Mosaic Attenuation Differential Diagnosis and Methods of Differentiation
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Mosaic Attenuation Etiologies, Pitfalls, and Methods of Differentiation
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Mosaic Attenuation

Small Airways Disease
- Constrictive bronchiolitis
- Asthma
- Cellular bronchiolitis
  - Hypersensitivity pneumonitis
  - Infection
- Smoking related lung diseases
  - RB
  - DIP

Vascular Disease
- Pulmonary Hypertension
  - Idiopathic
  - Secondary

Parenchymal Disease
- Any cause of ground glass opacity
  - Organizing Pneumonia
  - Pneumocystic Pneumonia
  - Edema
  - Hemorrhage

Mosaic Attenuation Methods of Differentiation
- NOT ALWAYS EASY!
- Look at trachea
- Look at bronchi
- Look at pulmonary artery
- Look at heart
- Look at vessel size and characteristics
- Look at prior studies

Assess Vasculature in Lucent Lung

Uniform vascularity
- Assess parenchyma
- Assess airways
- Assess heart and PA

Decreased vascularity

Assess pulmonary vasculature in lucent lung

Assess parenchyma

Assess airways

Assess heart and PA
**MOSAIC ATTENUATION**

- Assess pulmonary vasculature in lucent lung
- Uniform vascularity
- Decreased vascularity
- Increased vascularity
- Assess airways
- Assess Heart and PA

**Classification of Small Airways Disease**

<table>
<thead>
<tr>
<th>Primary Bronchiolar Disorders</th>
<th>Interstitial Lung Disease with Prominent Bronchiolar Involvement</th>
<th>Bronchiolar Involvement in Large Airways Disease</th>
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</thead>
<tbody>
<tr>
<td>Constrictive bronchiolitis</td>
<td>Hypersensitivity pneumonitis</td>
<td>Chronic bronchiolitis</td>
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<tr>
<td>Acute bronchiolitis</td>
<td>Respiratory bronchiolitis</td>
<td>Asthma</td>
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<tr>
<td>Diffuse Panbronchiolitis</td>
<td>Desquamative interstitial pneumonitis</td>
<td>Bronchiectasis</td>
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<td>Bronchiolar involvement</td>
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<td>Respiratory bronchiolitis</td>
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<tr>
<td>Mineral dust airways disease</td>
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<tr>
<td>Follicular bronchiolitis</td>
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</tbody>
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**Assess Small Airways for Evidence of Injury (Centrilobular Nodules)**

- Upper lobe predominant centrilobular nodules in hypersensitivity pneumonitis
- Upper lobe predominant centrilobular nodules in respiratory bronchiolitis

**Assess Distribution of Large Airway Abnormality**

- Large Airways Abnormal in Lucent Lung (Cystic Fibrosis)
- Upper lobe predominant centrilobular nodules in hypersensitivity pneumonitis

**Assess the Large Airways**

- Ammonia Inhalation

**Constrictive Bronchiolitis in GVHD**

- Constrictive bronchiolitis in GVHD
- Assess pulmonary vasculature in lucent lung
- Uniform vascularity
- Decreased vascularity
- Increased vascularity
- Assess airways
- Assess Heart and PA
**Assess Small Airways for Evidence of Injury (Centrilobular Nodules)**

- Upper lobe predominant fibrosis with a few centrilobular nodules in hypersensitivity pneumonitis
- Upper lobe predominant fibrosis, GGO with a few centrilobular nodules in smoking related fibrosis with desquamative interstitial pneumonia

**Indirect Assessment of Small Airway Injury (Air Trapping on Expiration)**

**Constrictive Bronchiolitis in RA**

**Etiologies of Constrictive Bronchiolitis**

- Post-infectious
  - Viral
  - Mycoplasma
- Collage vascular disease
  - RA
  - SLE
  - Systemic Sclerosis
- Transplant
  - Graft versus host
  - Allograft recipients
- Cryptogenic
- Drugs
  - D-penicillamine
  - Gold
  - Cocaine
  - Carmustine
- Toxic fume exposure
  - Nitrogen dioxide
  - Sulfur dioxide
  - Ammonia
  - Chlorine
  - Phosgene
- Occupational (popcorn workers)
- Miscellaneous
  - Ulcerative colitis
  - Diffuse Idiopathic Pulmonary Neuroendocrine Cell Hyperplasia (DIPNECH)
  - Stevens-Johnson syndrome
  - Paraneoplastic pemphigus

**CT imaging in Air Trapping**

- Mosaic Attenuation
- Hyperlucent lung abnormal
  - Air trapping
  - Decreased perfusion
- Expiration is key
  - Normal lung increases in density
  - Abnormal lung does not change in density
  - Difference more pronounced
- LOOK AT TRACHEA
- LOOK AT BRONCHI

**Expiration?**
Question PNA in morbidly obese patient

Look for Additional Clues

Clamshell Sternotomy
Joint Erosions
Scattered Nodules

Assess pulmonary vasculature in lucent lung
Assess parenchyma
Assess Heart and PA
Assess airways

Decreased vascularity
Uniform vascularity

40 year-old woman with progressive SOB

Mosaic Attenuation

Assess pulmonary vasculature in lucent lung

Uniform vascularity
Decreased vascularity

Assess parenchyma
Assess airways
Assess Heart and PA

Idiopathic Pulmonary Arterial Hypertension

Mosaic Attenuation in Pulmonary Hypertension

- Hypoattenuated regions
  - Hypoperfusion
  - Reduced vessel size
- Normal or high attenuation areas
  - Compensatory blood flow
- More common
  - CTEPH
  - Pulmonary Artery Hypertension (PAH)
- Less common
  - Cardiac etiologies
  - Lung etiologies
- Mosaicism typically more well-defined (segmental and subsegmental) in CTEPH compared to idiopathic PAH
Look at Heart and Central PAs

PA : Aorta Diameter > 1
Right Ventricular Hypertrophy

Look at Heart and Peripheral Pulmonary Arteries

PA : Bronchial Diameter >> 1
(most pronounced in dense lung)

70 year-old with chronic SOB

Mosaic Atteunation in Chronic Thromboembolic Disease (CTEPH)

CTEPH vs PAH (primary)
Look at the Heart

Sinus Venosus ADS with PAPVR

**INSPIRATION**

PAH

B.O.

**EXPIRATION**

PAH

BO

Air-Trapping in CTEPH

Parenchymal Abnormality Creating Mosaicism

- Infection
  - Pneumocystis Pneumonia
- Pulmonary Hemorrhage
- Organizing Pneumonia
- Diffuse Alveolar Damage
- Combination
  - HP
  - DIP
  - OP

Mosaic Attenuation

- Assess pulmonary vasculature in lucent lung
- Assess parenchyma
- Assess Heart and PA
- Assess airways
- Assess Heart and PA
Uniform Vascularity

Pneumocystis Jeroveci Pneumonia  Pulmonary Edema

Ground Glass Opacity and Septal Thickening

Cryptogenic Organizing Pneumonia

Where are abnormal bronchi?

Look for Centrilobular Nodules

Consider Mixed Disease States

Pulmonary Capillary Hemangiomatosis
66 year-old woman with RA
Constrictive bronchiolitis with Organizing Pneumonia

Conclusion

• Numerous causes of mosaic attenuation
  – Small airways disease
  – Vascular disease
  – Parenchymal disease
• Can be very difficult to determine normal from abnormal lung
• Expiration images are useful
  – However, not always acquired

• Look for secondary clues
  – Look at bronchi
  – Look at PA
  – Look at right heart
  – Compare size of airway to vessel
  – Look up medical record

• May have to bring patient back for expiratory imaging