PEDIATRIC RADIOLOGY

Enrico B. Arkink

5th year - 28.09.2022-30.09.2022

UNIVERSITY OF ICELAND

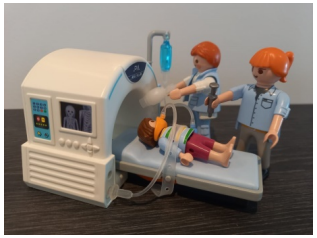
LANDSPÍTALI
HÁSKÓLASJÚKRAHÚS

Schedule

- Wednesday 28.09.2022
  - 13.00-13.45: Introduction and MSK
  - 14.00-14:45: Thorax
- Friday 28.09.2022
  - 13.00-13.45: Abdomen
  - 14.00-14.45: Neuro and ENT

PEDIATRIC RADIOLOGY

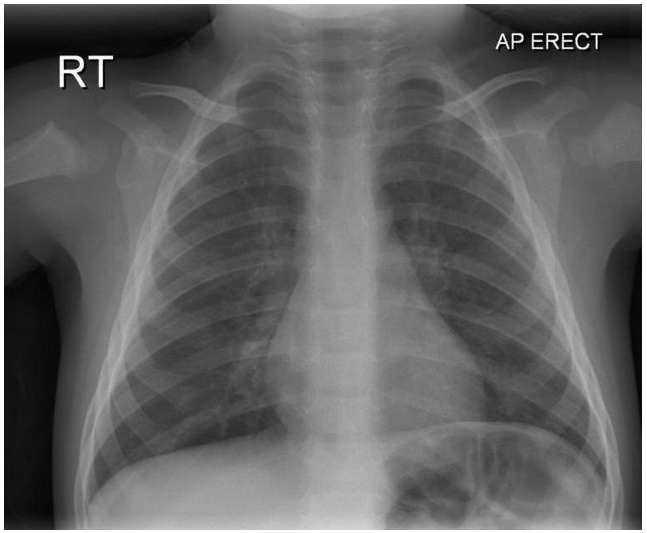
Thorax



UNIVERSITY OF ICELAND

LANDSPÍTALI
HÁSKÓLASJÚKRAHÚS

Chest radiograph: indications

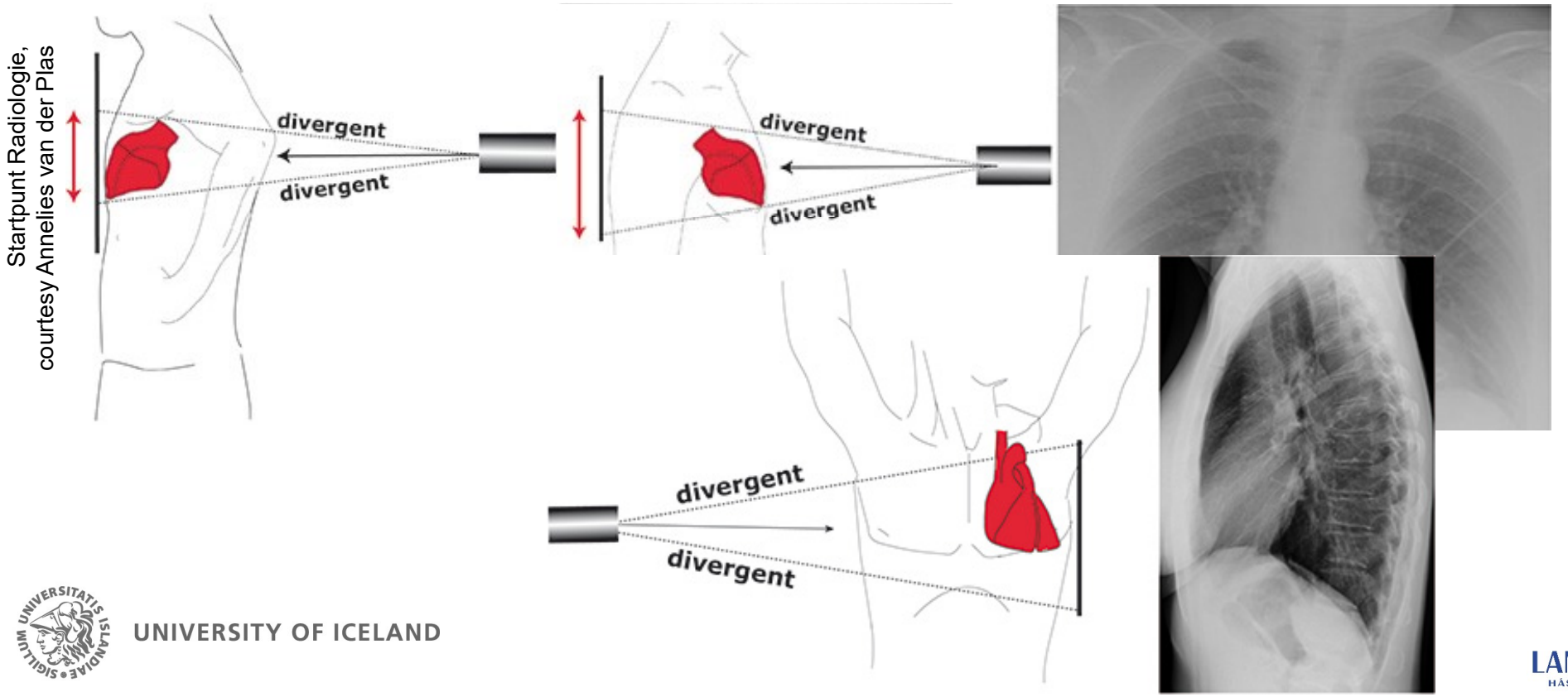


Radiopaedia, courtesy Ian Bickle

- One of the most commonly requested imaging exams in the pediatric patient

- Possible indications:
  - Lung disease
    - Respiratory distress syndrome
    - Pneumonia (incl. TB)
    - Bronchiolitis
    - Pneumothorax
  - Cardiac disease
  - Trauma
  - Foreign bodies
  - Control line placement and tracheal tube position

Chest radiograph: technique



Startpunt Radiologie, courtesy Annelies van der Plas

UNIVERSITY OF ICELAND

LANDSPÍTALI
HÁSKÓLASJÚKRAHÚS

Chest radiograph: technique

- Orientation often depends on expected pathology
- Standard chest X-ray (first investigation):
  - PA
  - Lateral
    - Left side towards detector if expected lung pathology
    - Right side towards detector if expected cardiac pathology
- Follow-up X-ray:
  - Lateral often of little value for FU; only perform if abnormalities better seen than on PA only

Chest radiograph: technique

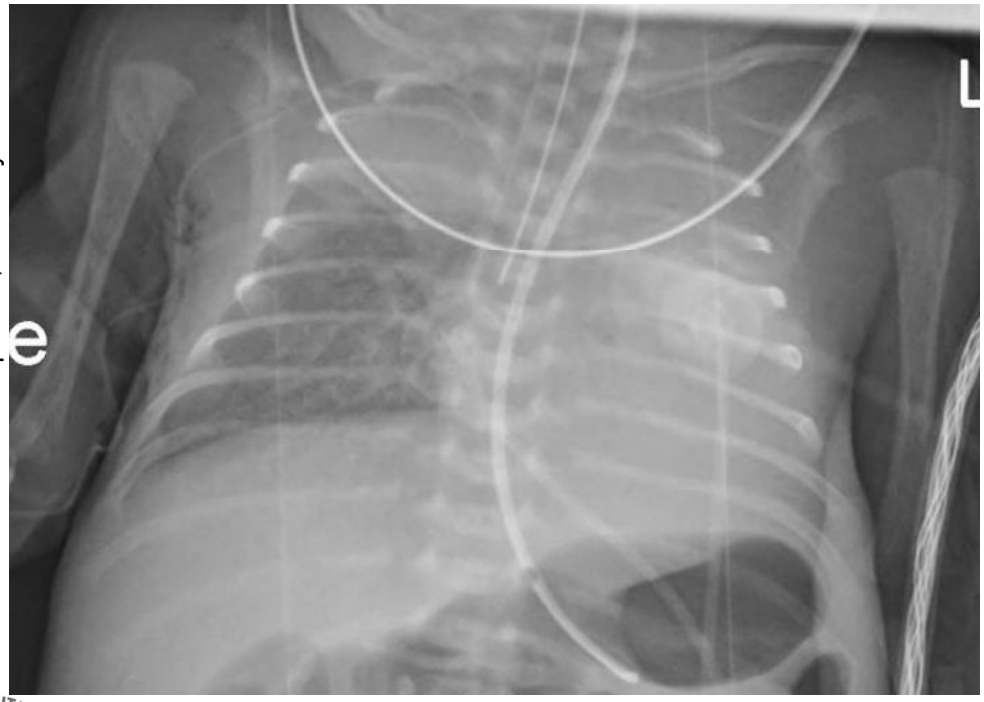
- Neonatology:
  - AP
  - Lateral with horizontal beam → particularly useful for question pneumothorax

- Specific indications may give need for additional exposures!
  - Foreign bodies:
    - PA in inspiration
    - PA in expiration (air-trapping!)
    - Lateral (presumed high position, add lateral neck, presumed lower, add abdominal radiograph)

Chest radiograph: technique

- Specific indications may give need for additional exposures!
  - Pneumothorax:
    - Neonates: AP and lateral in supine position with horizontal beams
    - Older children: begin with standard PA in inspiration; add PA in expiration if no pneumothorax or alternative explanation for symptoms seen.
  - Trauma (rib fractures):
    - PA and lateral
    - If suspected NAI: add obliques (posterior rib fractures!)

Chest radiograph: assessment

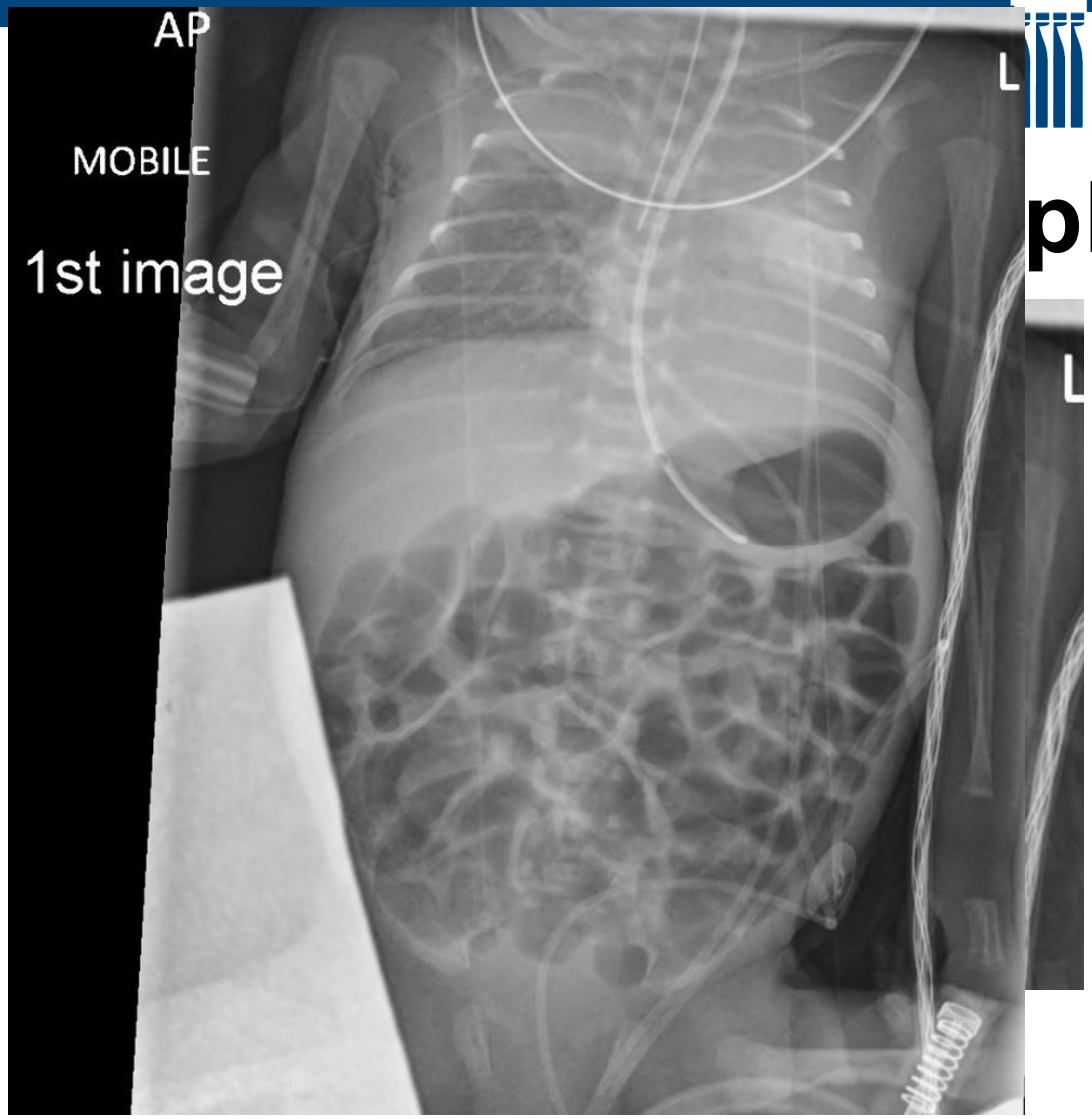


Radiopaedia, courtesy Ian Bickle

UNIVERSITY OF ICELAND

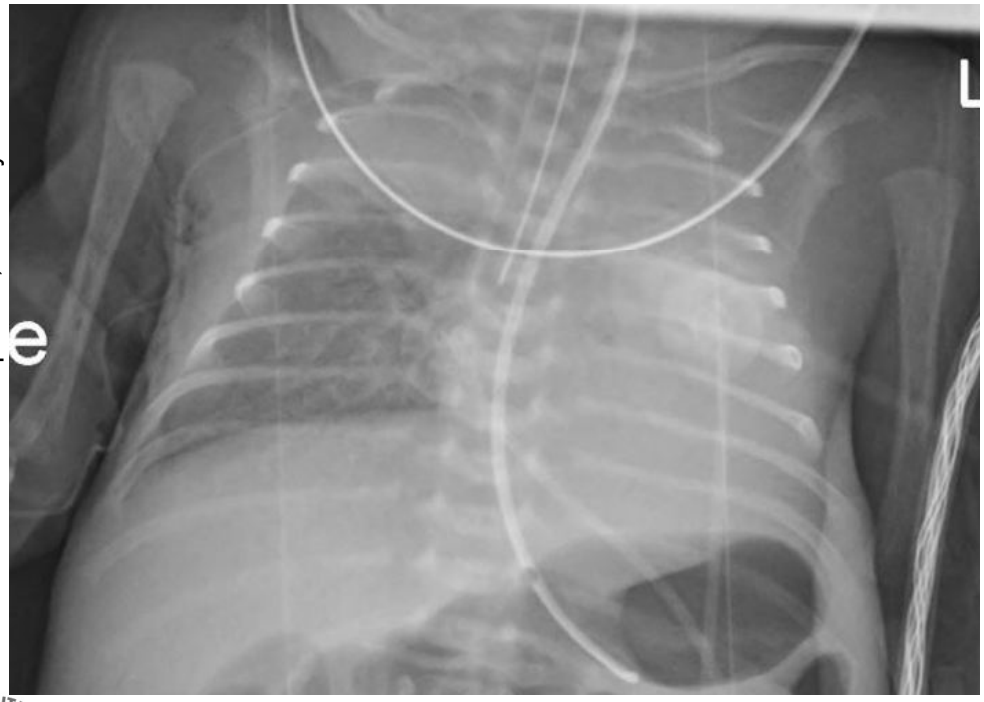
LANDSPÍTALI
HÁSKÓLASJÚKRAHÚS

ph: assessment



LANDSPÍTALI
HÁSKÓLASJÚKRAHÚS

Chest radiograph: assessment

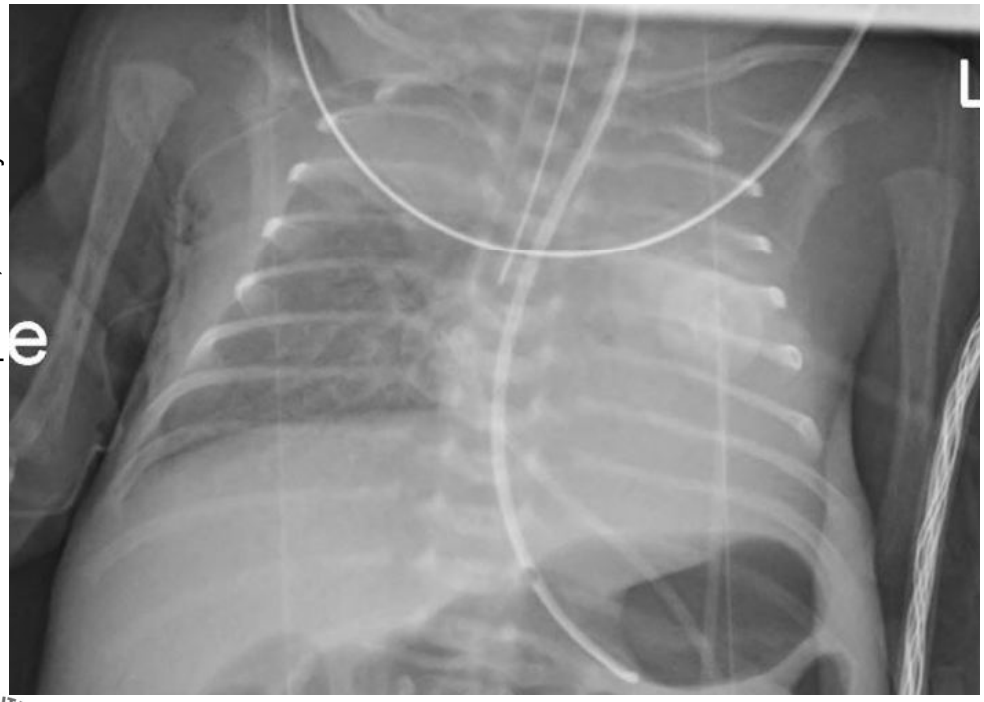


Radiopaedia, courtesy Ian Bickle

First question to ask:

<u>WHAT</u> do I see?

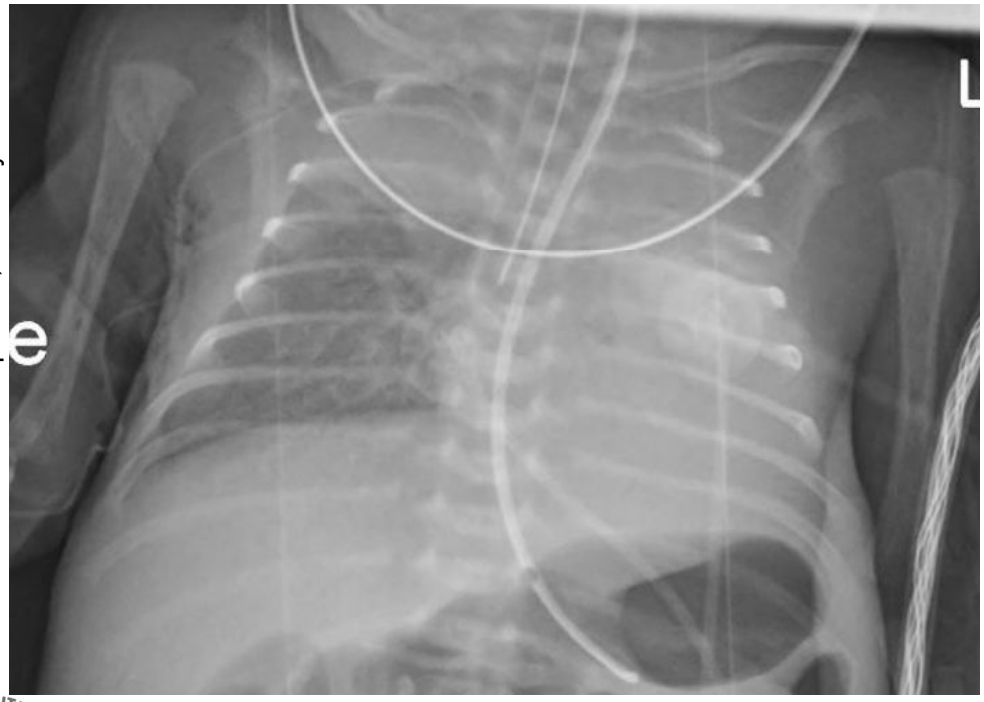
Chest radiograph: assessment



Radiopaedia, courtesy Ian Bickle

- Systemic assessment
  - Technique (vertebral column visible through heart?)
  - Inspiration: diaphragm position, ribs, airtrapping/hyperinflation (horizontal position ribs, bulging pleura between ribs)
  - External materials: tracheal og nasogastric tube, drain positions, venous lines, etc.

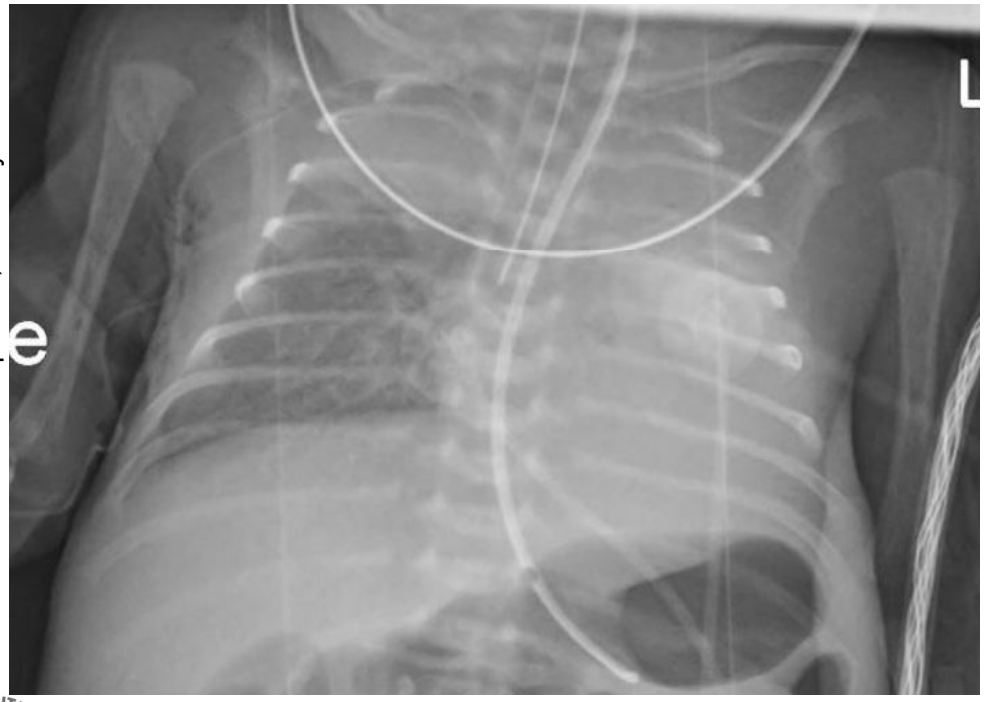
Chest radiograph: assessment



Radiopaedia, courtesy Ian Bickle

- Systemic assessment
  - Bones and soft tissues
  - Heart: CTR larger
    - Neonate: 0.6
    - Older child: 0.5
    - Adult: <0.5
  - Mediastinum: left hilus 1-2 cm higher than right.
  - Lung boundaries: diaphragms, pleura, pleural sinuses
  - Lung fields

Chest radiograph: interpretation



Radiopaedia, courtesy Ian Bickle

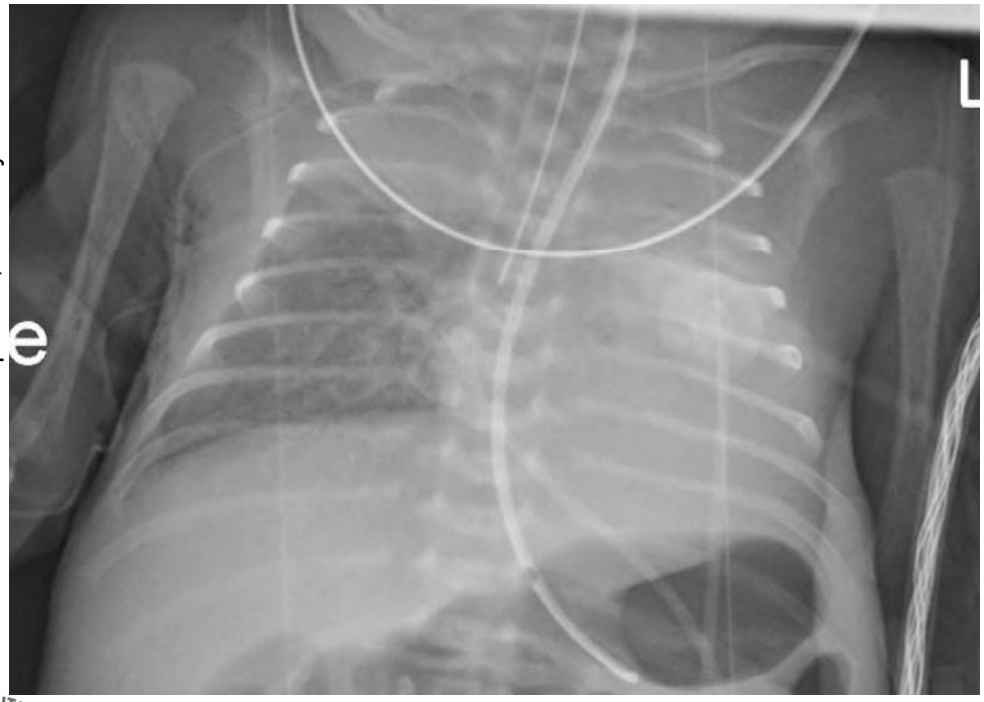
Next question:

HOW TO INTERPRET
what I see?

UNIVERSITY OF ICELAND

LANDSPÍTALI
HÁSKÓLASJÚKRAHÚS

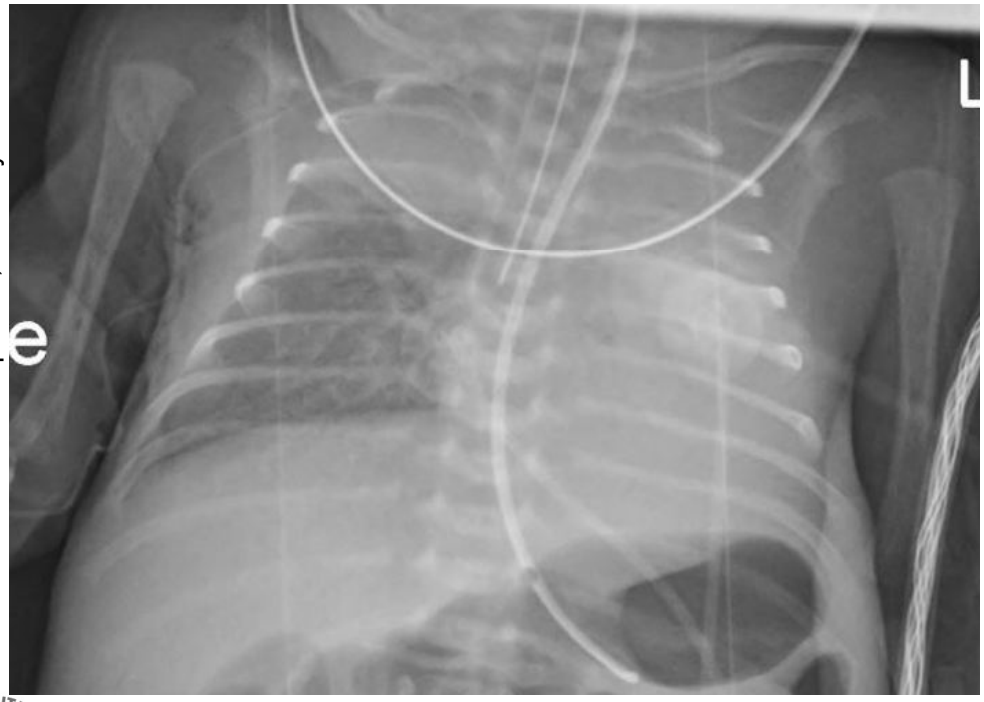
Chest radiograph: interpretation



Radiopaedia, courtesy Ian Bickle

- Rules of thumb regarding the affected thoracic side:
  - The side with less vascular markings
  - The smaller hemithorax, especially when completely white/grey
  - The side that changes the least between inspiration and expiration

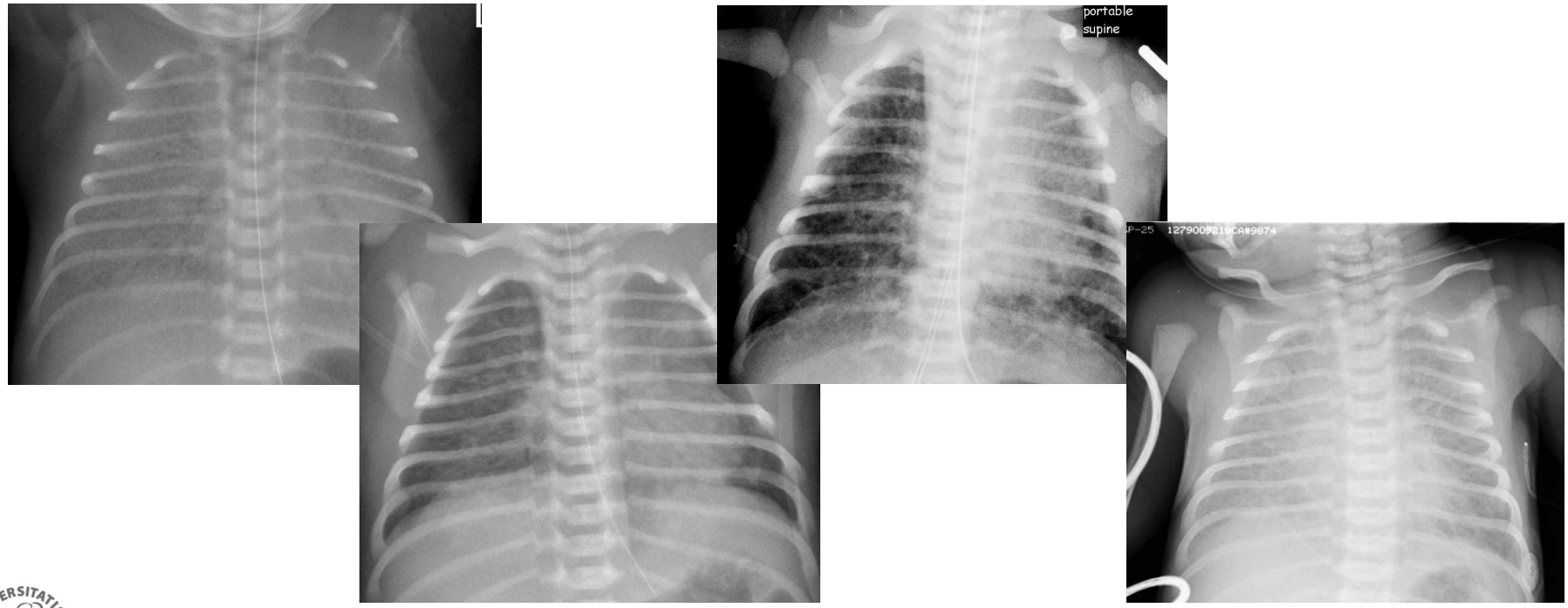
Chest radiograph: interpretation



Radiopaedia, courtesy Ian Bickle

- In this case:
  - Normal inspiration, no hyperinflation
  - Nasogastric sonde √
  - Tracheal tube X
  - Cardiac size and mediastinum difficult to assess
  - Atelectasis right upper lobe and whole left lung (left hemithorax smaller!)

Neonatal radiograph: common findings

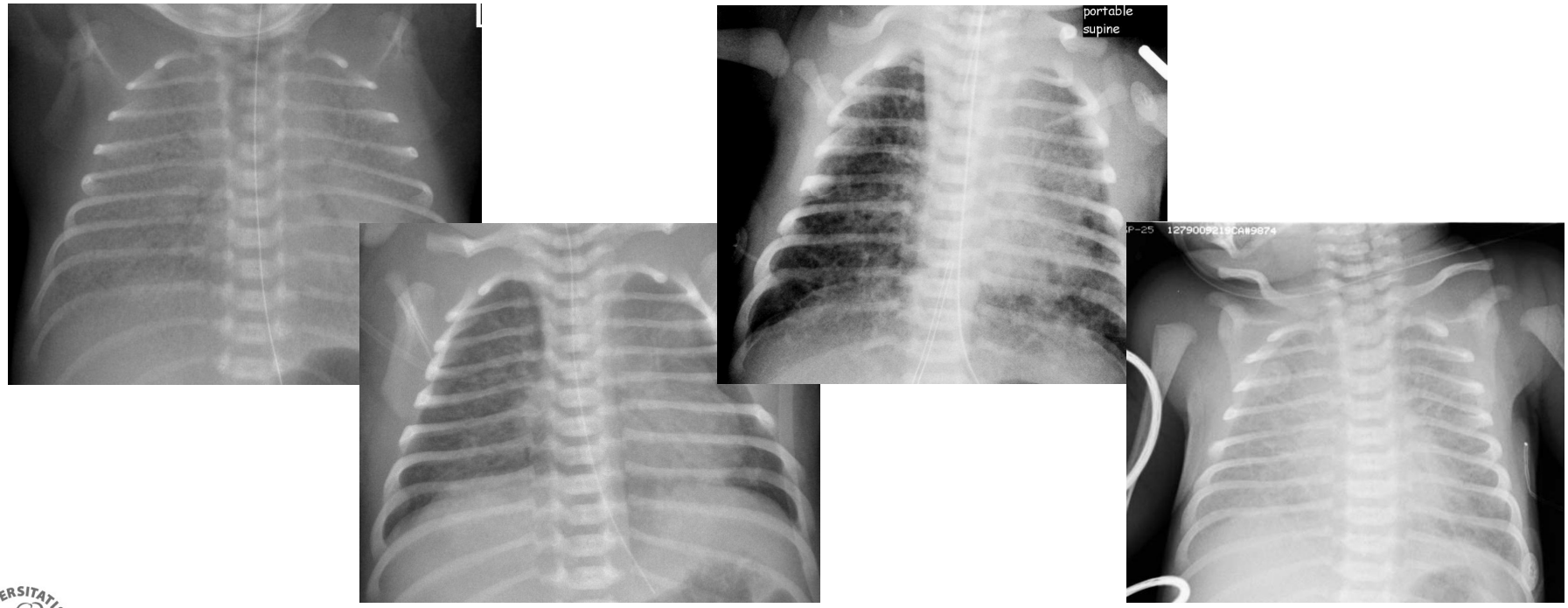


Radiopaedia, courtesy Jeremy Jones, Frank Gaillard, Radswiki

UNIVERSITY OF ICELAND

LANDSPÍTALI
HÁSKÓLASJÚKRAHÚS

Neonatal radiograph: common findings

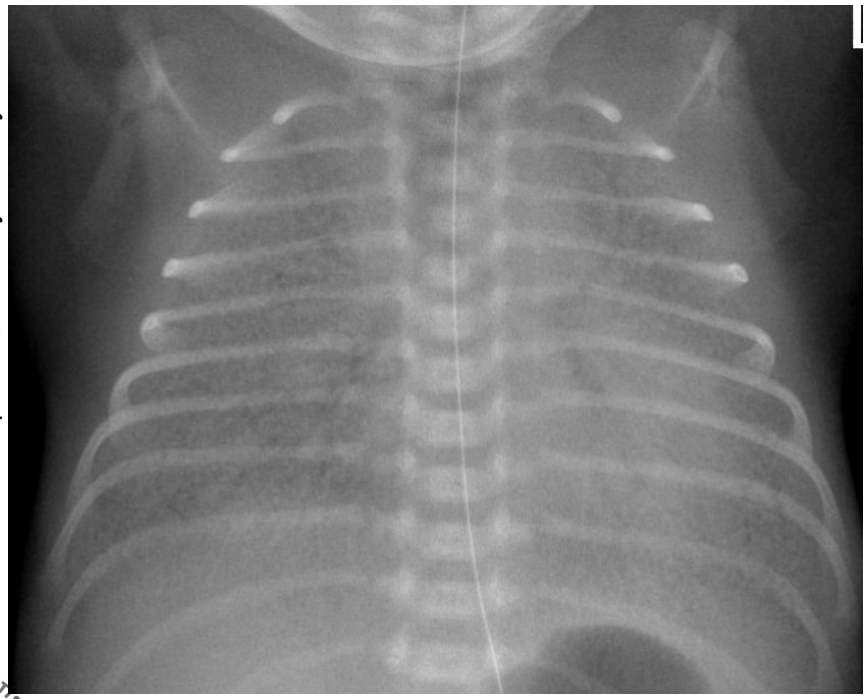


Radiopaedia, courtesy Jeremy Jones, Frank Gaillard, Radswiki

UNIVERSITY OF ICELAND

LANDSPÍTALI
HÁSKÓLASJÚKRAHÚS

Neonatal radiograph: common findings



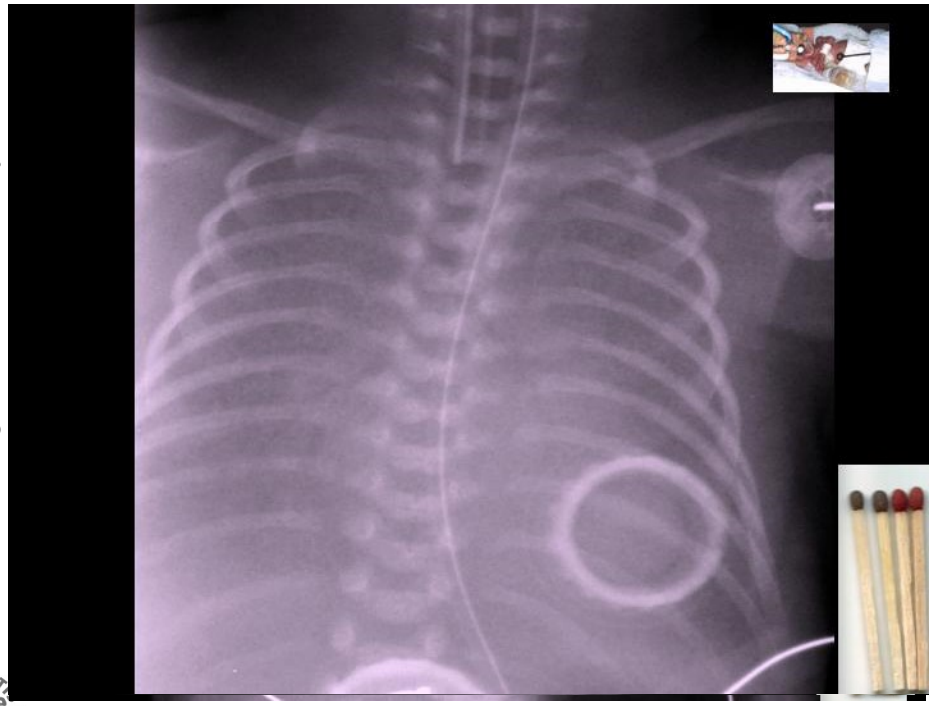
Radiopaedia, courtesy Jeremy Jones

- Preterm neonate, emergency caesarean section, increased oxygen demand
- X-ray:
  - Nasogastric tube √
  - Relatively small lung volumes
  - Diffuse fine granular opacifications, symmetric
  - Air bronchograms
- **(idiopathic) Respiratory distress syndrome**

Respiratory distress syndrome

- Premature infants
- Underdeveloped pulmonary surfactant production
- Lack of surfactant → alveolar collapse → atelectasis
- DDx:
  - Wet lung
  - Infection (pneumonia)
  - ARDS
  - Pulmonary edema (of cardiogenic, neurogenic, toxic origin)
- Hyperinflation excludes diagnosis (unless intubated)

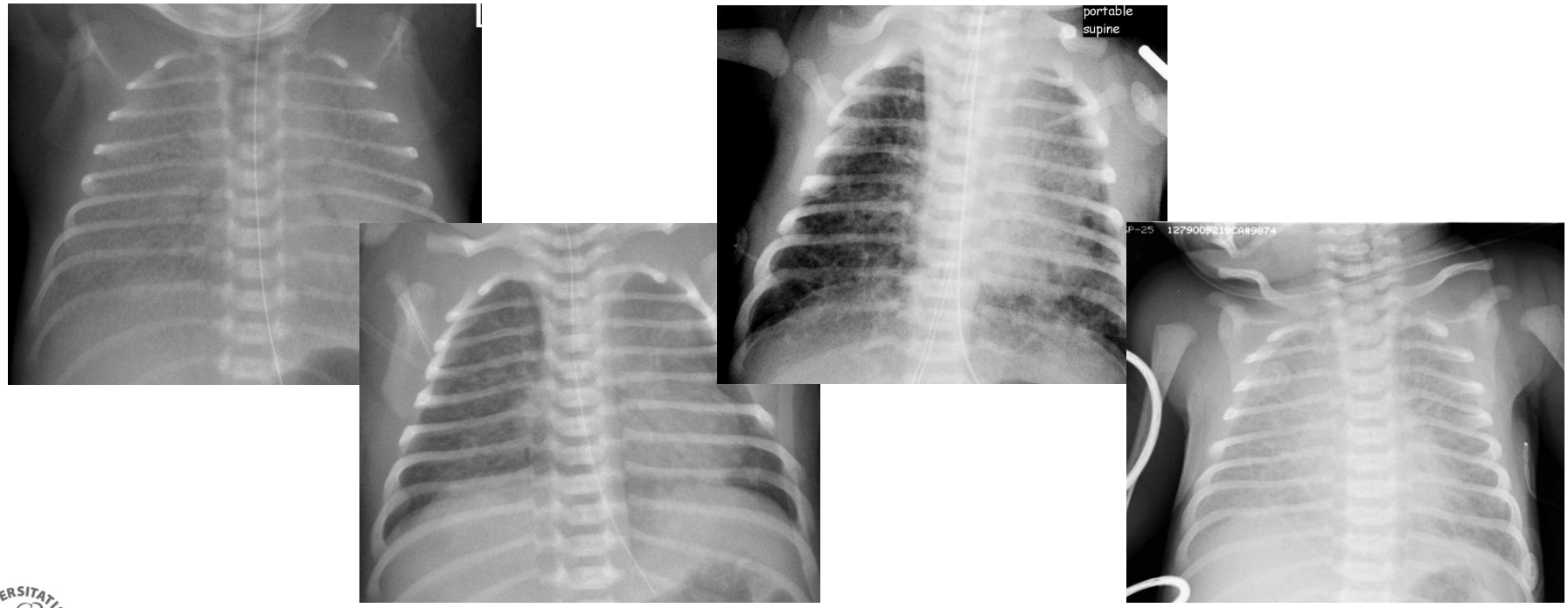
Respiratory distress syndrome



Kinderradioloige-online.de, courtesy M. Pätzel,

- **4 stages:**
- 1: slight reticular decrease transparency of lung, near normal
- 2: soft opacifications with air bronchogram, overlapping heart
- 3: like 2, but gradual stronger decrease in transparency, blurring heart and diaphragm
- 4: practically homogenic lung opacity

Neonatal radiograph: common findings



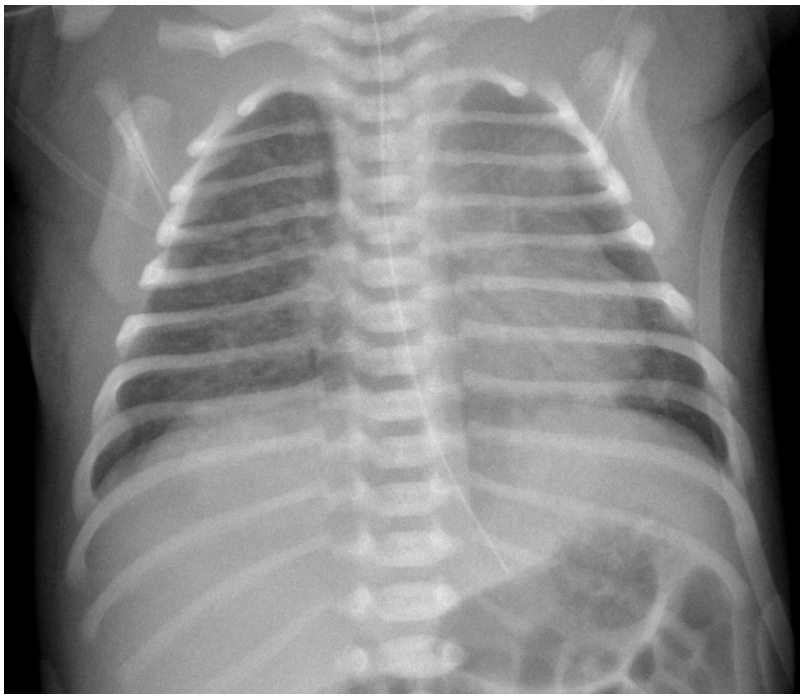
Radiopaedia, courtesy Jeremy Jones, Frank Gaillard, Radswiki

UNIVERSITY OF ICELAND

LANDSPÍTALI
HÁSKÓLASJÚKRAHÚS

Neonatal radiograph: common findings

Radiopaedia, courtesy Jeremy Jones

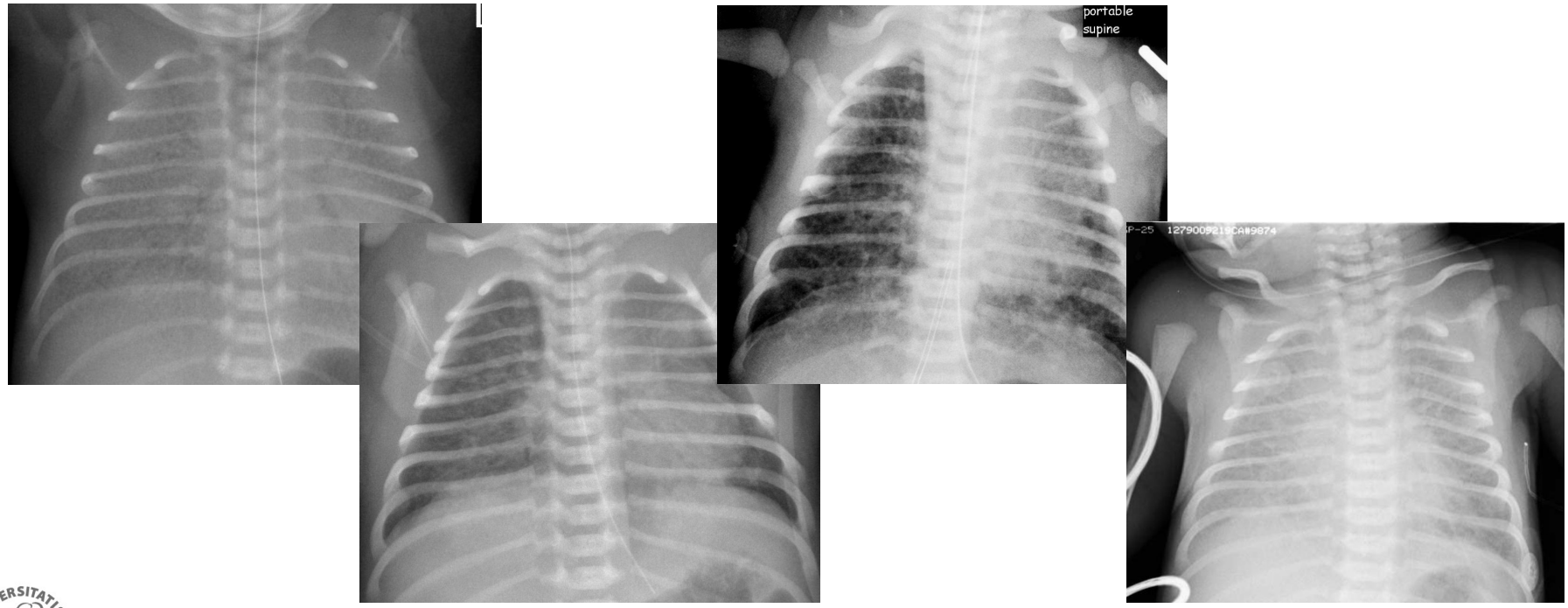


- Preterm neonate, respiratory distress
- X-ray:
  - Nasogastric tube √
  - Bilateral patchy alveolar consolidations
  - No pleural effusions
  - No pneumothorax
- **Neonatal pneumonia**

Neonatal pneumonia

- Inflammatory changes of respiratory system caused by neonatal infection
- Risk factors: rupture of membranes > 6 hrs prior to delivery, prolonged and complicated labour, prematurity, immune disorders
- Symptoms: tachypnea, chest recession/sternal retraction (sign of negative pressure on inspiration), apnea, respiratory distress, cough (in up to a third)
- Infection through transplacental spread → aspiration of infected amniotic fluid
  - Maternal systemic infections (*rubella, CMV, syphilis, listeria, TB, HIV, COVID19*)
  - Bacteria: **streptococci** (group A & B), staphylococcus aureus, e. coli, klebsiella, proteus spp.

Neonatal radiograph: common findings

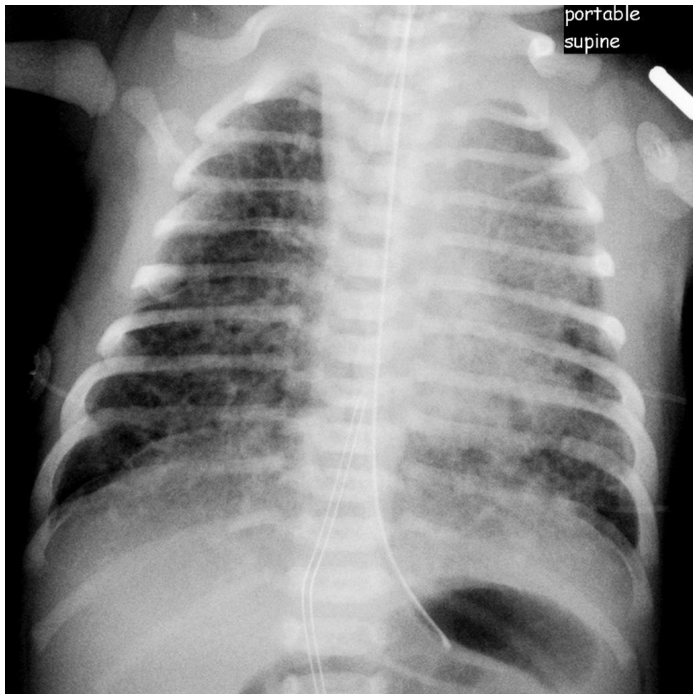


Radiopaedia, courtesy Jeremy Jones, Frank Gaillard, Radswiki

UNIVERSITY OF ICELAND

LANDSPÍTALI
HÁSKÓLASJÚKRAHÚS

Neonatal radiograph: common findings



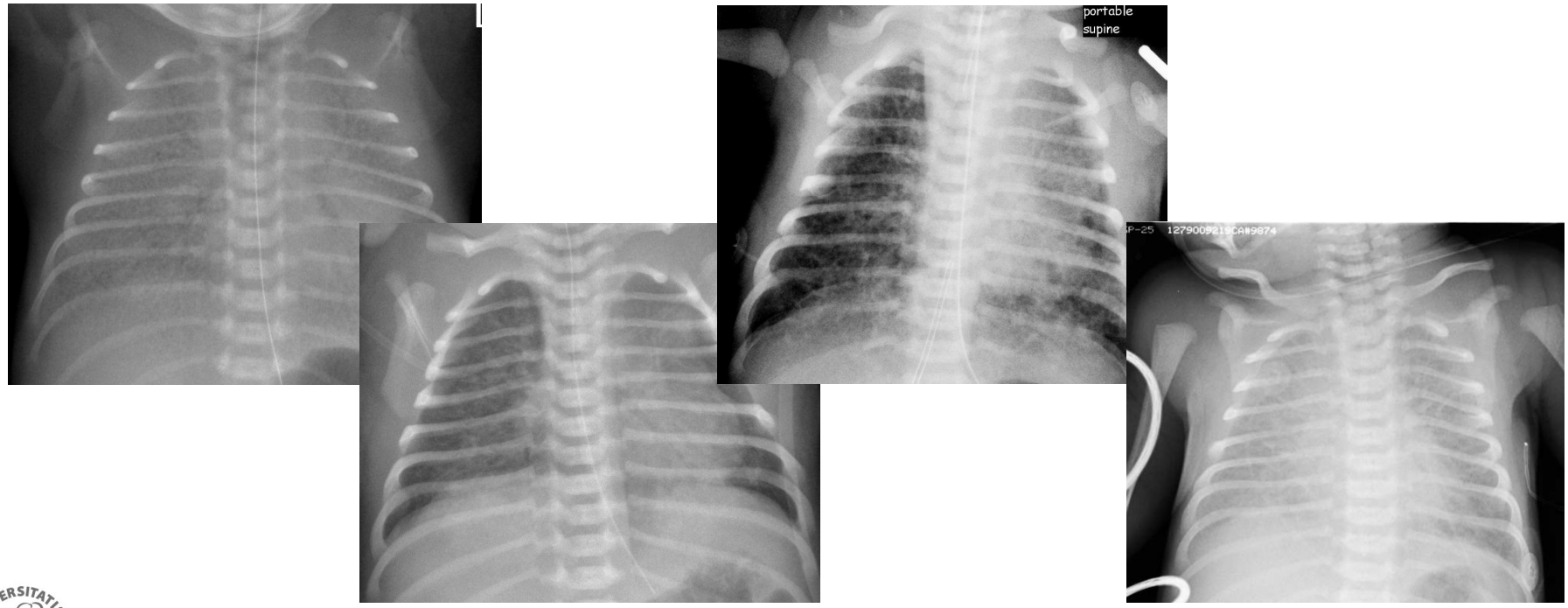
Radiopaedia, courtesy Frank Gaillard

- Term neonate, difficult delivery, respiratory distress
- X-ray:
  - Tracheal tube, nasogastric sonde, umbilical venous line √
  - Hyperinflation
  - Bilateral though asymmetric coarse alveolar consolidations
  - Areas of subsegmental atelectasis (LUL) and airtrapping
  - Pleural effusion
- **Meconium aspiration**

Meconium aspiration

- Secondary to intrapartum or intrauterine aspiration of meconium, usually in setting of fetal distress, typically term or post-term infants
- Meconium containing amniotic fluid in 10-15% of births after week 34, though only 1-5% meconium aspiration
- Chemical pneumonitis

Neonatal radiograph: common findings



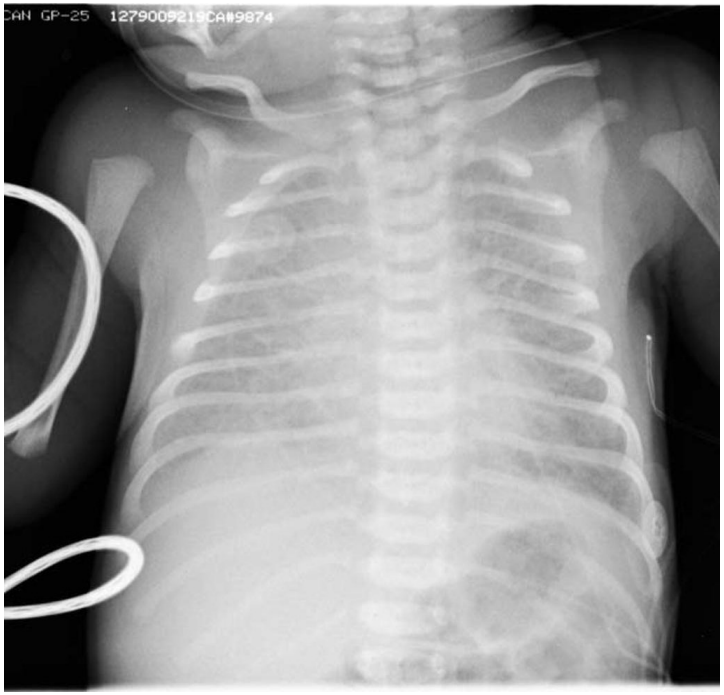
Radiopaedia, courtesy Jeremy Jones, Frank Gaillard, Radswiki

UNIVERSITY OF ICELAND

LANDSPÍTALI
HÁSKÓLASJÚKRAHÚS

Neonatal radiograph: common findings

Radiopaedia, courtesy Radwiki

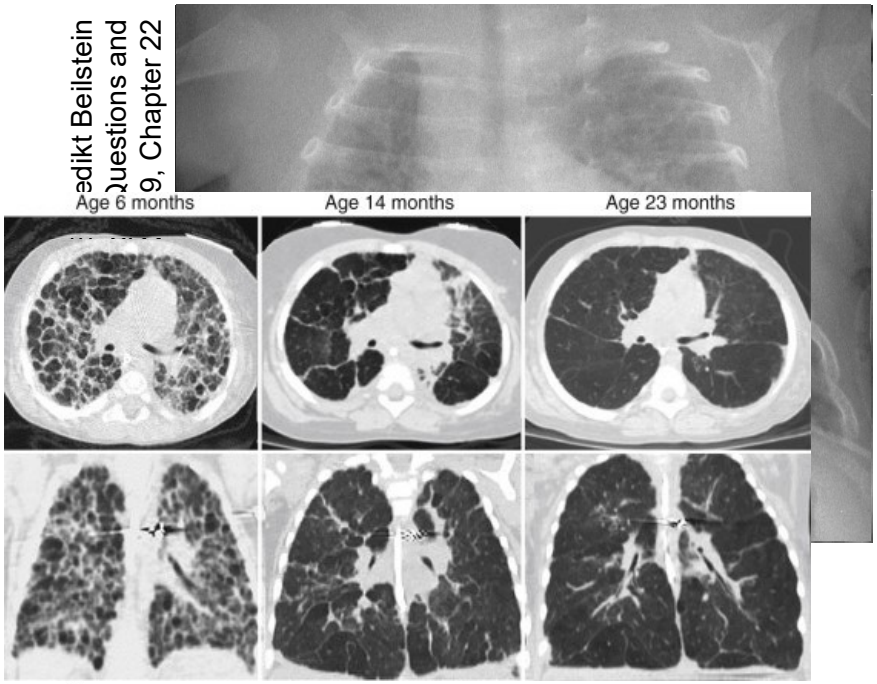


- Term neonate, respiratory distress within first hours of life
- X-ray:
  - Hyperinflation
  - Bilateral opacification of both lungs, symmetric
  - Thickened interstitium (edema); perihilar streakiness
  - Pleural effusion
- **Transient tachypnea of the newborn (wet lung)**

Transient tachypnea of the newborn

- Retained fetal fluid in the lungs
- Presentation with tachypnea within first hours of life, often lasting up to a day, resolving within 48 hours
- Affects 1-2% of newborns, equal gender predilection
- Risk factors: DM mother, caesarean section, quick vaginal delivery
- May show cardiomegaly in extreme cases

Bronchopulmonary dysplasia

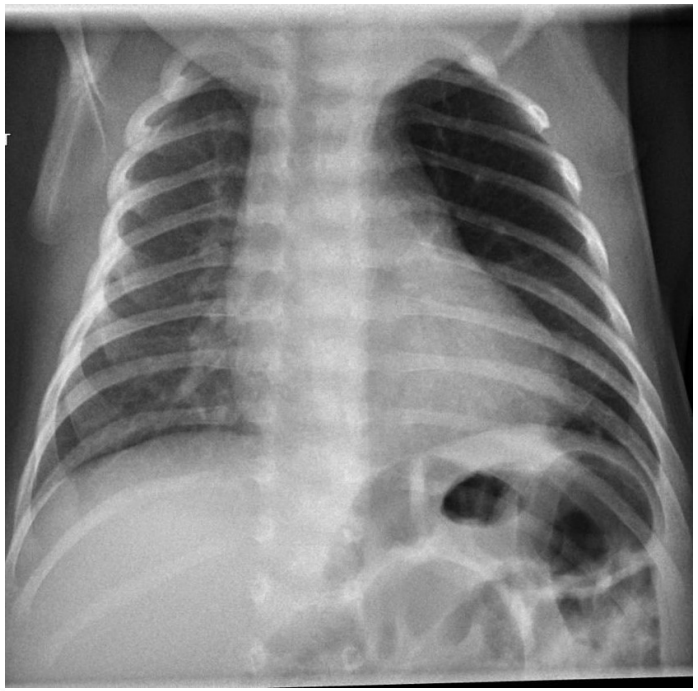


- Pathologic lung changes several weeks after prolonged ventilation
- X-ray:
  - Hyperinflated lungs
  - Ill-defined reticular markings with interspersed round lucent areas
  - Cardiomegaly might indicate pulmonary hypertension
- CT:
  - Mosaic lung pattern (low attenuation areas and focal air trapping on expiratory HRCT)
  - Bronchial wall thickening
  - Subpleural opacities

UNIVERSITY OF ICELAND

LANDSPÍTALI
HÁSKÓLASJÚKRAHÚS

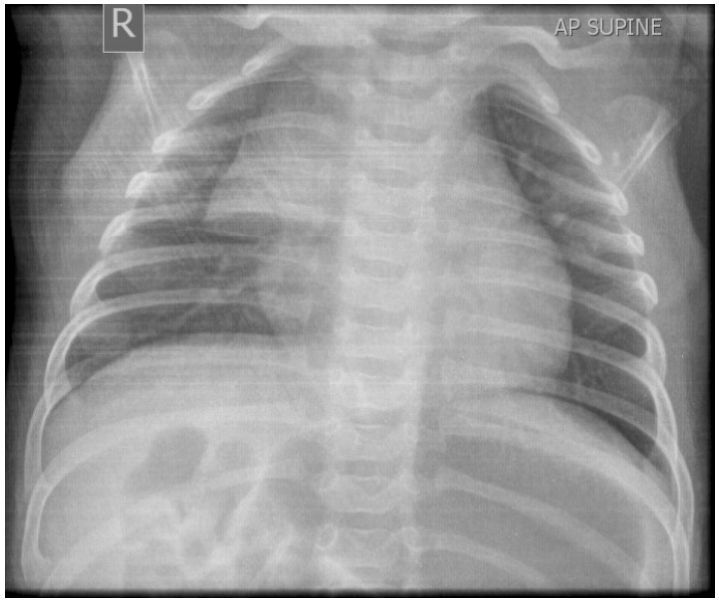
Congenital lobar overinflation



Radiopaedia, courtesy Jeremy Jones

- Previously congenital lobar emphysema
- Left upper lobe most commonly involved (then ML, RUL; rare in lower lobes)
- More common in males (M:F=3:1)
- Usually presentation within 6 months
- Result of airtrapping, lobe progressively overinflated
- On X-ray:
  - Hyperlucent lung segment with overinflation
  - Contralateral mediastinal shift

Thymic sail sign

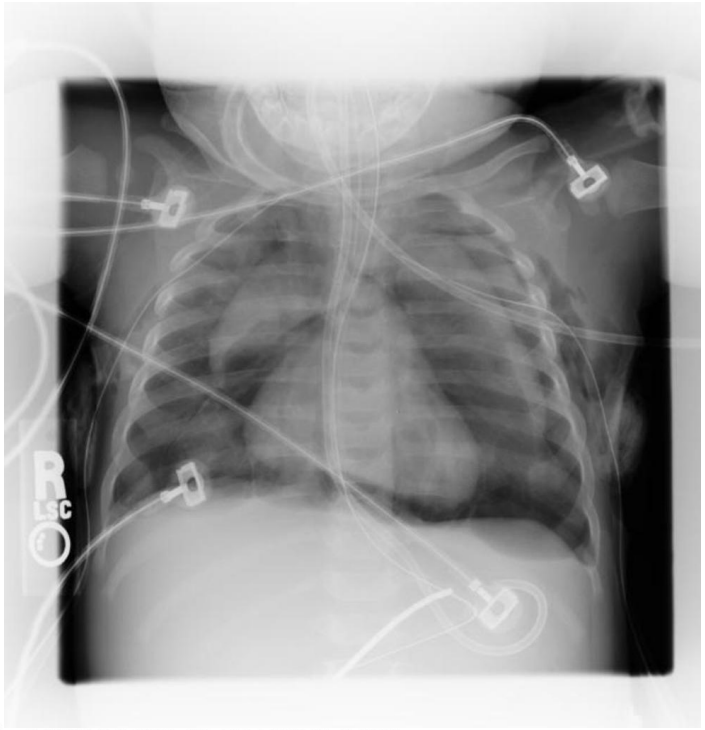


Radiopaedia, courtesy Hidayatullah Hamidi

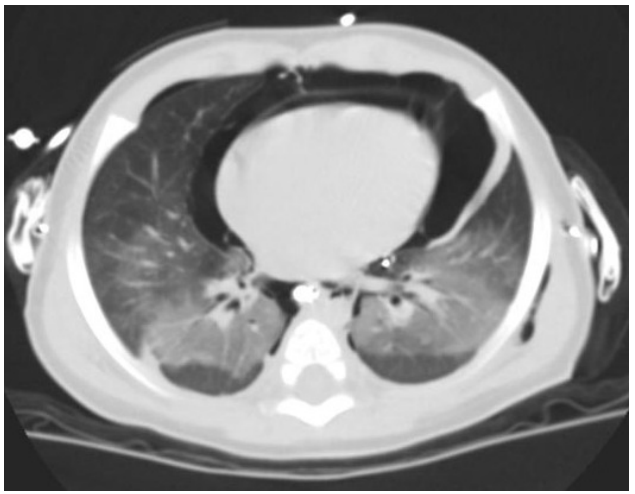
- Triangular shape of the normal thymus
- Commonly on the right
- In 3-15% of neonates

Spinnaker sign

Radiopaedia, courtesy Radswiki



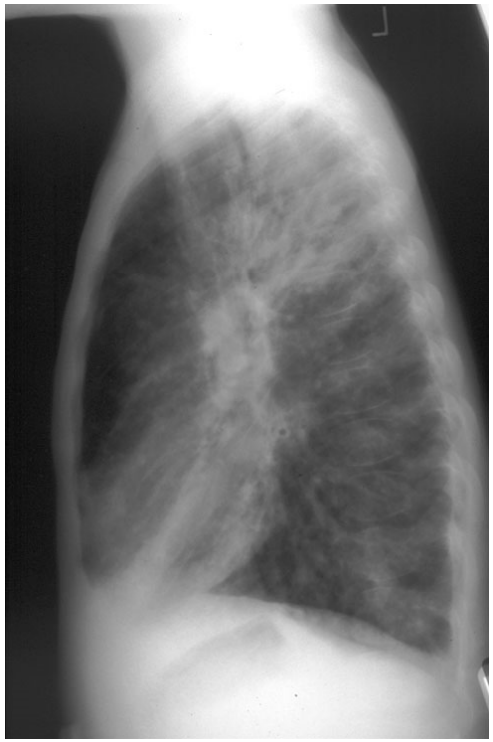
- Angel wing sign
- Indicates pneumomediastinum
- Thymus outlined by air with each lobe displaced laterally



Chest X-ray in older pediatric patients

- Pneumothorax
- Pneumomediastinum
- Other pulmonary conditions:
  - Asthma:
    - Often normal X-ray; sometimes peribronchial thickening, hyperinflation
    - Recurrent atelectasis due to mucus plugging
  - Cystic Fibrosis
    - Generalized and localized hyperinflation; peribronchial thickening; atelectases in the upper lung fields
    - Hilar enlargement; bronchiectasis; pulmonary hypertension

Cystic fibrosis



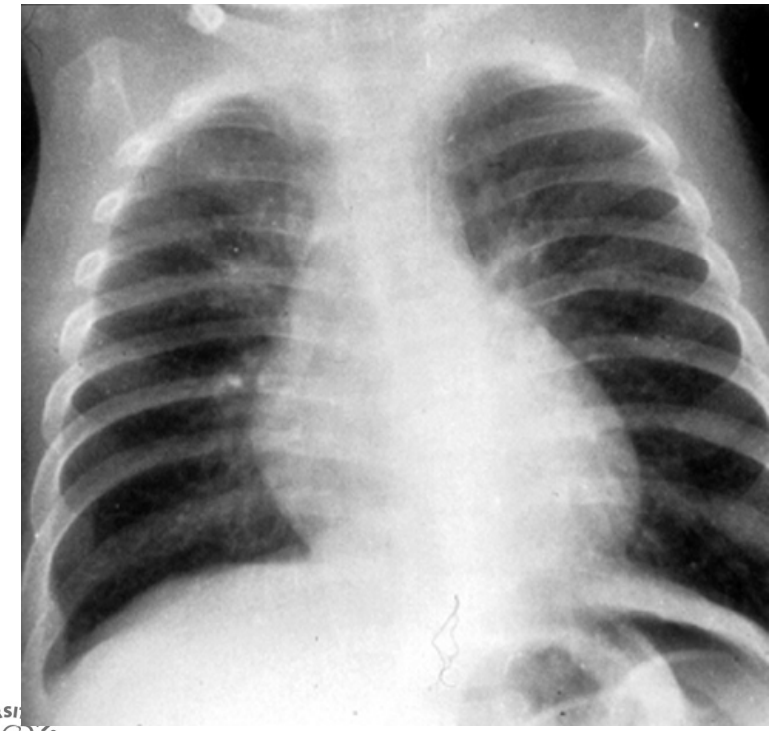
- Coarse interstitial pattern
- Bronchial wall thickening
- Consolidation
- Suggestion of bronchiectasis formation

Cystic fibrosis

Radiopaedia, courtesy Alexandra Stanislavsky

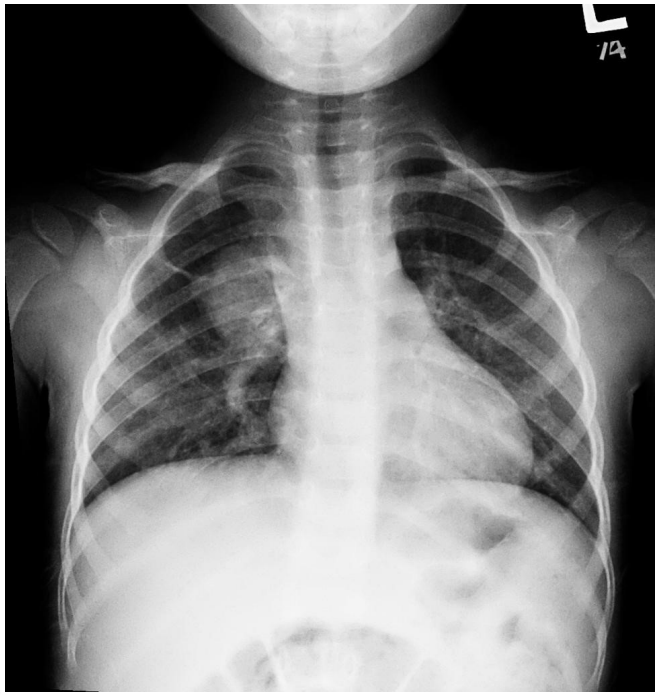
- ♀ 25 years
- Severe bilateral central bronchiectasis on X-ray
- Bilateral severe, widespread bronchiectasis with occasional mucus plugging on CT

Viral pneumonia



- Hyperinflation
- Increased perihilar interstitial/peribronchial thickening
- Everchanging segmental atelectases
- Hilar enlargement
- Diffuse unsharp infiltration
- Complication: bronchopneumonic infiltrates

Round pneumonia



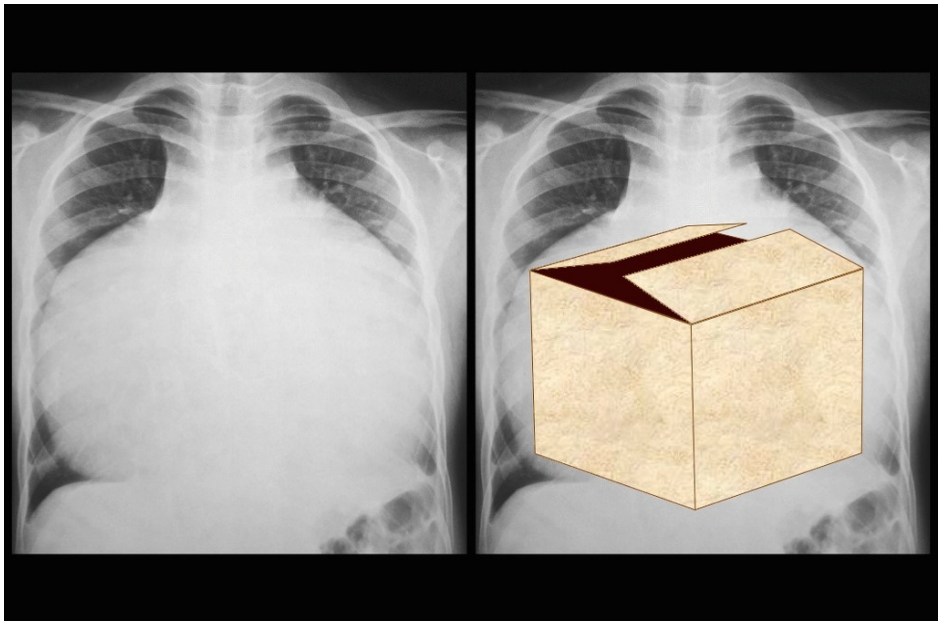
Radiopaedia, courtesy Hani Makky Al Salam

- Pneumonia typical seen in pediatric patients; 90% <12 yoa, uncommon after 8 yoa
- Well-defined rounded opacities representing consolidation of infectious origin
- Proposed theory for their origin:
  - Children still lack interalveolar communications and collateral airways (pores of Kohn and canals of Lambert) that normally allow air drift and thus infection dissemination
  - Limited spread of infection → round pneumonia

Congenital heart disease

- Affecting both heart and greater vessels
- Numerous different conditions, ranging from persistent connections (truncus arteriosus), anomalous pulmonary venous return, transposition of great arteries, VSD, ASD, etc. etc.
- Often multimodal imaging (chest radiography, cardiac ultrasound, CT/CTA, MR/MRA) necessary to come to a specific diagnosis
- Some however have typical findings on imaging

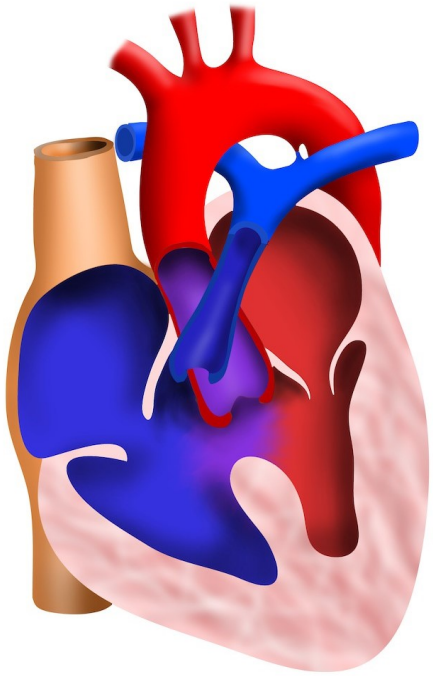
Ebstein anomaly



Radiopaedia, courtesy Vincent Tatco

- Tricuspid valve anomaly leading to regurgitation, leading to right-sided cardiomegaly (RA dilatation)
- Associated with trisomy 13/21, Turner, ASD
- Box-shaped heart classically described on frontal chest radiography

Tetralogy of Fallot



d

- Boot-shaped heart classically described on frontal chest radiography
- Four features:
  - VSD
  - RV outflow obstruction
  - Overriding aorta
  - RV hypertrophy

Questions?