Systematic in interpretation of pediatric chest X-ray

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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
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
Paralysis of phrenic nerve

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 hypoluent 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

Dissiminated infiltration in M. Wegener
Atelectasis due to intubation

Atelectasis due to aspirated foreign body at the left side

Atelectasis due to intubation
Interstitial pneumonia
(Pneumocystis carinii)

Interstitial pneumonia
allergic toxic genesis
Longparenchyma
Pulmonary 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
Overprojection of heart and mediastinum by thymus (curtain effect)

Ultrasound image of normal thymus
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
Mediastinal widening in achalasia

Air-fluid level

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
Iatropic rib fractures after fysiotherapy in BPD (Bronchopulmonary dysplasia)
Right sided ewingsarcoma 9th rib with additional soft tissue tumor

Ribanomalies 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