## Congestive Heart Failure

### Causes of

- Coronary artery disease
- Hypertension
- Cardiomyopathy
- Valvular lesions
  - AS, MS
- L to R shunts
Congestive Heart Failure
Clinical

- Usually from left heart failure
  - Shortness of breath
  - Paroxysmal nocturnal dyspnea
  - Orthopnea
  - Cough
- Right heart failure
  - Edema
# Left Atrial Pressures Correlated With Pathologic Findings

<table>
<thead>
<tr>
<th>Normal</th>
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<tr>
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- Very low pressure circuit
- Pulmonary capillary bed only has 70cc blood
- Yet, it could occupy the space of a tennis court if unfolded
- Therefore, millions of capillaries are “resting,” waiting to be recruited
Keeping the Lungs Dry

Pulmonary capillary hydrostatic pressure is low — about 7 mm Hg

Plasma colloid oncotic pressure is high — about 28 mm Hg

Normal osmotic tendency to dehydrate the interstitium and alveoli
Pressure and Flow

Pressure = Flow x Resistance

Normally, resistance is so low that flow can be increased up to 3x normal without increase in pressure
Pulmonary Interstitial Edema
X-ray Findings

- Thickening of the interlobular septa
  - Kerley B lines
- Peribronchial cuffing
  - Wall is normally hairline thin
- Thickening of the fissures
  - Fluid in the subpleural space in continuity with interlobular septa
- Pleural effusions
Pulmonary Interstitial Edema
Kerley B Lines

- B = distended interlobular septa
- Location and appearance
  - Bases
  - 1-2 cm long
  - Horizontal in direction
  - Perpendicular to pleural surface
Kerley B Lines are short, white lines perpendicular to the pleural surface at the lung base.
**Kerley A and C Lines**

- **A**=connective tissue near bronchoarterial bundle distends
  - Location and appearance
    - Near hilum
    - Run obliquely
    - Longer than B lines

- **C**=reticular network of lines
  - C Lines probably don’t exist
Kerley A and C Lines form a pattern of interlacing lines in the lung
## Peribronchial Cuffing

- Interstitial fluid accumulates around bronchi
- Causes thickening of bronchial wall
- When seen on end, looks like little “doughnuts”
Peribronchial cuffing results when fluid-thickened bronchial walls become visible producing "doughnut-like" densities in the lung parenchyma.
Fluid in The Fissures

- Fluid collects in the subpleural space
  - Between visceral pleura and lung parenchyma
- Normal fissure is thickness of a sharpened pencil line
- Fluid may collect in any fissure
  - Major, minor, accessory fissures, azygous fissure
Fluid in the major or minor fissure (shown here) produces thickening of the fissure beyond the pencil-point thickness it can normally attain.
Pleural Effusion

- Laminar effusions collect beneath visceral pleura
  - In loose connective tissue between lung and pleura
  - Same location for “pseudotumors”
Laminar pleural effusions can be difficult to see. Aerated lung should normally extend to the inner margin of the ribs. The white band of fluid seen here (white arrow) is a laminar effusion, separating aerated lung from the inner rib margin.
Cephalization
A Proposed Mechanism

- If hydrostatic pressure >10 mm Hg, fluid leaks in to interstitium of lung
- Compresses lower lobe vessels first
  - Perhaps because of gravity
- Resting upper lobe vessels “recruited” to carry more blood
- Upper lobes vessels increase in size relative to lower lobe
Cephalization means pulmonary venous hypertension, so long as the person is erect when the chest x-ray is obtained.
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Correlated With Pathologic Findings

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Pulmonary Edema
Types

- Cardiogenic
- Neurogenic
- Increased capillary permeability
Congestive Heart Failure
X-ray patterns

- Interstitial
- Alveolar
## Congestive Heart Failure
### Pulmonary interstitial edema

- Thickening of the interlobular septa
  - Kerley B lines
- Peribronchial cuffing
  - Wall is normally hairline thin
- Thickening of the fissures
  - Fluid in the subpleural space in continuity with interlobular septa
- Pleural effusions
Congestive Heart Failure
Pulmonary alveolar edema

- Acinar shadow
- Outer third of lung frequently spared
  - Bat-wing or butterfly configuration
- Lower lung zones more affected than upper
In pulmonary alveolar edema, fluid presumably spills over from the interstitium to the air spaces of the lung producing a fluffy, confluent “bat-wing” like pattern of disease.
Pulmonary Alveolar Edema
Clearing

- Generally clears in 3 days or less
- Resolution usually begins peripherally and moves centrally
### Differential Diagnosis
Kerley B lines and Peribronchial cuffing

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**Differential Diagnosis**  
**Distribution of Pulmonary Edema**

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<tr>
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<tr>
<td>Renal</td>
<td>Central 70%</td>
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| ARDS        | Peripheral in 45%  
             | Even in 35%  |
Differential Diagnosis
Air Bronchograms

- Cardiac 20%
- Renal 20%
- ARDS 70%
### Differential Diagnosis

**Pleural Effusions**

- Cardiac: 40%
- Renal: 30%
- ARDS: 10%
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