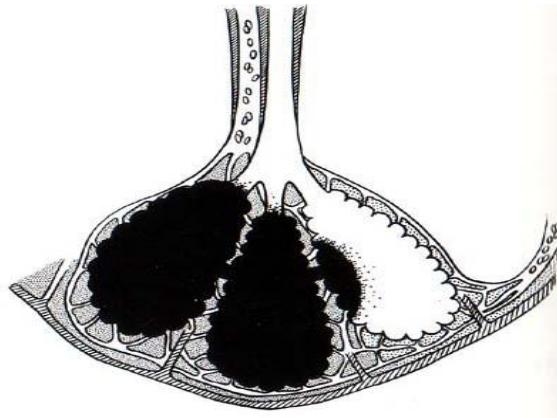


Interpretation of pathological changes of the LUNG

1. Opacities

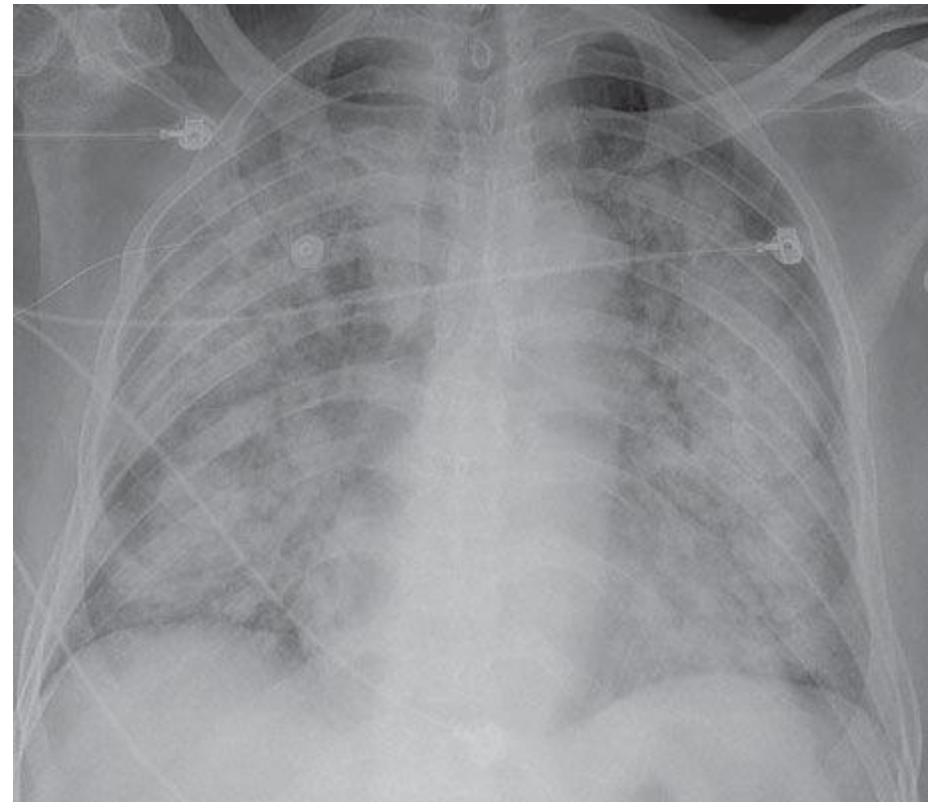
consequence of the reduction or complete disappearance of air in the lungs!

- The pathological processes that **fill** the bronchoalveolar system with solid tissue (tumors) or liquid (inflammatory exudate, edema, aspiration, bleeding into the alveoli)
- The pathological processes that **displace** air from bronchoalveolar system - atelectasis



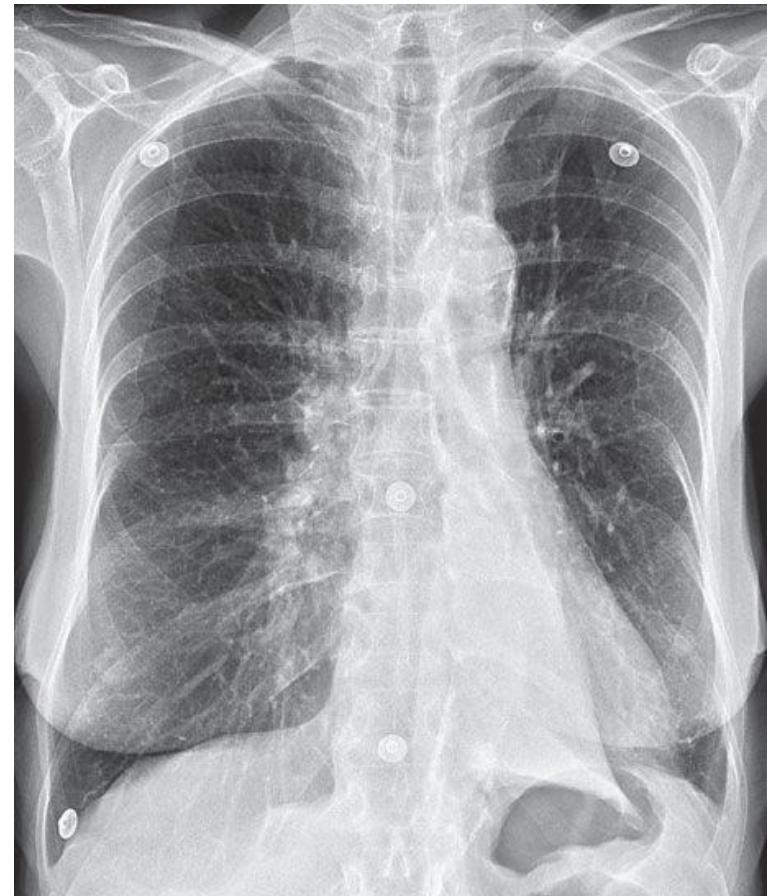
Interpretation of pathological changes of the LUNG

- The alveoli, or airspaces, that are normally filled with air have become filled with exudate. The exudate-filled alveoli surround the bronchi, so that the airfilled bronchi are visible as radiolucent branching structures within the more radiopaque background



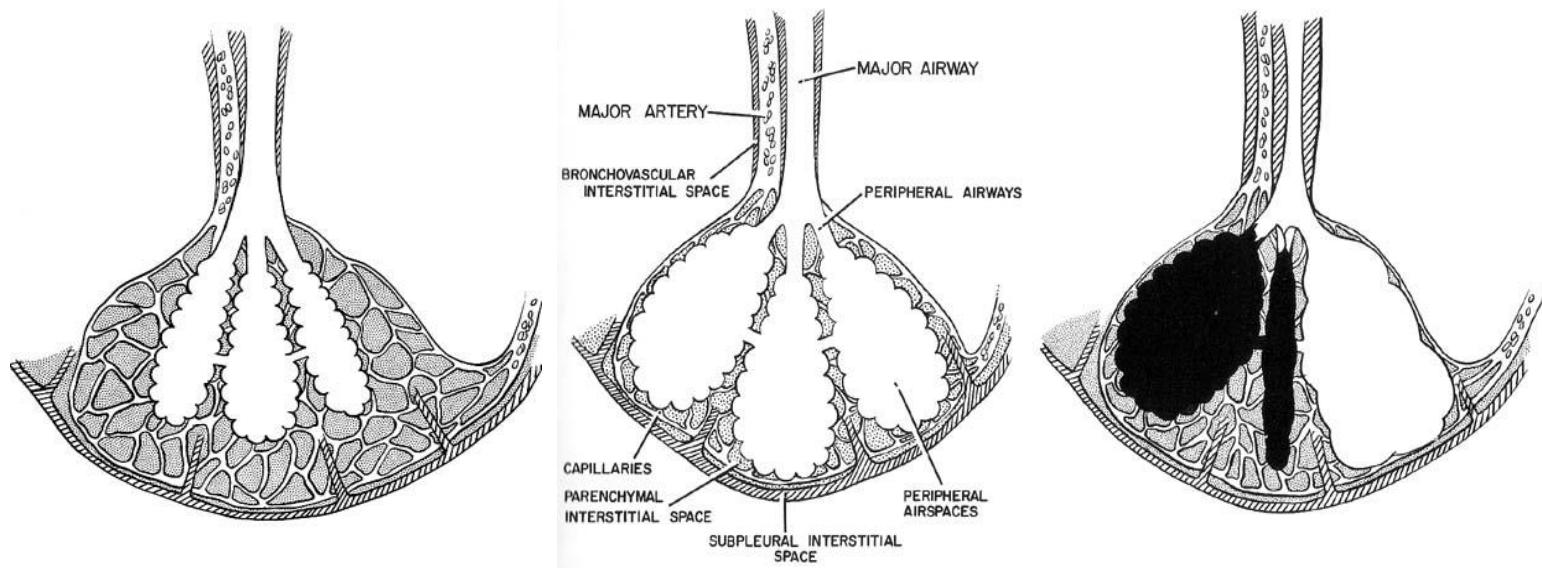
Interpretation of pathological changes of the LUNG

- The term *atelectasis* refers to volume loss, or airlessness, within the lung. The term *collapse* is often used to describe complete atelectasis of an entire lobe or an entire lung.
- Atelectasis can occur as a result of several pathophysiologic processes (obstruction of a bronchus by bronchogenic carcinoma, foreign body...)
- Passive atelectasis occurs as a result of a space-occupying process within the pleural space



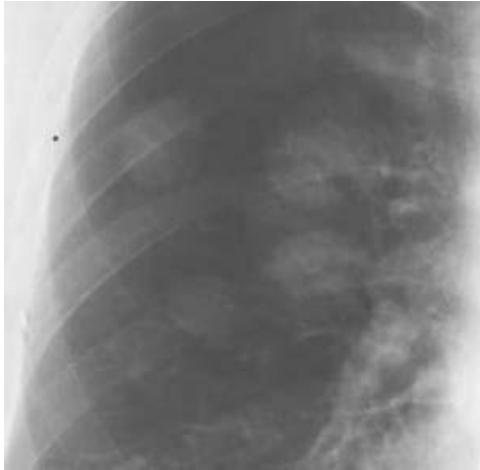
1. ZASJENJENJA

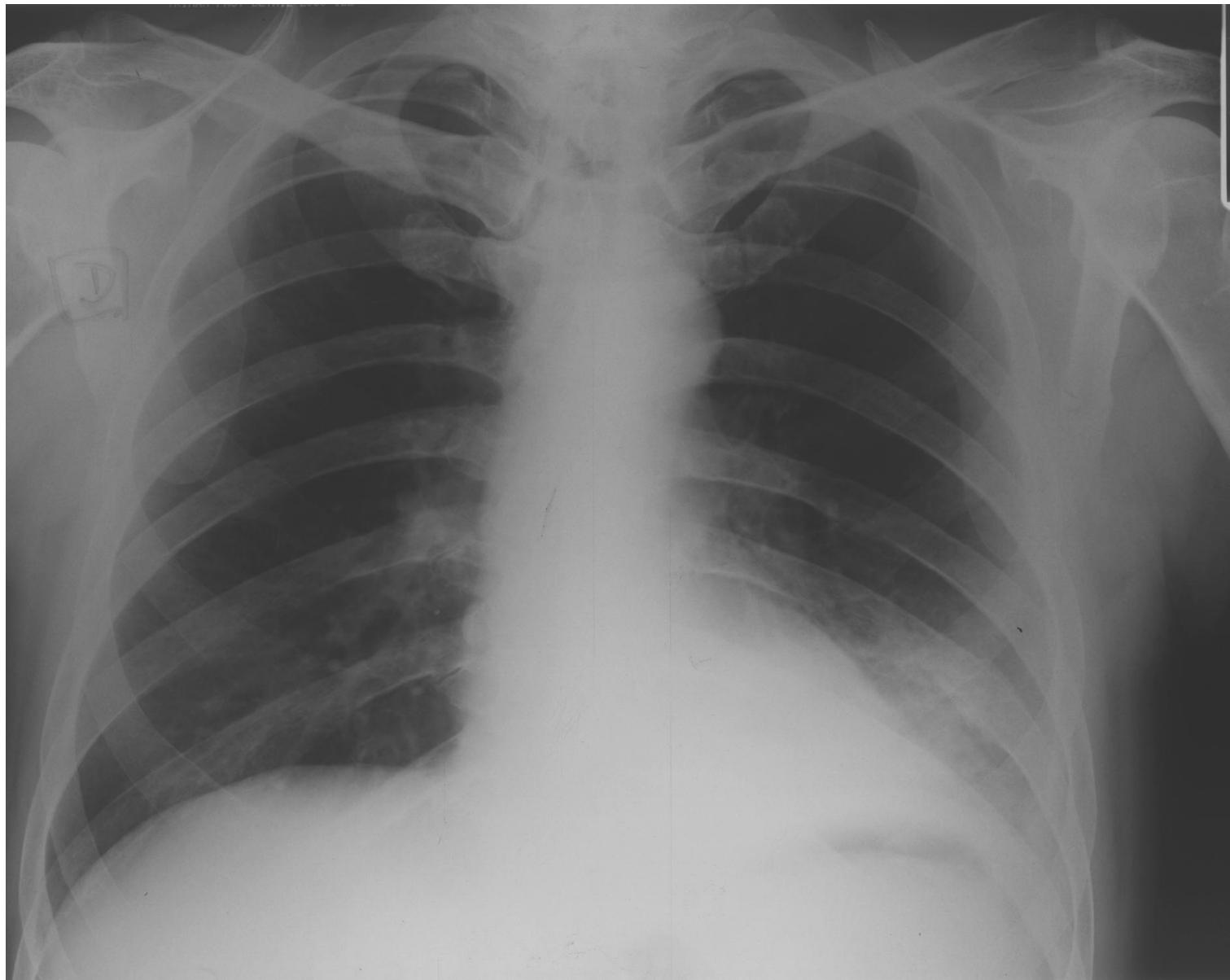
- Bolesti izvan bronhoalveolarnog sustava koje dijelom prekrivaju, potiskuju i komprimiraju zrak u bronhoalveolarnom sustavu (bolesti plućnog intersticija, ekstrapulmonalni procesi - pleuralni izljev, procesi u medijastinumu ili drugim dijelovima toraksa)
- Često se radi o kombinaciji nekoliko različitih uzroka!



Opisi zasjenjenja:

- **Plošne sjene** - gusta homogena zasjenjenja koja zauzimaju veće dijelove toraksa (mogu biti inhomogena)
- **Žarišne (okrugle) sjene**- ograničena, cirkumskriptna zasjenjenja na manjem arealu
- **Prugaste (trakaste) sjene**- zasjenjenja u obliku tračaka, najčešće zadebljanja intersticija, pleuralne kožure, fibrozne promjene pluća
- **Prstenaste sjene** - transparentno središte uz prstenasto zasjenjenje- šupljine u plućnom tkivu različite etiologije. Polumjesečaste sjene- prstenaste sjene s horizontalnom razinom tekućine.



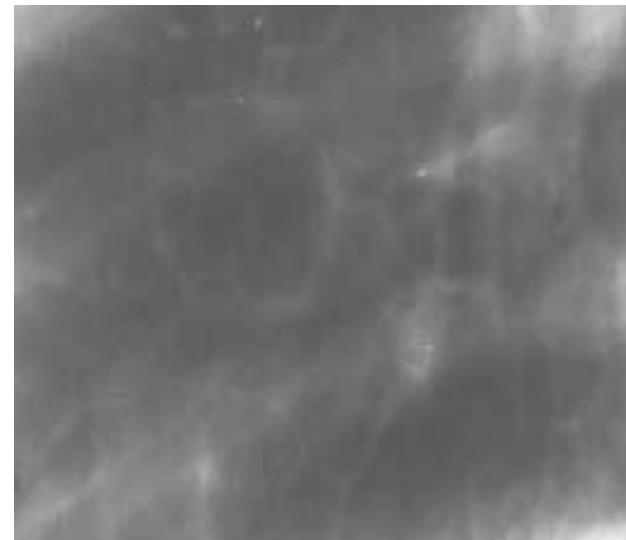


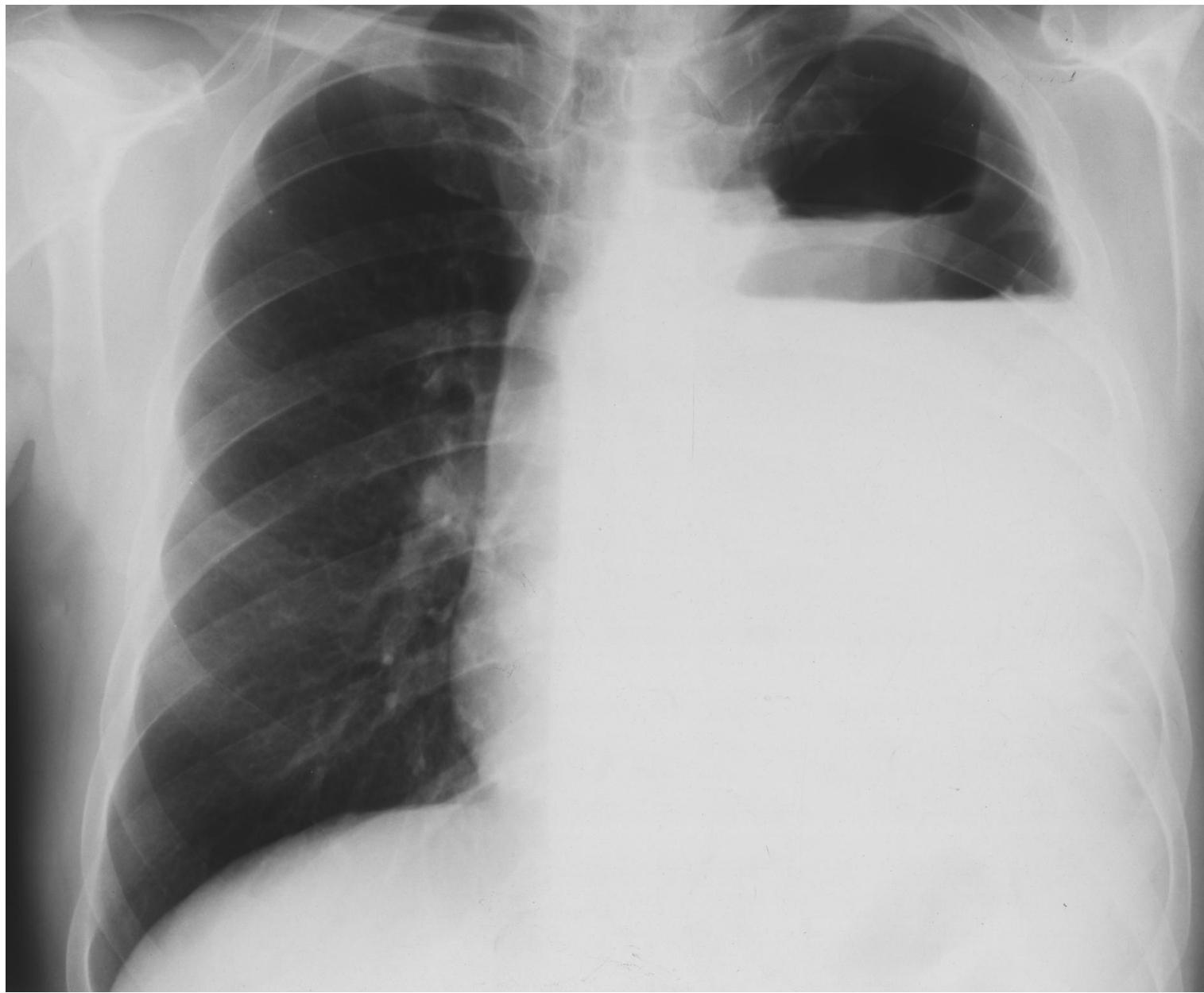
INTERPRETACIJA PATOLOŠKIH PROMJENA NA SUMACIJSKOJ SNIMCI TORAKALNIH ORGANA

2. TRANSPARENCIJE (pojačane prozračnosti)

Povećana količina zraka u toraksu!

- Zrak u pleuri - pneumotoraks, medijastinumu- pneumomedijastinum i subkutano - subkutani emfizem
- Povećana količina zraka u alveolama- KOBP
- Šupljine u plućima ispunjene zrakom- ciste, bule (razaranje pl. tkiva)



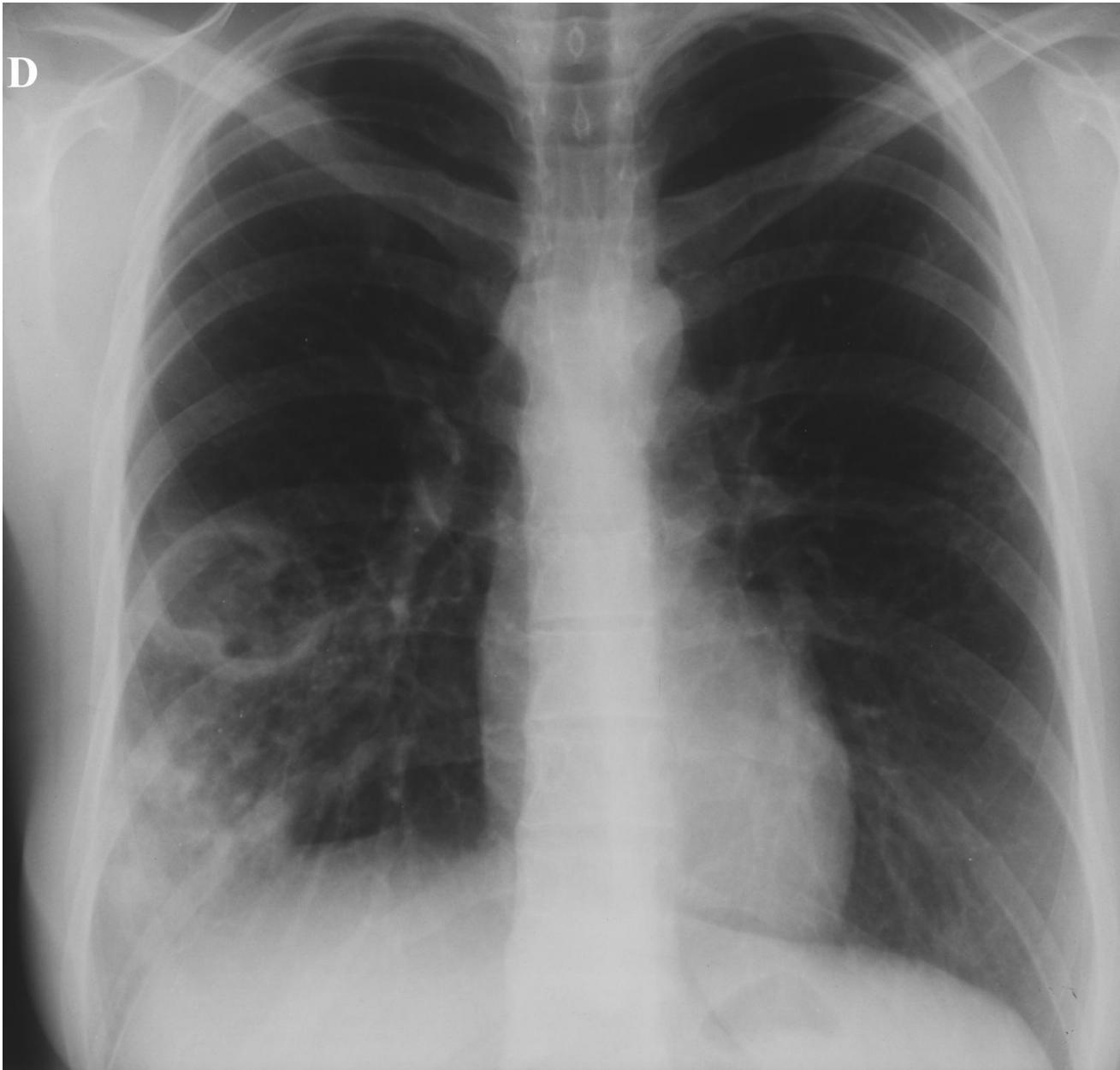


INTERPRETACIJA PATOLOŠKIH PROMJENA NA SUMACIJSKOJ SNIMCI TORAKALNIH ORGANA

3. KOMBINACIJA ZASJENJENJA I TRANSPARENCIJA

- Bronhiekstazije
- Šupljine (raspad, kavitarija) - prstenasta zasjenjenja u tuberkulozi, apsesu, nekrotizirajućem tumoru





ANALIZA PATOLOŠKIH PROMJENA PLUĆA NA SUMACIJSKOJ SNIMCI TORAKALNIH ORGANA

1. Položaj procesa prema anatomski fiksnim točkama

Desno- lijevo, ventralno- dorzalno, kranijalno- kaudalno, apikalno-bazalno

2. Veličina procesa- U centimetrima ili milimetrima!

3. Oblik- okrugli, zvjezdoliki, nepravilni

4. Broj- jedna promjena, višebrojna

5. Raspored - jednostrano, difuzno, simetrično, asimetrično

6. Intezitet- maglušav, mekih česti, poput vapna, poput metala

7. Struktura- homogena, nehomogena, mrljasta, mrežasta

8. Granice- oštro ili neoštro ocrtane, glatke, neravne, izbrisane

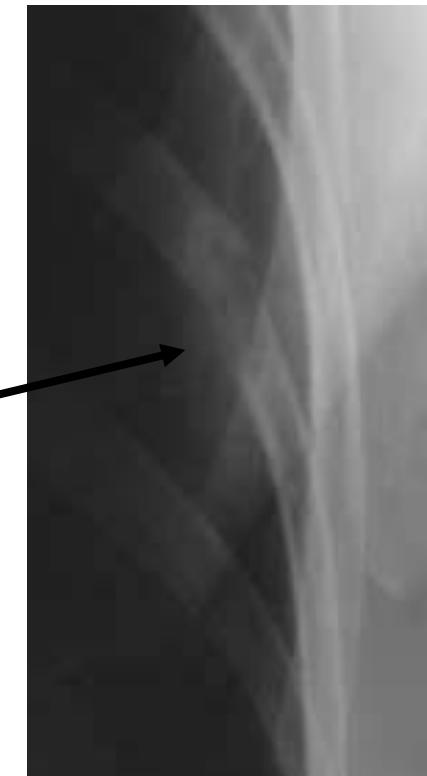
9. Odnos prema okolini- pomak okolnih struktura,

10. Gibljivost- neke tvorbe se pomiču ovisno o položaju tijela, respiraciji, kašljaju, šmrcanju, gutanju, pulziraju



BOLESTI KOŠTANE STIJENKE

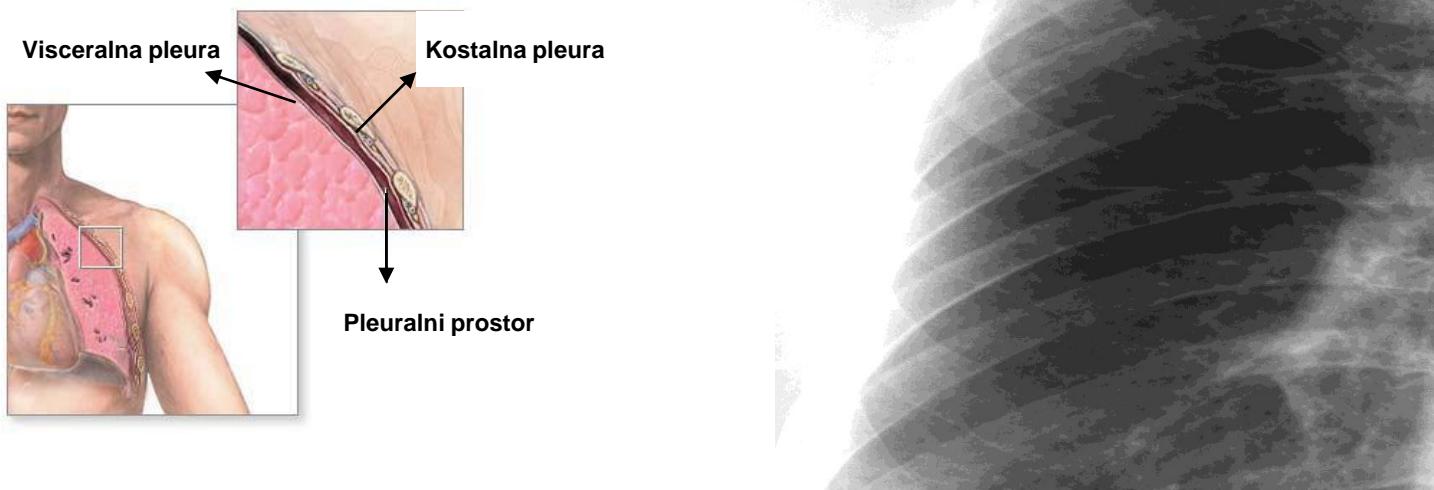
Najčešća patologija- trauma i tumori (metastaze, primarni tumori kosti)



BOLESTI PLEURE

Pleura se normalno ne vidi osim tangencijalno zahvaćena interlobarna pleura!

- Tekućina u pleuralnom prostoru- **likvidotoraks**
Transudat, eksudat, krv, gnoj, limfa
- Zrak u pleuralnom prostoru- **pneumotoraks**
- **Priraslice**- fibrotoraks, kalkarea pleure
- **Tumori**- najčešće maligni: mezoteliom pleure, metastatski tumori



BOLESTI PLEURE

PNEUMOTORAKS



Pneumotoraks: sumacijska snimka torakalnih organa



Pneumotoraks: CT

BOLESTI PLEURE

LIKVIDOTORAKS



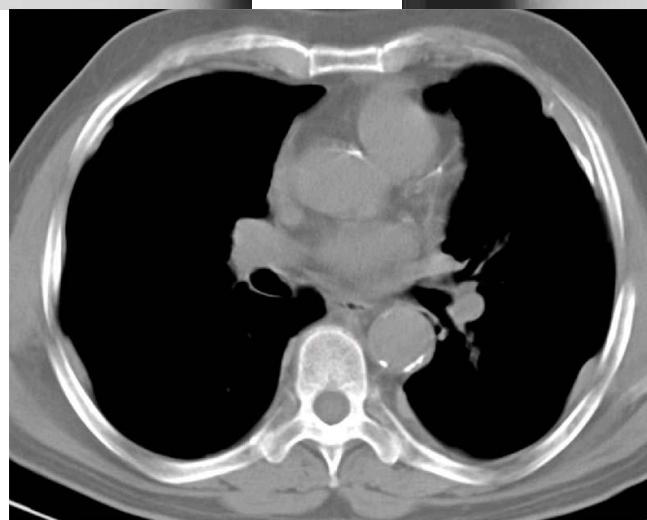
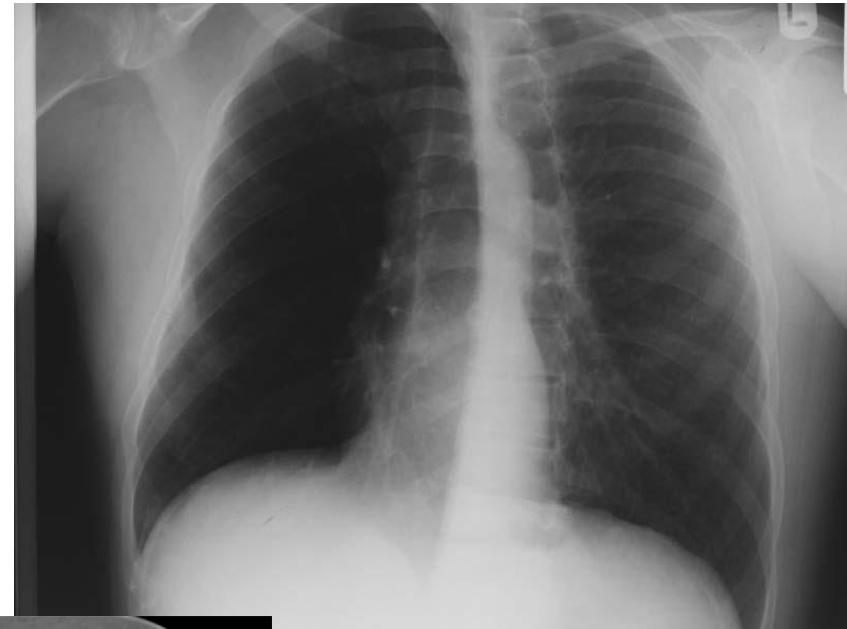
Likvidotoraks: plošno zasjenjenje laterouzlazne granice, bez diferencijacije kupole ošita



Likvidotoraks: CT drenaža

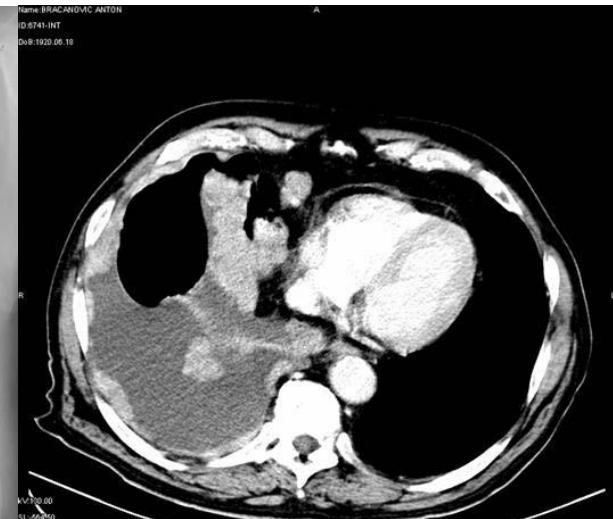
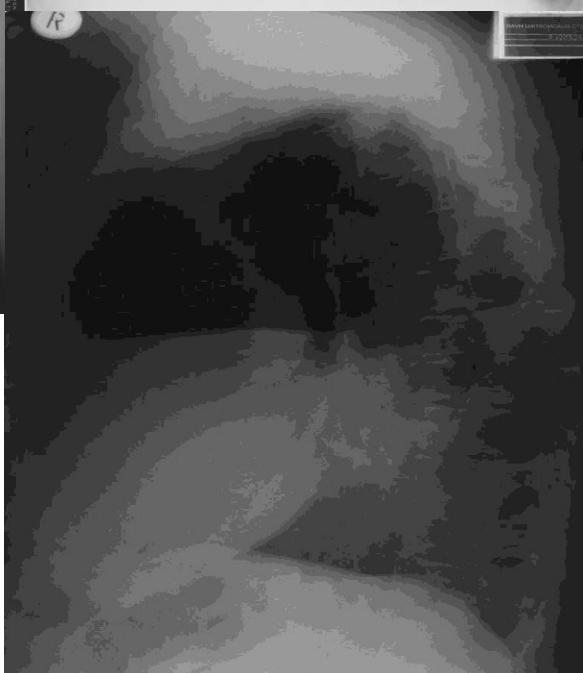
BOLESTI PLEURE

AZBESTOZA



BOLESTI PLEURE

MEZOTELIOM



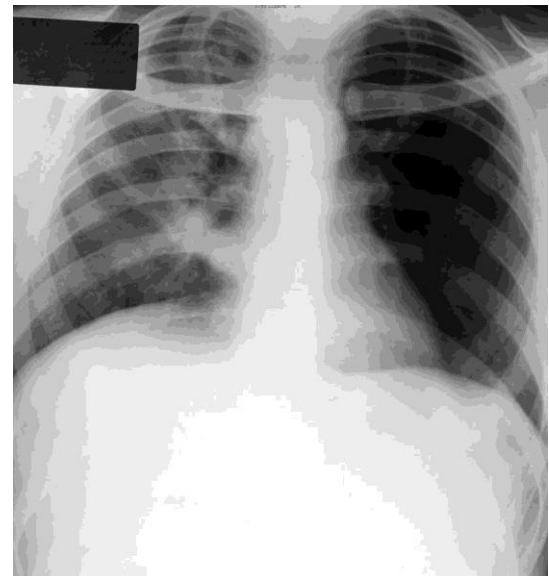
BOLESTI OŠITA

Promjene položaja

Jednostrano visoko položen ošit- urođeno, lezija frenikusa, potiskivanje abdominalnim organima

Obostrano visok stav ošita- u pretilih, trudnoći, ascitesu, pri ležećem položaju

Nizak stav ošita- posljedica plućne hiperinflacije u emfizemu



BOLESTI OŠITA

Promjene oblika

Trauma s hernijacijom abdominalnih organa, hernijacija kroz proširene prirodne otvore u ošitu, pleuralne adhezije

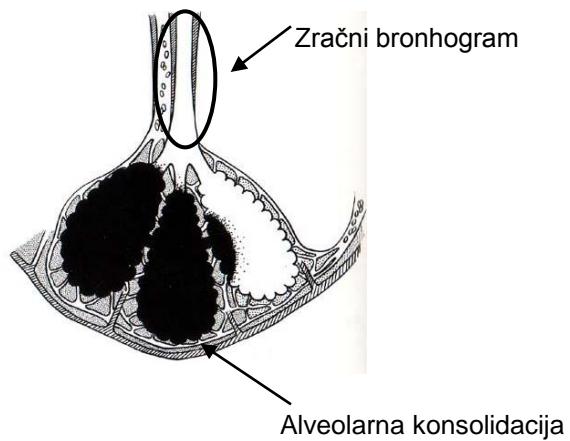
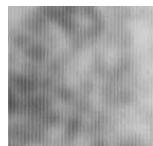
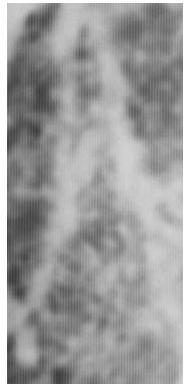
RUPTURA OŠITA



PLUĆNE BOLESTI

UPALE

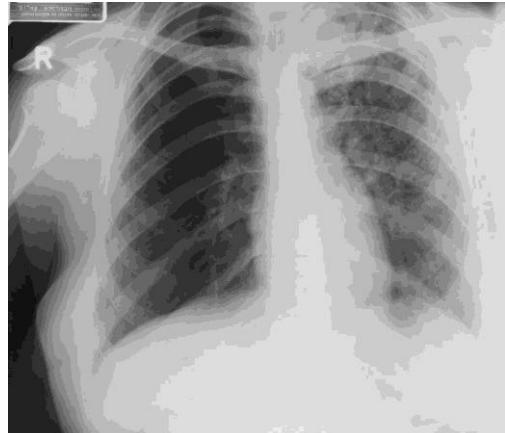
1. Bakterijske nespecifične upale



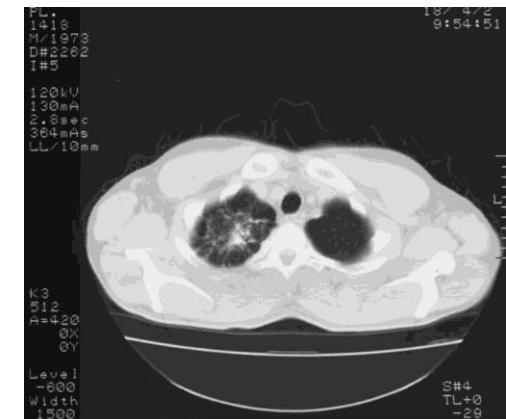
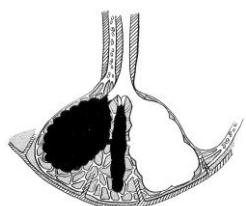
PLUĆNE BOLESTI

UPALE

2. Bakterijske specifične upale (TBC)



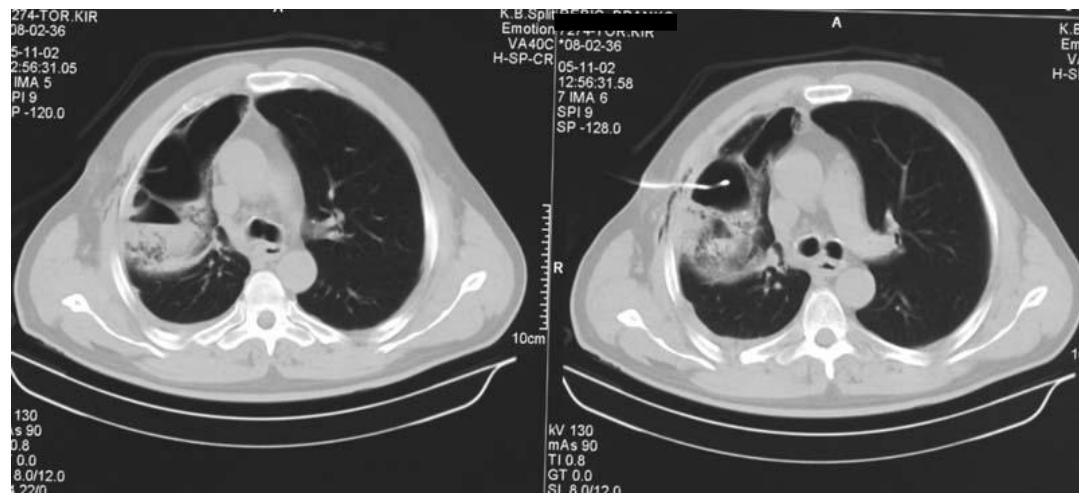
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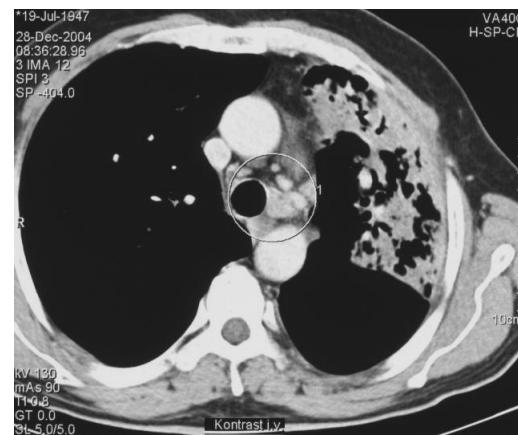
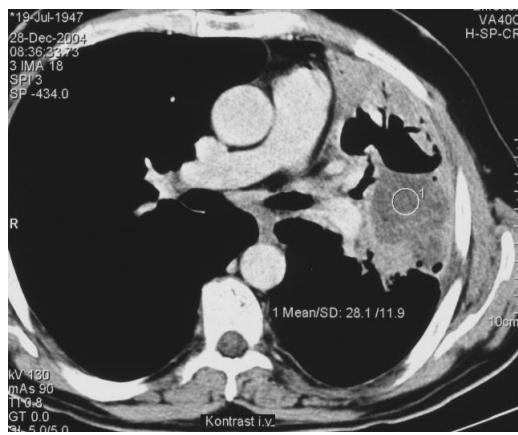
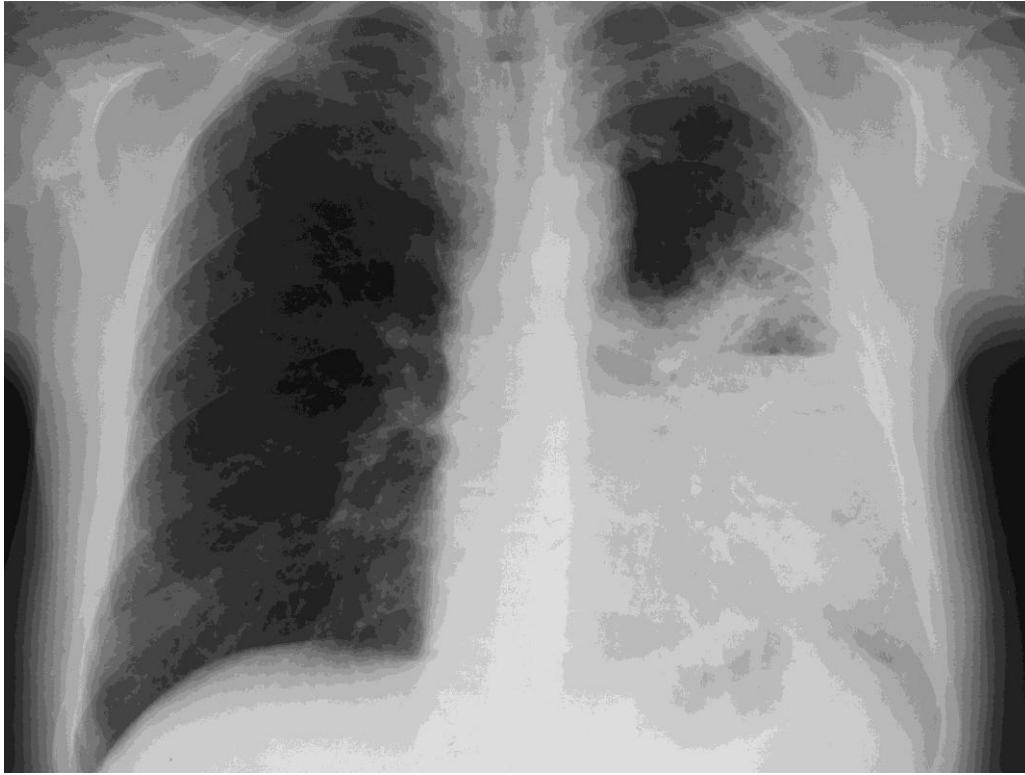


PLUĆNE BOLESTI

UPALE

3. Plućni apscesi

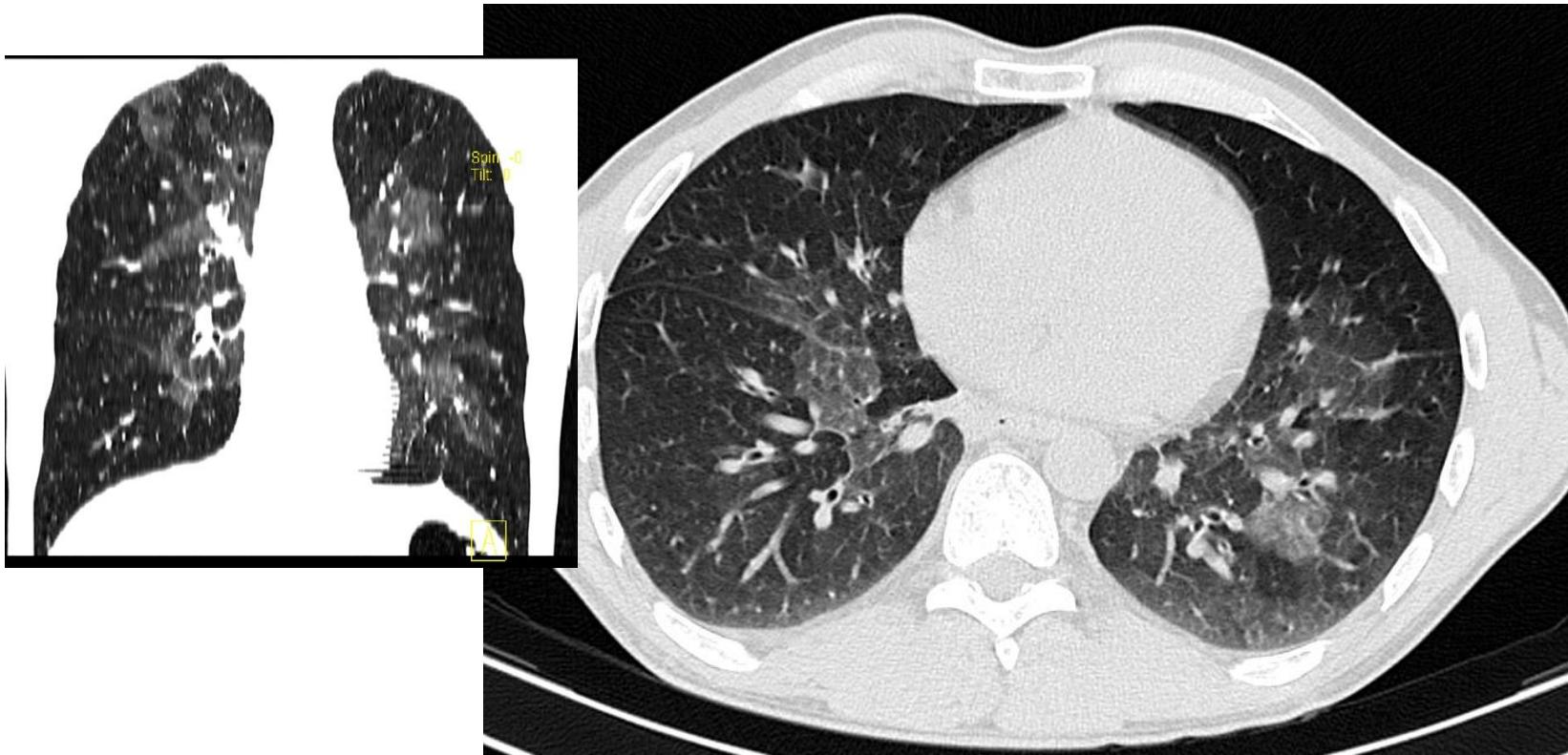




PLUĆNE BOLESTI

UPALE

5. Virusne upale



PLUĆNE BOLESTI

EDEM PLUĆA



PLUĆNE BOLESTI

TUMORI

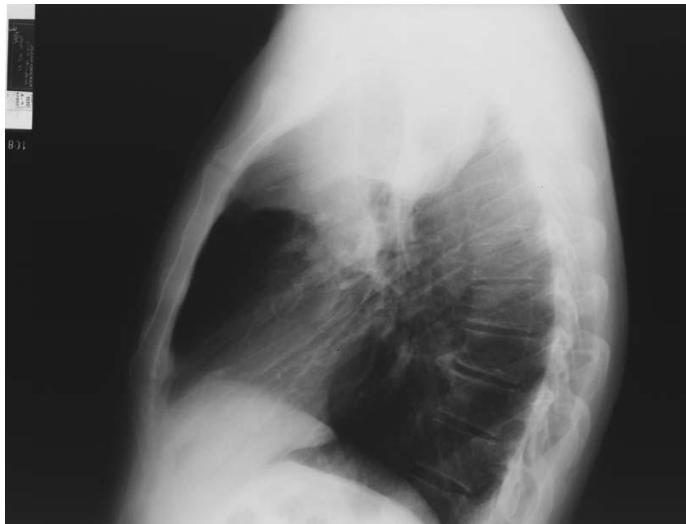
1. PRIMARNI TUMORI

MALIGNI TUMORI



PLUĆNE BOLESTI

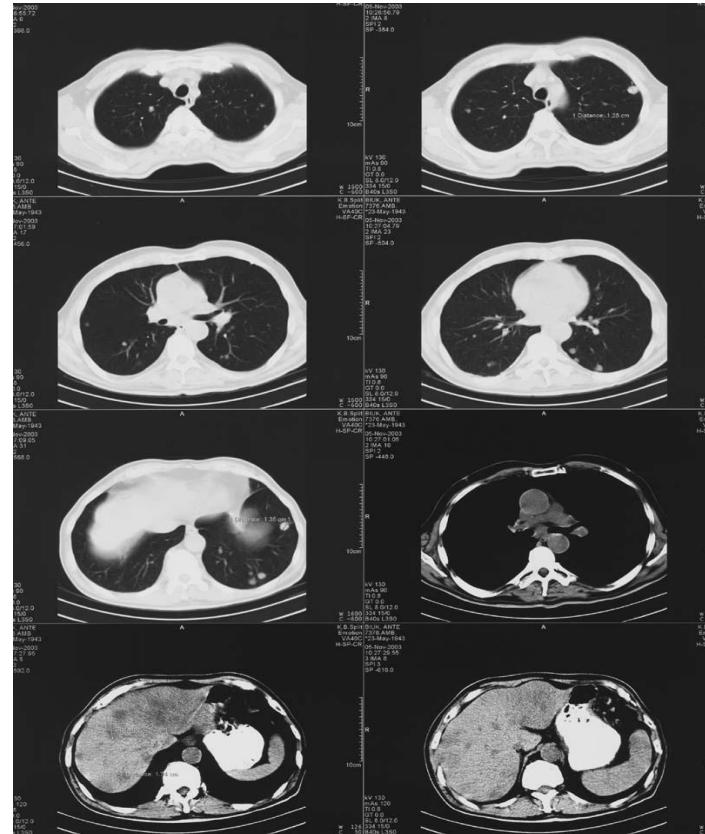
MALIGNI TUMORI



PLUĆNE BOLESTI

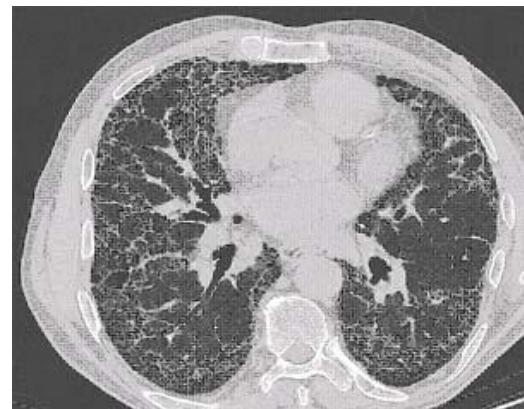
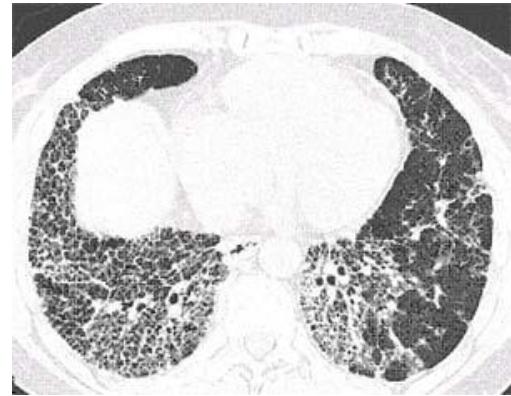
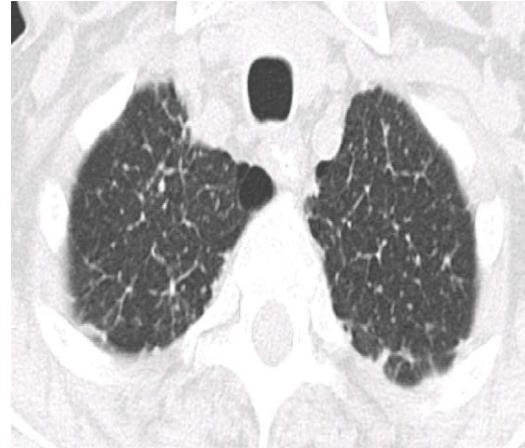
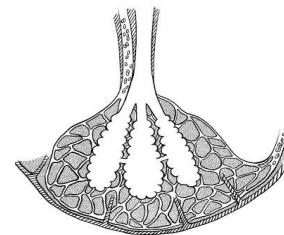
TUMORI

2. SEKUNDARNI- METASTAZE

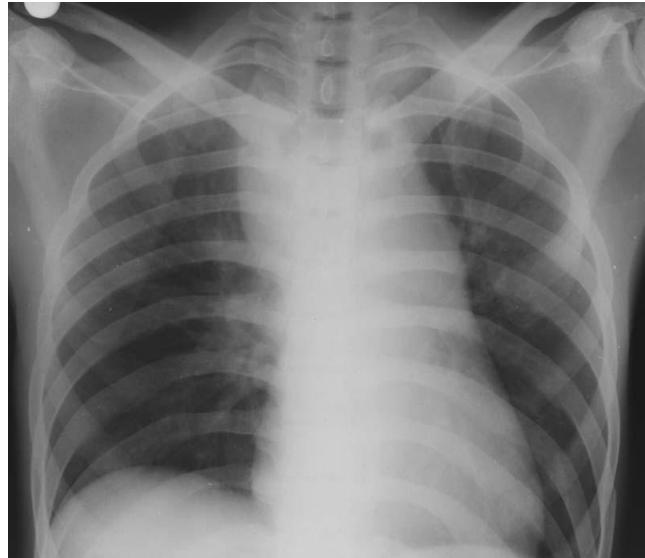
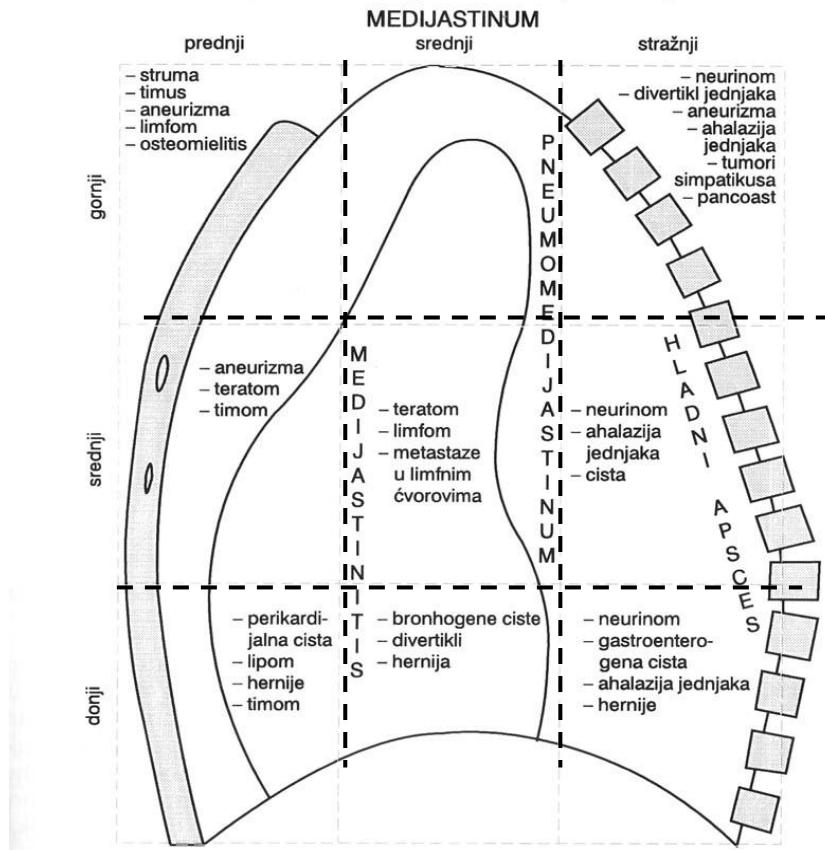


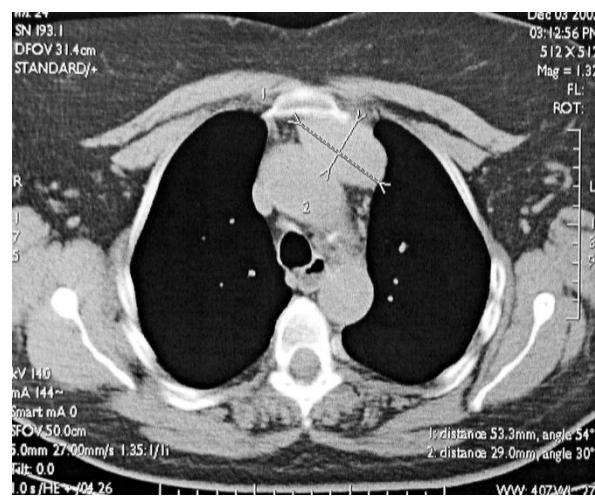
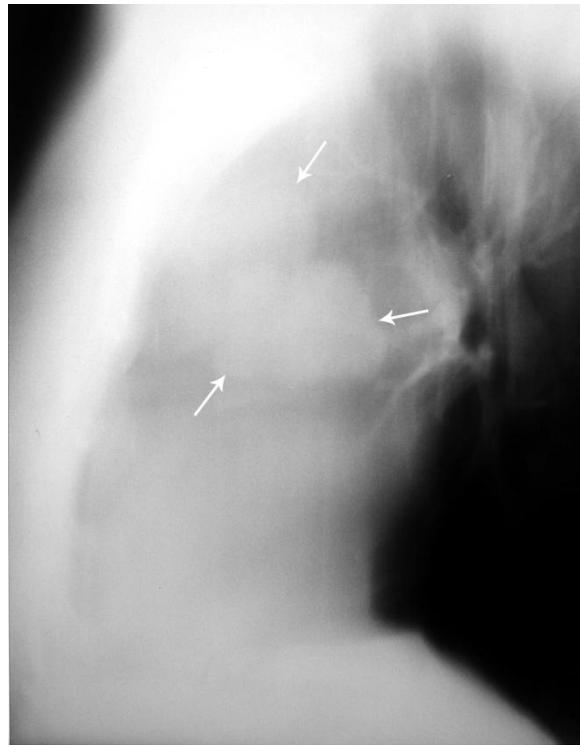
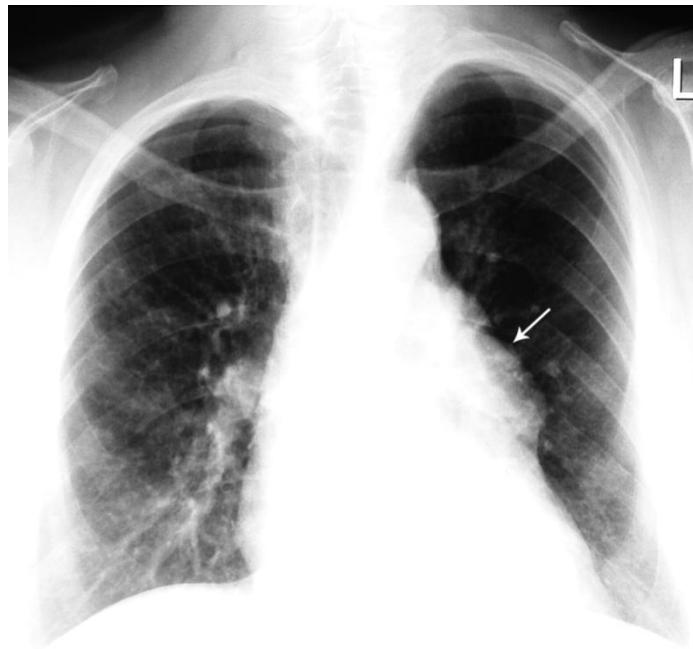
PLUĆNE BOLESTI

BOLESTI INTERSTICIJA



BOLESTI MEDIJASTINUMA

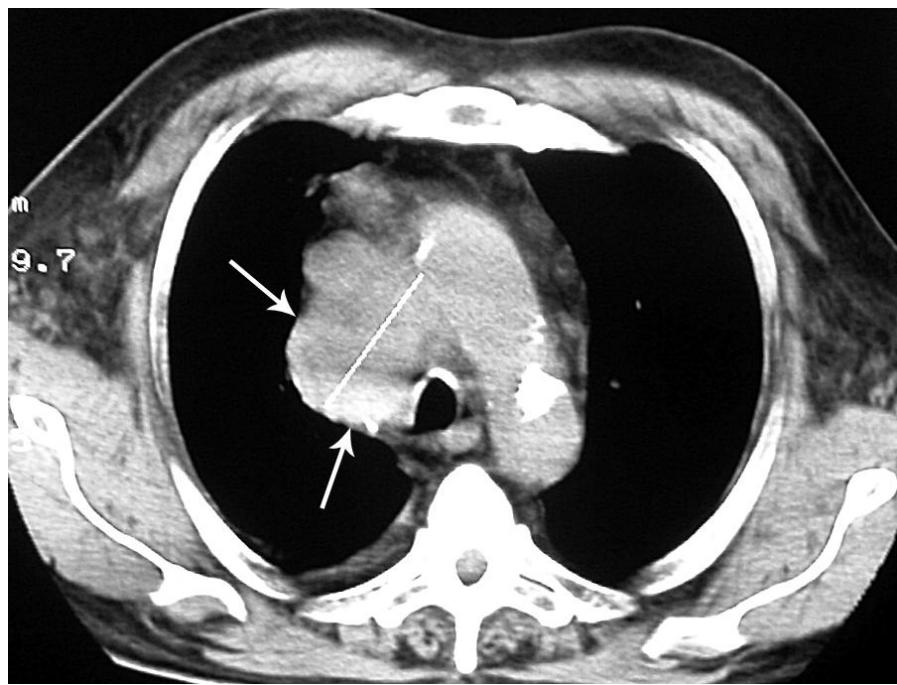




Timom



Hodgkin limfom





Ganglioneurinom



TRAUMA TORAKSA

