



# Systematic in interpretation of pediatric chest X-ray

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*International Foundation for*

*Pediatric Imaging Aid*

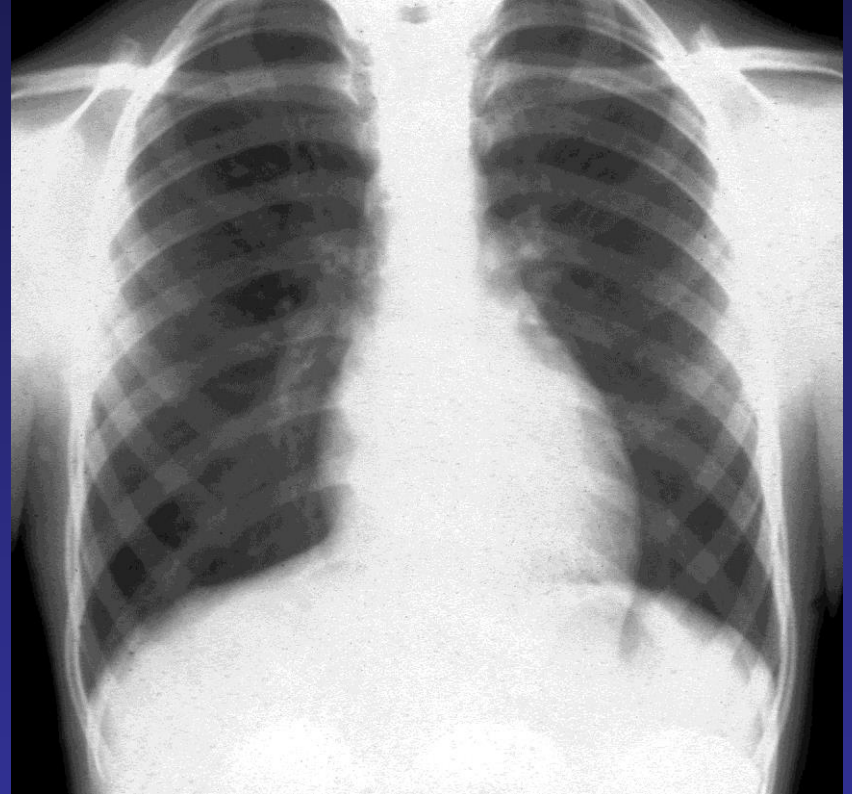
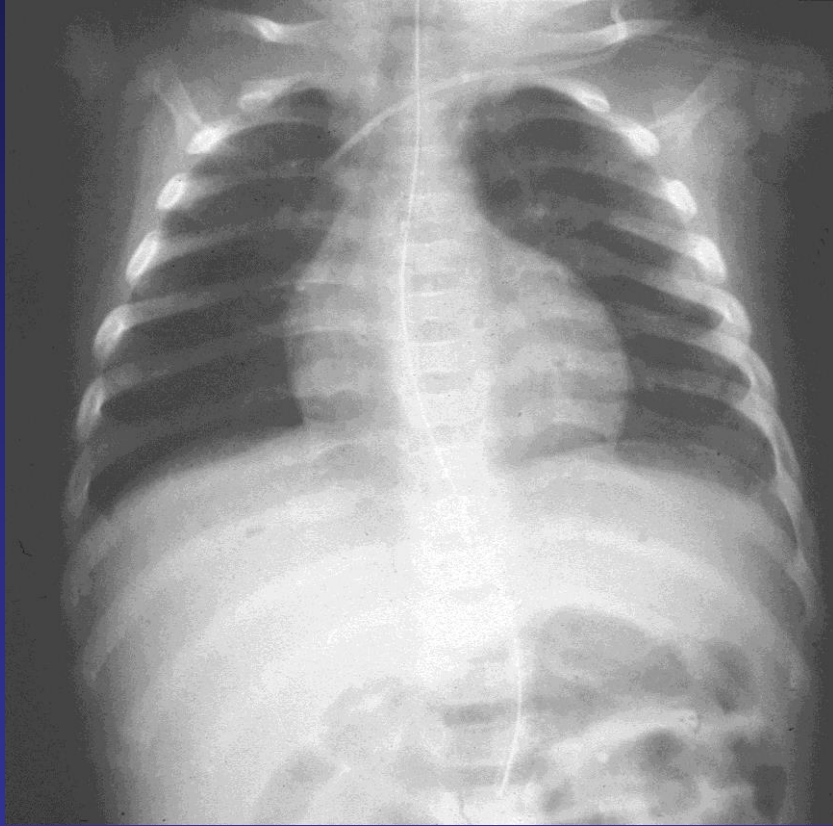
*Rotterdam, The Netherlands*

# Introduction

- 45% of conventional radiological studies are chest radiographs
- Systematic review of chest radiographs is necessary for accurate evaluation

# 12 important topics

1. Technique
2. Tracheo-bronchial tree
3. Diaphragm
4. Lung parenchyma
5. Hilum
6. Heart and lower mediastinum
7. Upper mediastinum
8. Skeletal system of the chest
9. Pleura
10. Upper abdomen
11. Soft tissues
12. Used medical accessories (tube, drains, catheters etc)



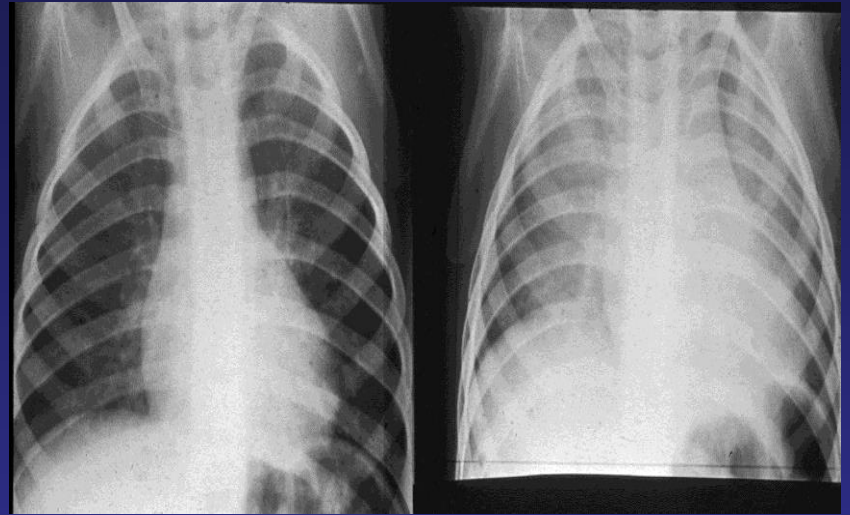
Normal chest X-ray

# Technique

- Inspiration
- Symmetry
- Projection
- Exposure
- Radiation protection



Chest X-ray without shuttering



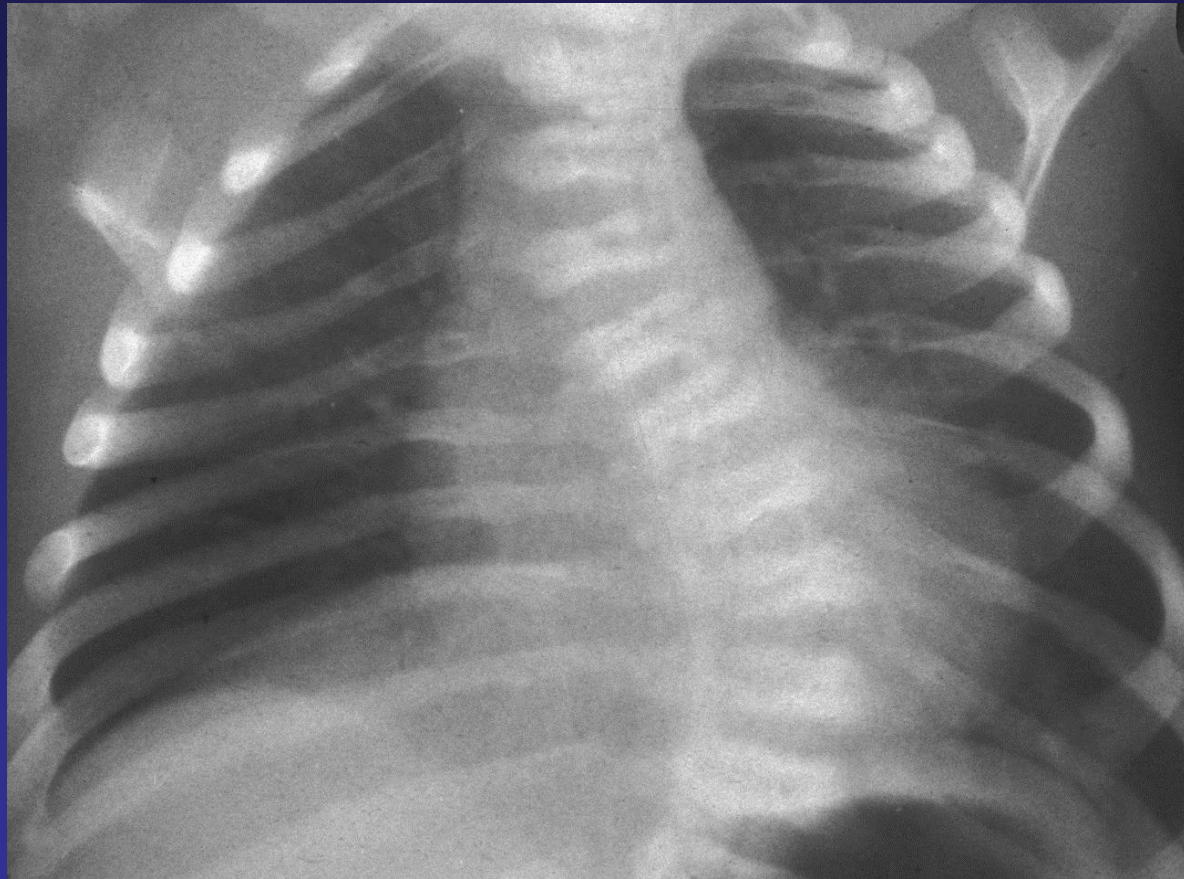
Inspiration

Expiration

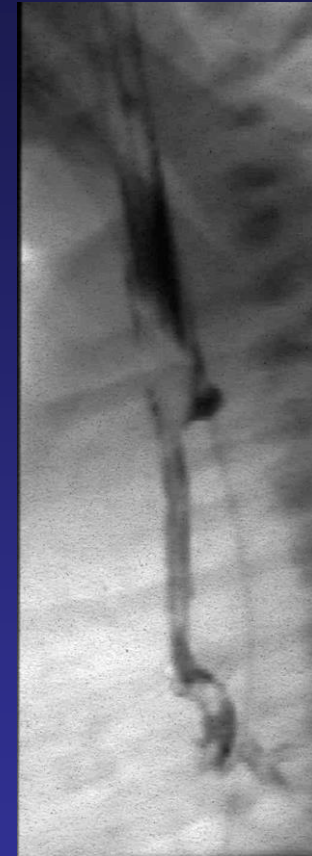
# Tracheo-bronchial tree

- Position trachea compared to vertebrae
- Displacement of trachea (mind: rotation head!)
- Stenosis of trachea and main bronchi
- Foreign bodies in airways





Agenesis of the trachea



Esophagus, no trachea seen at bronchography

# Diaphragm

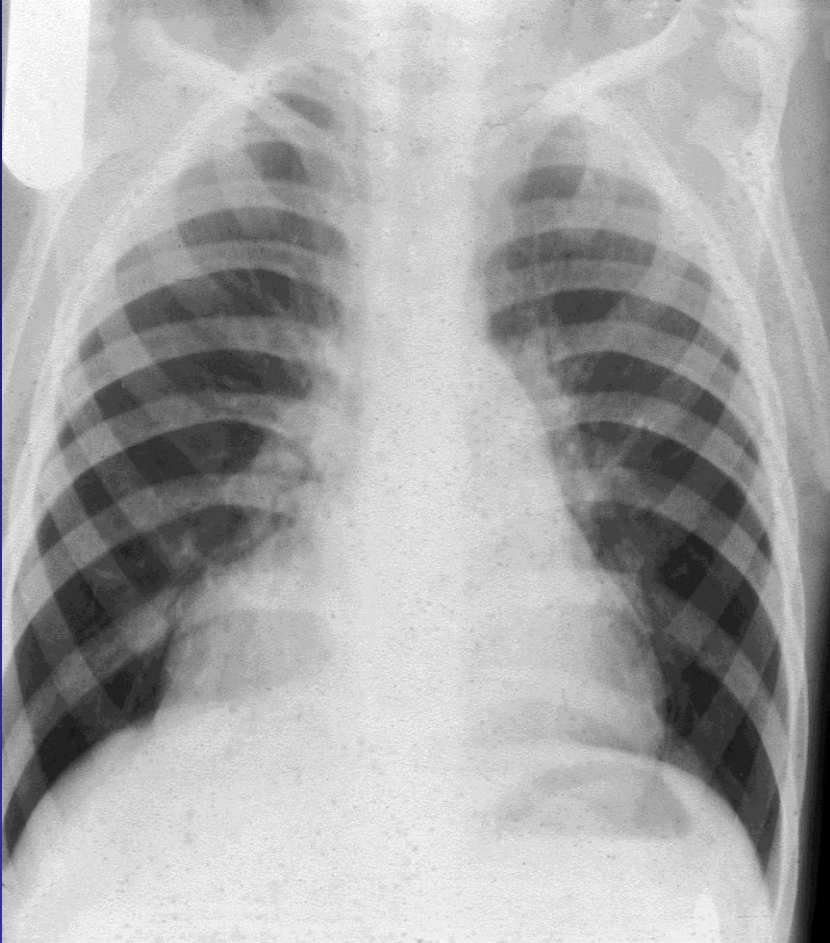
- Position
- Configuration
- Sharpness

# Diaphragm Position

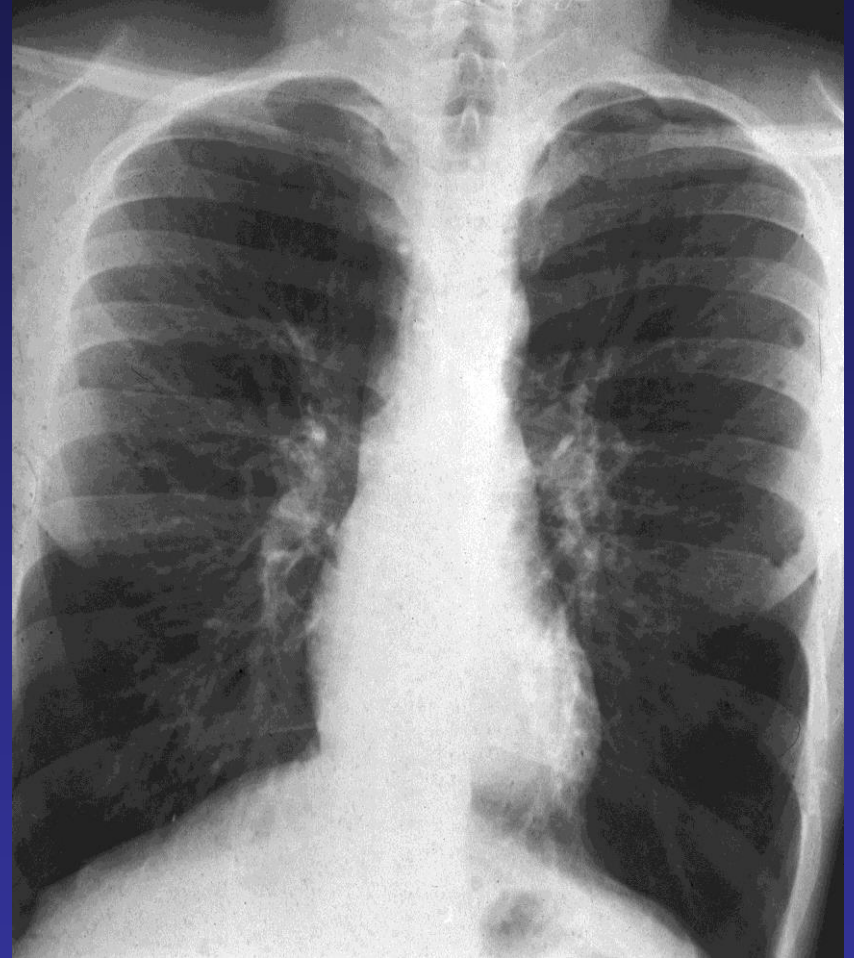
- Normal position:
  - 6th rib ventrally at inspiration
- Elevated diaphragm:
  - Paralysis n. phrenicus
  - Atelectasis
  - High intra-abdominal pressure (tumor or other causes)
- Low position of diaphragm:
  - Dyspnea, asthma

# Diaphragm Configuration

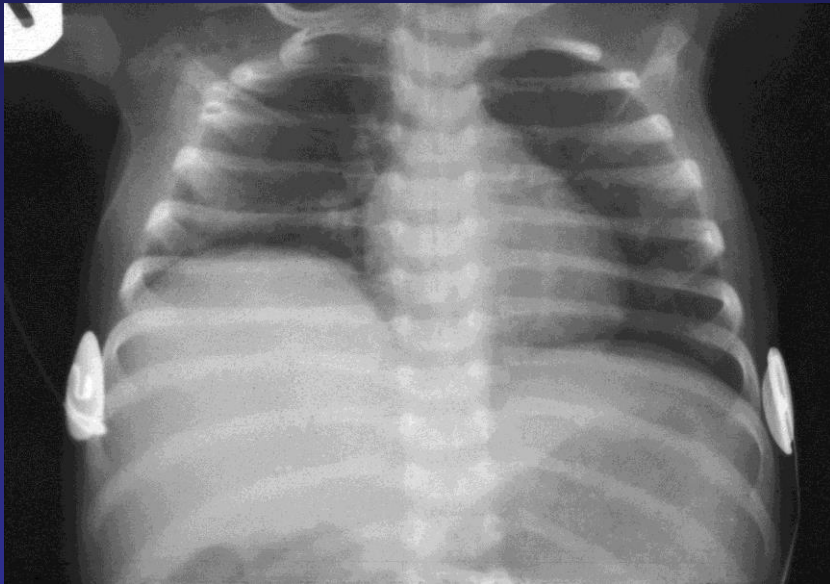
- Curved
  - Paralysis n. phrenicus
  - Liver enlargement and abdominal tumor
  - Partial relaxation
- Flattened
  - Excessive low position of the diaphragm (asthma, dyspnea)



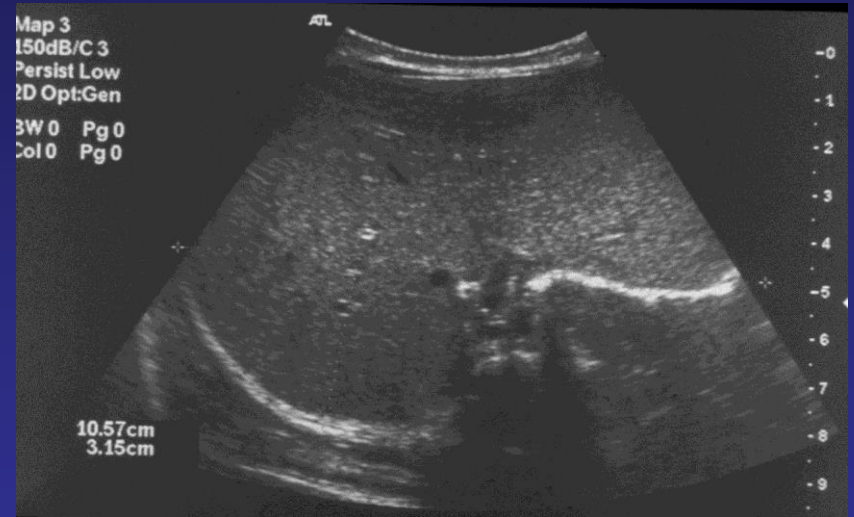
Relaxation right diaphragm



Flattened and low positioned diaphragm in asthma patient



Chest radiograph



Ultrasound

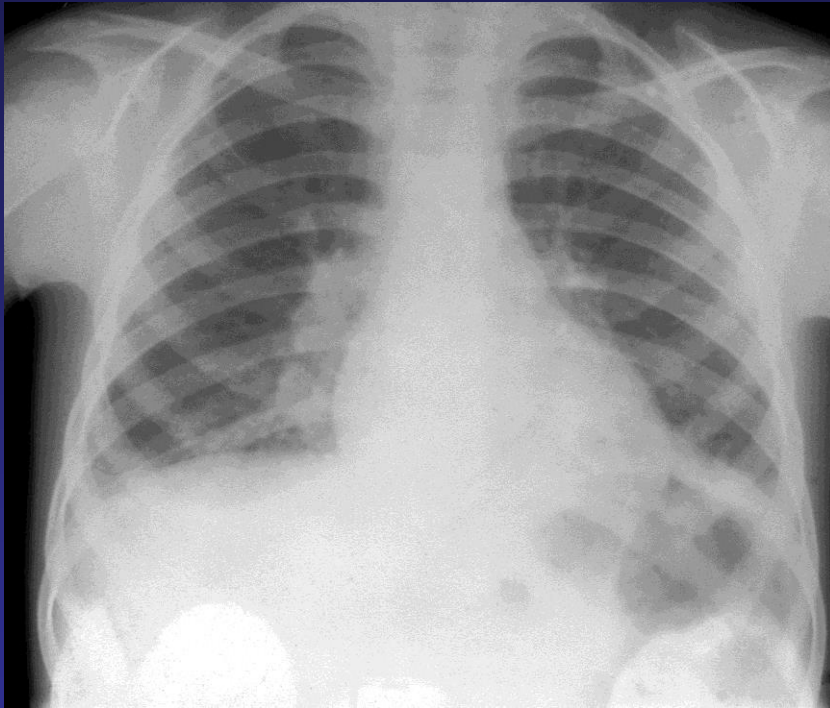
Paralysis of phrenic nerve



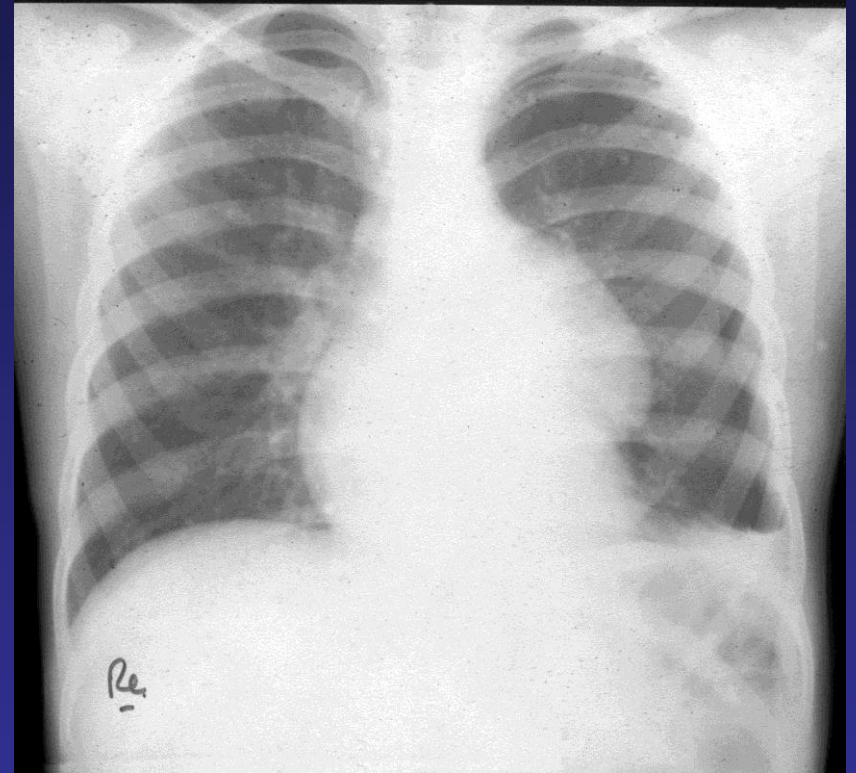
# Diaphragm

## Sharpness

- Normal
  - Sharp delineation of diaphragm and lung parenchyma
- Blurring
  - Pleural effusion
  - Infiltrate
  - Atelectasis



Bilateral basal pneumonia (L>R), blurring of diaphragm contour



Lymphosarcoma with some pleural fluid remaining after drainage. Diaphragm not sharply delineated.



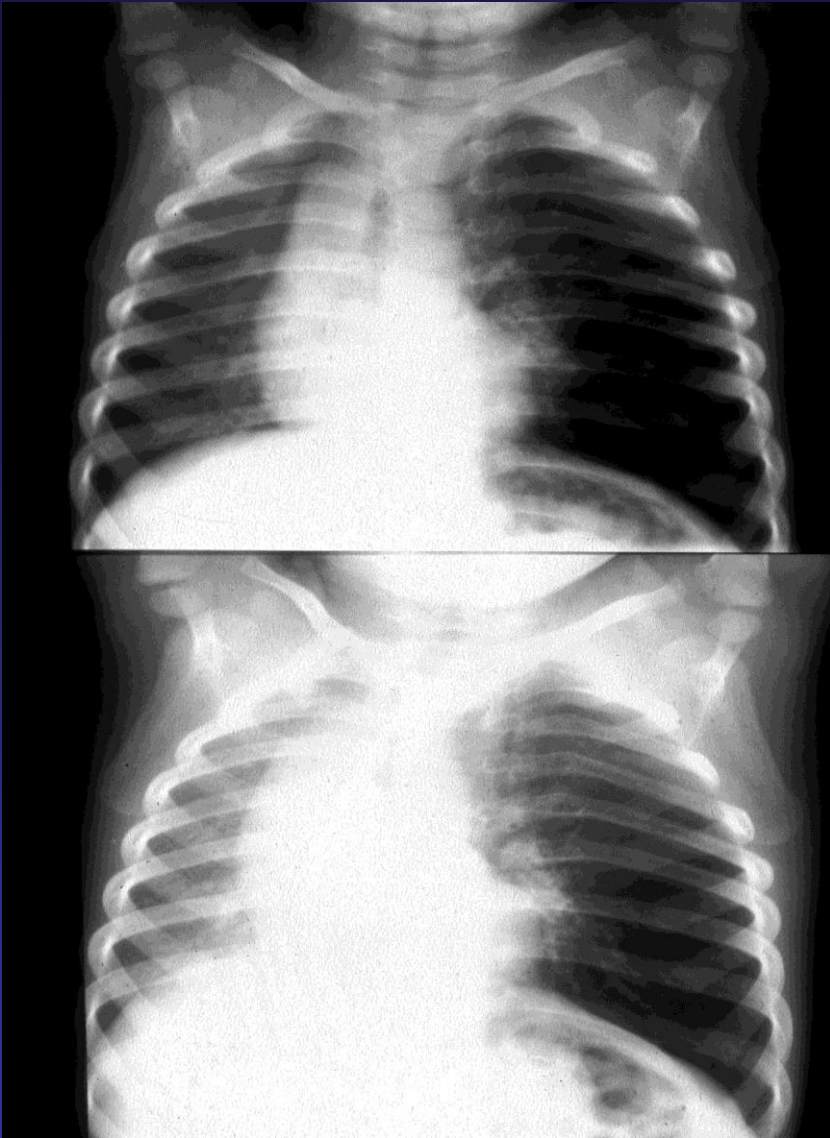
# Lung parenchyma

- Lucency
- Consolidation
- Vascular aspects
- Peribronchial thickening

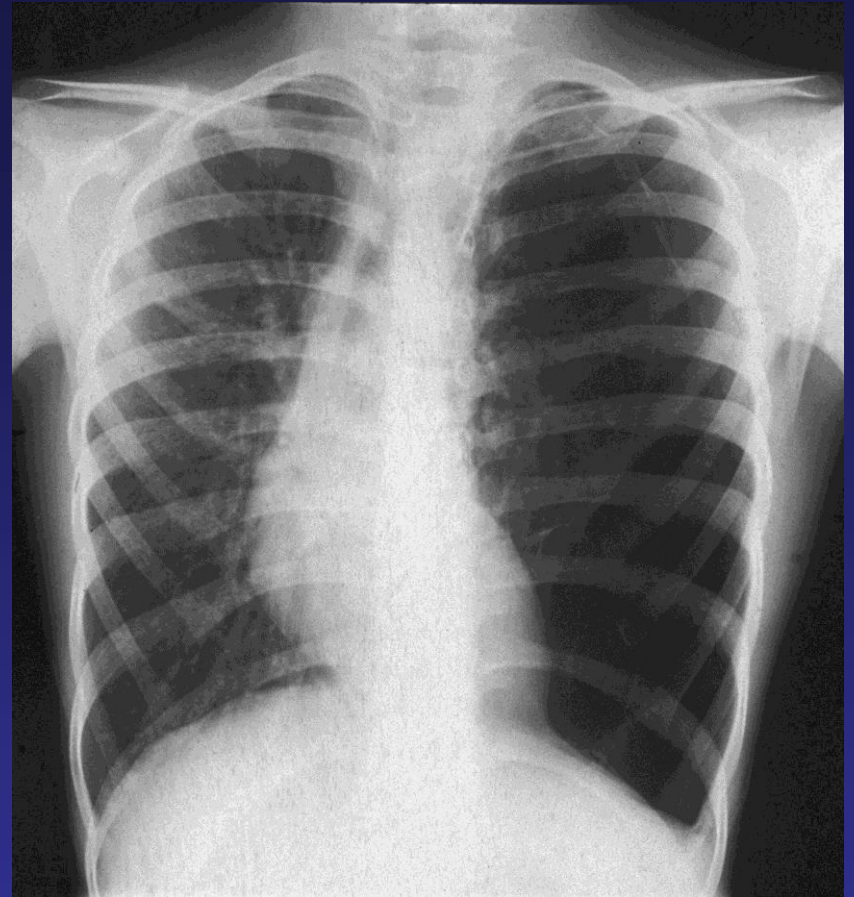
# Longparenchyma

## Lucency

- Hyperlucency
  - Dyspnea, asthma
  - Obstruction
  - Mind: overexposure
- Hypolucency
  - Early stage of atelectasis
  - Obstruction of bronchus
  - Mind: underexposure, expiration

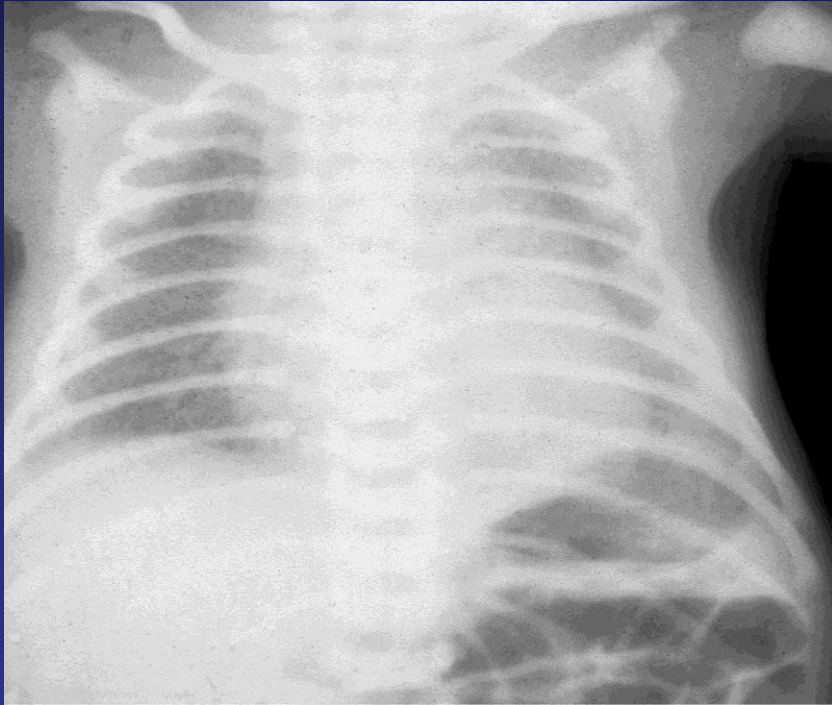


Foreign body in the left main bronchus with an obstructive emphysema

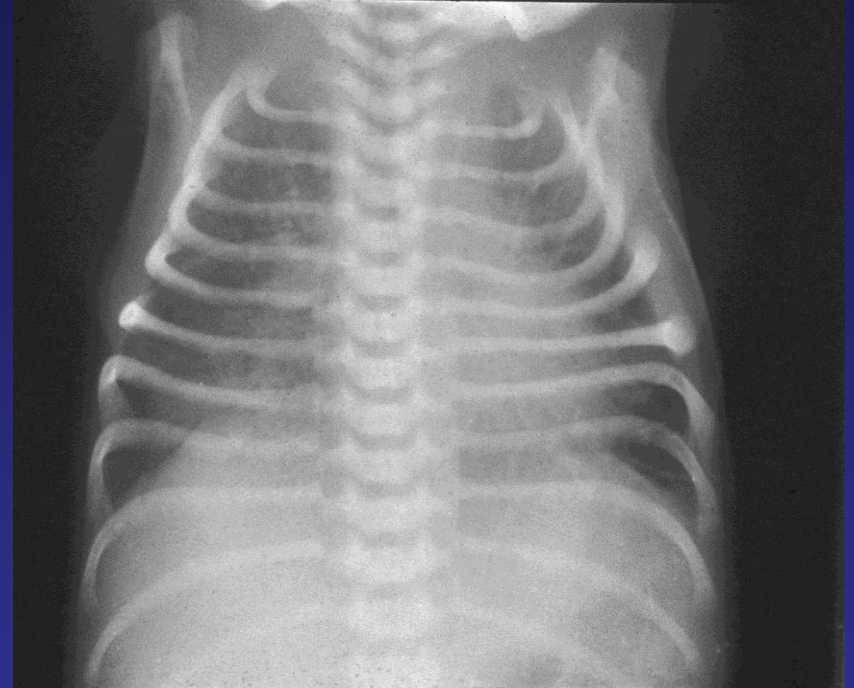


Cystic deformity of the left lung.

Hyperlucent left lung



Hyaline membrane disease with hypolucent lungs

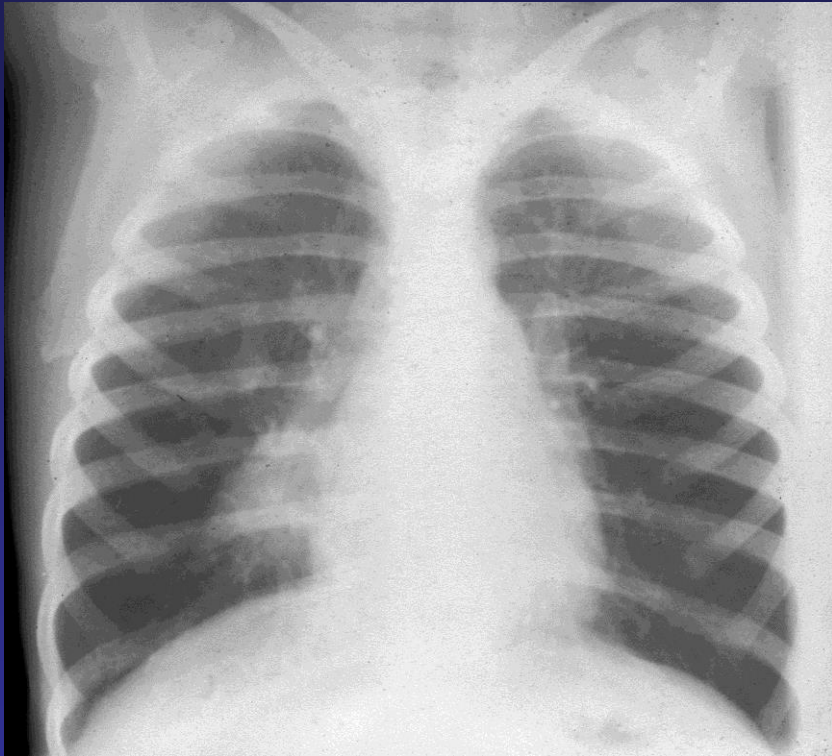


Wet lung disease with hyperlucent lungs

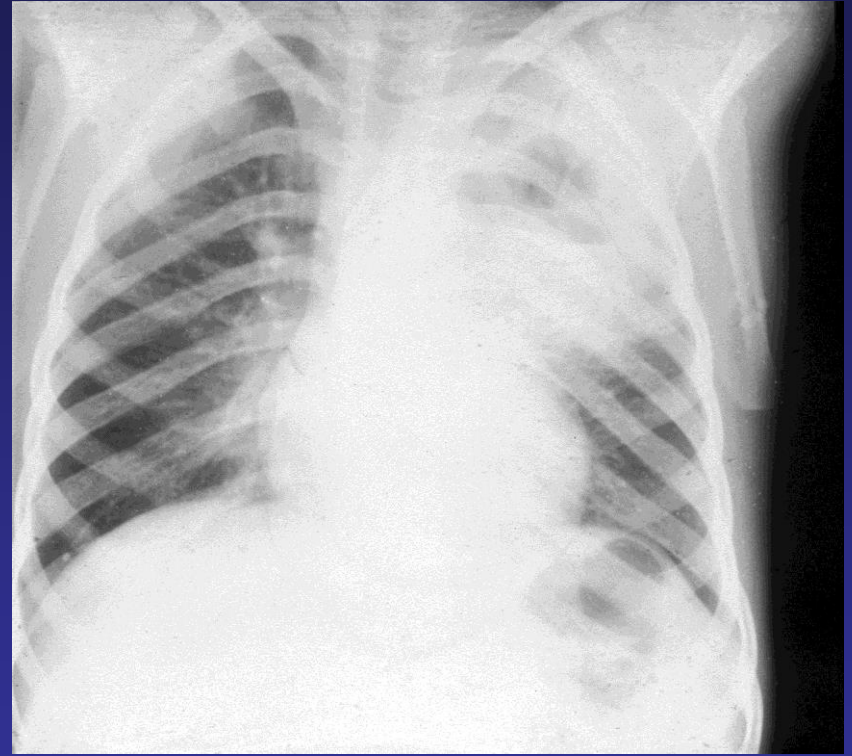
# Longparenchyma Consolidation

- Distribution
  - Focal or diffuse
  - Interstitial or alveolar
- Cause
  - Atelectasis
  - Infiltrate
  - Tumor
- Mind: Consolidation behind heartshadow!

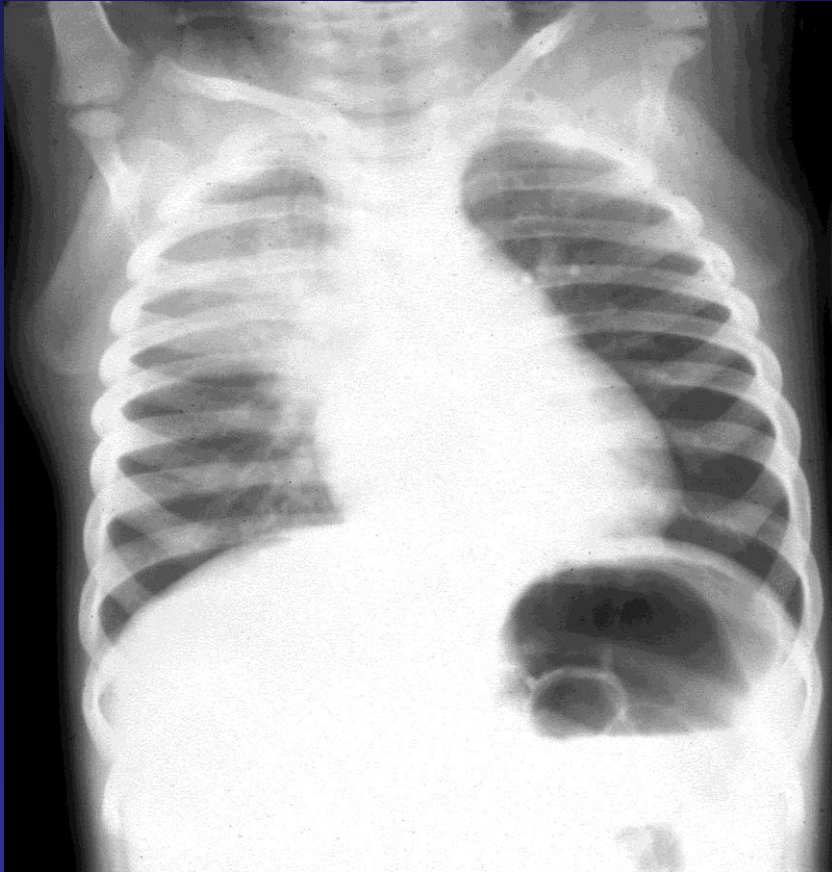




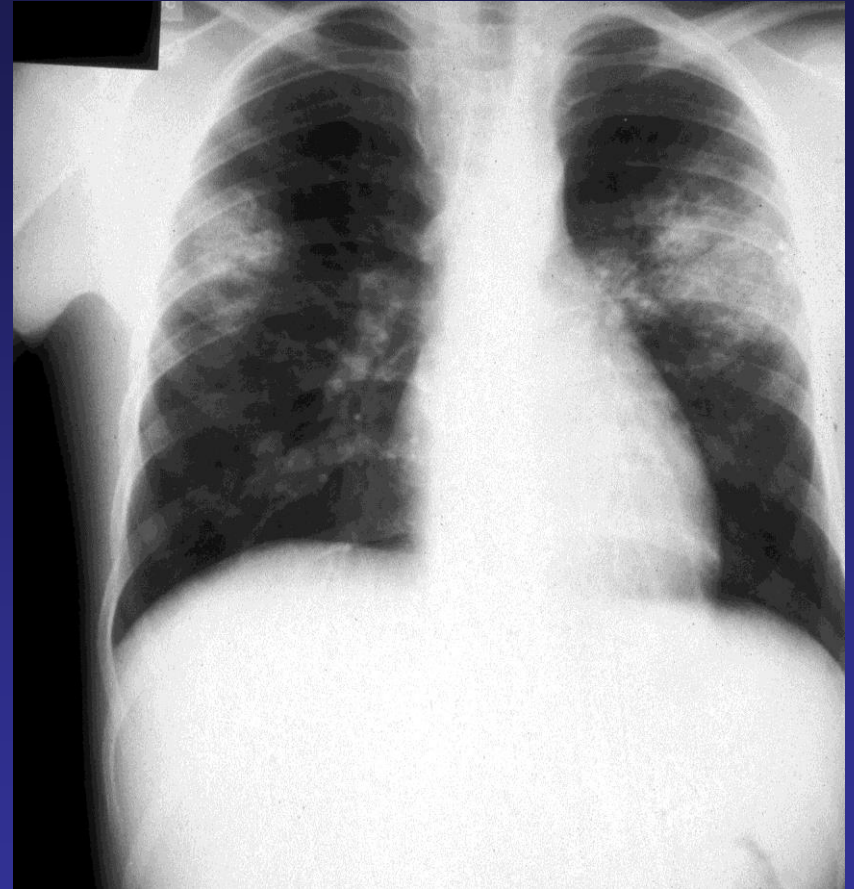
Bronchopneumonia right  
middle lobe



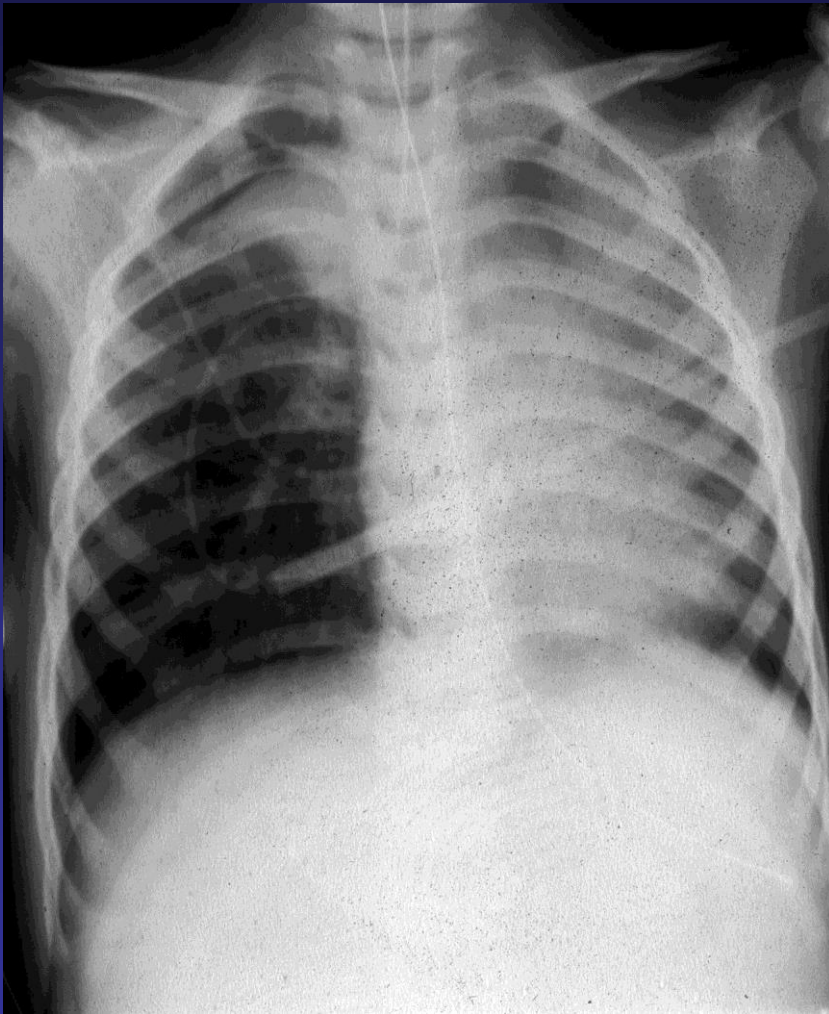
Post pneumonia abscess right  
upper lobe



Lobar pneumonia right upper lobe



Disseminated infiltration in M. Wegener

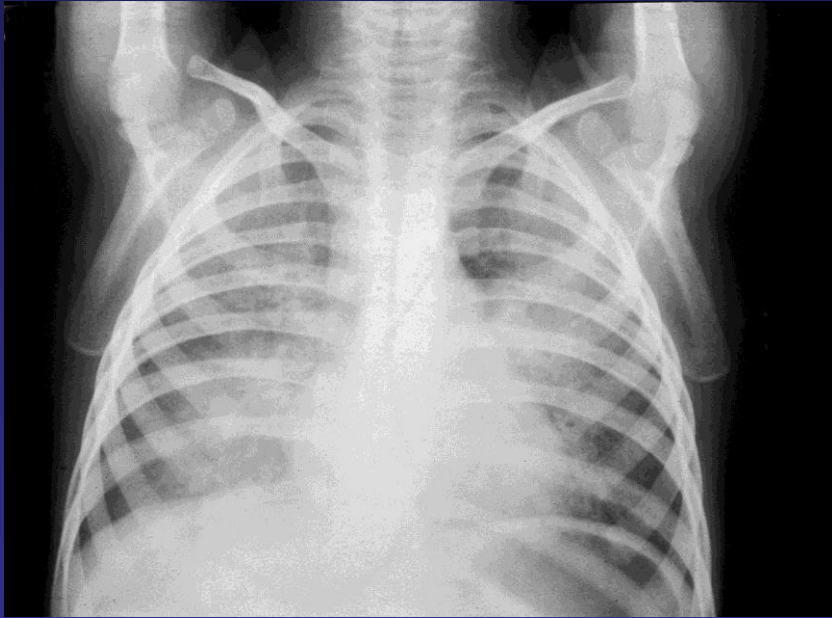


Atelectasis due to intubation

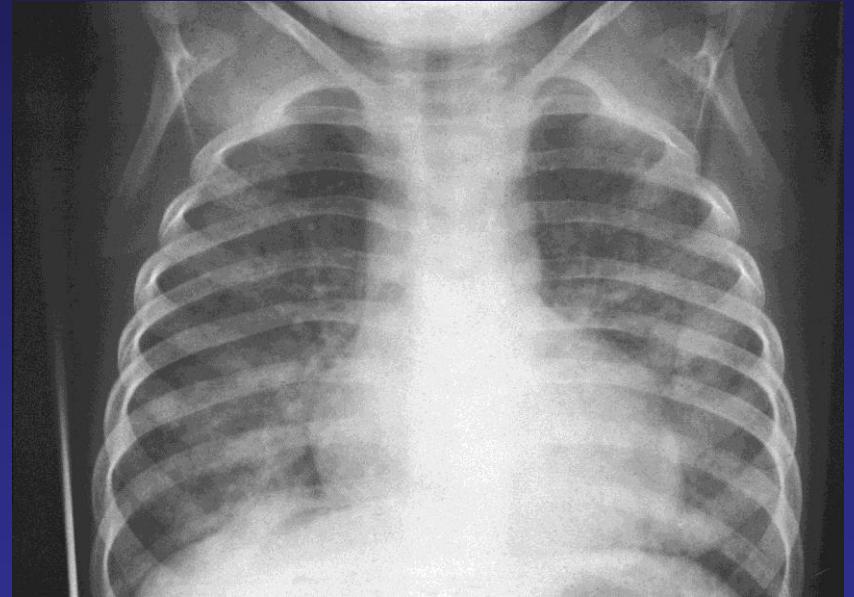


Atelectasis due to aspirated foreign body at the left side





Interstitial pneumonia  
(*Pneumocystis carinii*)

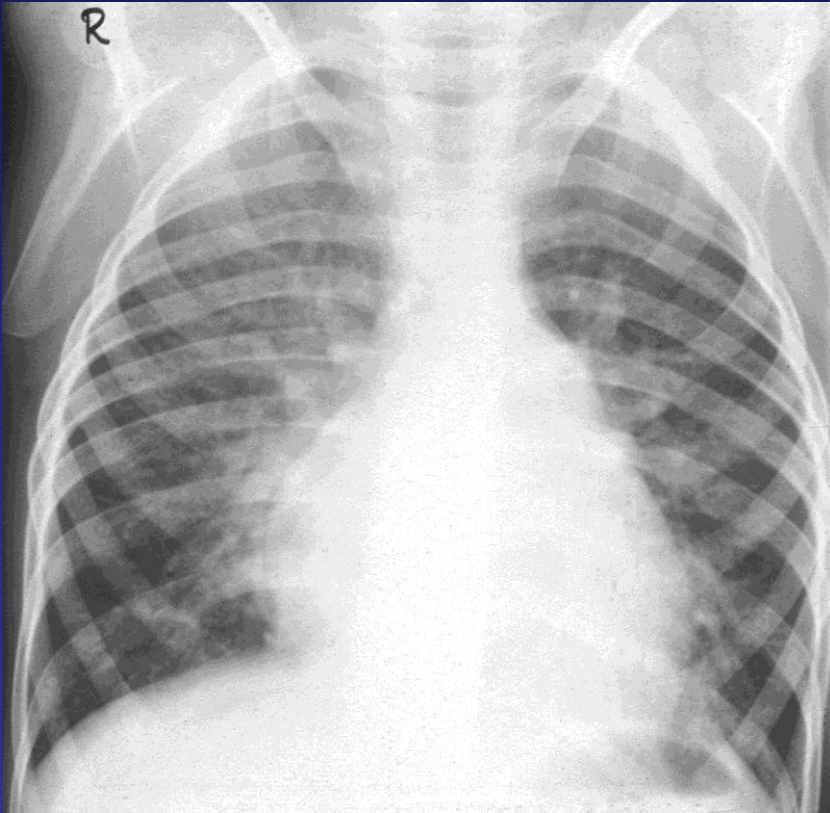


Interstitial pneumonia  
allergic toxic genesis

# Longparenchyma

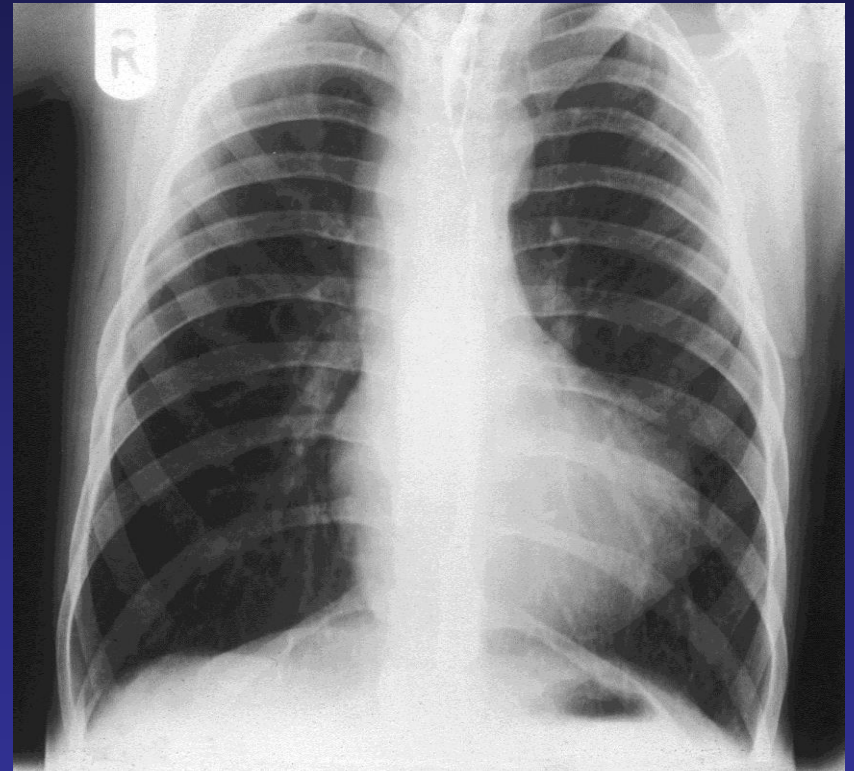
## Pulmonal vascularity

- Increased arterial vascularity
  - VSD, ASD
  - Open ductus Botalli
- Increased venous vascularity
  - Left decompensation
  - Anomalous pulmonary venous return
- Decreased vascularity
  - Pulmonary hypertension
  - Fallot's tetralogy
  - Shock
  - Pulmonary embolism
  - Swyer-James syndrome
  - Emphysema
  - Pulmonary hypoplasia



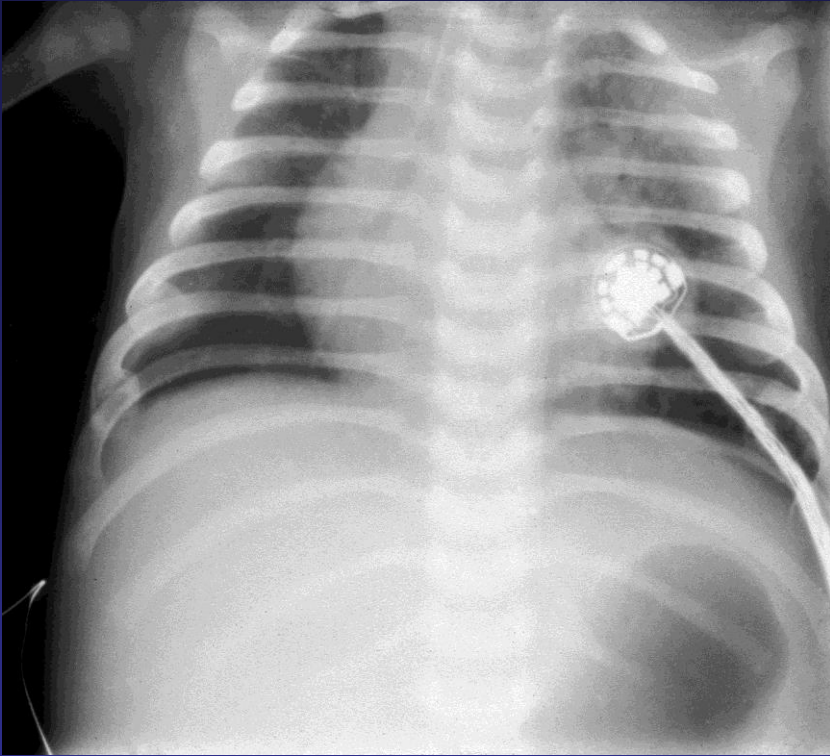
Atrial septum defect (ASD)

Increased arterial vascularity



Fallot's Tetralogy

Reduced vascularity

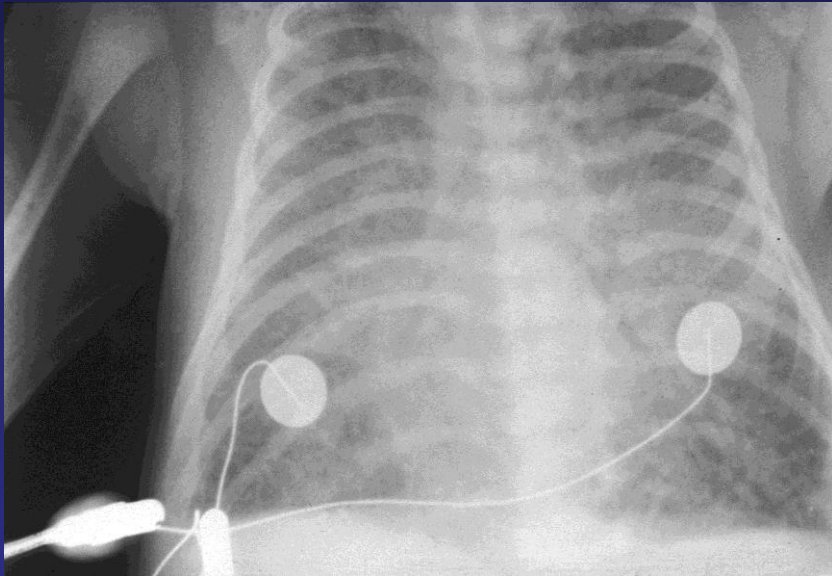


Pulmonary embolism with reduced vascularity right sided

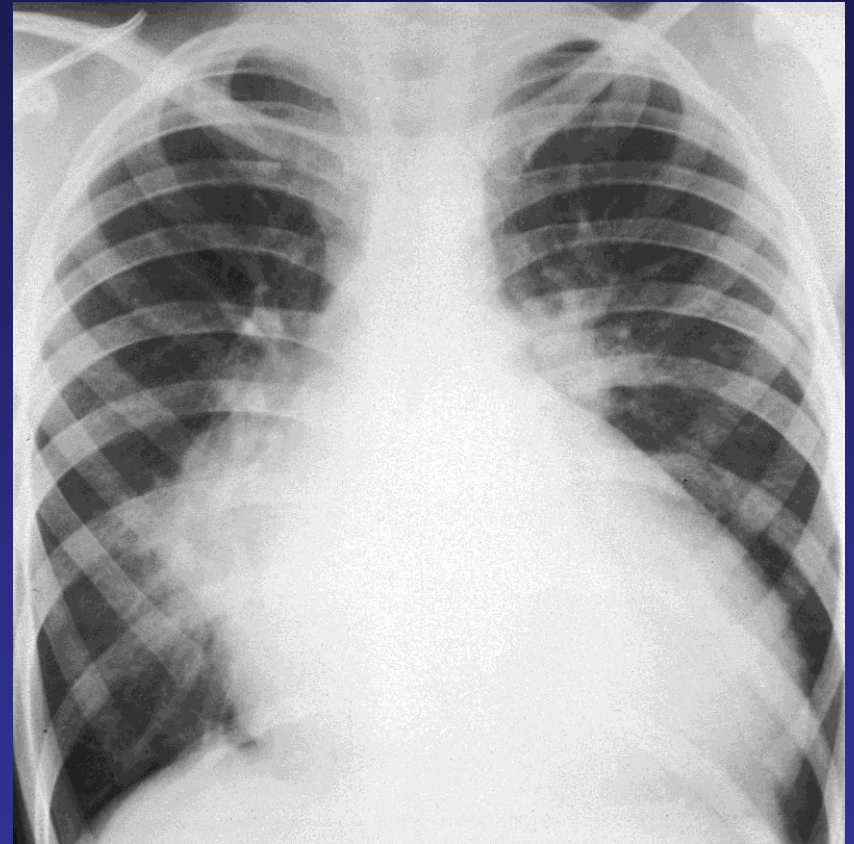


Nuclear scan: No activity in the right lung





Anomalous pulmonary  
venous return with  
vascular congestion

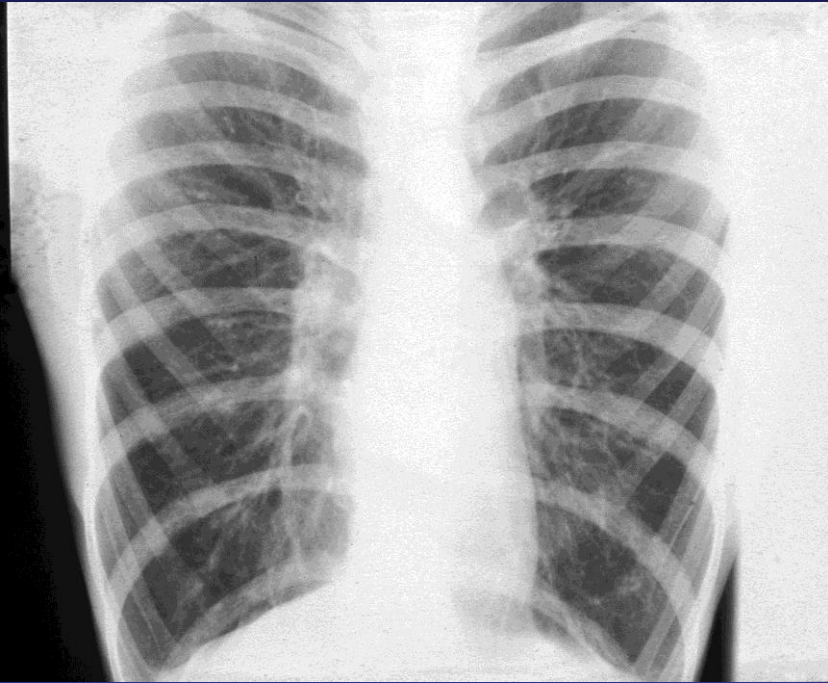


Vascular congestion in cardiac  
decompensation in mitral valve  
defect

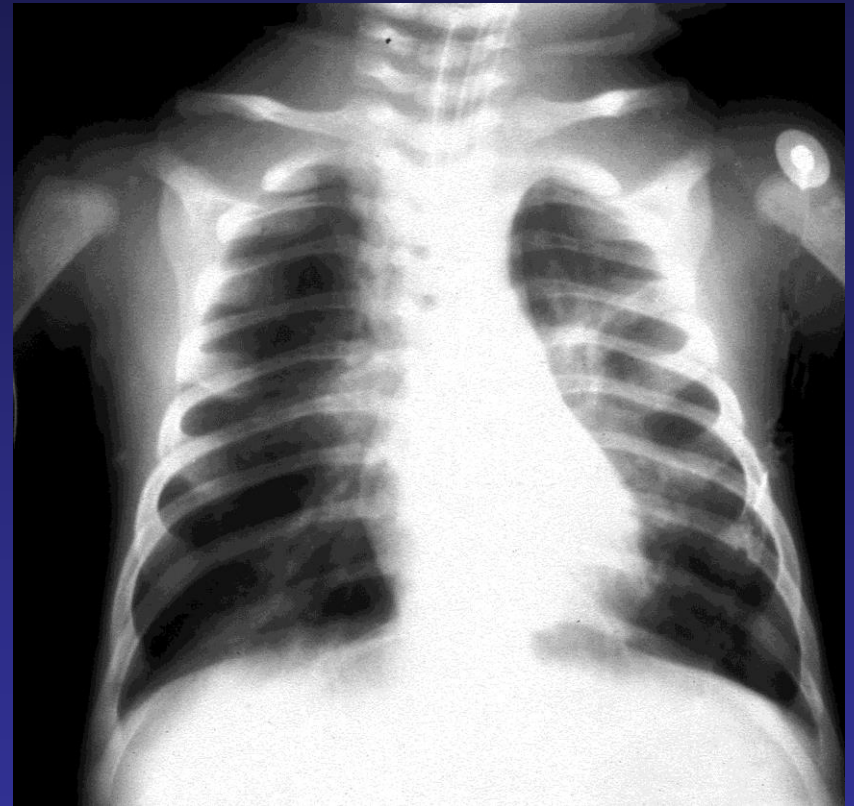
# Longparenchyma

## Peribronchial thickening

- Present in all aspecific chronic inflammation/infection of the airways e.g. in asthma and viral infections
- Iatrogenic: after longlasting ventilation



Peribronchial thickening in a patient with an asthma bronchiale attack



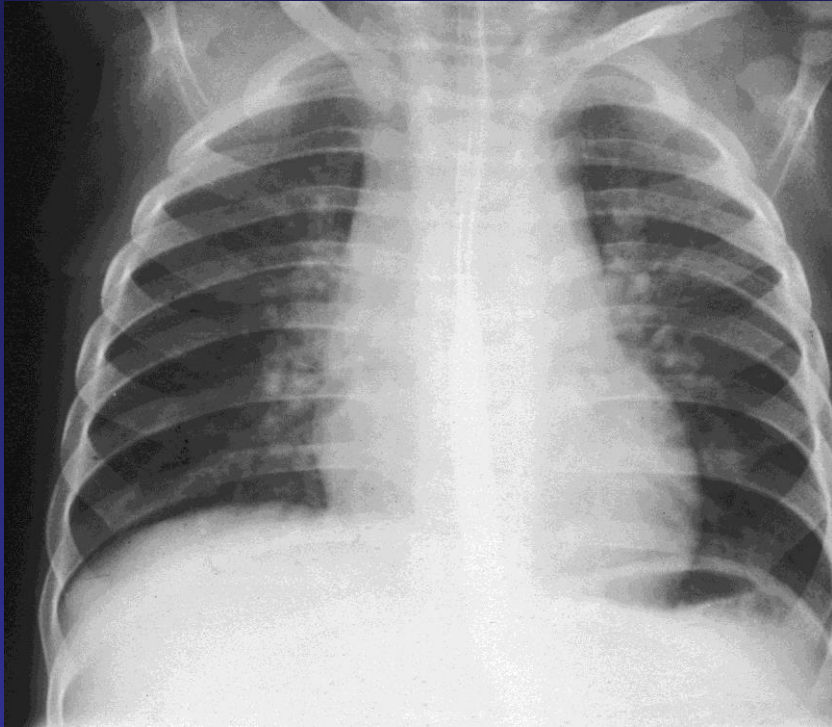
Peribronchial thickening due to hypersecretion in RSV infection

# Hilum

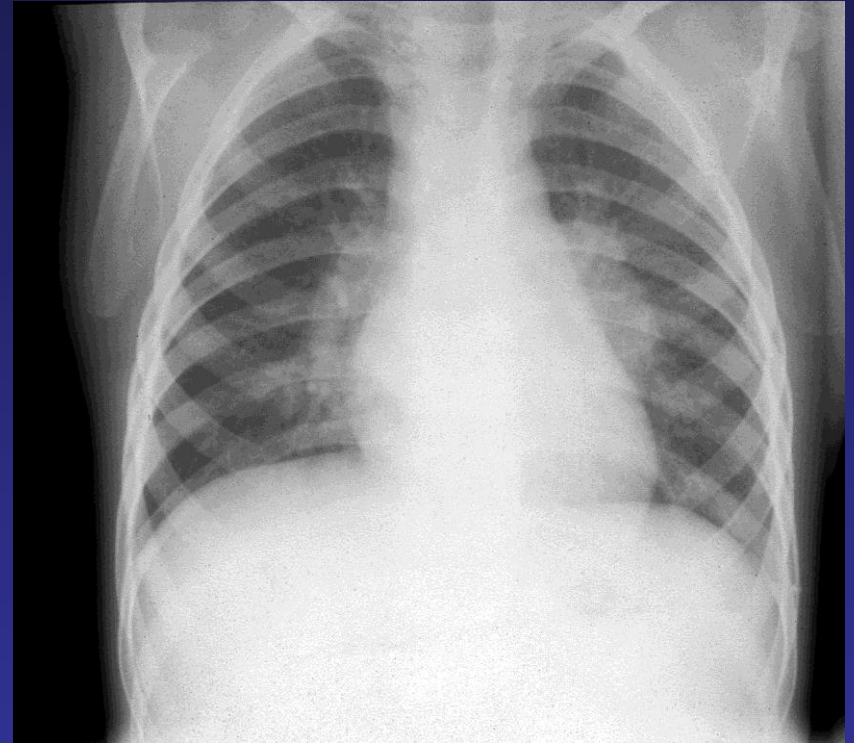
## Widened

- Vascular:
  - Arterial: ASD, VSD, ductus Botalli
  - Venous: cardiac decompensation
- Lymphadenopathy
  - Inflammatory: TBC
  - Malignancy: M. Hodgkin, lymphosarcoma
  - Generalized disease: sarcoidosis





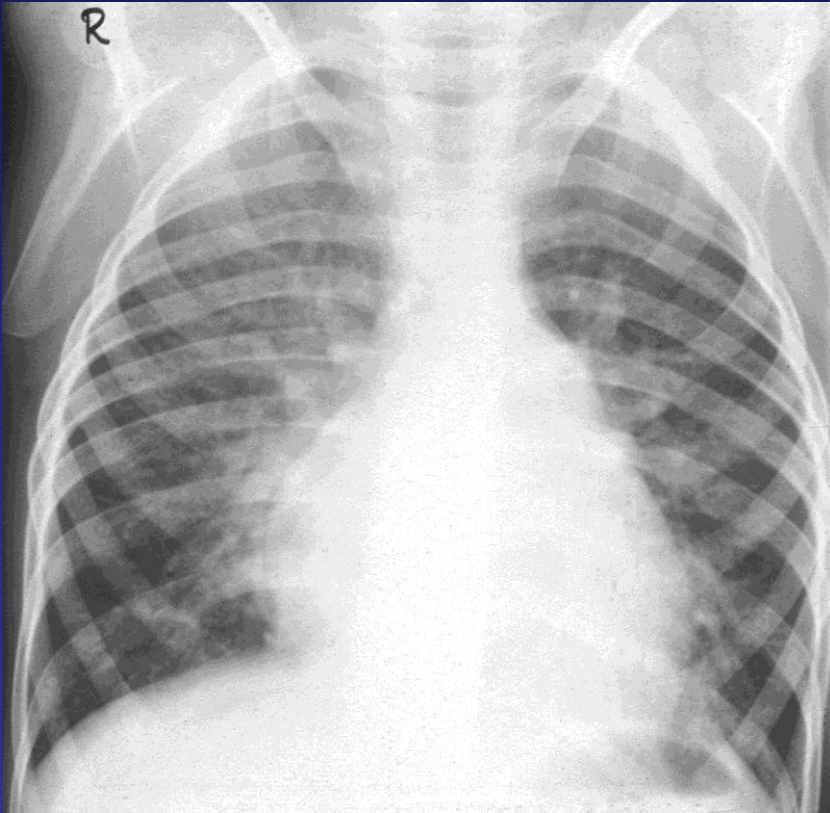
Open ductus Botalli with prominent hilum and venous congestion



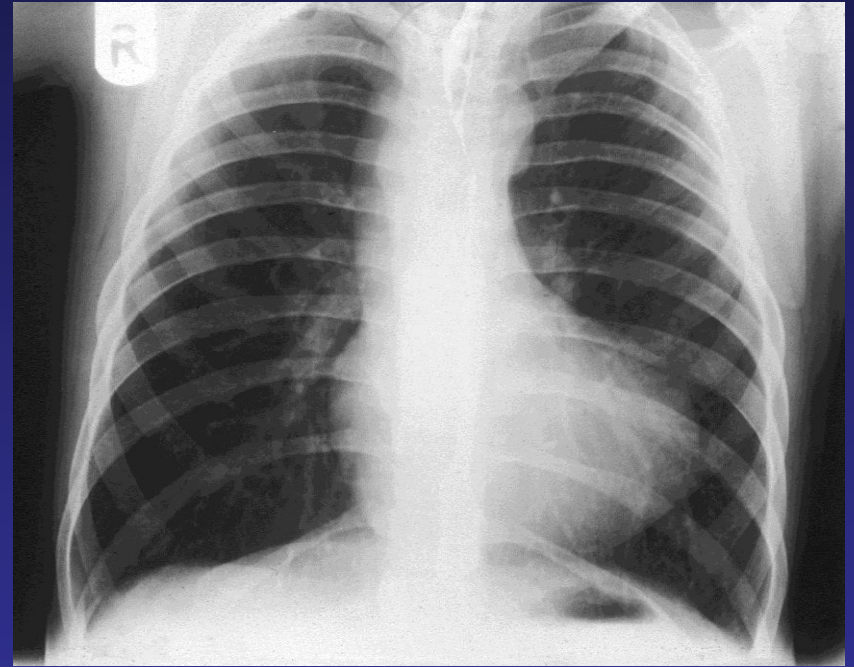
Primary lung TBC with bilateral hilar lymphadenopathy

# Heart and lower mediastinum

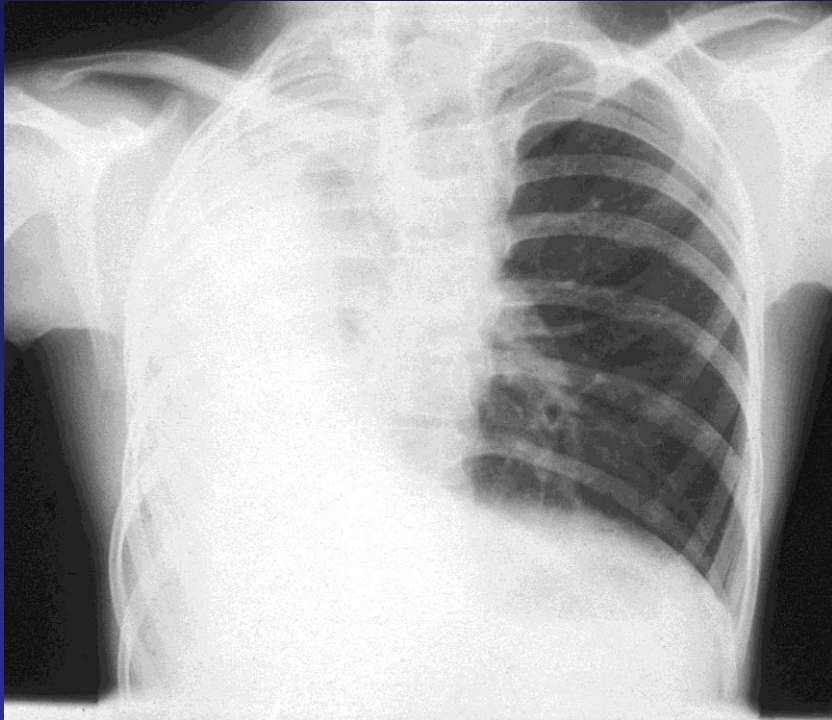
- Heart size (cardio-thoracic index)
- Heart shape
  - Apex, waist, right heart contour
- Position of the heart
  - Dextrocardia, dextroposition
  - Displacement due to pleuro-pulmonary cause
- Space occupying masses



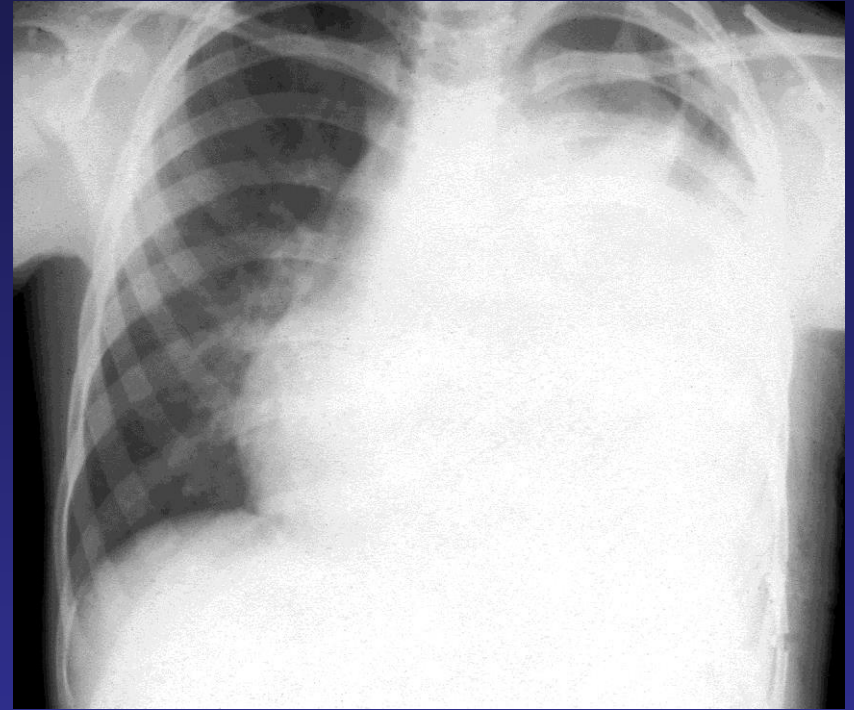
Increased heart size and  
abnormal configuration in ASD



Abnormal heart configuration  
in Fallot's tetralogy

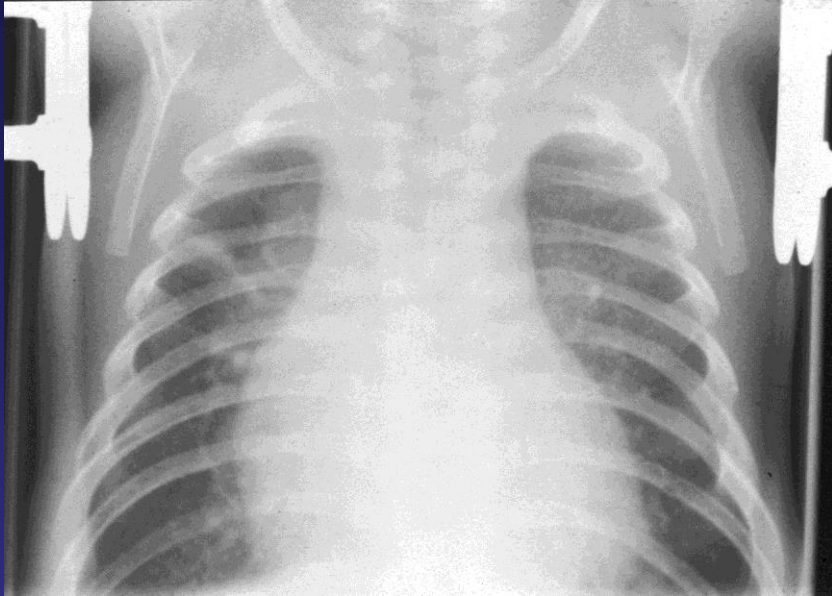


Displacement of the heart to the right side due to agenesis of the right lung (space saving effect)

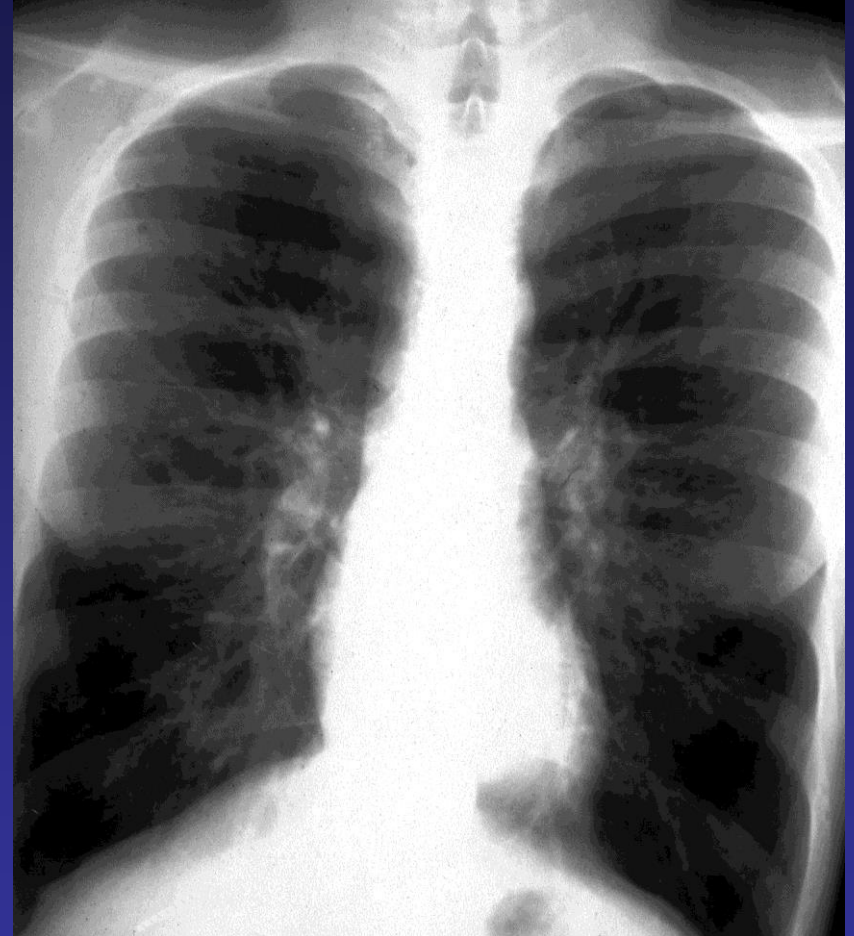


Displacement of the heart to the right side due to pleural effusion and tumor (space occupying effect)





Cardiomegaly in a case with  
purulent pericarditis

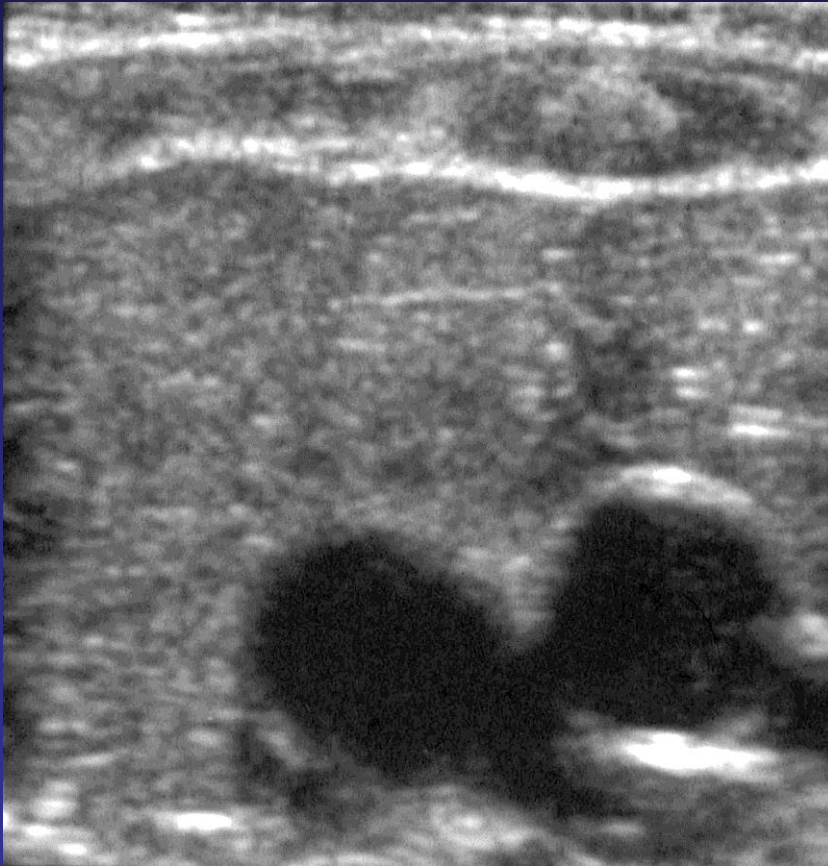


Small heart in a case of  
asthma bronchiale

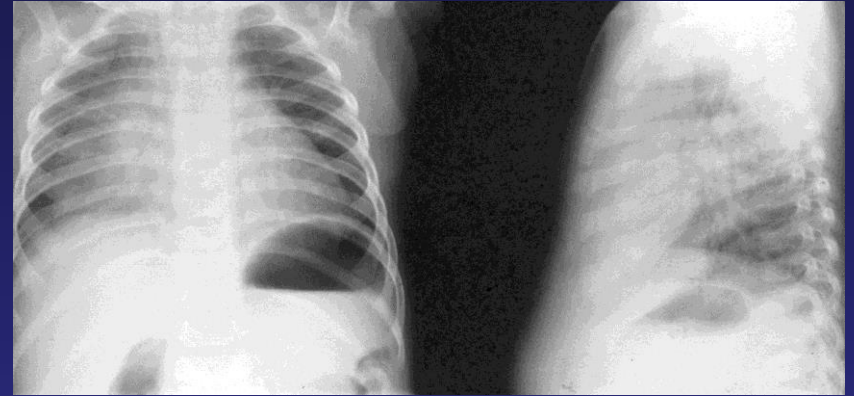
# Upper mediastinum

## Widened

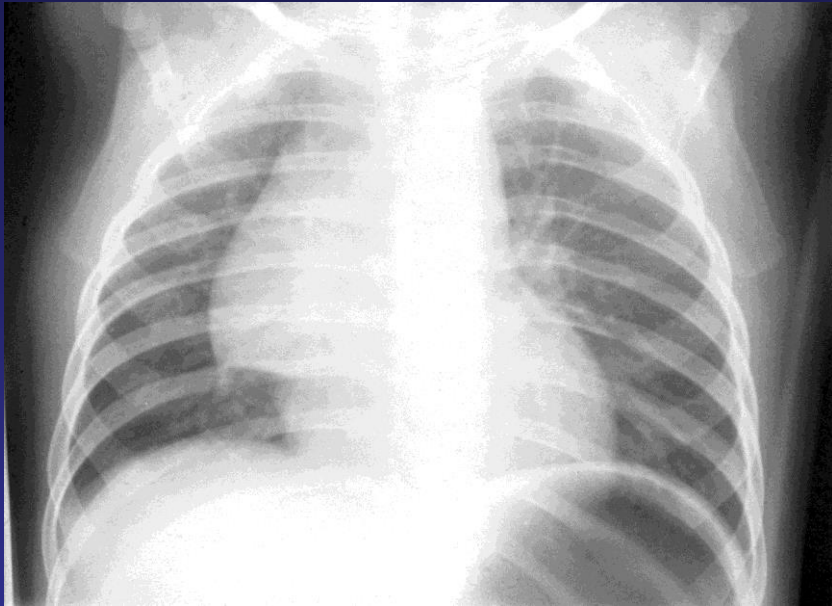
- Thymus, thymoma
- Esophagus
- Great vessels (aortic coarctation)
- Lymphoma
- Thyroid
- Teratoma
- Neurogenic tumors (neuroblastoma, neurofibroma)
- Trachea (bronchogenic cyst)
- Hemorrhage
- Iatrogenic causes



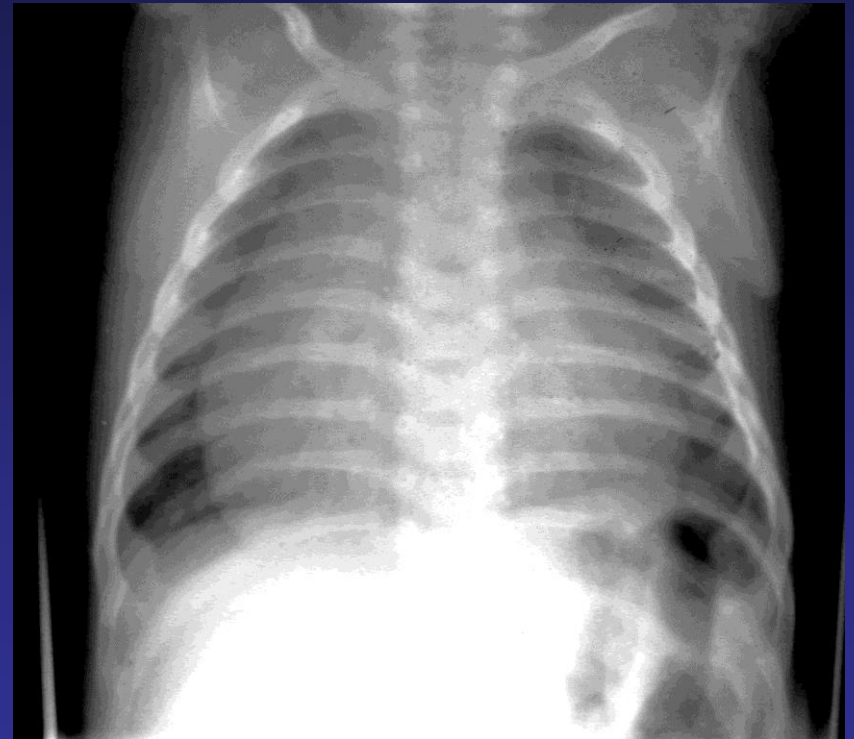
Ultrasound image of  
normal thymus



Overprojection of heart and  
mediastinum by thymus (curtain  
effect)

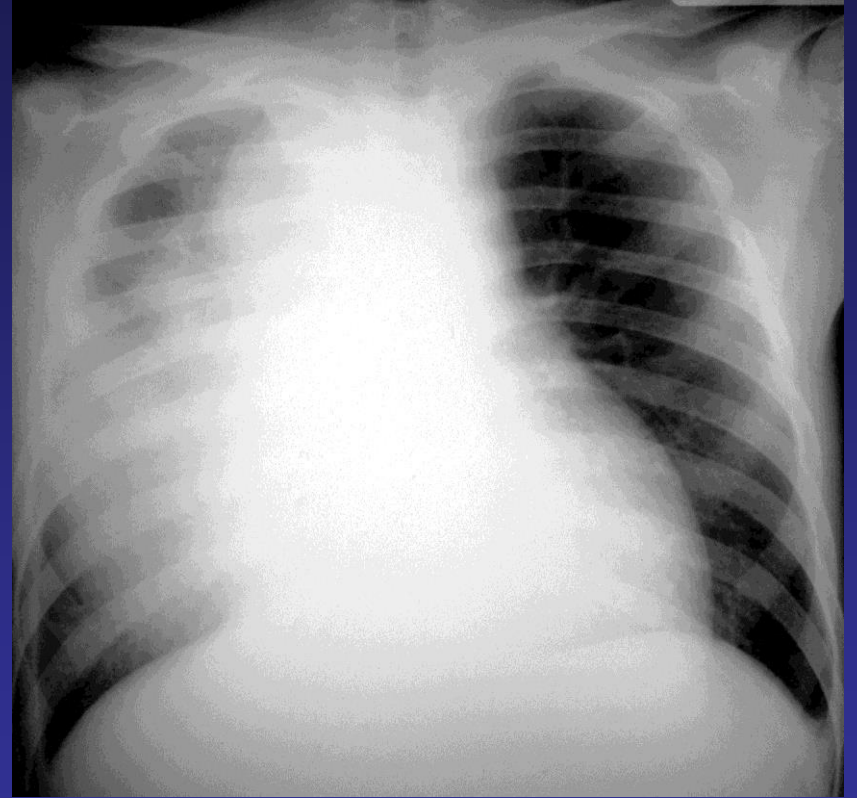
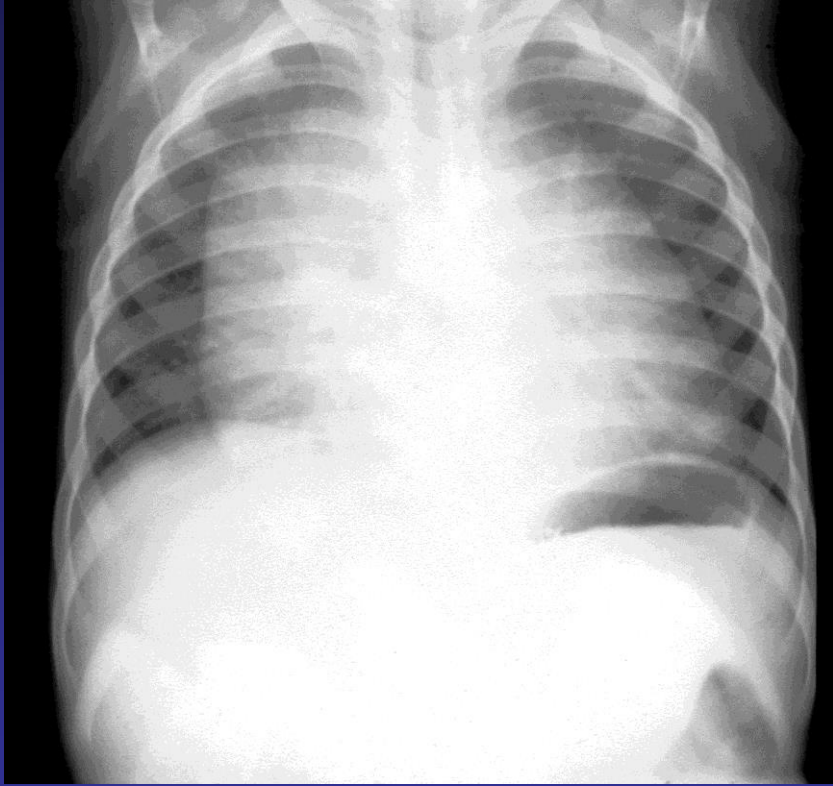


Normal large thymus with typical configuration

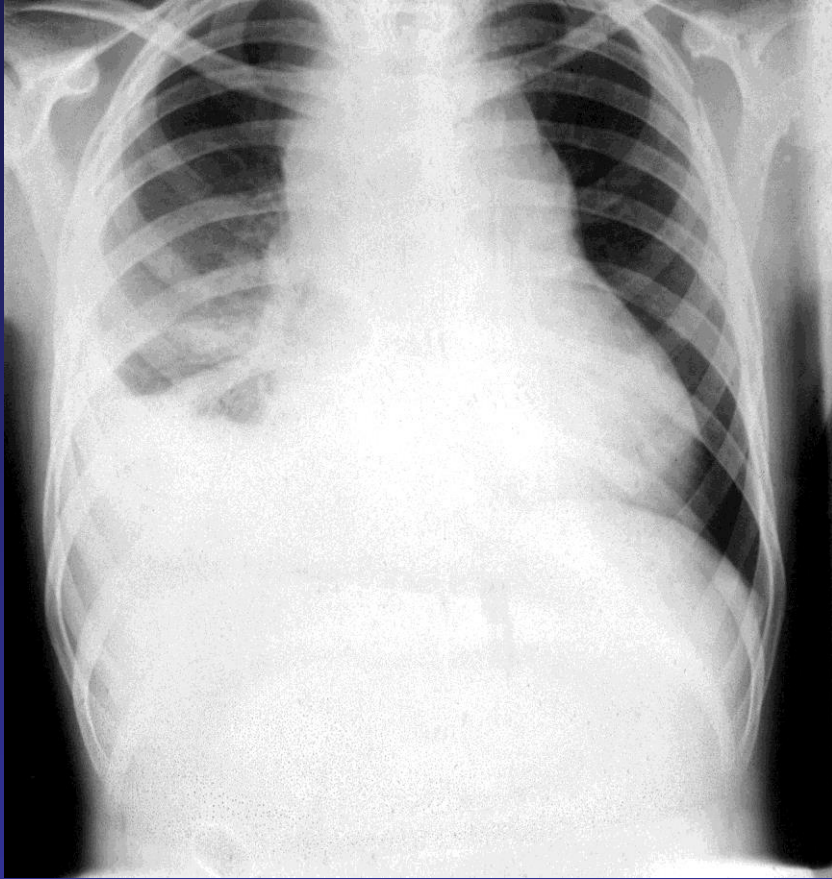


Thymus 'curtain' over heart shadow and mediastinum

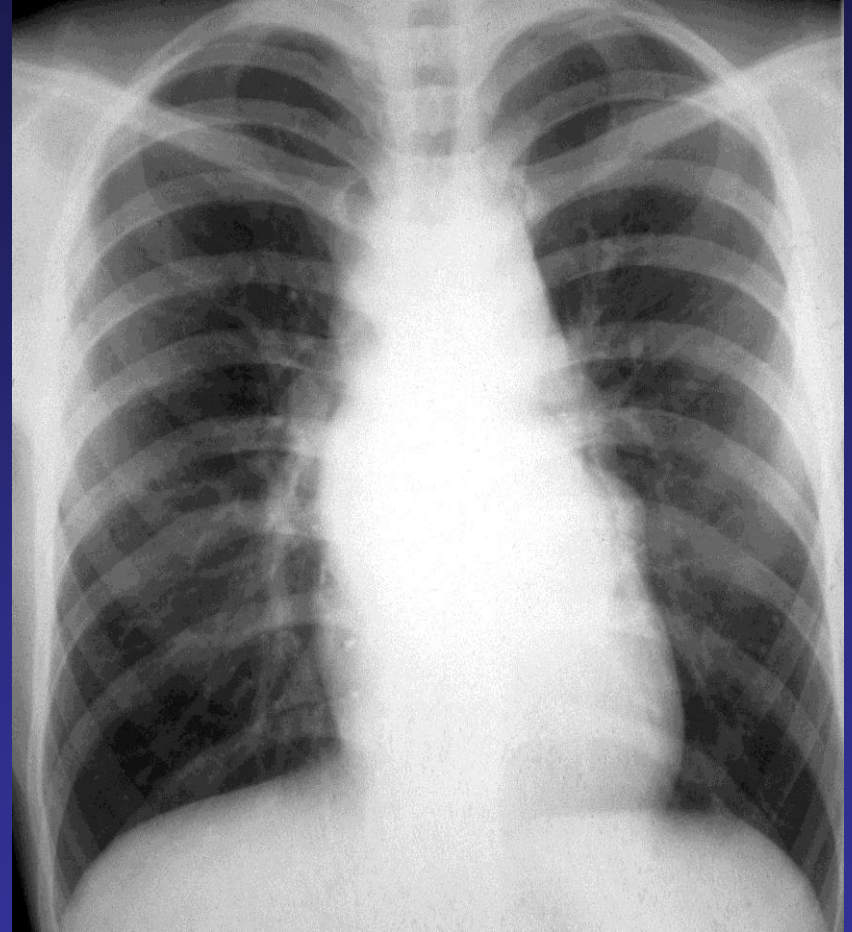




Pathologic thymus in 2 cases with T-cell leukemia

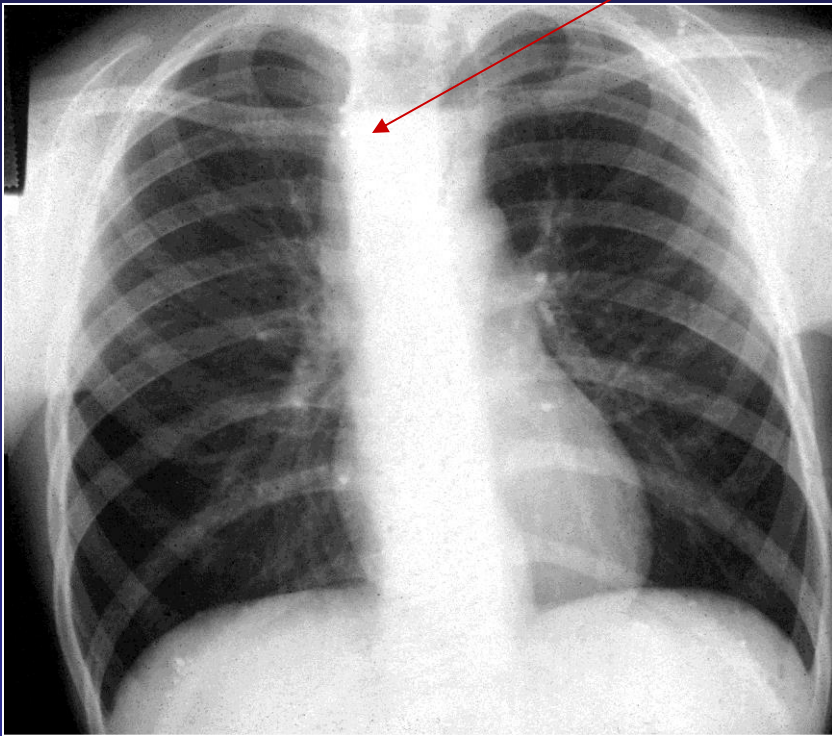


Lymphosarcoma with  
mediastinal and hilar  
adenopathy

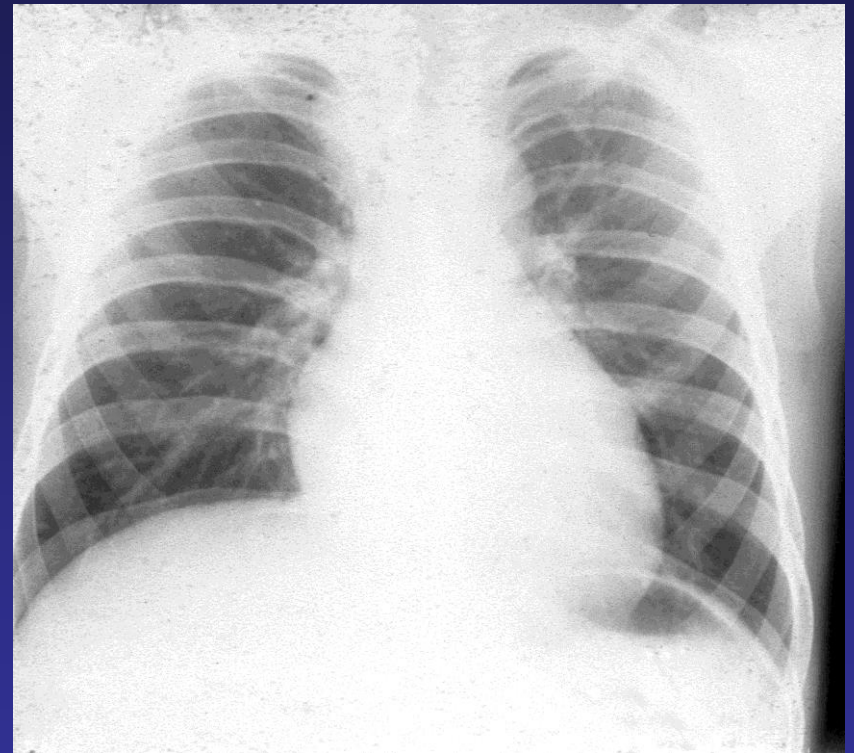


Mediastinal lymphadenopathy  
in a case of M. Hodgkin

Air-fluid level

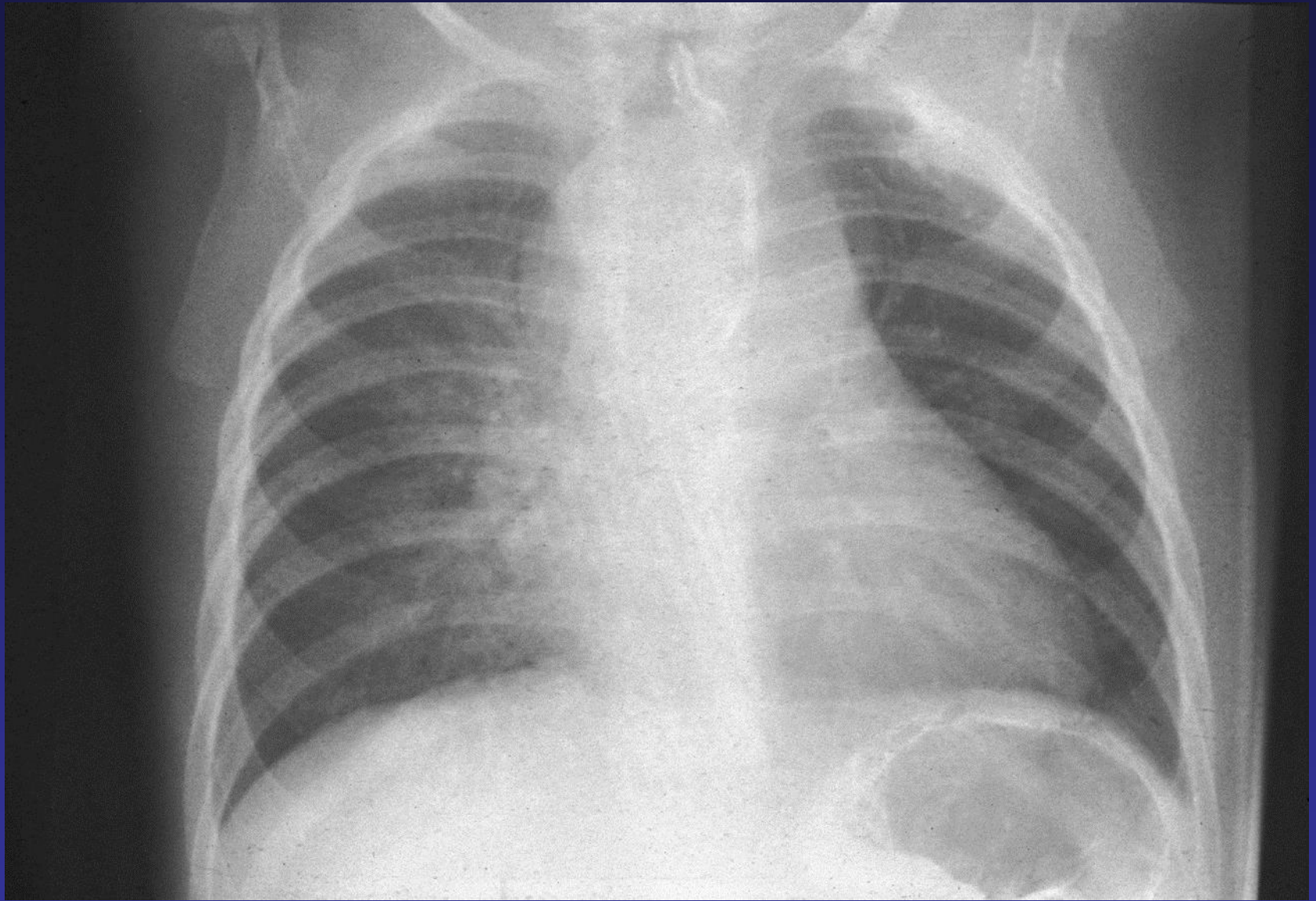


Mediastinal widening in  
achalasia

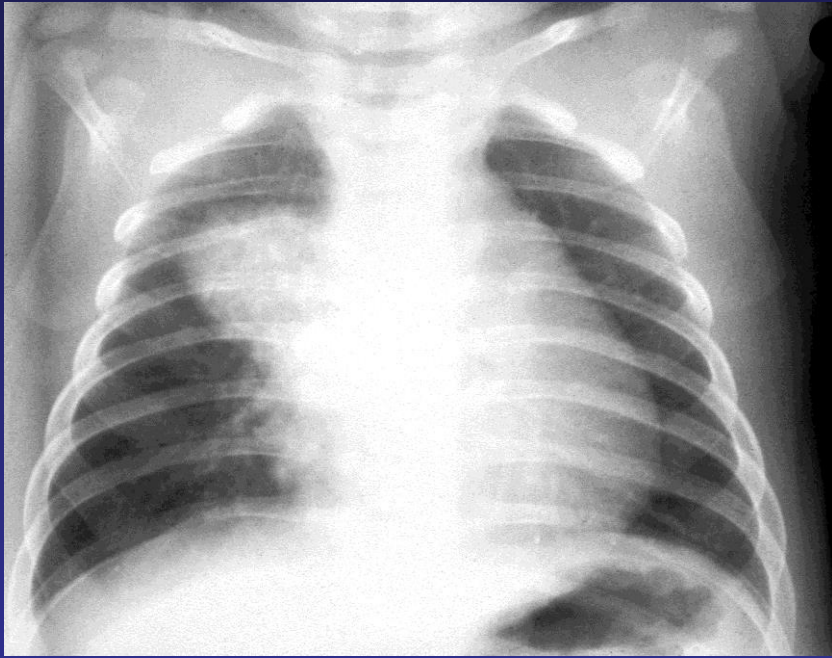


Right sided aortic arch

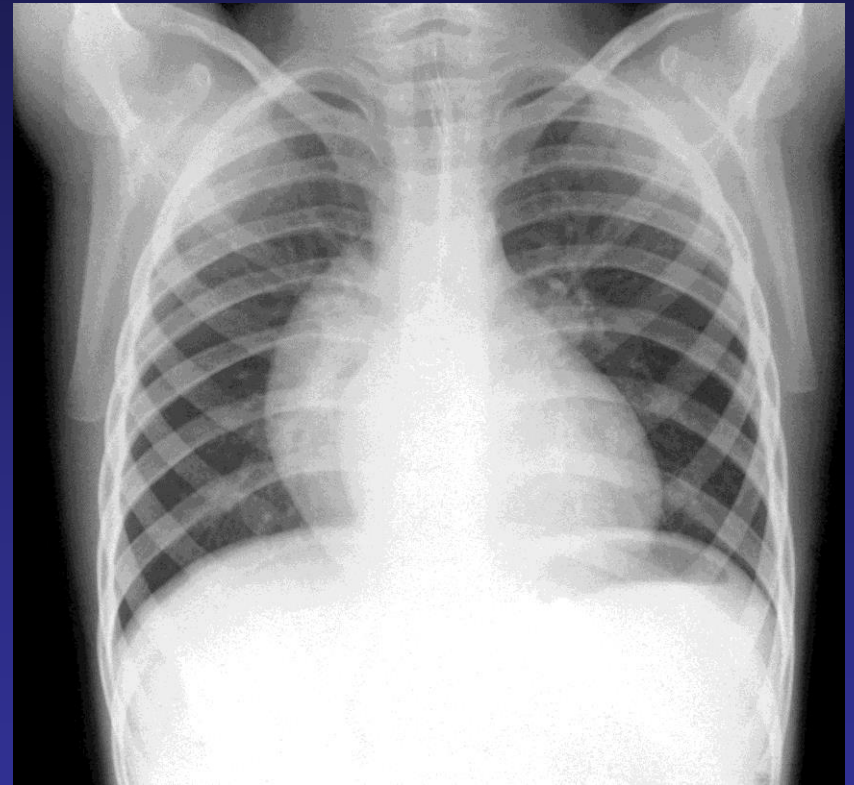




Bronchogenic cyst with widening of mediastinum superior



Right sided neuroblastoma of  
mediastinum



Right sided ganglioneurinoma

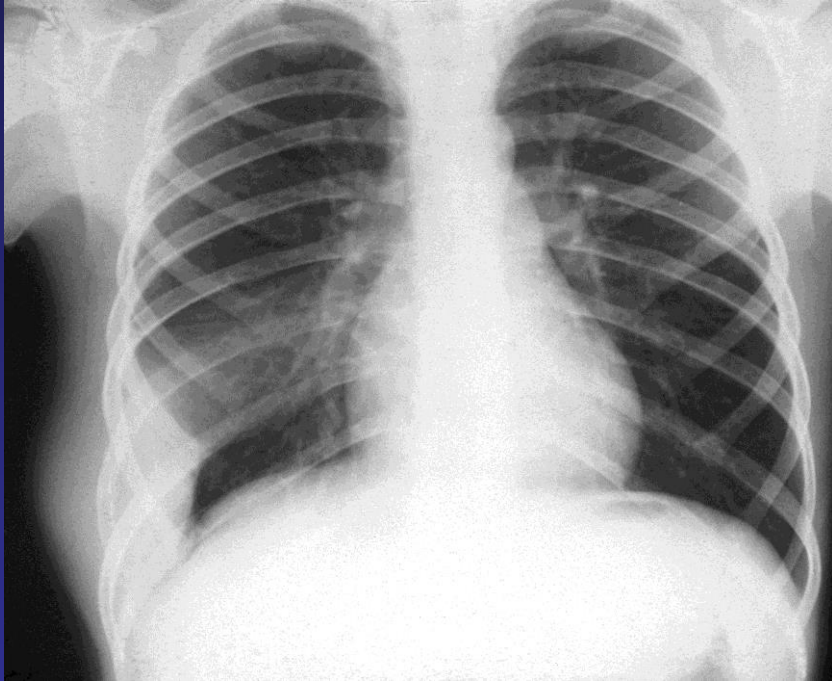


# Skeletal structures

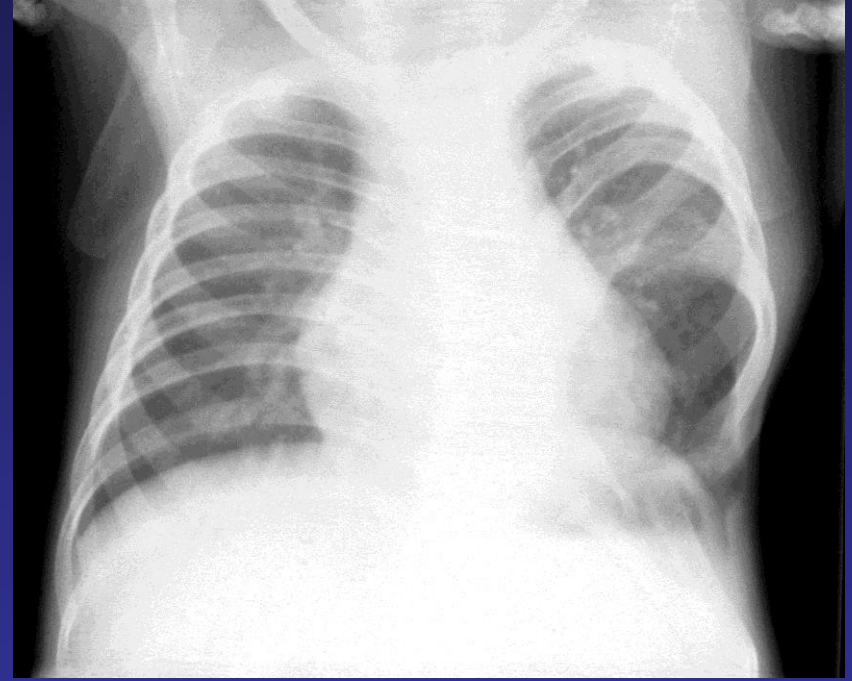
- Disturbance of skeletal mineralisation (e.g. rickets)
- Position anomalies of thoracic spine
- Rib anomalies
- Fractures
- Generalized disorders
- Osteomyelitis
- Tumors



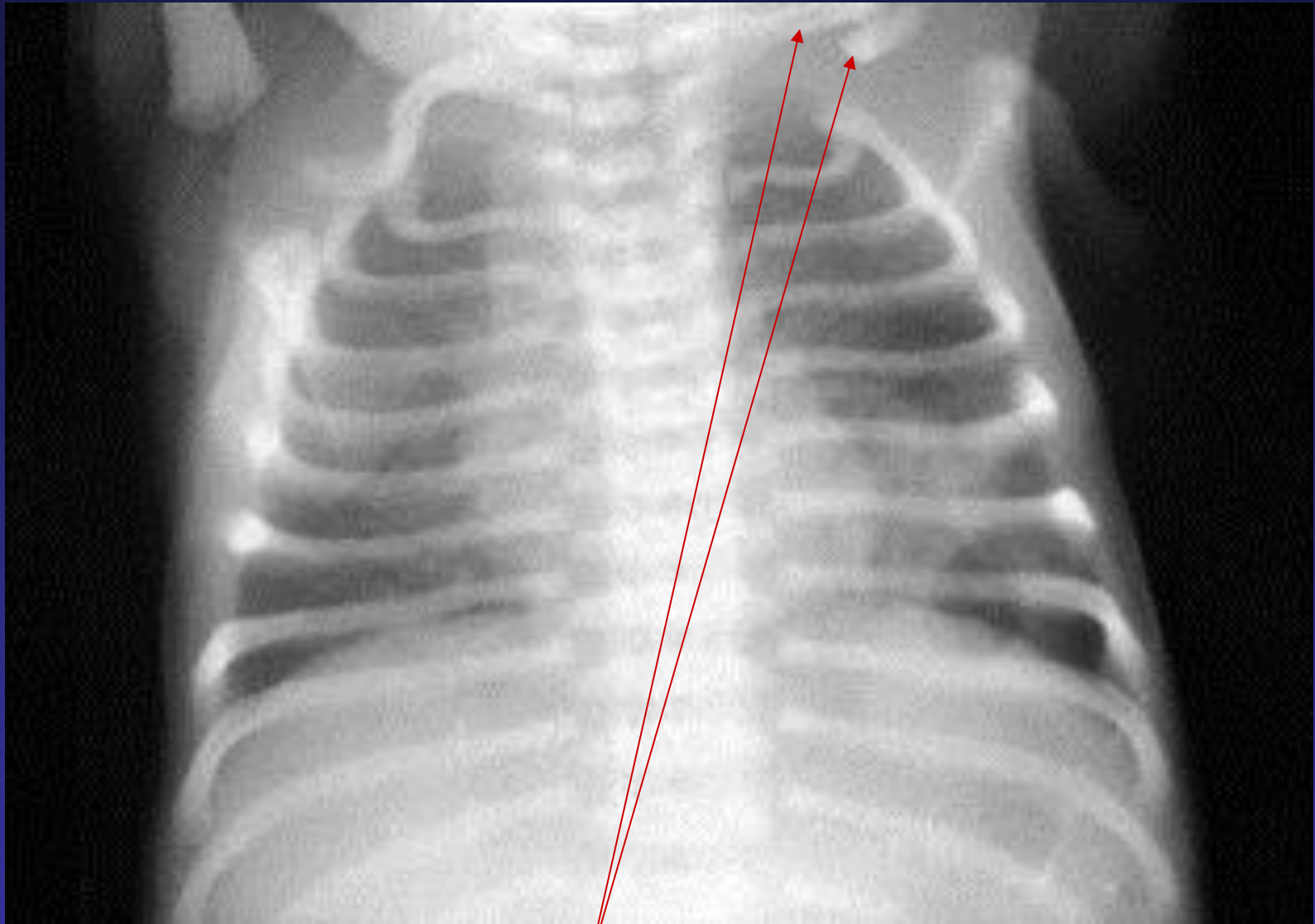
Iatrogenic ribfractures after fysiotherapy in BPD (Bronchopulmonal dysplasia)



Right sided ewingsarcoma 9th rib  
with additional soft tissue tumor



Rib anomalies in a case of  
Jarcho-Levin syndrome

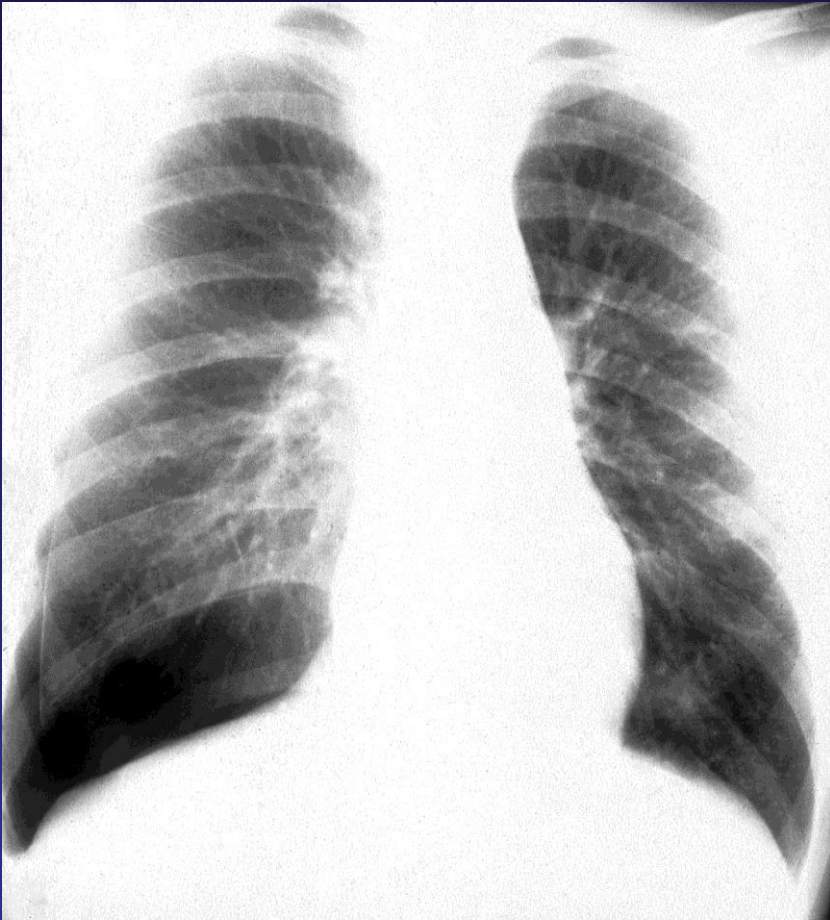


Fracture of the left clavicle caused by a traumatic partus

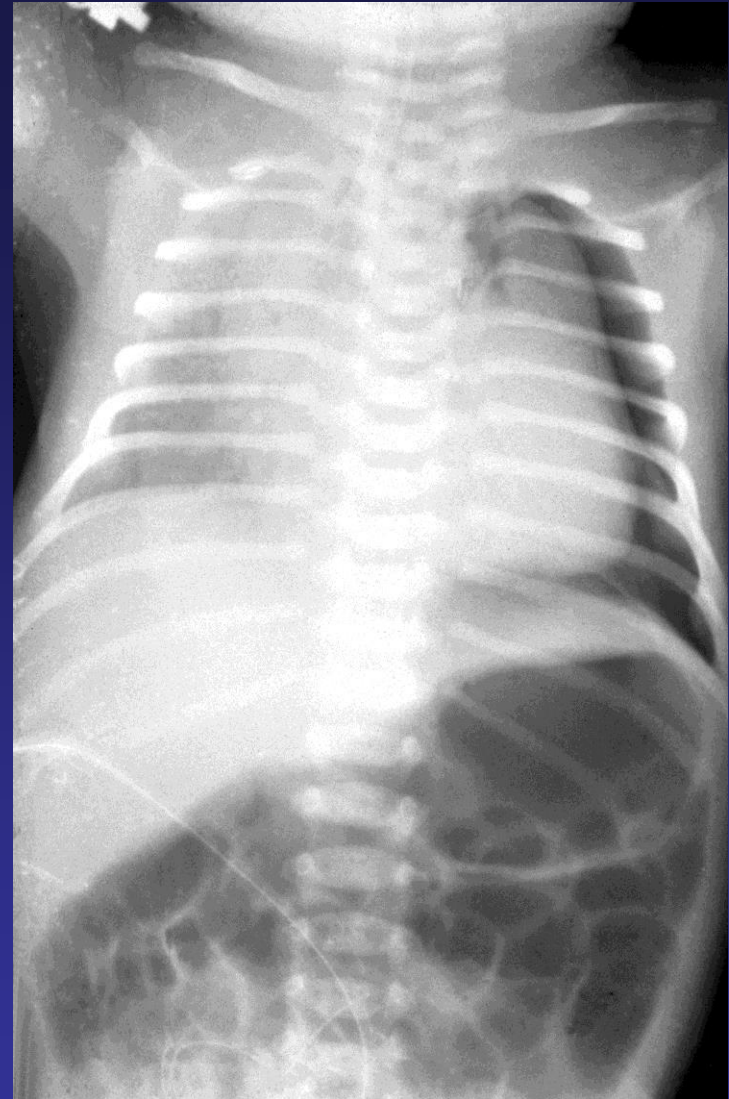
# Pleura

- Pleural adhesions
- Pleural effusion (exsudate, empyema)
- Pneumothorax



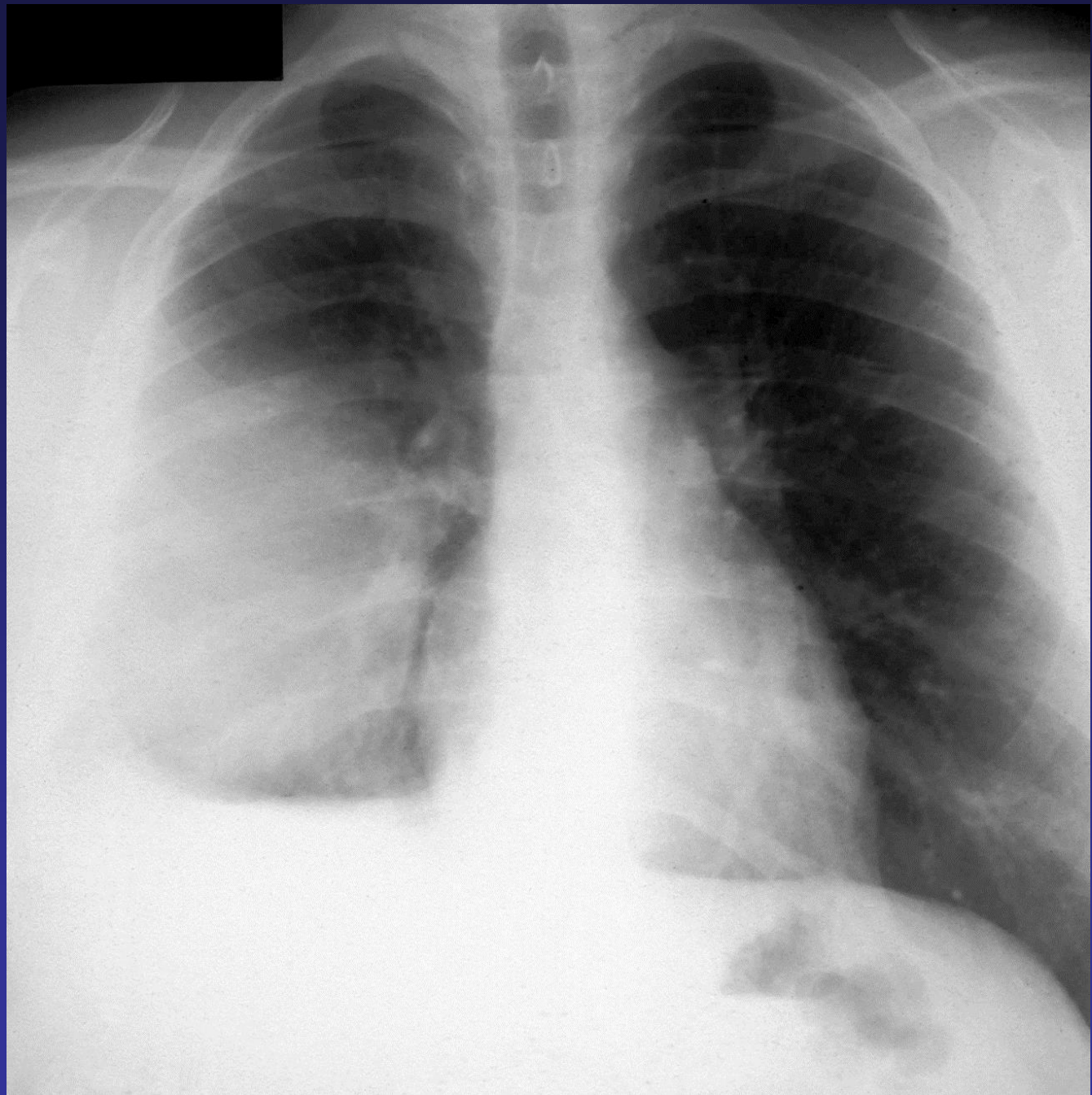


Subpleural pneumothorax on the right side in a case of chronic airway infection



Left sided pneumothorax

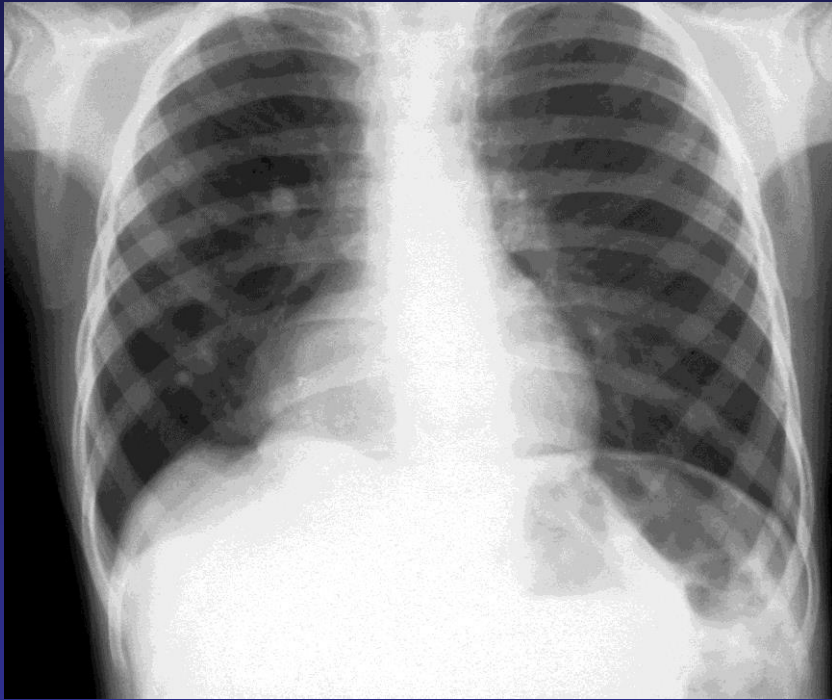
Right-sided  
pleura-empyema



# Upper abdomen

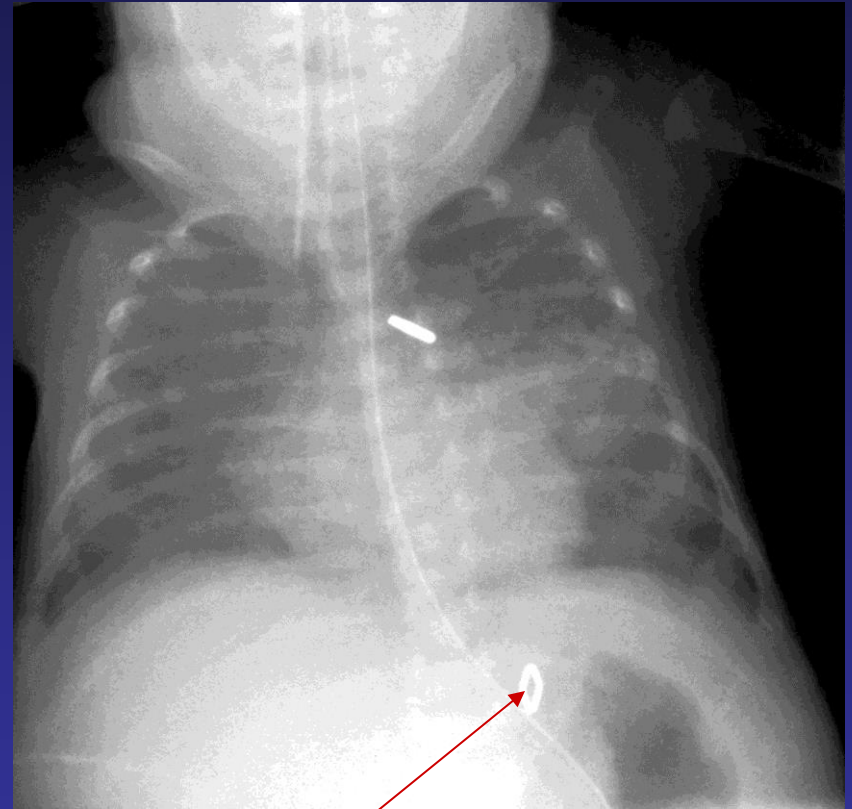
- Pneumoperitoneum
- Malposition of stomach and liver
- Colon interposition





Scimitar syndrome

Increased lucency of left  
colon flexure

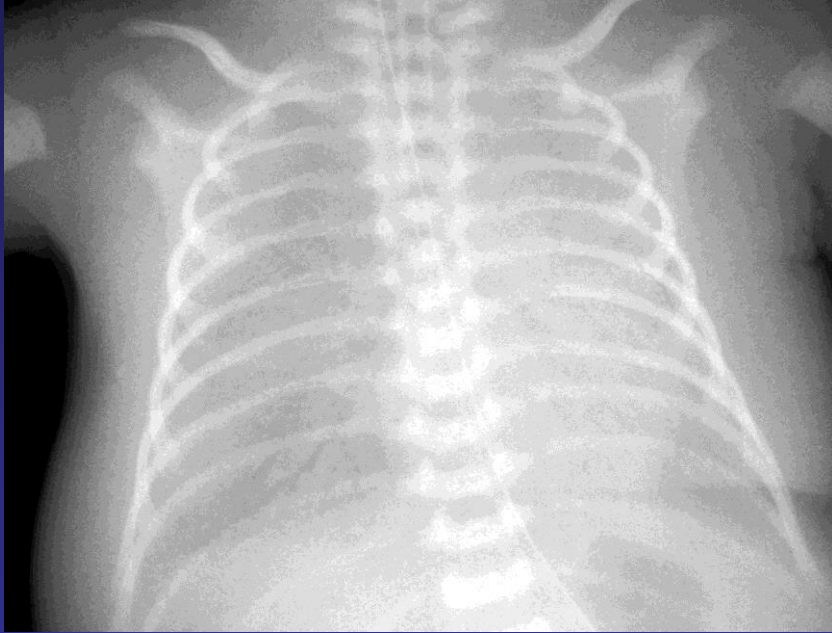


Loose clip descendent on the  
level of the abdominal aorta

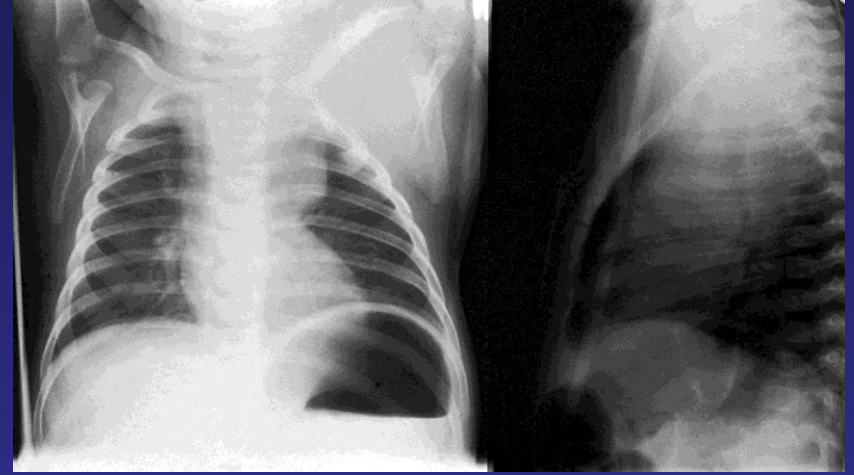
# Soft tissues

- Chest wall edema
- Tumor originated from thoracic wall
- Subcutaneous emphysema





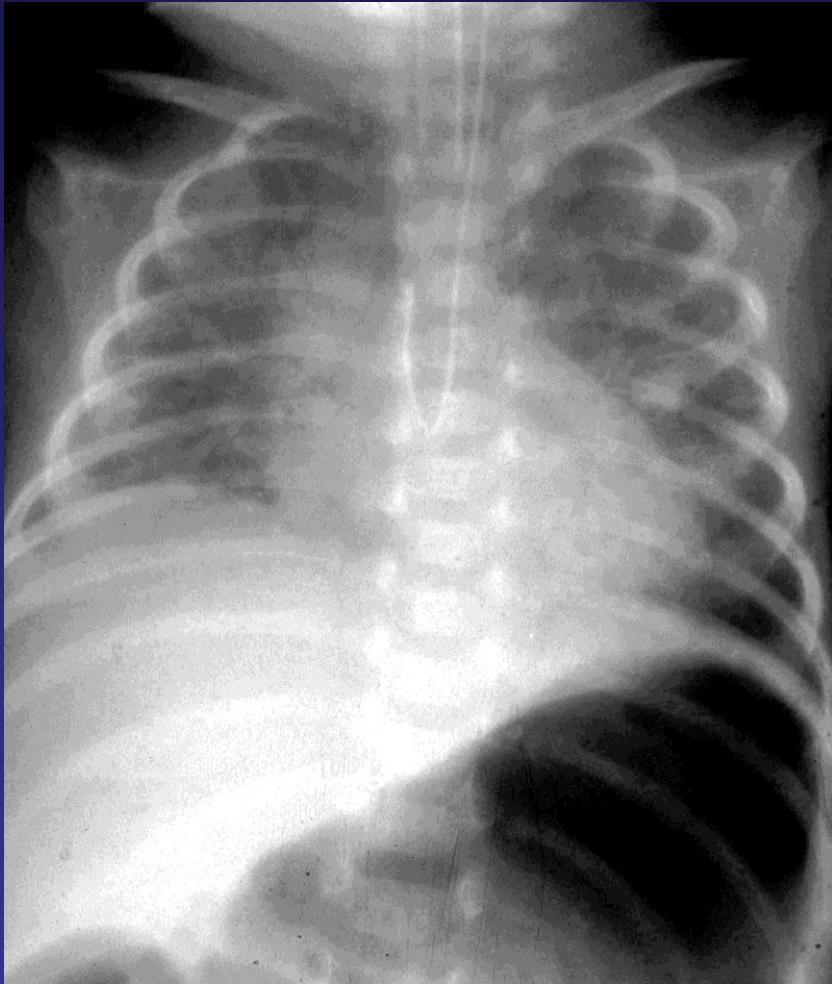
Soft tissue edema of the chest wall due to capillary leak after surfactant therapy



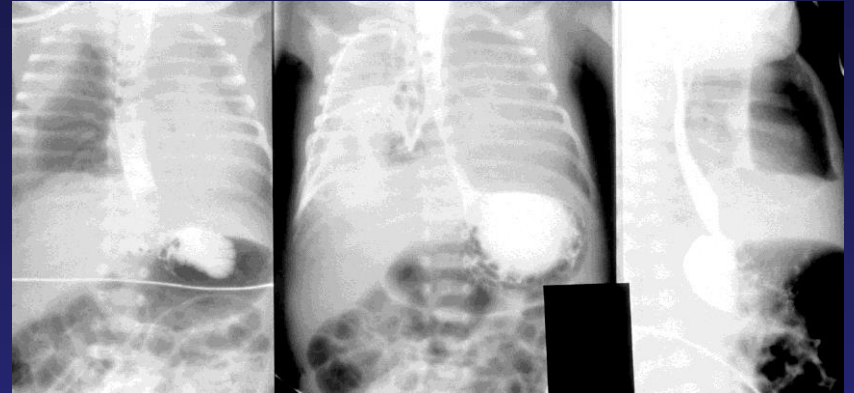
Mediastinal soft tissue accompanied by hygroma colli extending in mediastinum

# Medical accessories in situ

- Location of trachea tube
- Thorax drains
- Central lines
- Ventricle drains (liquor drains)
- Pacemaker
- Valve prosthesis



Malposition of the feeding tube  
in the esophagus



Pneumomediastinum due to  
esophagus perforation in a  
premature baby

# Conclusions

- Chest radiographs in expiration or overexposed images cannot be interpreted
- Evaluation of chest radiographs should not only be focused on the clinical question
- Systematic approach in evaluation of chest radiographs facilitates accurate diagnosis

# Conclusions

- Iatrogenic changes of the chest film need special attention especially in intensive care patients
- Normal retrosternal thymus shadow functions as 'curtain' over the heartshadow
- Hilar structures need special attention because of possible primary TBC