Pleural disease
Chest X-ray

- Most important imaging technique
  - Demonstration
  - Follow-up
- PA and lateral view (erect)
- Expiratory chest x-ray in case of suspicion of (small) pneumothorax
- Lateral decubitus (?) and lateral supine film
- Pleura only visible at fissures
Ultrasound

• Evaluate and guide aspiration and drain insertion
• Normal pleura presents as echogenic stripe comprising both parietal and visceral pleura
CT

- Can play a role in specific situations
- Thin slice CT for detailed view of small pleural changes
- Standard slice CT with IV contrast
  - 20-60 seconds after contrast injection
  - Differentiate pleural thickening from pleural fluid
- Normal pleura only visualised at the fissures
Magnetic Resonance

- Limited role
- High contrast between pleural abnormalities and extra-pleural fat
- Respiration artifacts:
  - Respiratory gating
  - Ultra fast acquisition
Positron Emission Tomography (PET) and integrated PET-CT

- Limited role
- Diagnosis and staging of tumor (malignant mesothelioma)
Pleural disease

• Accumulation of fluid
• Accumulation of air
• Pleural thickening and fibrothorax (with and without calcification)
• Pleural tumors
Accumulation of Pleural Fluid: Pleural Effusion
Pleural Effusion: Goals of diagnostic imaging

1) Detection of the effusion and differentiation from other pathological pleural (and non pleural) processes

2) Detection of underlying pulmonary, cardiac, mediastinal or abdominal pathology

3) When possible, trying to make a specific diagnosis
Main causes of pleural effusion

- **Hypoproteinemia**
  - hepatic cirrhosis
  - nephrotic syndrome
- **Cardiovascular disease**
  - constrictive pericarditis
  - SVC obstruction
  - post cardiac injury syndrome
  - PE
- **Neoplasm**
  - bronchial carcinoma
  - metastases (lung, pleura)
  - pleural tumor (benign, malignant)
  - lymphoma
- **Infection**
  - bacterial (tbc), viral, chlamydial, protozoal, metazoal, fungal
- **Trauma**
  - ruptured esophagus
  - post surgical (thorax/abdomen)
  - open/closed chest trauma
  - CVP line insertion, ventriculopleural shunt, radiation
- **Inhalation**
  - asbestos exposure
- **Inflammatory (non infectious)**
  - RA
  - SLE
  - Wegener’s
- **Drug toxicity**
  - methotrexate
- **Subdiaphragmatic disease**
  - ascites - uremic pleurisy
  - pancreatitis - splenic infarction
  - subphrenic/ hepatic abscess
Chest radiograph
Pleural effusion: Typical findings

- Upright position:
  - Obliteration of post. costophrenic angle (lat view) (> 100ml)
  - Obliteration of lateral costophrenic angels (pa view) (> 175ml)
  - Superiorly concave meniscus
Pleural effusion: Typical findings

- Supine position: (> 500ml)
  - Obliteration diaphragmatic contour
  - Opacification lateral costophrenic angles
  - Decreased translucency of (lower part of) hemithorax
Pleural effusion: Atypical findings

1. **Loculated effusion:**
   - Ill-defined opacity en face
   - Semicircular opacity tangentially
   - Obtuse angle with the chest wall

2. **Interlobar effusion:**
   - In minor and major fissures
   - Biconvex
   - Sharply defined tangentially
Pleural effusion: atypical findings

3. Subpulmonic effusion:
   - Accumulation of pleural fluid between the diaphragm and the lung
   - Sharp costophrenic angle
   - Up to 1000 ml
   - Left sided: distance between inferior lung and gastric bubble > 2cm
Pleural effusion: atypical findings

4. **Apical effusion:**
   - Accumulation of pleural fluid at the apex of the chest
   - In supine body position
   - Increased opacity at the lung apex
   - Ill or sharply defined
Ultrasound (US)
US

• Distinguish between pleural fluid and solid pleural and extrapleural lesions
  » Doppler examination
  » Opaque hemithorax

• Identify small amounts of pleural fluid, pleural fluid in unusual locations (subpulmonary)

• Localize pleural fluid for aspiration, and identify solid components for biopsy
US

• Can suggest type of pleural fluid
  – **Transudate**: echo-free, fluid-lung interface is highly echogenic
    » Lymphoma and neurogenic tumors may also be hypoechoic
  – **Exudate and hemorrhagic effusion**: more echogenic with mobile strands of fibrin and accompanied by pleural thickening
    » Differential diagnosis with solid pleural thickening can be difficult
Computed Tomography (CT)
CT

- Not indicated in every patient presenting with pleural effusion on chest X-ray
- CT density measurement cannot distinguish between exudate and transudate, clotted blood can sometimes be identified
CT

- Can characterize the morphology of the pleural thickening that often accompanies a pleural effusion and in this way help to differentiate between benign and malignant pleural effusion.
- Identify underlying lung disease that might have provoked the effusion.
Pleural thickening and Pleural Fluid

1. Empyema
2. Organised (encapsulated) pleural effusion
3. Malignant pleural effusion
   Metastatic disease
   Malignant mesothelioma
1. Empyema

- Thickening is **uniform/smooth**
- Thickening and **enhancement**: specificity of 96% in predicting presence of (infectious) exudate
- Often thickening and increased attenuation of the **extrapleural fat**
- **Split pleura sign**: thickening and enhancement of visceral and parietal pleura
2. Organised (encapsulated) pleural effusion
3. Malignant pleural effusion

- CT may only show pleural fluid
- Malignant pleural effusion associated with malignant pleural thickening
  - nodular pleural thickening
  - parietal pleural thickening >1cm
  - often additional features in lung, mediastinum, chest wall that suggest malignancy
Magnetic Resonance Imaging (MRI)
MRI

- Low T1 and T2 signal intensity
- Does not allow to differentiate between exudates and transudates
- Subacute and chronic haemorrhage may be recognised by the high signal intensity on both T1 and T2 weighted images
Accumulation of Air: Pneumothorax
Main Causes of Pneumothorax

• **Traumatic:**
  – Rib fracture
  – Stab wound

• **Iatrogenic:**
  – Thoracentesis (eg. subclav. catheder)
  – Percut. Lung biopsy
  – Pos. press. Ventilation
  – Tracheostomy

• **Spontaneous**
  – Subpleural bulla
  – Pneumatocoele
  – “Cystic” lung disease (eg. Histiocytosis, LAM,…)
  – Cystic fibrosis
  – Pneumonia and abscess

• **Esophageal rupture**
• **Pneumoperitoneum**
• **Pneumomediastinum**
• **Catamenial**
Chest Radiograph
**Typical Signs**

- **Pleural line** parallel to the chest wall
- **Vascular markings** absent lateral to this hairline shadow
- **In upright position**: air accumulates at the **apex**
- **Pneumothorax increase on expiratory view** (occasionally useful in case of doubt)
Skin folds
(Bullous) Emphysema

Orientation of lines
Chest radiograph
Atypical Signs

In supine patients and when the pleural space is partially obliterated

- Ipsilateral transradiancy
- Deep finger-like costophrenic sulcus laterally
- Visible anterior costophrenic recess as an oblique line or interface in the hypochondrium ("double diaphragm sign")
CT?

• In case of **doubt** even when a repeat chest film and an expiratory chest film have not been helpful

• To **distinguish** between bullae and pneumothorax

• To reveal clues to the **underlying cause** of the pneumothorax
Hydropneumothorax
Pleural thickening
Pleural Thickening

• Focal (localised) pleural thickening
• Multifocal pleural thickening
• Diffuse pleural thickening

• Benign
• Malignant
Benign vs Malignant Pleural Thickening

**Benign**
- Smooth Regular
- “small”
- “Plateau” like
- No chest wall invasion

**Malignant**
- Irregular
- “large”
- Nodular
- Chest wall invasion
Benign Pleural Thickening

• Focal (localised):
  – Fibrous thickening (scarring)*
  – Tumor: lipoma, fibroma

• Multifocal:
  – Pleural plaques related to asbestos exposure*

• Diffuse: Fibrothorax*  
  * May contain calcifications
Benign focal pleural thickening:
1. Focal fibrous thickening

- Usually a sequel of pleural inflammation
  - Delayed complication of hemothorax, pleural empyema or recurrent pneumothorax
  - Often basal
- "Apical pleural cap"
  - Unilateral or bilateral
  - Age related fibrous thickening (?)
  - Differential diagnosis with superior sulcus tumor
Benign focal pleural thickening: 2. Lipoma

- Benign pleural tumor
- **Incidental** finding on chest X-ray
- Sharply defined pleural mass
- CT: homogeneous fat density

⚠️ When heterogeneous and soft tissue attenuation: suspected for liposarcoma or infarction
Benign focal pleural thickening:
3. Fibrous mesothelioma

- Middle age
- Half of patients are asymptomatic
- 10 – 30 % develop hypertrophic osteoarthropathy
- Pleural based, well-demarcated rounded (slightly lobulated) mass
- Sometimes pedunculated (variable position)
- 2 – 20 cm
Benign focal pleural thickening:
3. Fibrous mesothelioma

- **CT:**
  - Enhancing soft tissue mass
  - Heterogeneous (necrosis)
  - Rarely calcified
- **MRI:** low signal on both T1 and T2

> 10 cm may indicate malignancy
Benign Diffuse pleural thickening
Fibrothorax

- A smooth uninterrupted pleural thickening extending over at least a fourth of the chest wall (chest x-ray) or extends more than 8cm in craniocaudal direction, 5 cm laterally and with a thickness > 3mm (CT) but less than 1cm
- Sequel of empyema, tbc, haemorrhagic effusion (may be calcified) and rarely induced by asbestos exposure (often bilateral)
- To be differentiated from malignant pleural thickening
Malignant pleural thickening

- Can be focal, multifocal, diffuse
- Malignant mesothelioma or metastasis (usually indistinguishable)
- Irregular nodular thickening
  - With or without pleural effusion
  - May extent into the fissures
  - Often associated with lymphnode metastasis (50% of cases)
- CT very helpful in diagnosis and staging
- MRI, PET and PET-CT: limited role
Diseases of the Pleura

- Chest radiograph is basic imaging modality to study pleural and chest wall disease
- CT can be performed in selected cases especially when there is suspicion for tumor aetiology
- US: evaluate and guide biopsy, aspiration, drain insertion
- MR: selected cases where high contrast detail is needed
- PET and PET/CT: role not defined yet