

Diagnostic radiology of the chest

2007-2008. 2nd semester

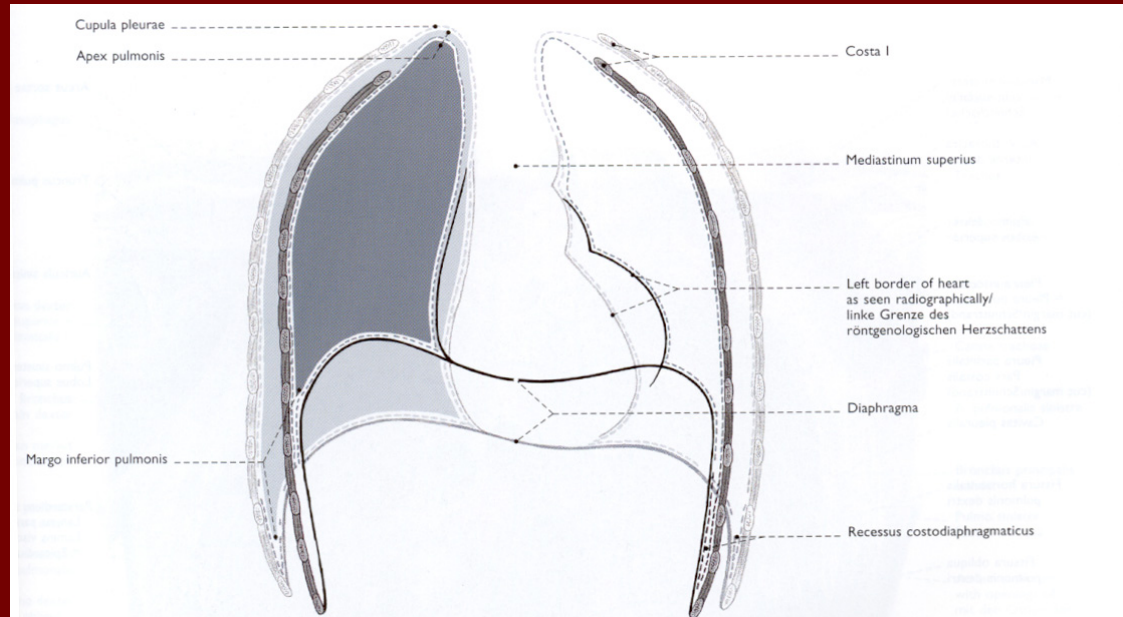
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The structure of the lungs

- Chestwall
 - Pleura
 - Mediastinum
 - Lungs
 - bronchus system
 - branches of the pulmonary artery
 - lung structure (interstitium)
- The blood supply of the lungs



Diagnostical modalities

■ In situ X-ray

P-A, A-P, lying position, Frimann-Dahl method

time for elonged analysis, storable, searchable (legal cons.)

■ Fluoroscopy, motional X-ray

motion of the diaphragma-, mediastinum (Holczknecht-Jacobson sign),

pulsation of the hilus, localisation of casted shades or pathological signs

■ CT –spiral CT, MSCT, HRCT

axial slices (with or w/o contrast material), volumen data-sampling,

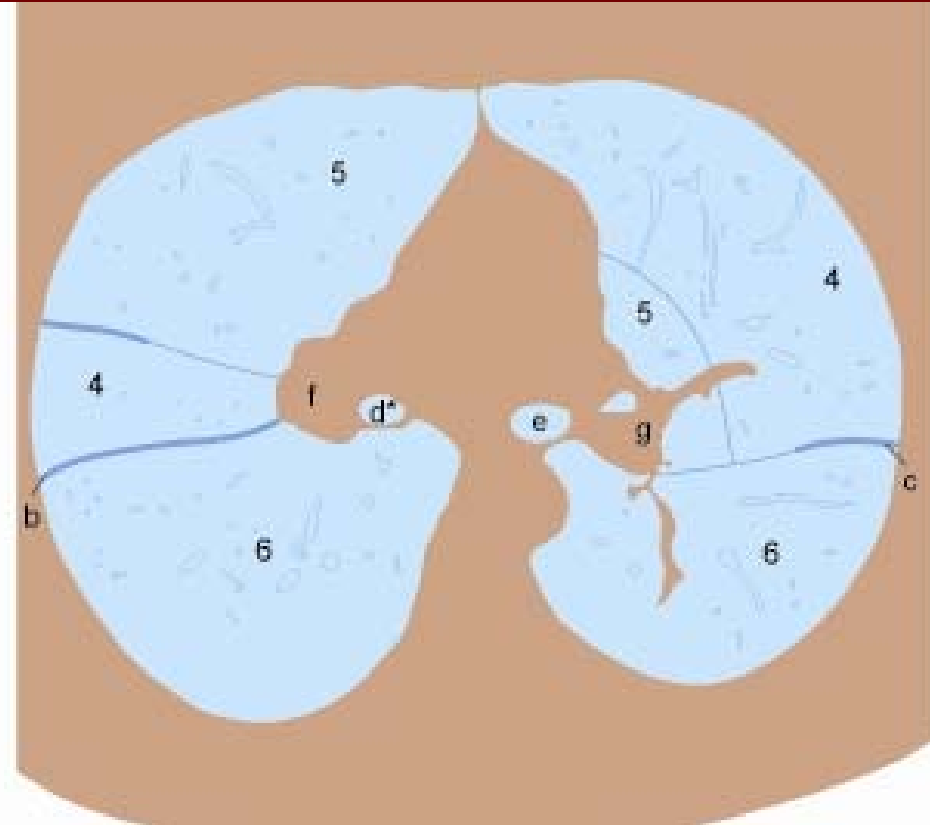
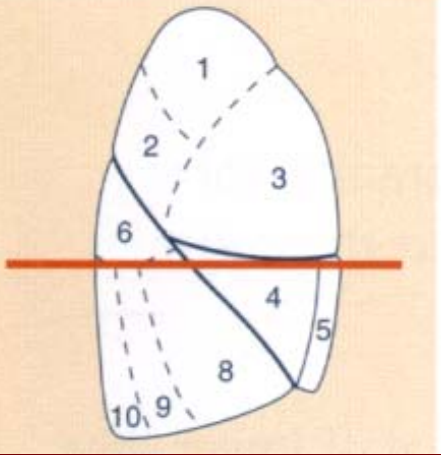
post-processing methods

■ MR - chestwall, mediastinum, heart, major arteries

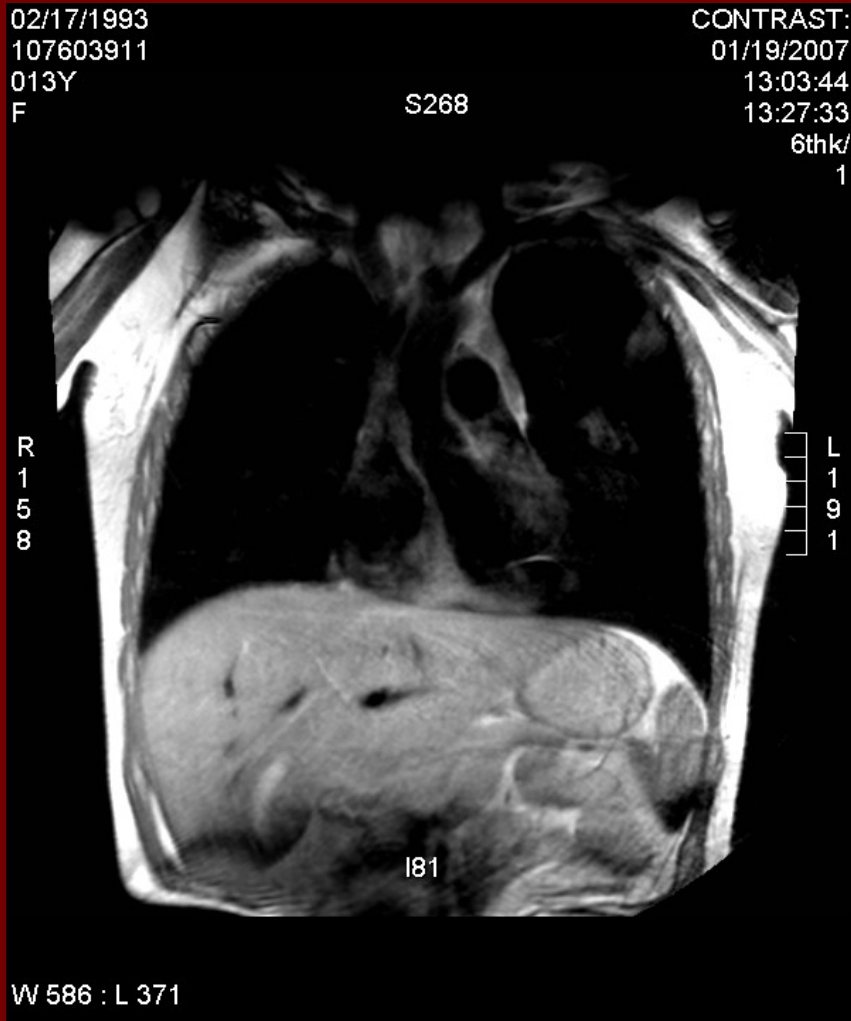
■ Radioisotope examination: ventillation, perfusion

■ Ultrasound: pleural fluids

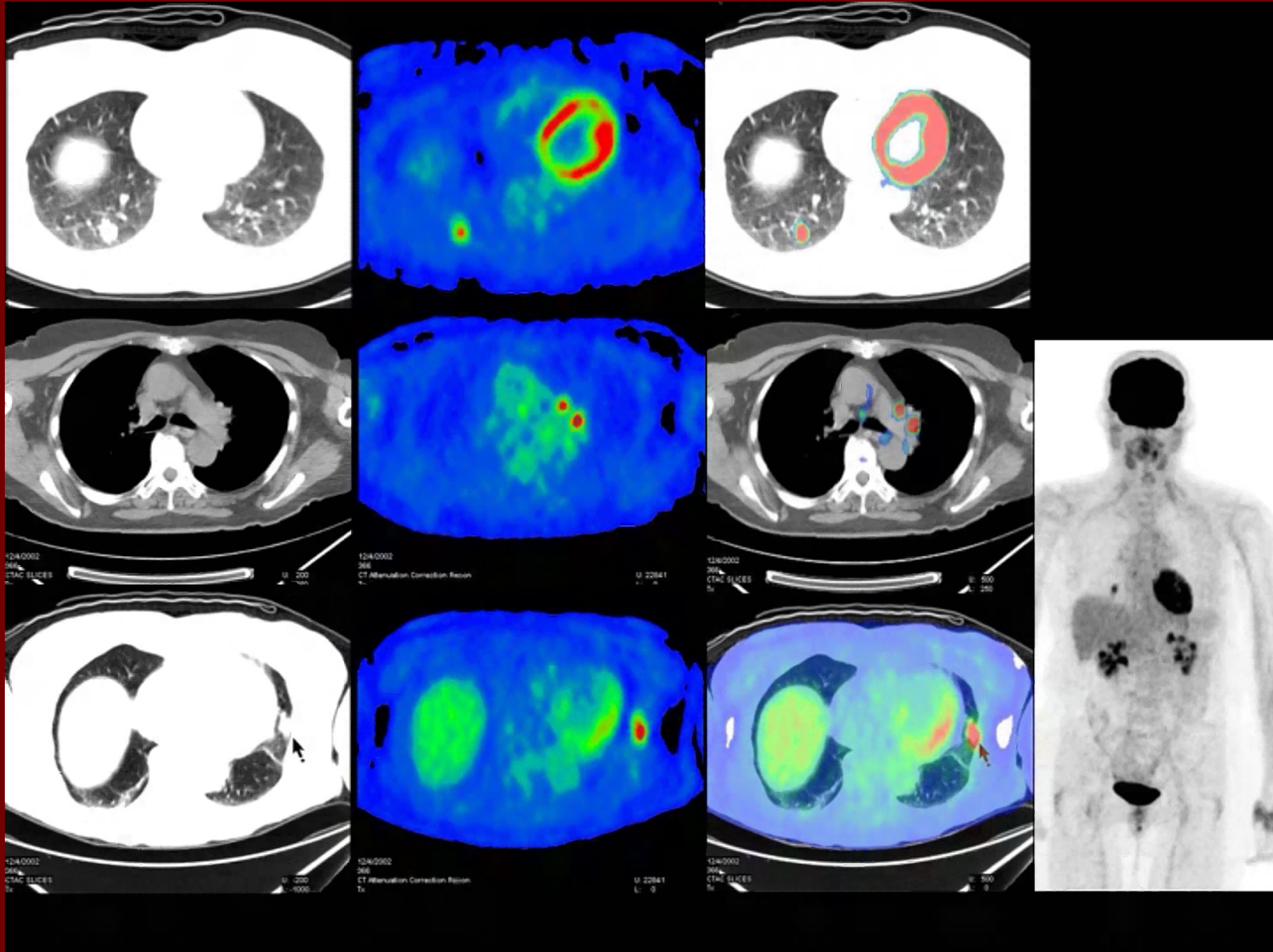
CT scan (axial slice)



MR imaging



PET-CT



Terminology for describing X-ray of the lungs

- 1. the typical discrepancies of the hila caliber
 - dilated, -thick hila vessels
 - slender, hypoplastic hila vessels
 - centropiferial caliber discrepancy
 - apicobasal caliber discrepancy
 - asymmetry of the hila
- 2. vascular variances
 - hypervascularisation
 - hypovascularisation (possibly marked)
 - avascularised regions

Terminology for describing X-ray of the lungs

- 3. „parenchymal“ (interstitial) linear shades
 - diffuse or marked web-like image
 - pinstripe and atelectatic streaks
- 4. patchy opacities
 - multiplex small patches (diffuse)
 - irregular and regular shaped patchy opacities
 - blur
- 5. cavernous shades
- 6. transparential shades
 - less transparent
 - more transparent

X-ray report

- Patient's X-ray history
- Dynamic observation (longitudinal section)
- X-ray report (consilium)

The detailed and accurate description of the image

– **Is there anything pathological?**

– If yes, then what are the attributes?

localisation, size, type, structure, the relation to the surrounding tissue, multiplicity, etc.

- **Opinion** (definite answer or presence of alternatives, or cannot be stated with the current examination - suggestion of other imaging modalities)

- Which report is better?

The report of an experienced radiologist and the report of a radiologist, who's familiar with the case (signs, symptoms and patient history)!

$$\frac{\text{air}}{\text{tissue} + \text{fluid}} = \text{transparency}$$

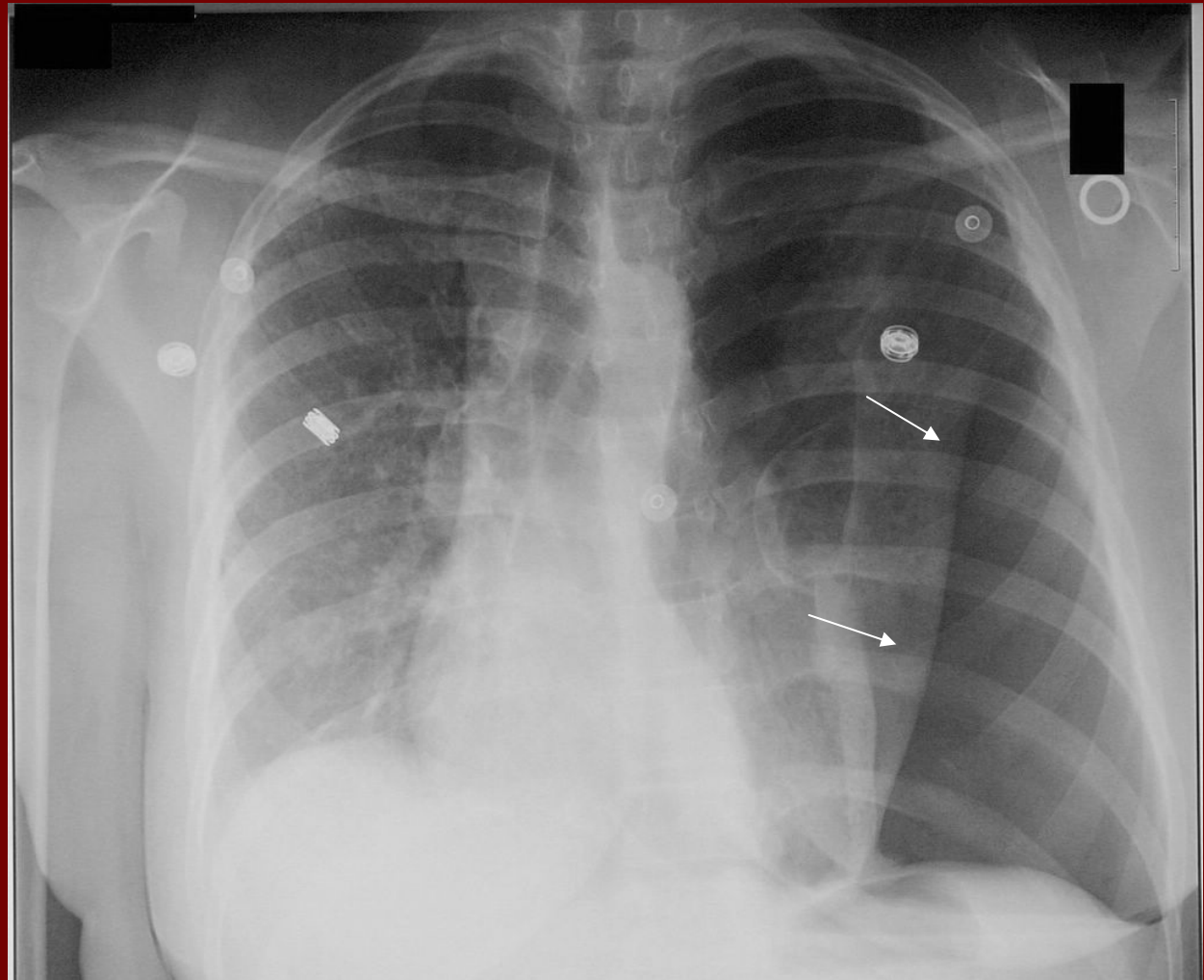
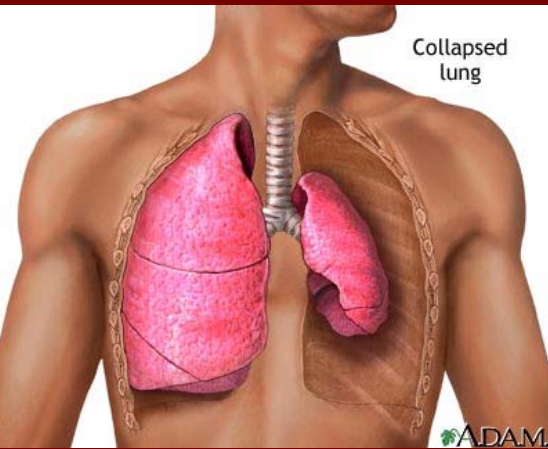
Everybody must recognise:

- pneumothorax
- pleural fluid
- pneumo-hydrothorax
- atelectasis
- chest trauma
- cardio-respiratoric statuses (stasis of bloodflow, pulmonary oedema)
- pneumonia
- lung cancer
- postoperate monitoring

Pneumothorax

- **Stripe-shade without outlines** between the chestwall and the collapsed lung's visceral pleura.
- If the presence of pneumothorax is suspected, the image must be taken during **expiration!**
- A skin fold of a lying, thin patient can have similar appearance!
- In case of a **tension ptx**, the midline is dislocated towards the opposite side – needs urgent therapy.
- In case of a hydro-ptx, the presence of **air-fluid level** is pathognomonic!

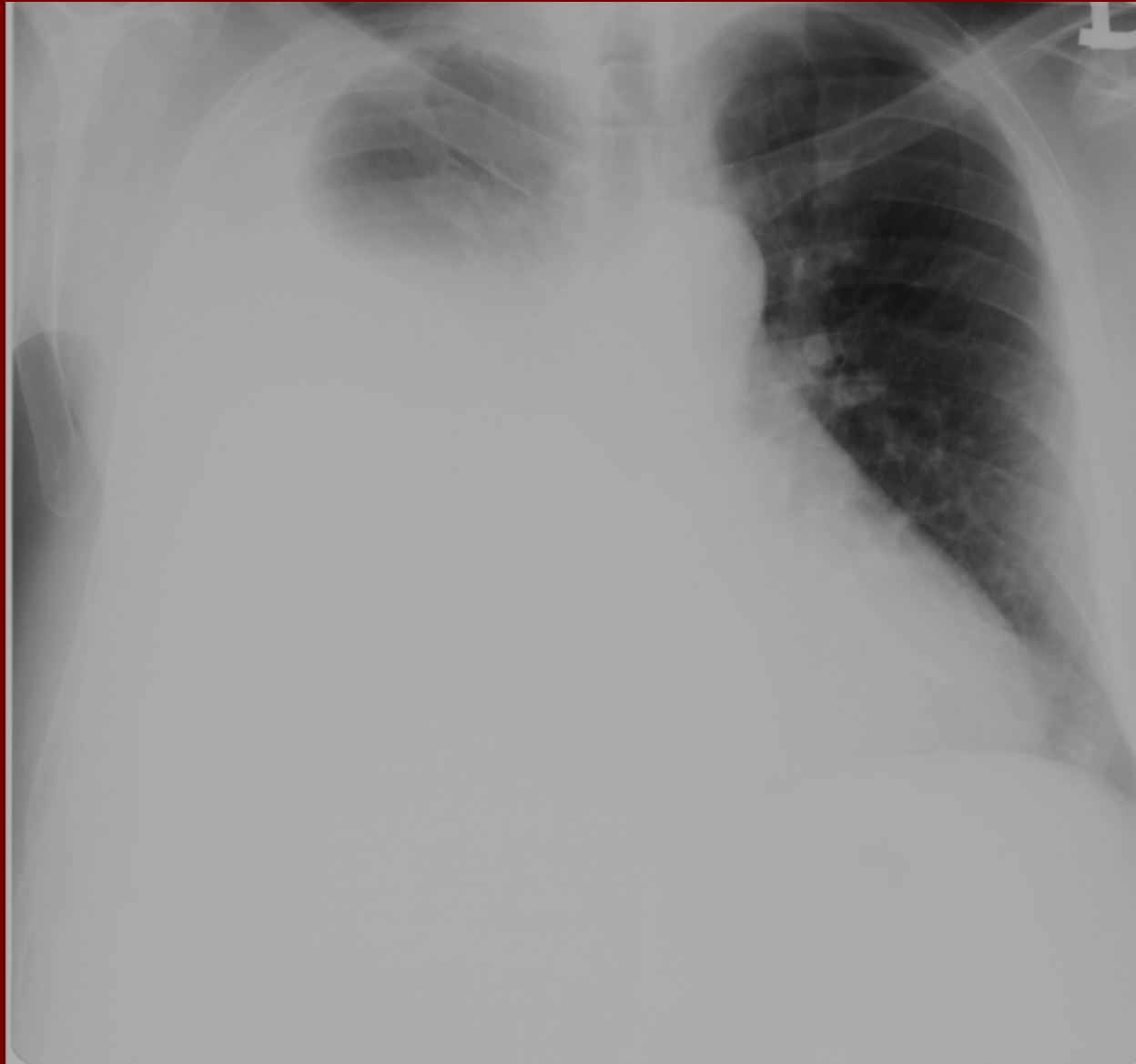
PTX pneumothorax, lung collapse



Pleural fluid

- The amount is variable: from the shade which covers the sinus to the complete obscuration of the lungs – these are the typical appearances.
- Large amount of pleural fluid will dislocate the midline.
- Its localisation might be **subpulmonal** (needs a Frimann-Dahl snapshot to prove)
- If pleural adhesions are present, the **encapsulated fluids**, and the **marked fluid gatherings** in the small fissure might imitate **pneumonia** on a p-a image.

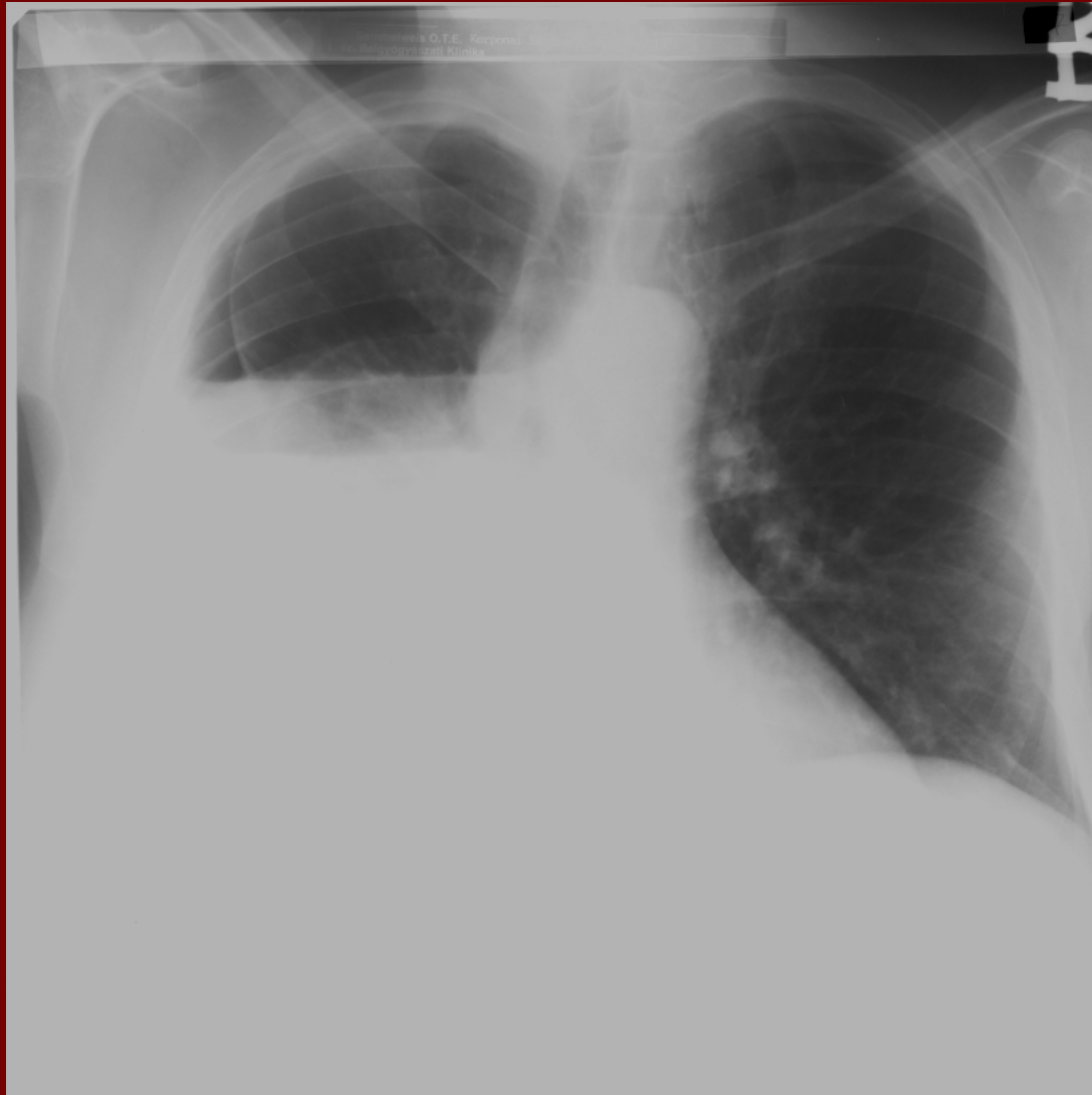
Hydro-thorax



Hydro-thorax



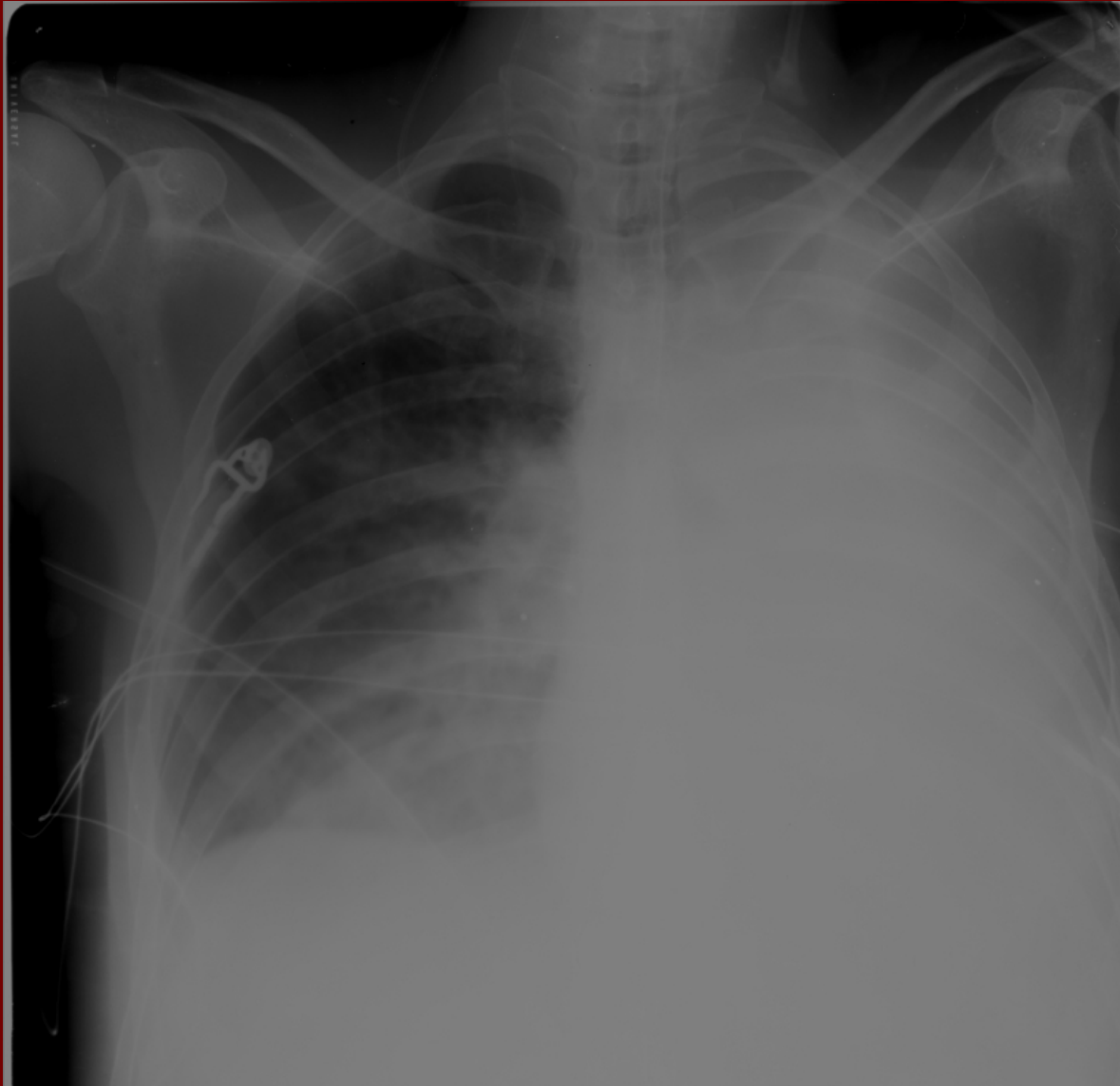
Pneumo-hydrothorax



Atelectasis

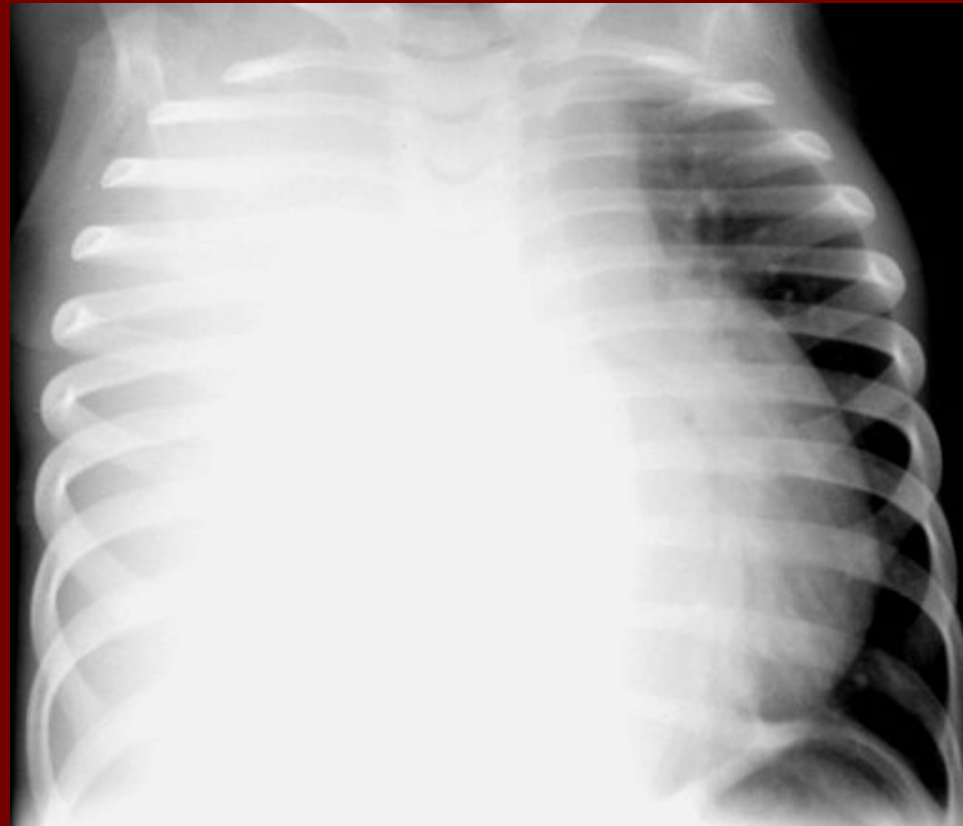
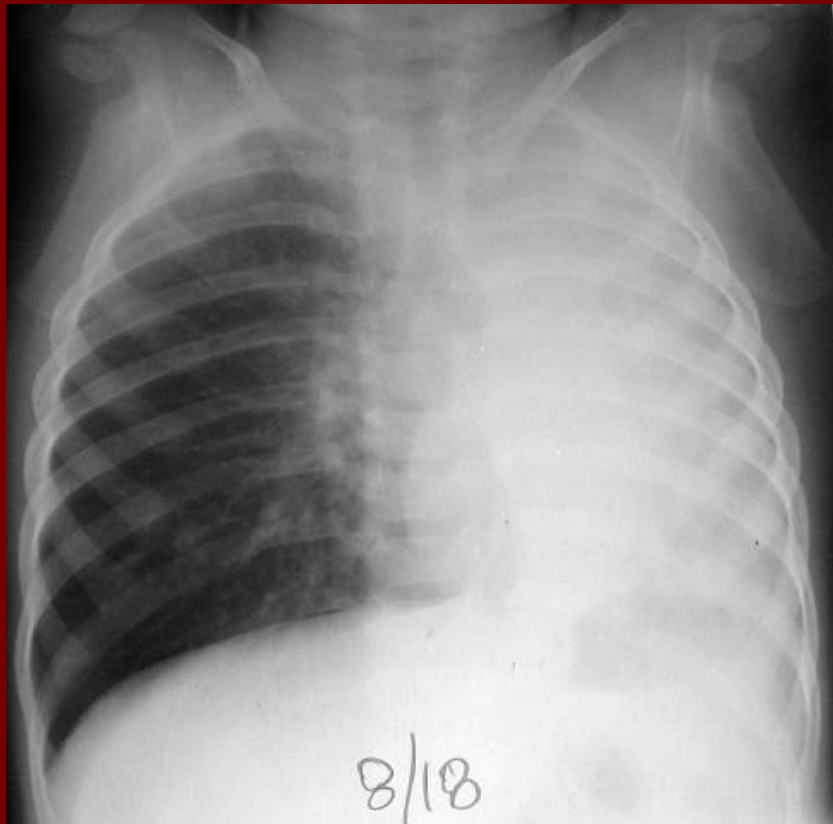
- The **deaeration** of the lung-tissue, and the consequential **patchy opacities** in the air-filled surroundings of the lung.
- The **decrease or complete disappearance of the alveolar air**, because of the losing of connection with the outer airspace, and the absorption of the air inside the alveoli, and the consequential collapse of the healthy, elastic lung-tissue.
- **Differential diagnosis:** pneumonia

Atelectasis



atelectasis - pulls

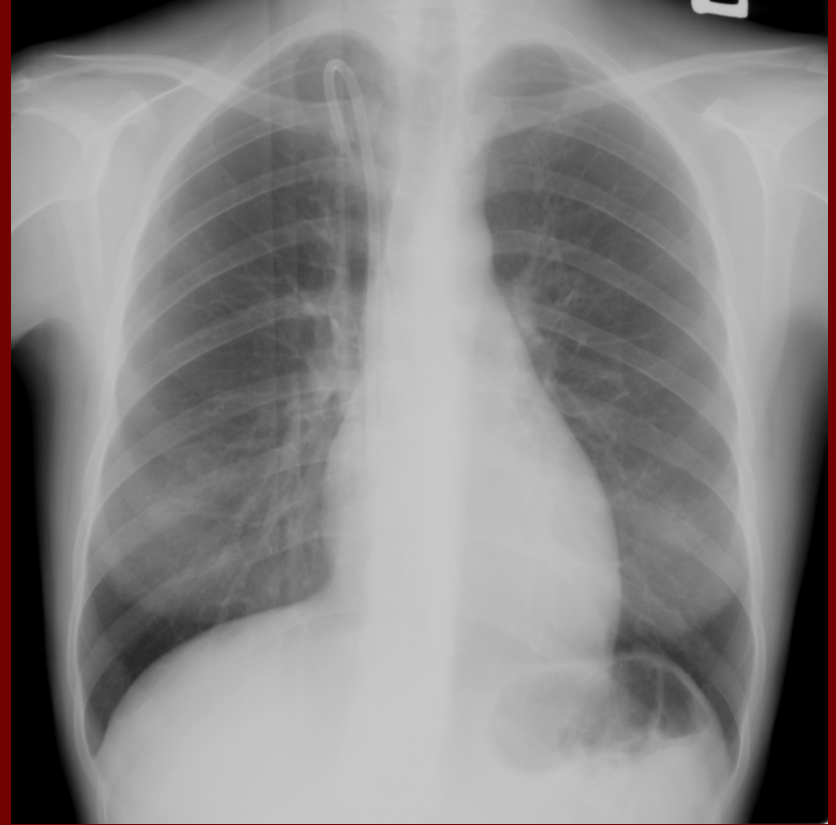
pleural fluid - pushes



Pulmonary stasis of bloodflow/oedema

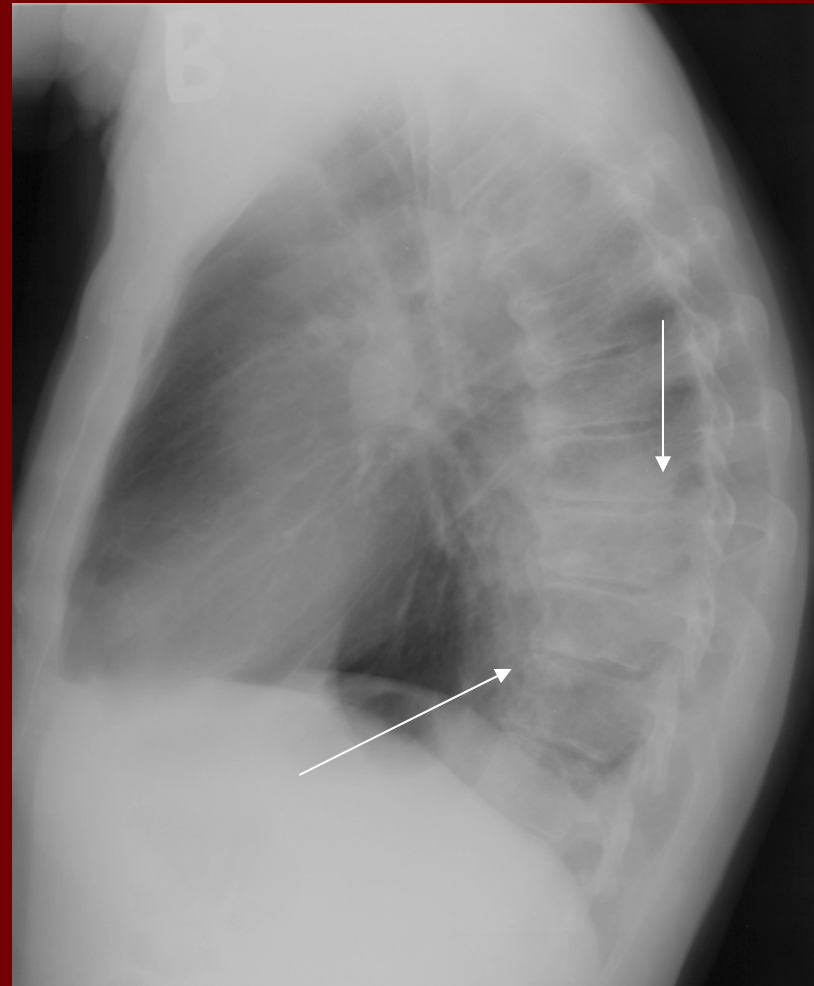
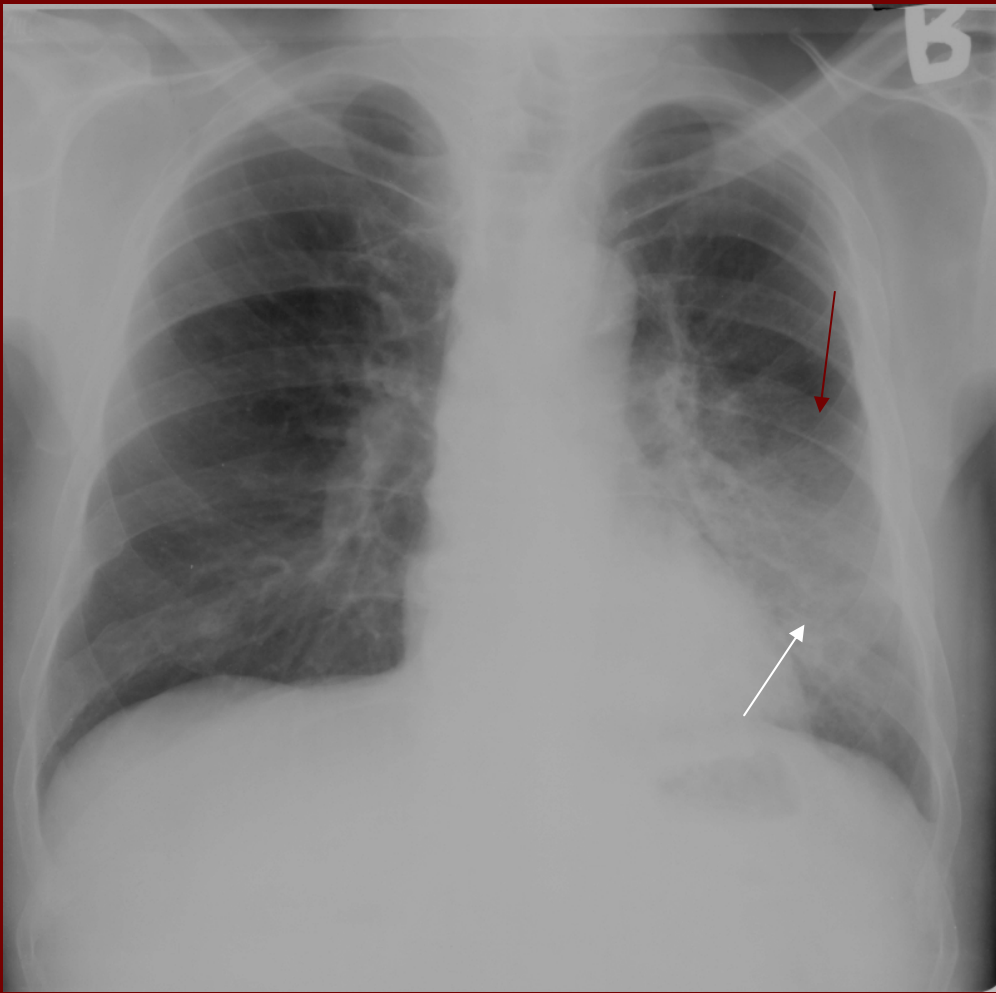
- The lymphvessels cannot transport the **increased amount of fluid, which filters from the capillary into the interstitium.**
- The causes of increase in extravascular fluid:
 - Increased hydrostatic pressure,
 - Increased permeability of the capillars,
 - Overload,
 - Occlusion of the pulmonary vein.,
 - Pulmonary embolisation,
 - Decreased osmotic pressure,
 - Transfusion reaction,
 - Decreased level of plasma proteins,
 - ARDS

Pulmonary stasis of bloodflow



Pneumonia

- Appears as a **patchy opacity** on **X-ray images**, in various forms and extensions.
- Usually it's not specific for the causative agent
- Might have a similar appearance: lung infarction, tumour, tuberculosis, pulmonary oedema.
- The **clinical appearance** and the **dynamic imaging** helps with the diagnosis.
- The X-ray image is „**in latency**”



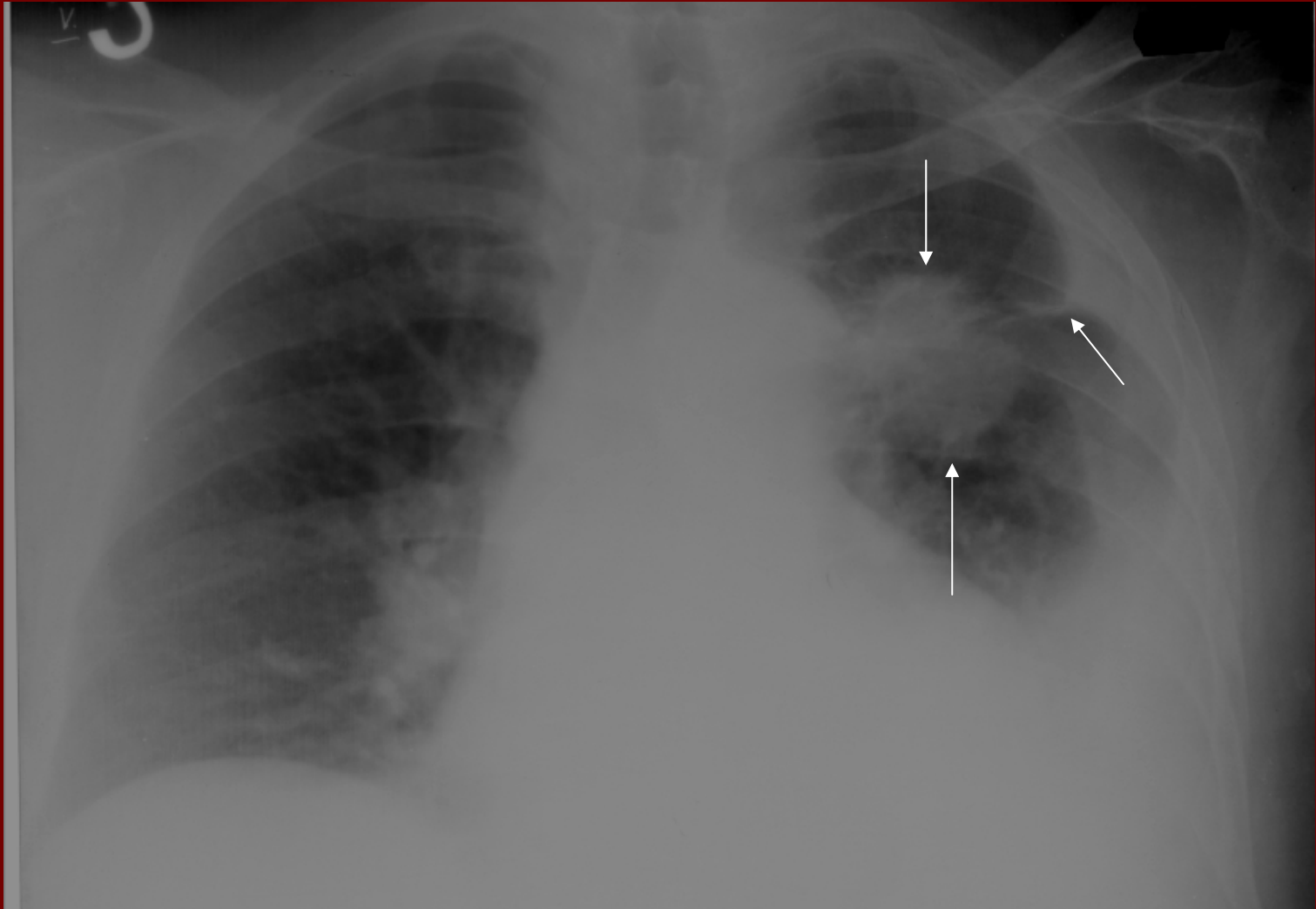
atelectasis - pneumonia differential

- Respects **anatomical borders**.
- The affected part of the **lung becomes smaller**.
- Dislocates the normal outlines of the fissures and the surrounding healthy lung zones.
- **Holzkecht-sign: pos.**
- **Homogenous shade**
- Rarely lobar, and doesn't have a segmented localisation
- The **size** of the affected part of the lung **doesn't change**.
- Doesn't dislocate fissures or surroundings.
- **Holzkecht-sign: negat.**
- **Rarely homogenous** (especially the borders)

Bronchus carcinoma

- Histology:
 - squamous cell carcinoma (central localisation)
 - Adenocell carcinoma (peripheral)
 - Anaplastic, larg cell carcinoma
 - Small cell carcinoma
- X-ray symptoms:
 - the tumor itself and/or
 - symptoms caused by bronchostenosis
 - metastasis

Bronchus carcinoma



Pancoast tumor

- It's a **bronchus cc.** in the **apex of the lung**, which spreads onto the **chestwall**.
- Symptoms are: shoulder pain, Horner trias, paralysis of the same side. It can cause the destruction of the vertebrae and the posterior arches of the I-II costae.

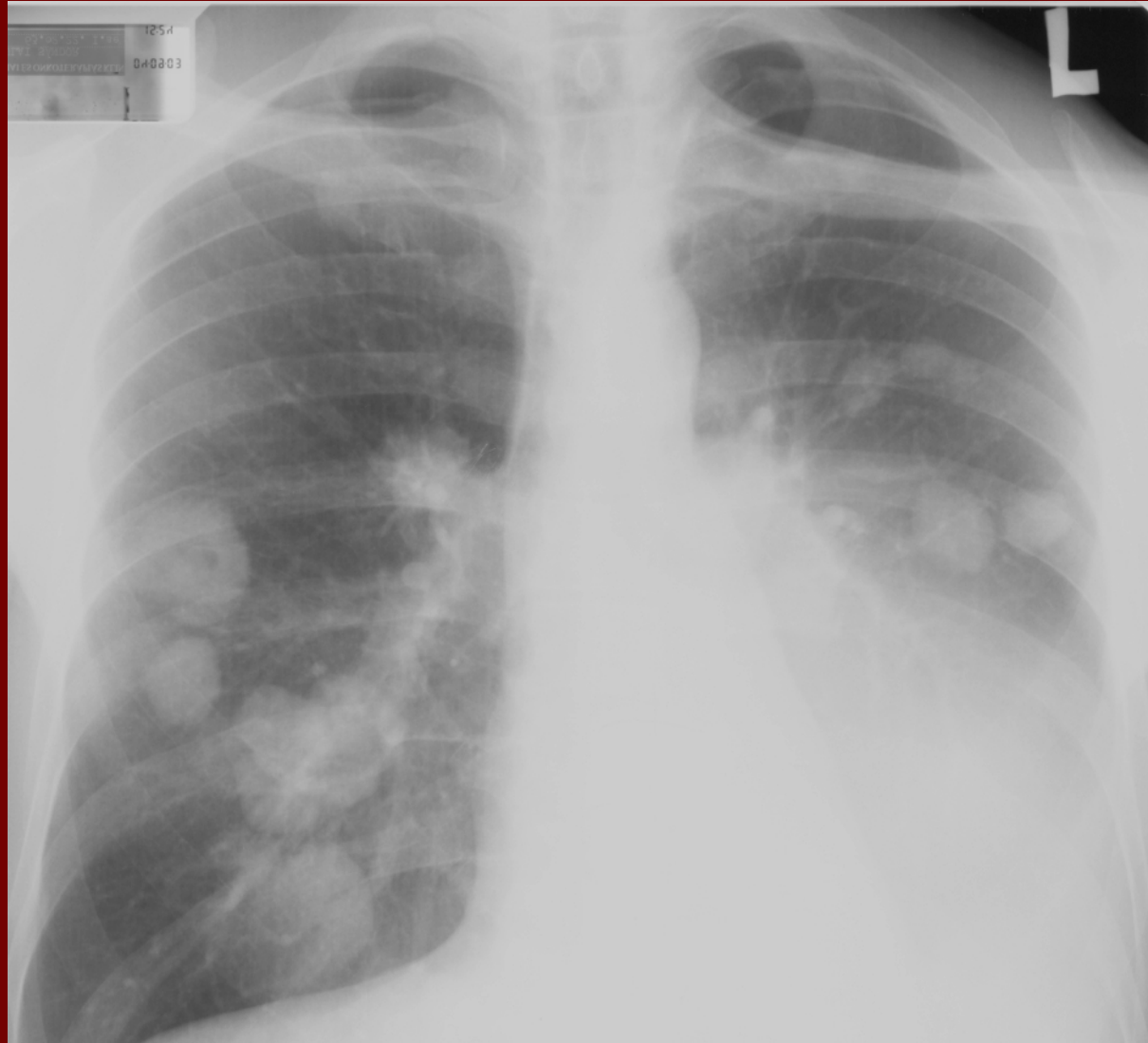


Bronchus carcinoma

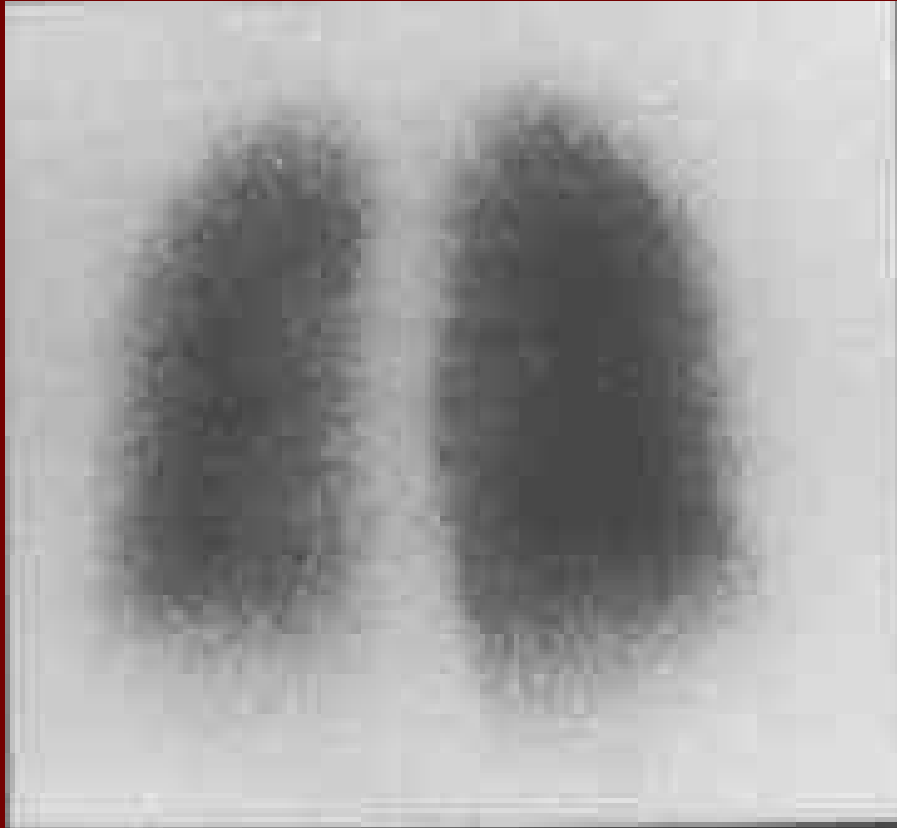
central location

- Localization: in the wall of one of the major-, or lobar bronchi, spreading towards the lumen.
- Symptoms: in the beginning the symptoms of **bronchostenosis** dominate: **retentive pneumonias, obstructiv emphysema, incomplete atelectasis, which can be complicated by inflammation.**
- After the extrabronchial breakthrough **unilateral widening of the hilus** (its shade becomes homogenous), with irregular outline, spreading towards its environment with broom like spurs.

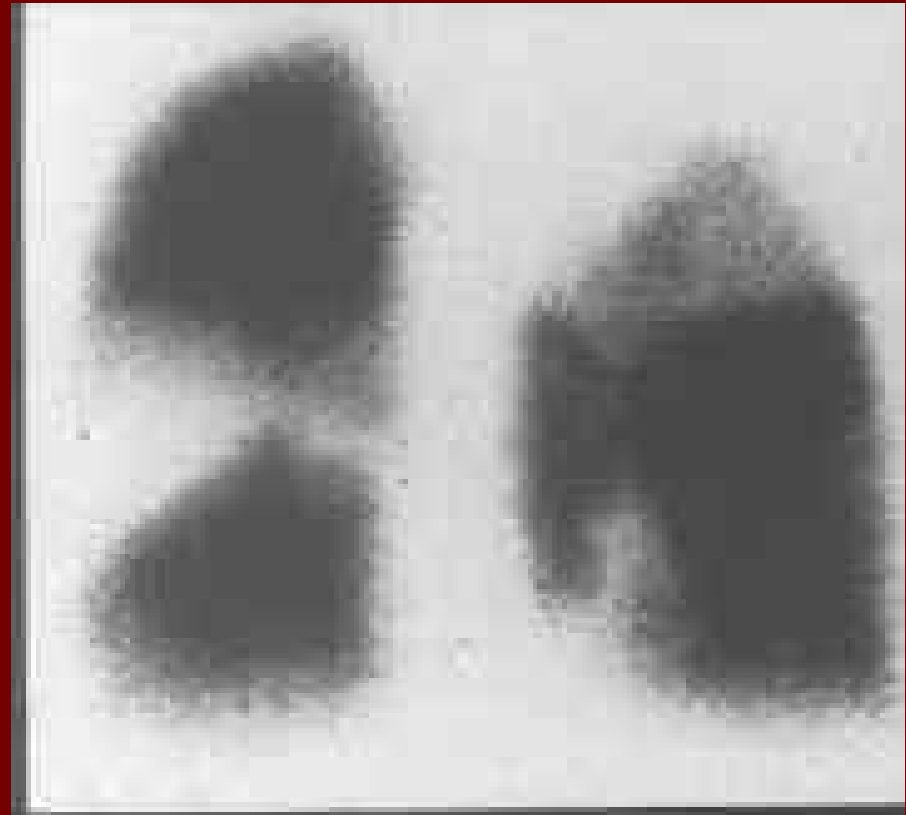
Multiplex metastasis in the lungs



Isotope examination of a suspected pulmonary embolisation



Ventilation lung-scintigram



perfusion lung-scintigram

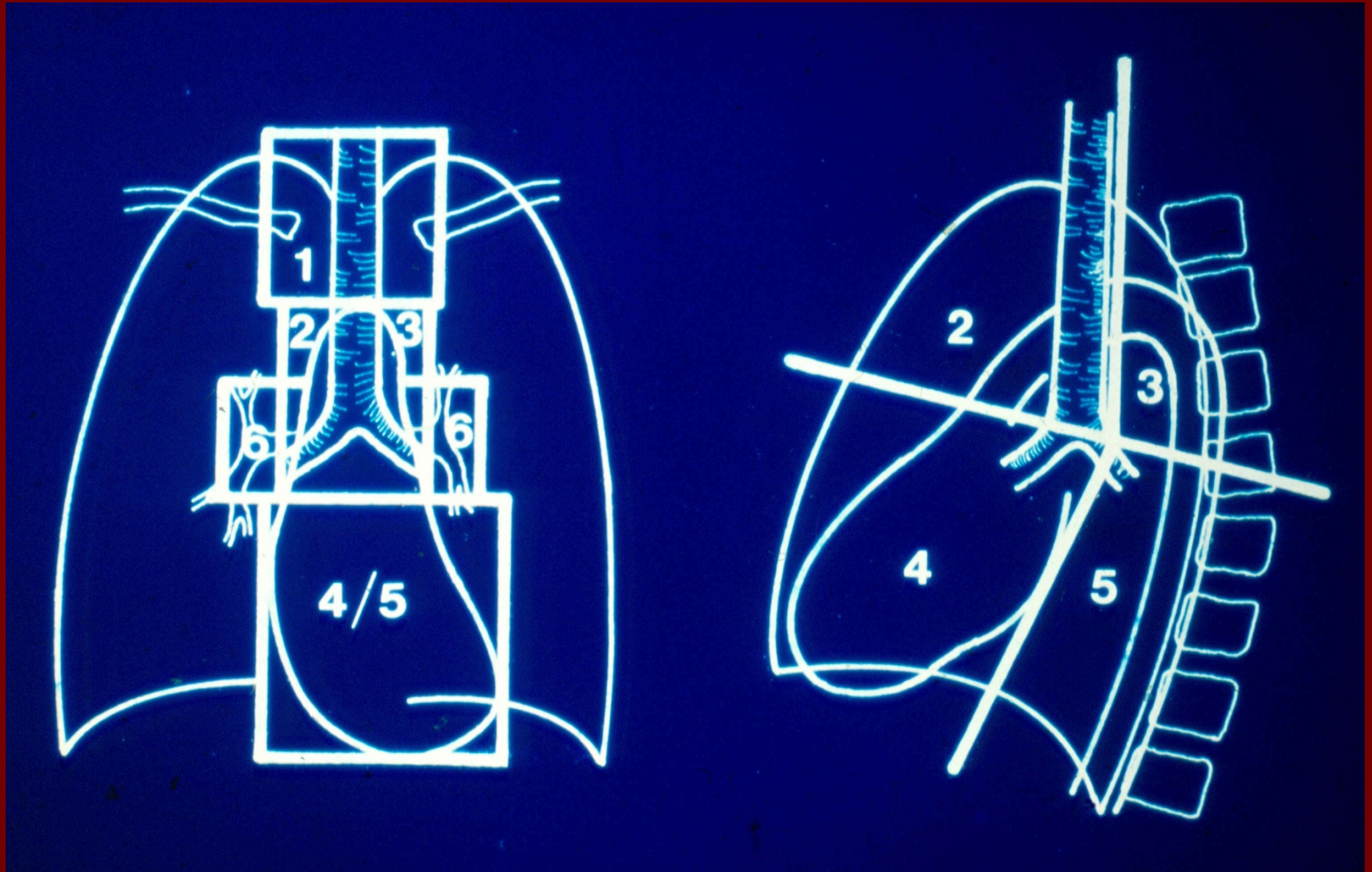
„mismatch effect“

Postoperative monitoring

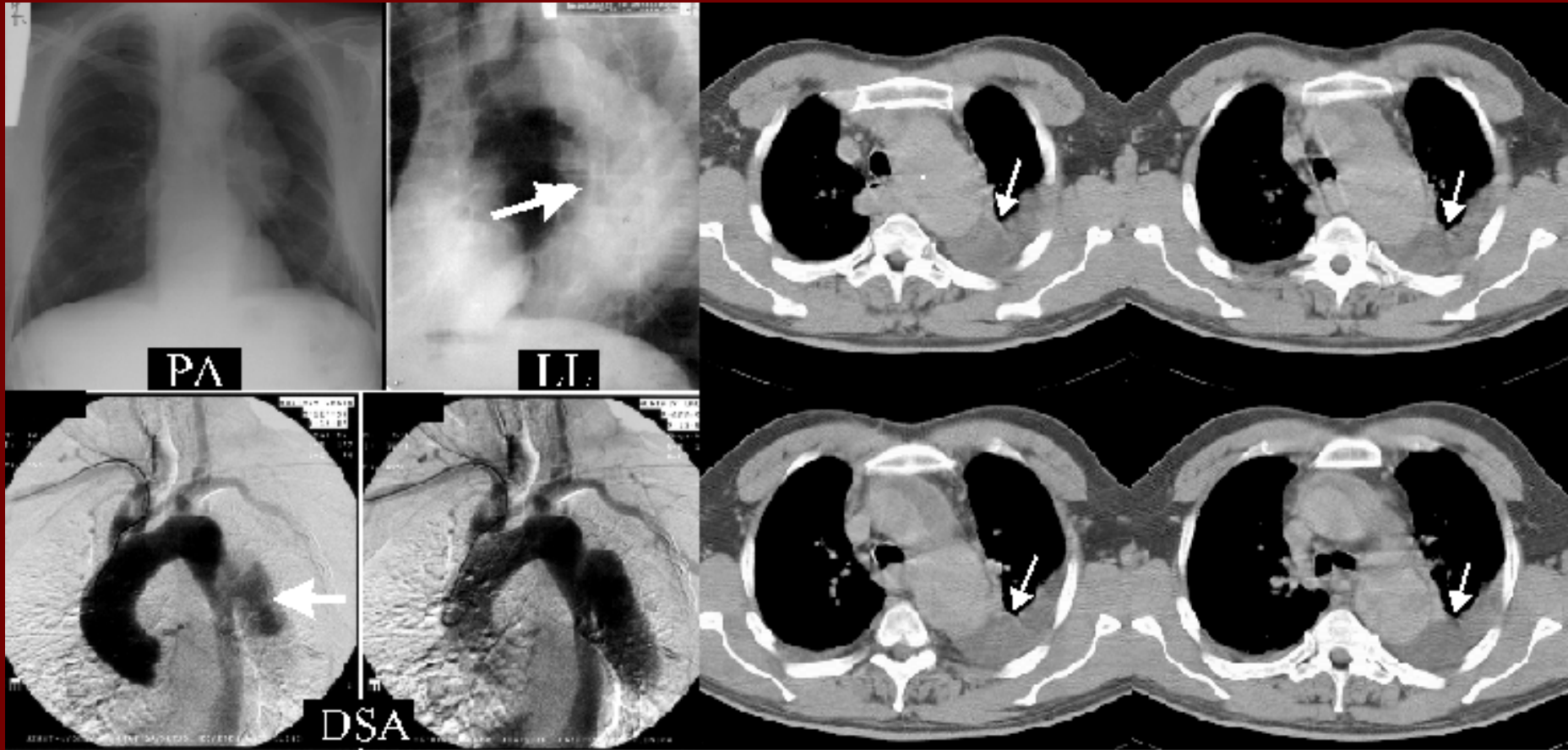
- **Location** of the central venous **canule** (possible complication: ptx?)
- Location of the endotracheal **tube** (the end of the tube should be 3-4 cms before the bifurcation)
- **Atelectasis**: hypoventillation and/or retention of the mucus
X-ray image: homogenous shade of the deflated segment or lobus. Rapid regression or progression both possible.
- **Aspiration pneumonia** (more common on the right side)

- **Pulmonary oedema** because of the increased capillar permeability (possible causes: heart failure, overload, fluid restrain, sepsis, shock...)
- **Pulmonary embolisation**
- **Pneumonia** (possible causes: infection, or as a complication of aspiration or atelectasis)
- **ARDS** (lung in shock)
Possible causes: major surgery, infectious complication of graveous pancreatitis, aspiration, contusion, fat-embolism, DIC.
- **RTG image: negative in the beginning** →
moderate interstitial oedema → **rapid onset of extensive pulmonary oedema may develop.**
- **Pleural fluid (ultrasound!)**

Anatomy of the chest - mediastinum



Aorta - aneurysm



Chest x-ray (p-a and lat): at the descending part of the thoracic aorta, distal from the isthmus a major saccular dilation can be seen (arrow).

DSA examination: the contrast material fills up the cavum of the aneurysm, which connects to the aorta only through a narrow hole (arrow).

CT scan: axial slices with contrast – a haematoma can be seen next to the aneurysm sac, on the posterior thoracic wall.

Mass in the upper mediastinum – struma



Swallowing test: a shade with calcareous outline (arrows) can be seen on the p-a images, at the level of the thoracic entrance, left to the midline. This mass dislocates and comprimates the oesophagus (struma nodosa).

Masses at the hilus

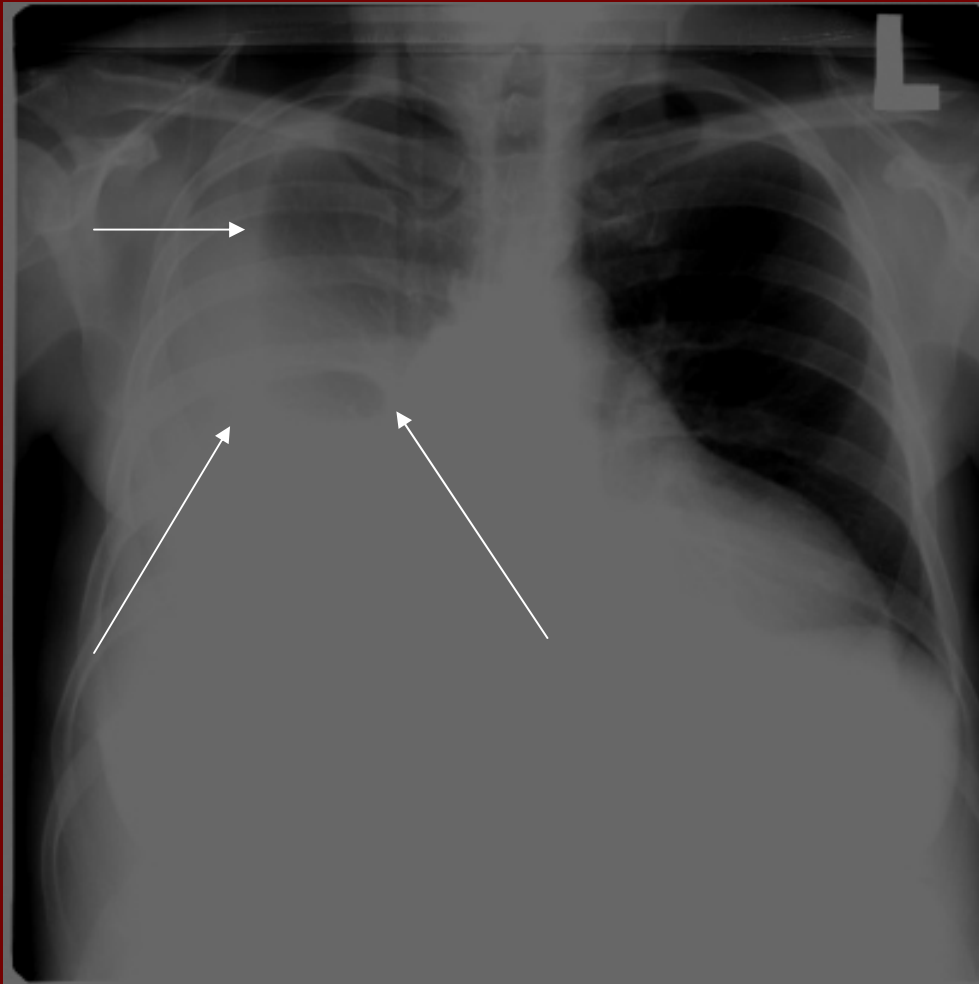


CT scan: native, axial slices from the middle of the mediastinum -
On the brink of the right side of the mediastinum an enlarged lymph node can be seen.
The rugged line shows the planned direction of the biopsy, then the needle can be
seen in the node.

Changes in the pleural space

- Pleural fluid
 1. **Transudate** – heart-, and chronic kidney failure, hypoproteinaemia, overload.
 2. **Exudate** – tbc and other infections, subphrenical abscess, lung cancer, SLE, RA.
 3. **Haemothorax (HTX)** – chest trauma, haematological diseases
 4. **Haemorrhagic pleural fluid** – pulmonary embolisation, lung cancer.

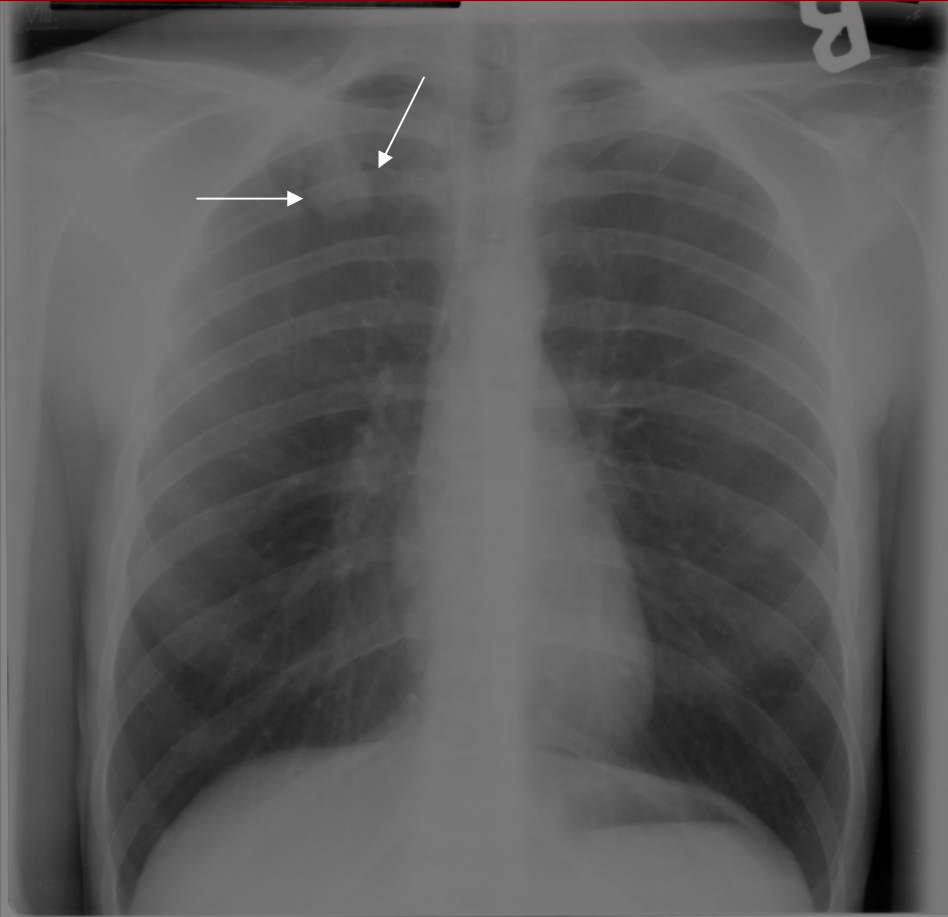
Pleural fluid

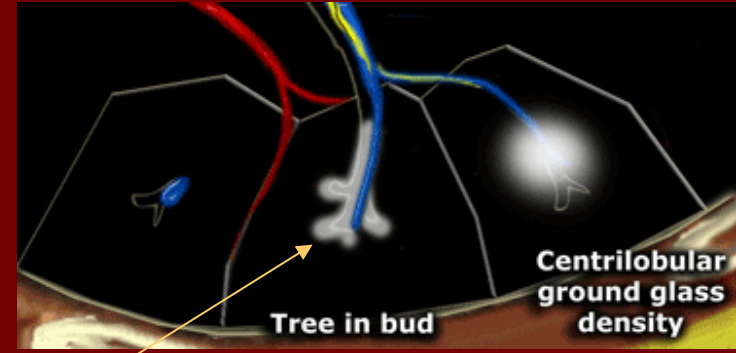
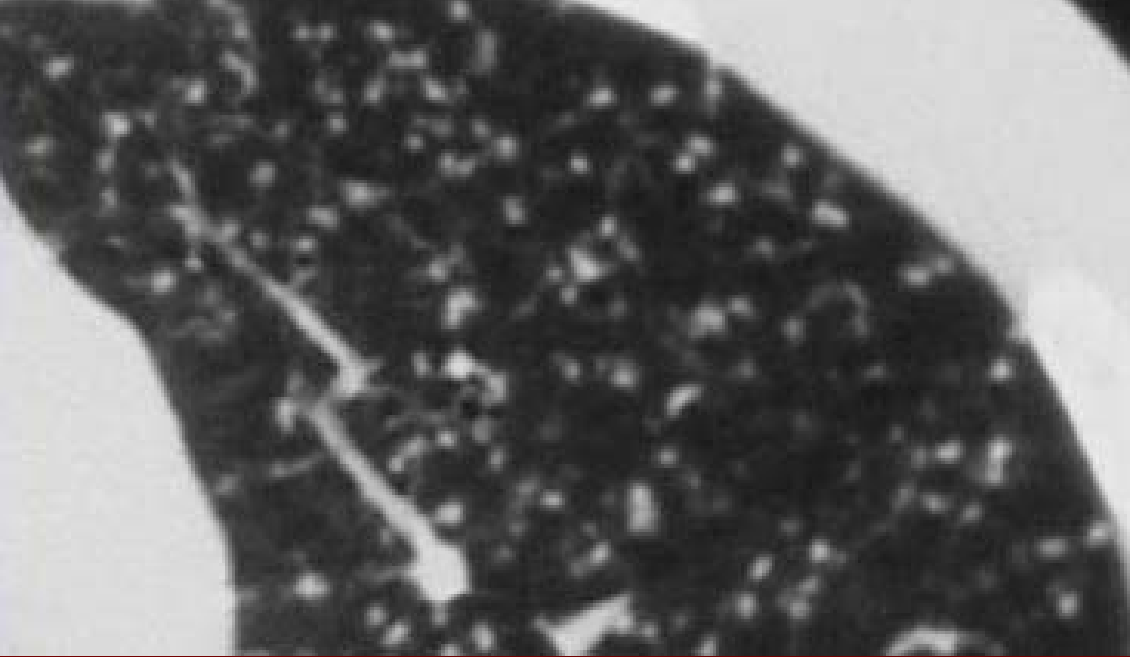




Active TBC

tuberculoma

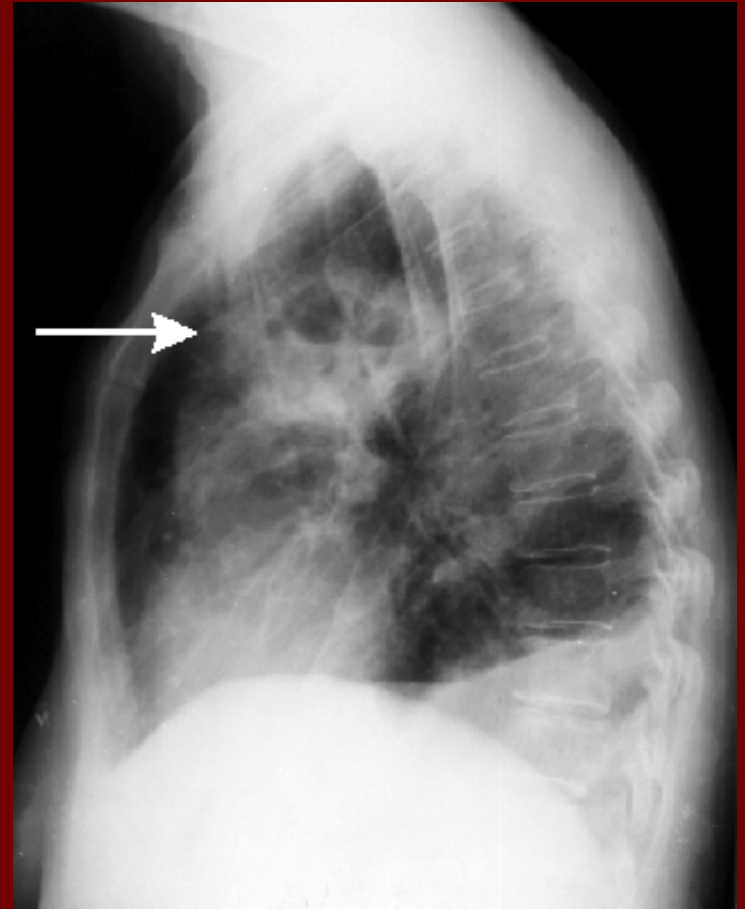
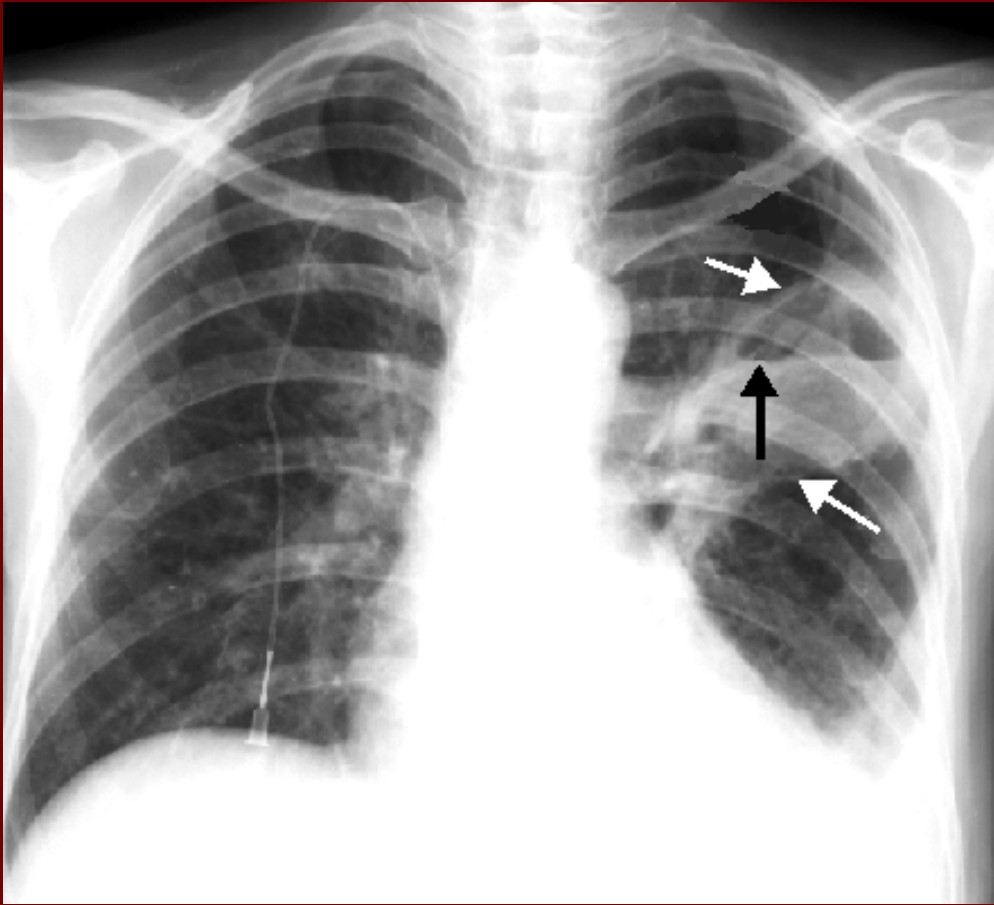




**Miliary tbc – HRCT
micronoduls, „tree
in bud“ sign**



Pulmonary abscess



<http://www.szote.u-szeged.hu/radio/mellk1/mellk7a.htm>

„basket” sign

The causes of the closure of a bronchus

- Foreign body
- Bronchus cc.
- Benign intrabronchial tumor
- Mucopurulent-plug
- Missed intubation
- Stricture after an infection
- Outer compression (tumor, lymph node)

Aspergilloma



Degenerative lung diseases

- emphysema
- fibrosis
- bronchiectasis
- pneumoconiosis

Emphysema



Bronchiectasis

types: cystic

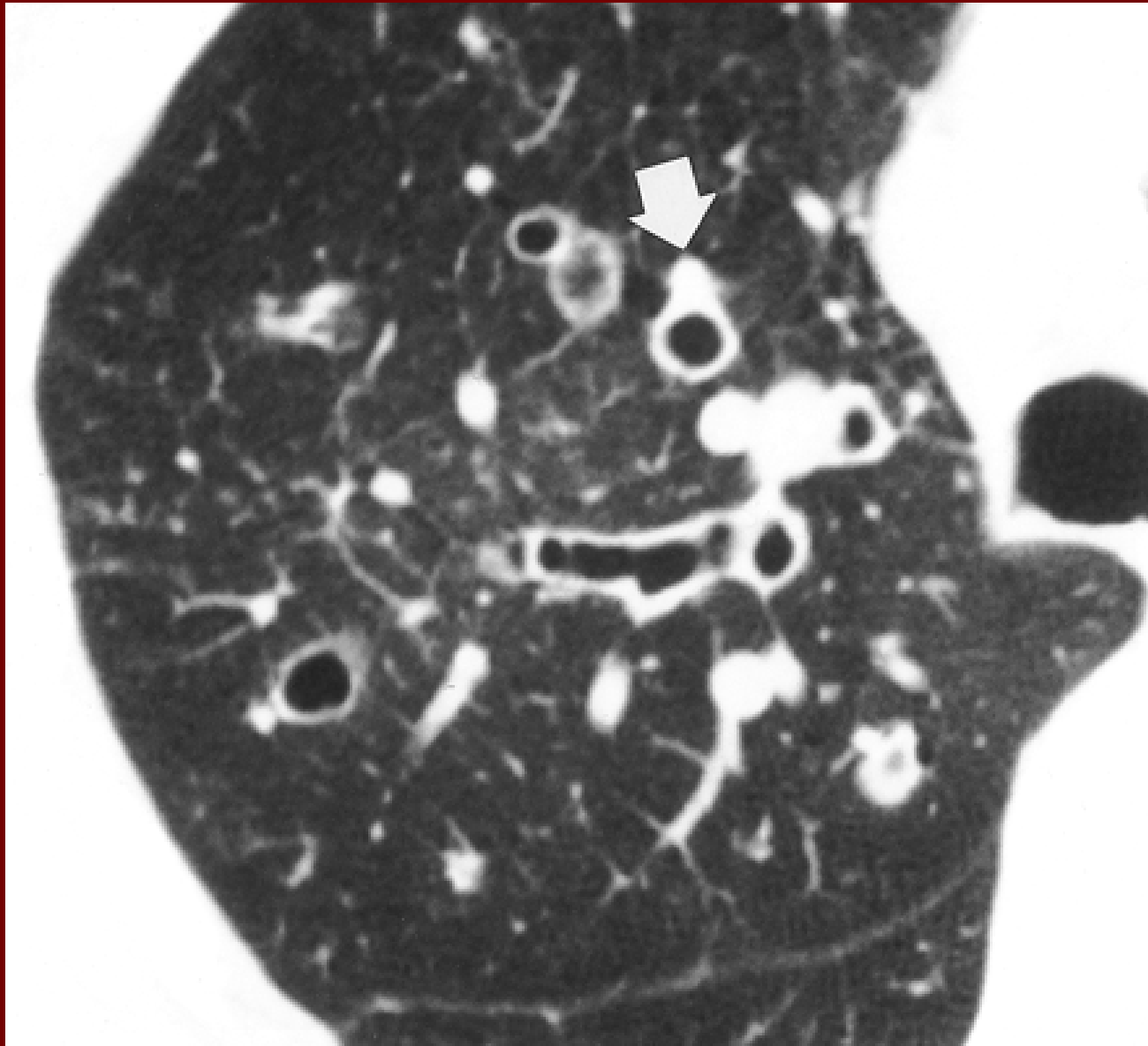
cylindric

varicous

X-ray image: summation of small, ring-like shades

HRCT: „signet-ring“ sign (a small artery-branch next to a wide bronchus)

Bronchiectasis – „signet-ring” sign



Lung-fibrosis

- The infiltration of the **interstitium** of the lung by tumor, oedema, or fibrosis.
 - manifests in an irregular, rough\smooth linear-shade network.

Accrued **fibro-reticular outline**, which not only covers the normal structure of the lung, but deforms it as well.

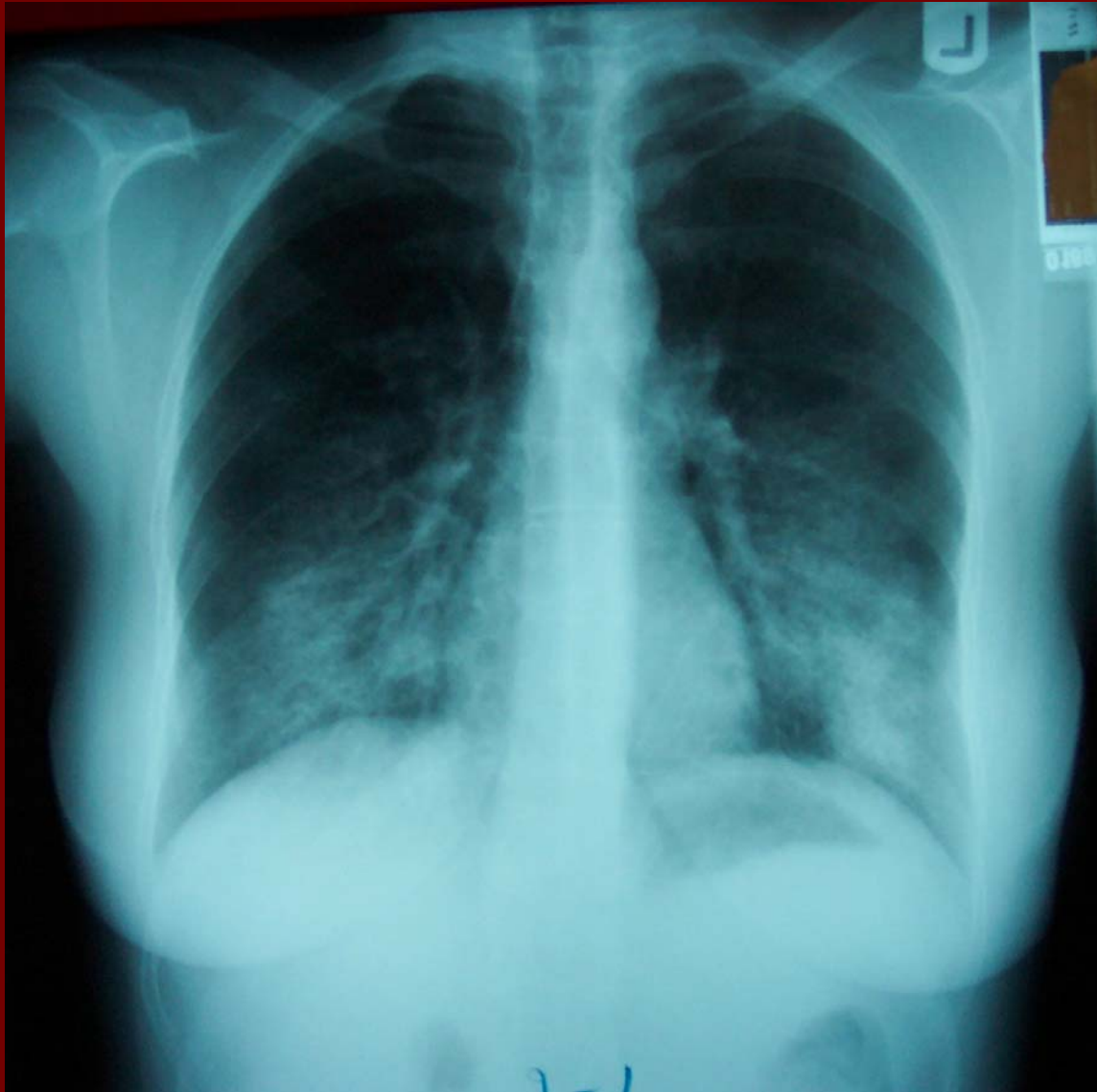
- In severe fibrosis „**honeycomb**” – lung can develop.

Major destruction of pulmonary parenchyma



<http://www.szote.u-szeged.hu/radio/mellk1/mellk7a.htm>

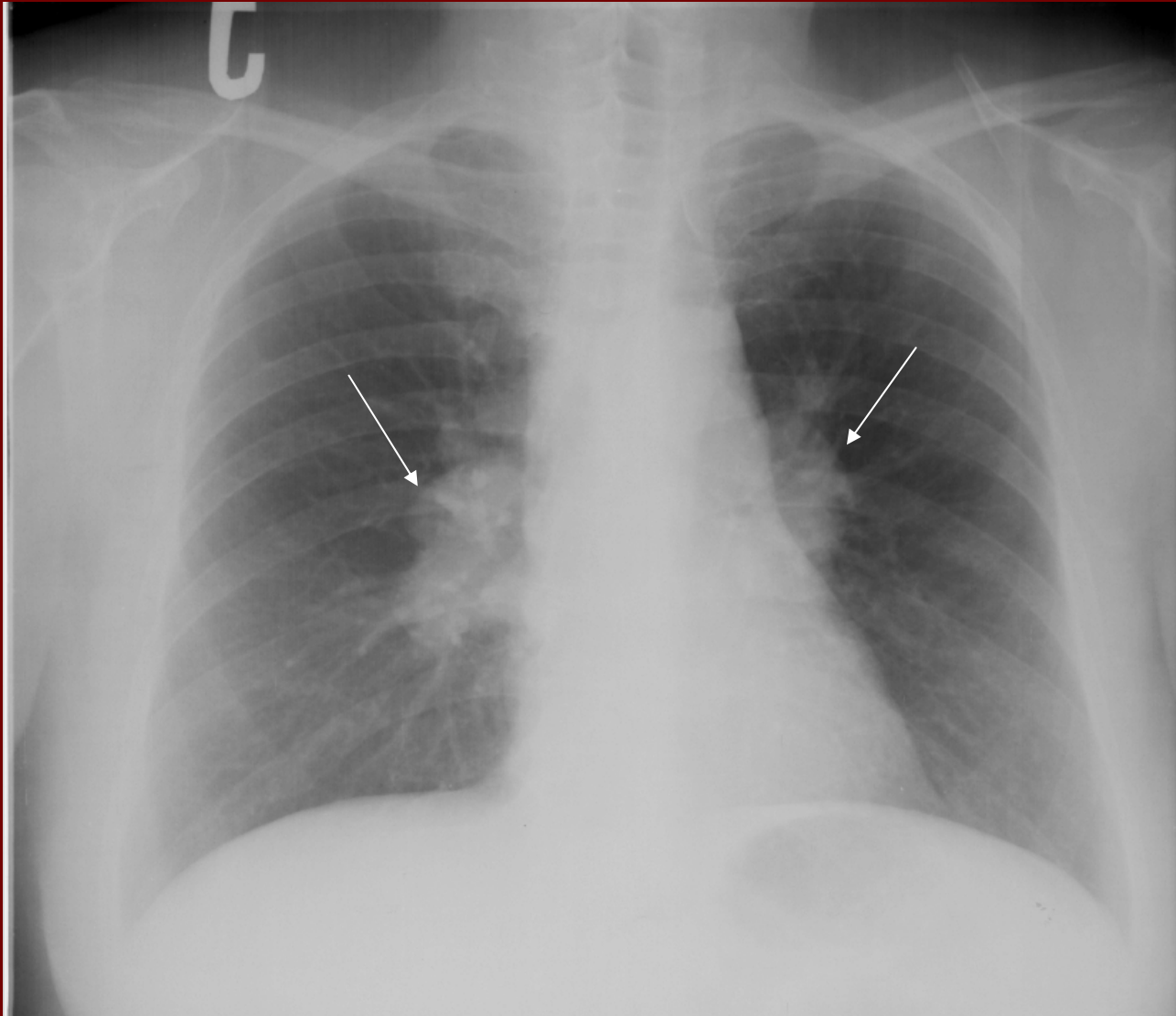
Acute interstitial pneumonitis/ inhalation of dust



Sarcoidosis

- It's a diffuse, non-caseous granulomatosis of unknown origin.
- **X-ray image: enlargement of the mediastinal and hilar lymph nodes on both sides + parenchymal, blurry plexus shades (1-3 mm in the beginning, up to even 1-3 cm)**

Sarcoidosis



Sarcoidosis- HRCT



Message

- Lung /chest anatomy
- Physiology /pathophysiology of respiration and circulation
- Investigating methods for pulmonary diseases
- The basic radiomorphology of the lung and lung disorders