Increased Lung Attenuation

Jeffrey P. Kanne, M.D.
Increased Attenuation

• Ground-glass opacity
• Consolidation
• Crazy paving pattern
Ground-Glass Opacity

- *Radiographs and CT scans.*—On chest radiographs, ground-glass opacity appears as an area of hazy increased lung opacity, usually extensive, within which margins of pulmonary vessels may be indistinct. On CT scans, it appears as hazy increased opacity of lung, with preservation of bronchial and vascular margins. It is caused by partial filling of airspaces, interstitial thickening (due to fluid, cells, and/or fibrosis), partial collapse of alveoli, increased capillary blood volume, or a combination of these, the common factor being the partial displacement of air. Ground-glass opacity is less opaque than consolidation, in which bronchovascular margins are obscured. (See also *consolidation.*)

Ground-Glass Opacity: Fibrotic vs. Non-fibrotic

• Fibrotic
  – Traction bronchiectasis
  – Reticular abnormality
  – Architectural distortion
  – Usually not considered as ground-glass pattern when associated with above

• Non-fibrotic
  – No underlying architectural or textural abnormality
Ground-Glass: Sick Patient

- Edema
  - Cardiac
  - Noncardiac
- Infection
- Hemorrhage
- Aspiration
Ground-Glass Opacity: Ambulatory Patient

- Hypersensitivity pneumonitis
- Smoking related lung disease (RB, RB-ILD, DIP)
- Cellular NSIP
- Drug toxicity
- Sarcoidosis
- Lymphoid interstitial pneumonia
Ground-Glass Opacity: Ambulatory Patient

- Eosinophilic pneumonia
- Pulmonary hemorrhage or vasculitis
- Aspiration
- Organizing pneumonia
- Adenocarcinoma
Respiratory Bronchiolitis
Hypersensitivity Pneumonitis
Diffuse Alveolar Hemorrhage
Diffuse Alveolar Hemorrhage
Ground-Glass Opacity: Clues to Diagnosis

- Mosaic attenuation
  - Hypersensitivity pneumonitis
- Peribronchovascular distribution
  - Sarcoidosis
  - NSIP
- Centrilobular nodularity
  - Hypersensitivity pneumonitis
  - RB/RB-ILD

- Cysts
  - LIP
  - DIP
  - Adenocarcinoma
    - Focal cysts and GGO
- Septal thickening
  - Edema
  - Sarcoidosis
  - Drug toxicity
Consolidation

• *Radiographs and CT scans.*—Consolidation appears as a homogeneous increase in pulmonary parenchymal attenuation that obscures the margins of vessels and airway walls. An air bronchogram may be present. The attenuation characteristics of consolidated lung are only rarely helpful in differential diagnosis (e.g. decreased attenuation in lipoid pneumonia and increased in amiodarone toxicity).

Consolidation: Sick Patient

- Infection
- Edema
  - Cardiac
  - Noncardiac
- Aspiration
- Hemorrhage
Consolidation: Ambulatory Patient

- Organizing pneumonia
- Eosinophilic pneumonia
- Adenocarcinoma (mucinous)
- Lymphoproliferative disease
- Chronic aspiration (lipid)
- Chronic infection
- Hemorrhage and vasculitis
- Sarcoidosis
Organizing Pneumonia

• Causes
  – Cryptogenic
  – Collagen vascular disease (polymyositis, dermatomyositis)
  – Drug toxicity
  – Aspiration

• Typical presentation
  – Non-resolving pneumonia
  – Systemic and pulmonary symptoms
Organizing Pneumonia

• Diagnosis
  – Transbronchial biopsy
  – Exclude other causes of consolidation

• Management
  – Usually responds to steroids
Eosinophilic Pneumonia

• Causes
  – Idiopathic
  – Drugs
  – ABPA
  – Parasites
  – Hypereosinophilic syndromes
  – Churg-Strauss vasculitis

• Typical presentation
  – Nonspecific
Eosinophilic Pneumonia

• Diagnosis
  – Blood or BAL eosinophilia
  – Exclude underlying cause

• Management
  – Usually steroid responsive
Adenocarcinoma Presenting as Consolidation

• Causes
  – Invasive mucinous adenocarcinoma

• Typical presentation
  – Short of breath
  – Cough, salty sputum
Adenocarcinoma Presenting as Consolidation

• Diagnosis
  – Transbronchial biopsy/BAL

• Management
  – Depends on genetic markers (EGFR, etc.)
Pulmonary Lymphoma

• Causes
  – Primary
  – Secondary
  – HIV related
    • Air bronchograms frequent

• Typical presentation
  – Asymptomatic (low-grade)
  – Dyspnea, fever, weight loss (high-grade)
Pulmonary Lymphoma

• Diagnosis
  – Transbronchial biopsy/BAL
  – Transthoracic needle biopsy
  – Resection

• Management
  – Resection (localized disease)
  – Chemotherapy
Pulmonary Lymphoma
Chronic Infection

• Causes
  – Nontuberculous mycobacteria: *Mycobacterium avium* complex (MAC), rapid growers (*chelonae, abscessus*)
  – Fungus: Coccidioidomycosis, NA blastomycosis, histoplasmosis
  – Bacteria: Actinomycosis, nocardiosis

• Typical presentation
  – Systemic and pulmonary symptoms
Chronic Infection

• Diagnosis
  – Sputum
  – BAL

• Management
  – Tailored antimicrobial therapy
  – Occasional resection
Granulomatosis with Polyangiitis (GPA)

• Typical presentation
  – Systemic symptoms, hemoptysis

• Management
  – Aggressive immunosuppression
  – Endoscopic or surgical therapy for large airways disease
Granulomatosis with Polyangiitis (GPA)

• **Diagnosis**
  – Multisystem involvement
    • Upper airway, eye, ear
    • Kidney
    • Trachea
    • Lungs (sometimes only site)
  – Serology:
    • c-ANCA, anti PR-3
  – Transbronchial or surgical biopsy
Eosinophilic GPA

• Formerly Churg-Strauss syndrome
• Typical presentation
  – Asthma, systemic symptoms, eosinophilia
• Causes
  – Associated with asthma
  – Idiopathic
Eosinophilic GPA

• Diagnosis
  – Multisystem involvement
    • Lung
    • Peripheral nerve
    • Skin
    • Kidney
  – Serology:
    • Peripheral ANCA (p-ANCA)
  – Transbronchial or surgical biopsy, skin biopsy, etc.
Sarcoidosis

• Typical presentation
  – Often asymptomatic with chest radiographic abnormality

• Diagnosis
  – Transbronchial biopsy

• Management
  – Corticosteroids
Lipoid Pneumonia

• Typical presentation
  – Often asymptomatic with chest radiographic abnormality
  – Cough and dyspnea

• Diagnosis
  – HRCT
  – Transbronchial biopsy

• Management
  – Cessation of offending agent
## Consolidation: Ambulatory Patient

<table>
<thead>
<tr>
<th>Entity</th>
<th>Clues to Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizing pneumonia</td>
<td>Reverse halo, Perilobular thickening</td>
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<tr>
<td>Eosinophilic pneumonia</td>
<td>Upper lung predominance</td>
</tr>
<tr>
<td>Adenocarcinoma (mucinous)</td>
<td>Patchy distribution, cysts, CT angiogram sign</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>Perilymphatic masses</td>
</tr>
<tr>
<td>Chronic infection</td>
<td>Tree-in-bud, cavities</td>
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<tr>
<td>Hemorrhage or vasculitis</td>
<td>Cavities (granulomatosis)</td>
</tr>
<tr>
<td>Sarcoidosis</td>
<td>Galaxy sign</td>
</tr>
<tr>
<td>Chronic aspiration (lipid)</td>
<td>Fat attenuation</td>
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</tbody>
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Crazy Paving Pattern

- This pattern appears as thickened interlobular septa and intralobular lines superimposed on a background of ground-glass opacity, resembling irregularly shaped paving stones. The crazy-paving pattern is often sharply demarcated from more normal lung and may have a geographic outline. It was originally reported in patients with alveolar proteinosis and is also encountered in other diffuse lung diseases that affect both the interstitial and airspace compartments, such as lipoid pneumonia.

Crazy-Paving Pattern: Differential Diagnosis

- **Common**
  - Pulmonary alveolar proteinosis
  - Lipoid pneumonia

- **Rare**
  - Adenocarcinoma
  - NSIP
  - Sarcoidosis
  - Organizing pneumonia

- **Acute lung diseases**
  - Diffuse alveolar damage
  - Pulmonary hemorrhage
  - *Pneumocystis* infection
  - Resolving pneumonia

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