Restrictive lung diseases

- Characterized by reduced compliance of the lung.
- Prominent changes in the interstitium (interstitial lung disease).
- Important signs and symptoms:
  - Dyspnea.
  - Hypoxia.
  - With progressive severe hypoxia, respiratory failure and cor pulmonale.
- It can be:
  - Acute.
  - Chronic.
Chronic restrictive lung disease

- Are a heterogeneous group with little uniformity regarding terminology and classification.
- Many entities are of unknown cause and pathogenesis.
- Similar clinical signs, symptoms, radiographic alterations and pathophysiological changes.
- Account for about 15% of non-infectious diseases.
Chronic restrictive lung disease

Major Categories of Chronic Interstitial Lung Disease

-Fibrosing: Pneumoconiosis

- Usual interstitial pneumonia (idiopathic pulmonary fibrosis)
- Nonspecific interstitial pneumonia
- Cryptogenic organizing pneumonia
- Associated with collagen vascular diseases
- Drug and Radiation Reactions

-Granulomatous: Sarcoidosis
  - Hypersensitibility pneumonitis.

-Eosinophilic

-Smoking related: Desquamative interstitial pneumonia
  - Respiratory bronchiolitis-associated interstitial lung disease
Usual interstitial pneumonia
(idiopathic pulmonary fibrosis)
(cryptogenic fibrosing alveolitis)
UIP

• A clinicopathologic syndrome with characteristic radiologic, pathologic and clinical features.
• Characterized histologically by diffuse interstitial fibrosis and inflammation.
Pathogenesis

- Some form of alveolar wall injury result in interstitial edema and alveolitis.
- Type I pneumocyte is more susceptible to injury.
- Type II pneumocyte hyperplasia (regenerate).
- Fibroblast proliferation with progressive fibrosis of intra-alveolar exudate and interalveolar septa.
- IgG deposits are seen in alveolar wall.

![Diagram of Pathogenesis](image)
Morphology of IPF

Gross
- The lungs are firm.
- Pulmonary edema.

• The morphologic changes vary according to the stage of the disease.
• Early cases:
  - Intraalveolar exudate.
  - Hyaline membranes.
  - Infiltration of the alveolar septa with mononuclear cells.
  - Hyperplasia of type II pneumocytes.
Morphology of IPF

Advancing disease:

- Organization of the intraalveolar exudates by fibrous tissue.
- Thickening of the alveolar septa owing to fibrosis and variable amounts of inflammation.
- Alternating areas of fibrosis and normal tissue.
- Geographic variation
- Temporal variation

• In the end, the lung consists of spaces lined by cuboidal or columnar epithelium separated by inflammatory fibrous tissue (honeycomb lung).
Clinical features of IPF

- Males are affected more often than females.
- Most patients are between 40 & 70 years old.
- Gradual onset of dyspnea with respiratory difficulty.
- Hypoxemia and cyanosis.
- Cor pulmonale and cardiac failure may result.
- The progression in individual cases is unpredictable.
- The median survival is about 3 to 5 years.
Nonspecific Interstitial Pneumonia

- Diffuse interstitial lung disease of unknown etiology
- 2 patterns: cellular and fibrosing
- Pt. Present with dyspnea and cough
- Occur at 50 year of age
- Pt. Have better prognosis than UIP
Cryptogenic Organizing Pneumonia (COP)

• “brochiolitis obliterans organizing pneumonia”

• Pt. Present with cough and dyspensa with patchy areas of airspace consolidation radiographically.

• No interstitial fibrosis.

• Patient recover spontaneously or after oral steroids.
Cryptogenic Organizing Pneumonia
Desquamative interstitial pneumonia

- Smoking related
- Age: fourth decade
- Dyspnea and cough
- Complete recovery after cessation of smoking
Hypersensitivity pneumonitis

- An immunologically mediated inflammatory lung disease that primarily affects the alveoli and is therefore often called allergic alveolitis.
- Hypersensitivity to inhaled antigens in the form of organic such as moldy hay, e.g. farmer’s lung, humidified lung or pigeon breeder’s lung.
- May present either as an acute reaction with fever, cough, dypsnea and constitutional complains 4 to 8 hours after exposure or as a chronic disease with insidious onset of cough, dyspnea, malaise and weight loss.
Hypersensitivity pneumonitis

• Acute syndromes result from the combination of:
  - A direct irritant effect.
  - Activation of the alternate complement pathway.
  - Immune complex.

• The chronic form of the disease is mediated by delayed hypersensitivity reactions.
<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Exposure</th>
<th>Antigens</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Selected cause of hypersensitivity pneumonitis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Microbes contaminating vegetable matter of water.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmer’s lung</td>
<td>Moldy hay</td>
<td>Various</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Actinomycetes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aspergillus spp.</td>
</tr>
<tr>
<td>Bagassosis</td>
<td>Moldy pressed sugar cane</td>
<td>Thermophilic Actinomycetes</td>
</tr>
<tr>
<td></td>
<td>(bagasse)</td>
<td></td>
</tr>
<tr>
<td>Maple bark disease</td>
<td>Maple bark</td>
<td>Cryptostroma Corticale</td>
</tr>
<tr>
<td>Humidifier lung</td>
<td>Cool-mist humidifier</td>
<td>Thermophilic Actinomycetes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aureobasidium</td>
</tr>
<tr>
<td><strong>Animal products</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigeon breeder’s lung</td>
<td>Pigeons</td>
<td>Pigeon serum proteins</td>
</tr>
<tr>
<td><strong>Chemicals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimelitic anhydried pneumonia</td>
<td>Chemical industry</td>
<td>Haptenated protein</td>
</tr>
</tbody>
</table>
Morphology of hypersensitivity pneumonitis

- Mononuclear cell infiltrates in the alveoli and alveolar walls and around terminal bronchioles.
- Interstitial non-caseating granulomas reflecting type IV hypersensitivity reaction are present in more than two thirds of cases.
- Diffuse interstitial fibrosis.
- Clinical course is variable.
Pneumoconiosis

- Non-neoplastic lung reaction to inhalation of mineral dusts.
- Most common dusts are coal dust, silica, asbestos and beryllium.

**Pathogenesis:**
- The development of pneumoconiosis is dependent on:
  - The amount of dust retained in the lung and airways.
    - Concentration of the dust in the ambient air.
    - Duration of the exposure.
    - Effectiveness of the clearance mechanisms.
  - The size (1-5µ) shape.
  - Their solubility and physiochemical activity.
  - The possible additional effects of other irritants, tobacco smoking.
- The particles are impacted at alveolar duct macrophage, accumulate inflammatory response fibrosis.
Coal worker’s pneumoconiosis (CWP)

- Occurs in coal workers after many years of underground mine work.
- Two forms:
  - The simple form:
    - Focal aggregations of coal dust-laden macrophages (coal macules).
    - Patients have slight cough and blackish sputum.
  - The complicated form:
    - With heavier pulmonary burdens of coal dust, fibrous scarring appears (complicated CWP) also called progressive massive fibrosis (PMF).
Coal worker pneumoconiosis

*Morphology*:

- Simple CWP:
  - Focal black pigmentations (macules), 1-2 mm up to 5 mm are scattered through the lung.
  - Mostly in the upper zones of the lower and upper lobes of the lungs.
  - Macules are composed of aggregations of coal dust-filled macrophages in close proximity to alveolar ducts.
Coal worker pneumoconiosis

Morphology:

• Complicated CWP:
  - Black scars exceed 2 cm in diameter some times up to 10 cm
  - It consists of dense collagen and carbon pigments.
  - Cor pulmonale.
  - Miners who have rheumatoid arthritis and PMF are called Caplan’s syndrome.
Silicosis

- Long exposure to silica particles.
- Nodular densely fibrosing pneumoconiosis.
- Encountered in a diversity of industries: mining of gold, tin, copper and coal, sandblasting, metal grinding, ceramic manufacturing.
- Silicosis does not predispose to lung cancer.

Pathogenesis:

- Crystalline silica is highly fibrogenic.
- Scattered lymphocytes and macrophages are drawn rapidly with fibrosis.
- Some particles are transported to lymph nodes.
Morphology of Silicosis

- Tiny collagenous nodules that enlarge forming stony-hard large fibrous scars usually in the upper lobes.
- The lung parenchyma between the scars may be compressed or emphysematous.
- Calcifications may appear (eggshell calcification).
- Similar collagenous nodules within the lymph nodes.
- Fibrous pleural plaques may develop.
Morphology of Silicosis

• Micro:

- Hyalinized collagen fiber surround an amorphous center (fibrous nodules).
- Scarring progress to PMF.
- Scarring extending and encroaching the pulmonary arteries.
- Cor pulmonale.
Asbestosis

• Inhalation of asbestos leads to:
  - Asbestos pneumoconiosis.
  - Pleural effusion.
  - Pleural adhesions.
  - Parietal pleural fibrocalcific plaques.
  - Increased incidence of mesothelioma, bronchogenic carcinoma, other cancer.

• These consequences occurs decades after exposure has ended.
• All types of asbestos (crocidolite and amosite) are fibrogenic but the crocidolite is the most carcinogenic.
• Characterized by scarring containing asbestos bodies.
scarring containing asbestos bodies.
Asbestosis

• In asbestosis, pt. develop progressively worsened dyspnea with cough and sputum progressing to cor pulmonale and death.

• Both bronchogenic carcinoma and mesothelioma develop in workers exposed to asbestos.

• The risk of bronchogenic carcinoma is fivefold and for mesothelioma is 1000 fold greater.
Asbestos body, microscopic
Fibrous pleural plaques, gross
Fibrous pleural plaque, low power microscopic
Lung, silicotic nodule, low power microscopic
Lung, anthracosis, microscopic
Lung, silicosis, polarized light microscopic
Lung, polarizable crystals with intravenous drug use, polarized light microscopic
Lung, fat embolization, microscopic
Lung, amniotic fluid embolus, microscopic
Lung, hypersensitivity pneumonitis, microscopic
Farmer’s lung scene
Lung, interstitial fibrosis, microscopic
Lung, interstitial fibrosis, Trichrome stain, microscopic
Lung, diffuse alveolar damage, gross
Lung, diffuse alveolar damage, microscopic