Learning objectives:

- Define terminology and classification of small airway disease / bronchiolitis
- Review common disease entities manifesting as bronchiolar disease
- Describe clinical and imaging clues helpful in narrowing the differential diagnosis

**Bronchioles**

Membranous and respiratory bronchiole

- No cartilage or submucosal glands
- Smaller than ≤ 1-2 mm

**Functional zones**

- Terminal bronchiole - **Conducting zone**
- Respiratory bronchiole - **Transition zone**
- Alveolar duct - **Respiratory zone**
- Alveolar sacs - **Respiratory zone**

**Small airway disease**

Inflammation or fibrosis of bronchiole usually centered in and around membranous and respiratory bronchiole

**Direct signs**

- Bronchiolar wall thickening
- Bronchiolectasis
- Luminal bronchiolar impaction
  - “Tree-in-bud” pattern
  - Centrilobular nodules

**Indirect signs**

- Mosaic - attenuation pattern
- Air trapping on Expiratory CT
**Bronchiolitis Direct Signs**

- Bronchiolar wall thickening

**Centrilobular Defined**

Pathology:
Beyond terminal bronchiole
Center on respiratory bronchiole or alveolar ducts

HRCT: In center of SPL
5-10 mm from pleural surface
Not related to interlobular septa

**Bronchiolitis Direct Signs**

- Bronchiolectasis
**Bronchiolitis**

**Direct Signs**

- Centrilobular nodules

**Tree-in-bud**

Tuft: Bronchioles, alveolar ducts
Stalk: Last order bronchus

**Small Airways Disease**

Classification

- Cellular bronchiolitis
- Obliterative bronchiolitis

**Cellular bronchiolitis**

Infectious bronchiolitis
Aspiration bronchiolitis
Respiratory bronchiolitis (RB; RB-ILD)
Hypersensitivity pneumonitis
Diffuse panbronchiolitis
Bronchiectasis (cystic fibrosis, ciliary dyskinesia)

**HRCT**

Direct signs:
- Bronchiolar wall thickening
- Bronchiolectasis
- Centrilobular nodules
- Centrilobular nodules and branching lines ("tree-in-bud")
<table>
<thead>
<tr>
<th>Condition</th>
<th>Causes</th>
<th>Imaging Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infectious bronchiolitis</td>
<td>Endobronchial spread, Tuberculosis, Nontuberculous mycobacteria, Viruses, fungi, mycoplasma</td>
<td>HRCT: Centrilobular nodules, Tree-in-bud opacities, Middle lobe and lingula bronchiectasis</td>
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<td>Infectious bronchiolitis</td>
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<tr>
<td>Aspirative bronchiolitis</td>
<td>Chronic inflammatory reaction, Esophageal disorders, Neurologic defects, Chronic illness</td>
<td>HRCT: Centrilobular nodules, Uni or bilateral tree-in-bud opacities, Dependent portions of the lung</td>
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<tr>
<td>Diffuse panbronchiolitis</td>
<td>Asian - Idiopathic, Sinu-bronchial syndrome, Chronic inflammation and accumulation of foamy macrophages at the RB</td>
<td>HRCT: Centrilobular nodules, Tree-in-bud opacities, Progressive bronchiectasis-bronchiolectasis, Decreased lung attenuation</td>
</tr>
</tbody>
</table>
**Bronchiectasis (cystic fibrosis)**

Most common cause of pulmonary insufficiency in the first 3 decades of life
Chronic and recurrent respiratory infections

**HRCT:**
- Cylindrical bronchiectasis
- Bronchial wall thickening
- Mucous plugging
- Tree-in-bud opacities

**Bronchiectasis (ciliary dyskinesia)**

Situs inversus (50%)
Sinusitis
Bronchiectasis

**HRCT:**
- Bronchial wall thickening
- Bronchiecetis
- Bronchiolectasis
- Tree-in-bud opacities

**Cellular bronchiolitis**

**HRCT**

**Direct signs:**
- Bronchiolar wall thickening
- Bronchiolectasis
- Centrilobular nodules
- Centrilobular nodules and branching lines ("tree-in-bud")

**Hypersensitivity pneumonitis**

**Immunologic disorder**
Inhaled organic - inorganic antigens
Dyspnea, cough, malaise

**HRCT:**
- Centrilobular GG nodules
- Patchy or diffuse GGO
- Expiratory air-trapping

**Hypersensitivity pneumonitis**

**Immunologic disorder**
Inhaled organic - inorganic antigens
Dyspnea, cough, malaise

**HRCT:**
- Centrilobular GG nodules
- Patchy or diffuse GGO
- Expiratory air-trapping

**Respiratory bronchiolitis**

Cigarette smokers
> 30 pack-years
Restrictive function

**HRCT:**
- Centrilobular GG nodules
- Patchy GGO
- Upper lobes predominance
Respiratory bronchiolitis

Folicular bronchiolitis
Hyperplastic lymphoid follicles with reactive germinal centers
Associated with Sjögren’s, RA, immunodeficiency
HRCT:
Centrilobular and peribronchiolar nodules
Mild bronchial dilatation /bronchial wall thickening

Pure inhalation talcosis
Accidental inhalation by children
Chronic inhalation of talc used for cosmetic purposes (adults)
No increase risk of neoplasm

Bronchiolitis
Indirect signs:
HRCT
Mosaic attenuation
Air-trapping

Obliterative bronchiolitis
Infection (viral, bacterial, mycoplasma)
Toxic fume inhalation
Collagen vascular disorders
Chronic lung transplant rejection
Chronic graft versus host disease
Idiopathic
Air-trapping on Expiratory CT
Obliterative bronchiolitis
Post-smoke inhalation

Supine  Supine

Air-trapping on Expiratory CT
Obliterative bronchiolitis
Post-smoke inhalation

Post-infectious

Air-trapping on Expiratory CT
Obliterative bronchiolitis
Post-smoke inhalation

Swyer James-McLeod syndrome

Expiration

Inspiration
Air-trapping on Expiratory CT
Obliterative bronchiolitis
Post-transplant

Air-trapping on Expiratory CT
Mimics Obliterative bronchiolitis

Bronchiolitis
HRCT
Tree-in-bud pattern
Infection
Aspiration
Centrilobular nodules – poorly defined (GGO)
Hypersensitivity pneumonitis
Respiratory bronchiolitis (RB; RBILD)
Mosaic attenuation / Air trapping
Obliterative bronchiolitis
Hypersensitivity pneumonitis

Bronchiolitis
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