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Congestive Heart Failure

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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

Normal	5-10 mm Hg
Cephalization	10-15 mm
Kerley B Lines	15-20
Pulmonary Interstitial Edema	20-25
Pulmonary Alveolar Edema	> 25

Pulmonary Circulation

Physiology

- **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

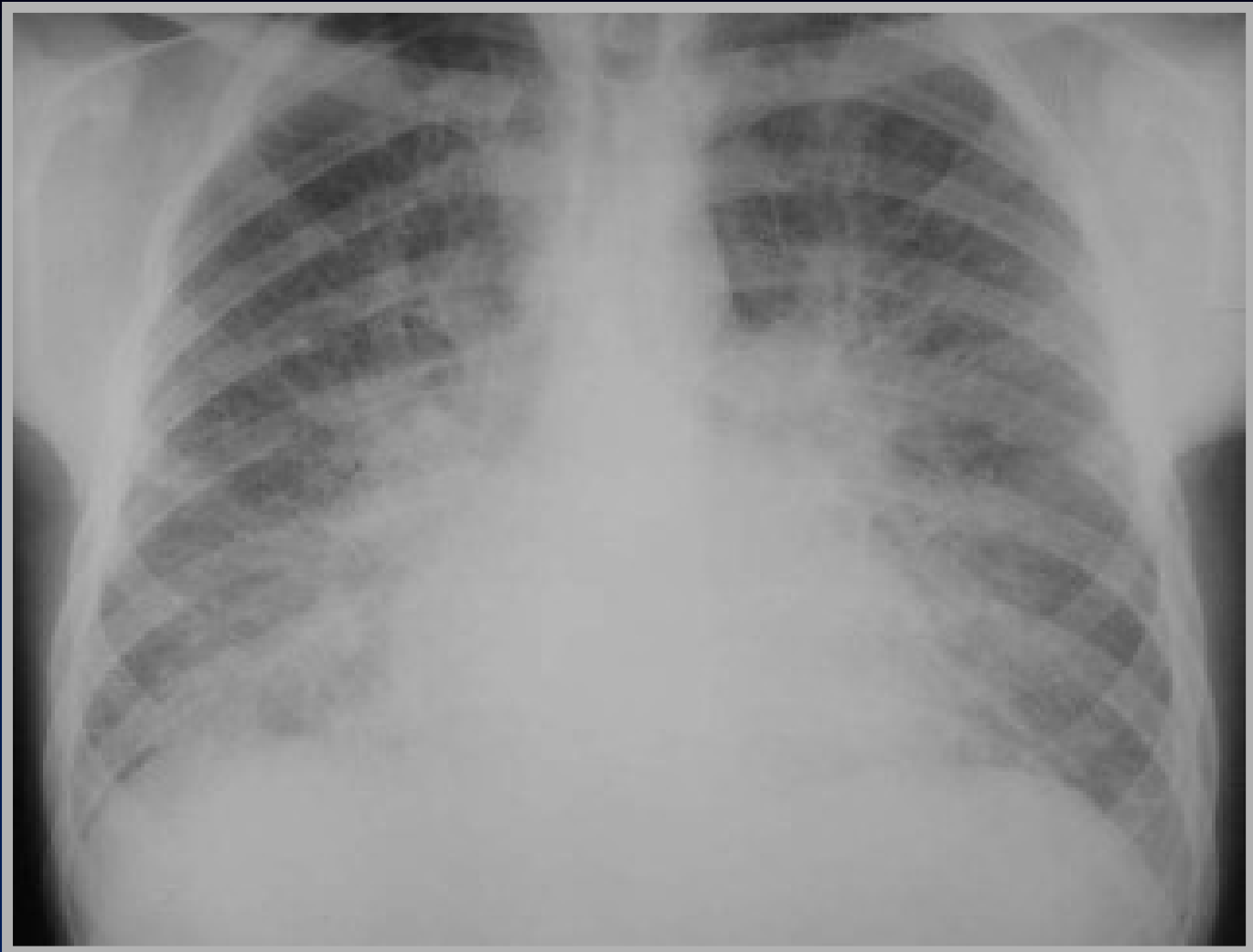
$$\text{Pressure} = \text{Flow} \times \text{Resistance}$$

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

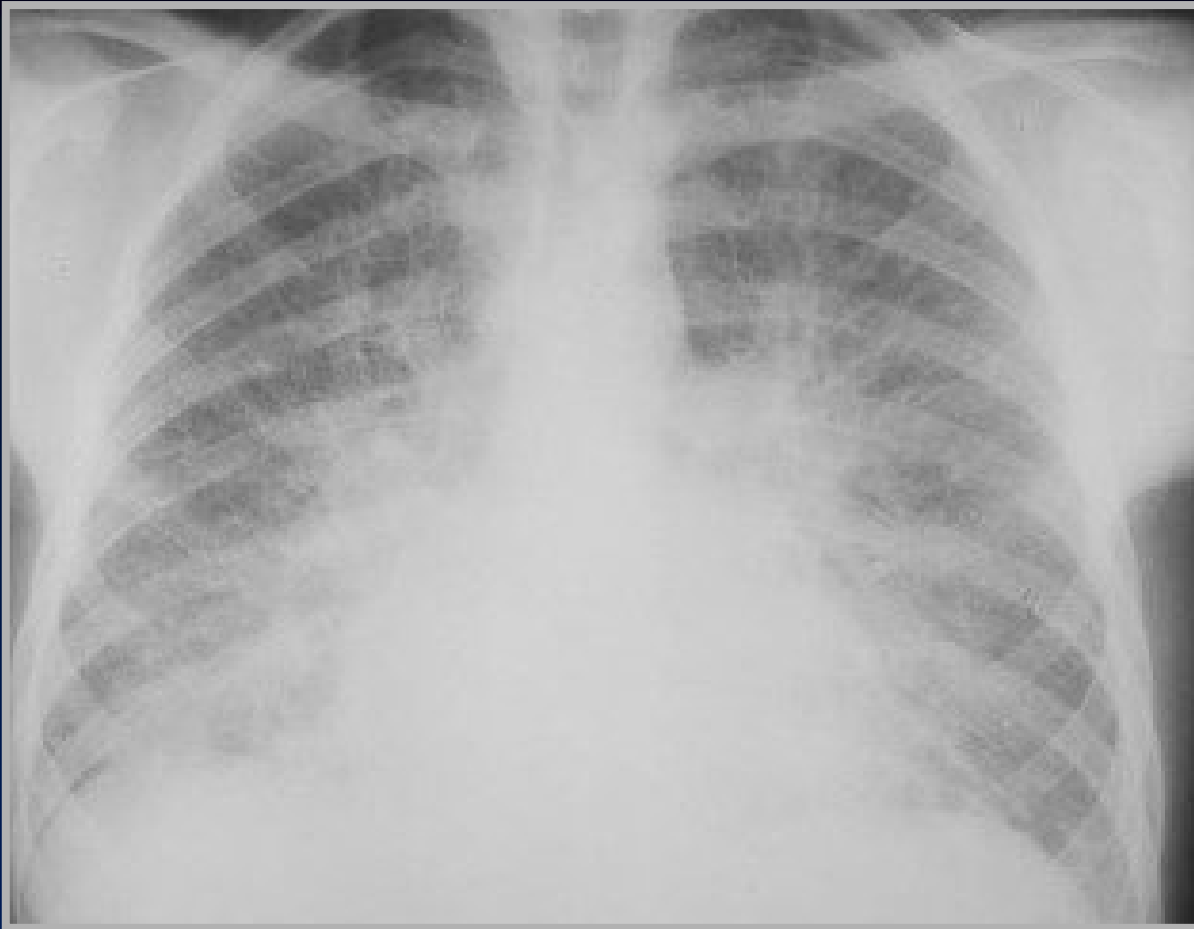
- **B=distended interlobular septa**
- **Location and appearance**
 - **Bases**
 - **1-2 cm long**
 - **Horizontal in direction**
 - **Perpendicular to pleural surface**



Kerley B Lines are short, white lines perpendicular to the pleural surface at the lung base.

Kerley A and C Lines

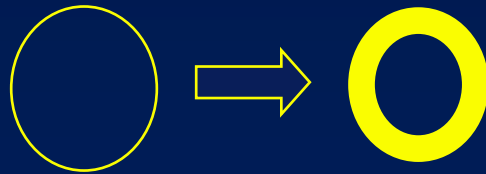
- **A=connective tissue near bronchoarterial bundle distends**
 - **Location and appearance**
 - Near hilum
 - Run obliquely
 - Longer than B lines
- **C=reticular network of lines**
 - **C Lines probably don't exist**

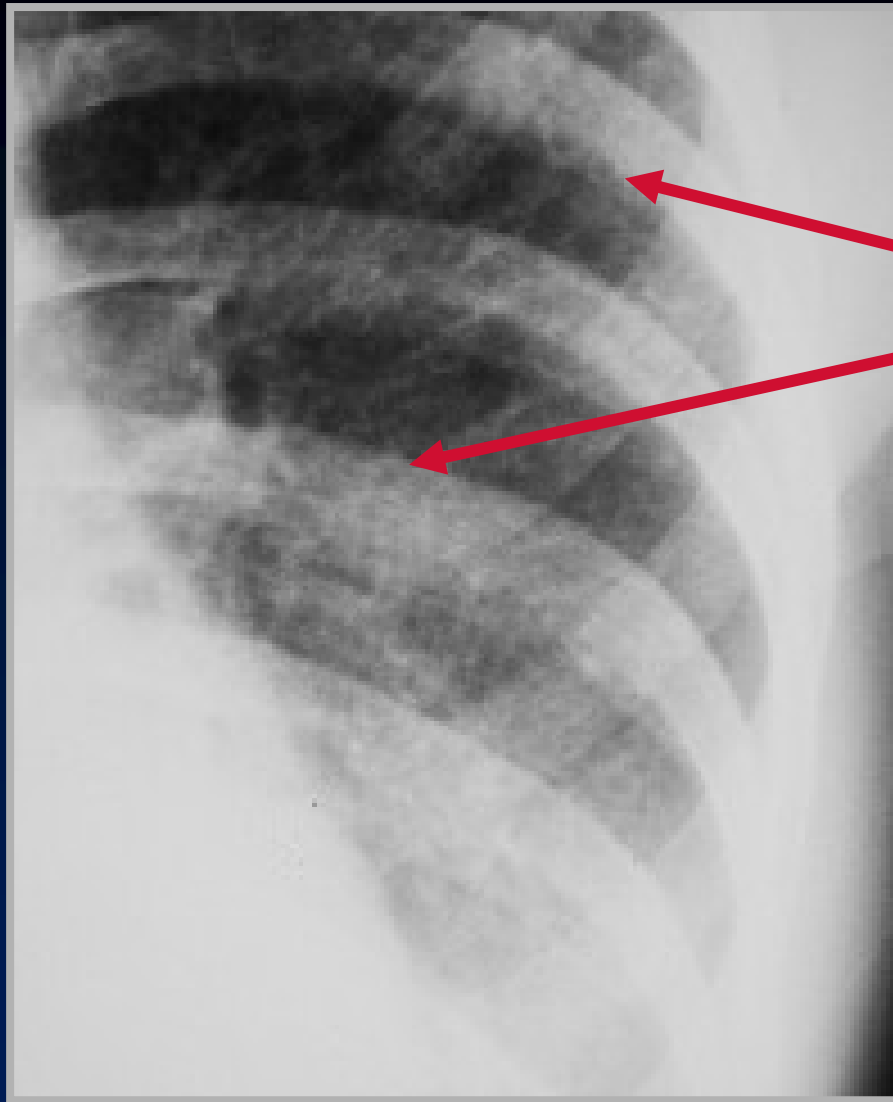


**Kerley A and C Lines form a pattern
of interlacing lines in the lung**

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

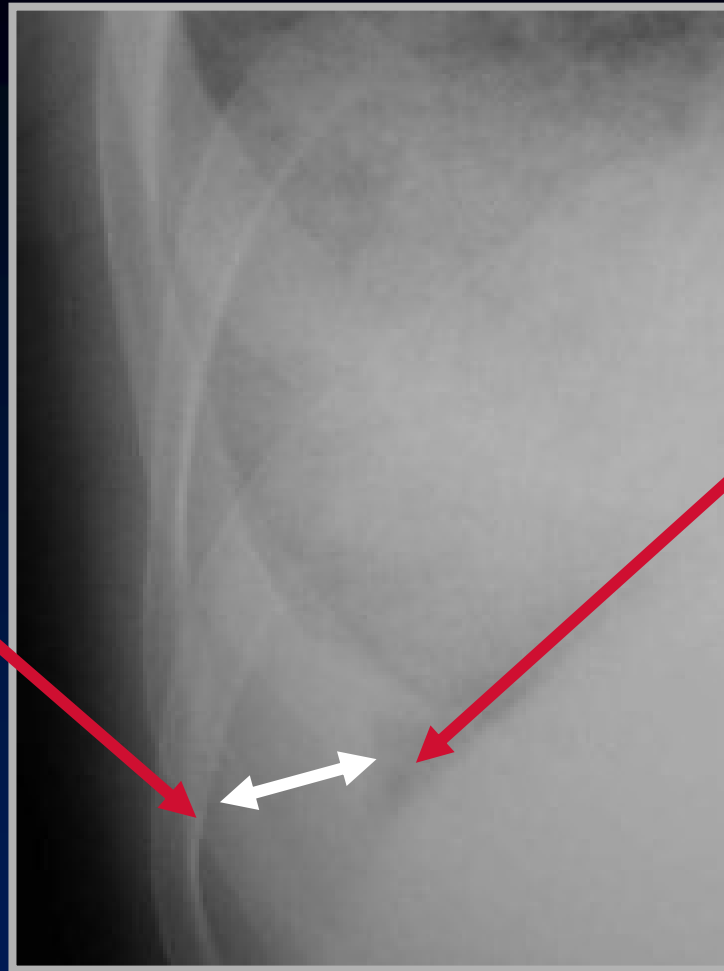


Fluid in the major or minor fissure (shown here) produces thickening of the fissure beyond the pencil-point thickness it can normally attain

Pleural Effusion

- **Laminar effusions collect beneath visceral pleura**
 - **In loose connective tissue between lung and pleura**
 - **Same location for “pseudotumors”**

Inner margin of the
rib starts here



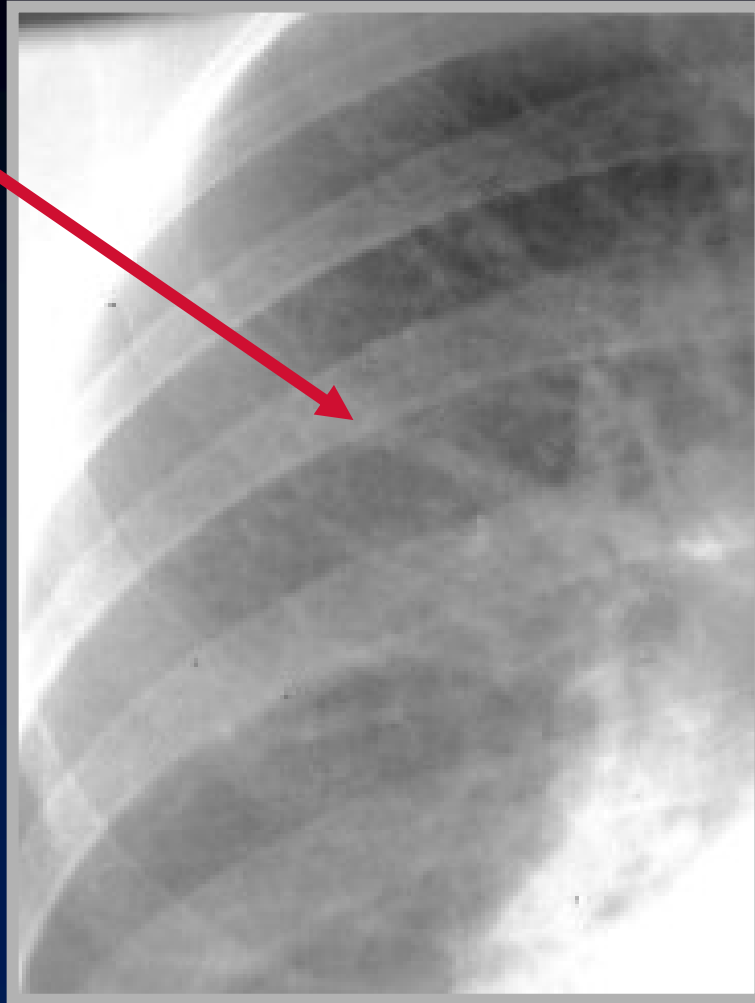
Aerated lung stops
here

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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Pulmonary Edema

Types

- **Cardiogenic**
- **Neurogenic**
- **Increased capillary permeability**

Congestive Heart Failure

X-ray patterns

- Interstitial
- Alveolar

Congestive Heart Failure

Pulmonary interstitial edema

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- **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

Pulmonary Interstitial Edema



Pulmonary Alveolar Edema



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

- Cardiac 30%
- Renal 30%
- ARDS None

Differential Diagnosis

Air Bronchograms

- Cardiac 20%
- Renal 20%
- ARDS 70%

Differential Diagnosis

Pleural Effusions

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

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