Part V
Restrictive Pulmonary Diseases

- Idiopathic pulmonary fibrosis/Pneumoconiosis
- Sarcoidosis

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Restrictive Pulmonary Disease

• **Background (divided into 3 groups):**
  - **Intrinsic lung diseases**, which cause inflammation or scarring of the lung tissue (interstitial lung disease) or fill the airspaces with exudate or debris (acute pneumonitis)
    - Idiopathic pulmonary fibrosis
    - Pneumoconioses
    - Sarcoidosis
  - **Extrinsic disorders**
  - **Neuromuscular disorders**

• **Clinical Features**
  - Symptoms of progressive breathlessness with exertion (dyspnea) or a persistent nonproductive cough.
  - Pulmonary symptoms associated with another disease, such as a connective tissue disease
  - History of occupational exposure (e.g., asbestosis, silicosis)
  - An abnormal chest imaging study
  - Lung function abnormalities on simple office spirometry, particularly a restrictive ventilatory pattern (i.e., reduced total lung capacity and forced vital capacity).

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Idiopathic pulmonary fibrosis

• Background
  o Most common diagnosis among patients with interstitial lung disease
  o 3 distinct histopathological patterns with unique histories and treatments

• Clinical Features
  o Dyspnea on exertion
  o Non-productive cough
  o PE may reveal digital clubbing and crackles
  o CXR shows evidence of progressive fibrosis
  o CT scan shows honeycombing
  o PFTs abnormal with restrictive pattern

• Treatment
  o Controversial
  o All patients will receive oxygen, pulmonary rehab, vaccinations

Digital Clubbing

http://en.wikipedia.org/wiki/Clubbing
Idiopathic pulmonary fibrosis

- Clinical Features (Radiology)
  - Patchy “Ground Glass” appearance
  - Reticular (network) pattern
  - Honeycombing (thick-walled cystic spaces) in the lung periphery
Pneumoconioses

• **Background**
  o Chronic fibrotic lung diseases most often caused by occupational exposures
  o Most commonly recognized are coal workers’ pneumoconiosis, silicosis, and asbestosis

• **Clinical Features**
  o Usually asymptomatic
  o Can result in dyspnea, crackles, clubbing and cyanosis
  o PFTs show restriction and reduced diffusing capacity
  o CXR
    • Each condition has specific CXR features (see next slide)

• **Treatment**
  o Primarily supportive
    • Vaccinations, oxygen, pulmonary rehab
  o Corticosteroids may relieve alveolitis in silicosis
  o Smoking cessation (especially in asbestosis)
Sarcoidosis Overview

• **What is it?**
  - Sarcoidosis is an idiopathic granulomatous disease characterized by formation of noncaseating granulomas
  - Although considered a pulmonary disease, it can affect virtually any organ in the body

• **Symptoms**
  - Sarcoidosis has a diverse presentation with both acute and chronic presentations
  - Most patients present with symptoms that are recognizable
  - Men > women, generally age 20-40

• **Pathophysiology**
  - Pathogenesis involves antigen exposure in a genetically susceptible host that triggers T cell mediated immune response

• **Clinical course of sarcoidosis ranges from incidental to devastating**

• Most deaths are related to pulmonary or cardiac disease
Signs & Symptoms of Sarcoidosis

• **Common**
  - It's common to have NO symptoms
    - Up to 50% of patients are asymptomatic
  - If symptoms are present, generally involve upper respiratory system, lymph nodes, skin and eyes
  - **Lofgren syndrome**
  - **Erythema Nodosum**

• **Uncommon**
  - Nonspecific symptoms include low grade fevers, night sweats, joint pains, weight loss
  - **Uveoparotid fever** (aka Heerfordt syndrome)
    - Fever, uveitis, and parotitis with or without CN VII palsy
  - Cardiac, Musculoskeletal and Neurological symptoms are uncommon, but still possible.

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**Clinical Application Point**

Pulmonary, ocular and skin manifestations are the most common signs/symptoms of Sarcoidosis.

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Lofgren syndrome

- Fever, bihilar LAD, ankle swelling and erythema nodosum
- Presence of all features has 95% diagnostic specificity for Sarcoidosis
  - If this syndrome is present, biopsy is NOT required
- Remember, Erythema nodosum (EN) is NOT required for diagnosis of Sarcoidosis but is a common cause of EN
Erythema Nodosum

- Erythema nodosum (EN) is characterized by red or violet subcutaneous nodules that usually develop in a pretibial location.
  - EN is presumed to represent a delayed hypersensitivity reaction to antigens associated with various infectious agents, drugs, and other diseases and the pathogenesis is largely unclear.
  - Worldwide, the majority of patients with EN have evidence of recent streptococcal infection or have no identifiable cause.
Common Sarcoidosis Signs & Symptoms

- **Pulmonary**
  - Nearly all patients (>90%) have lung involvement
    - may be clinically silent
    - many diagnoses found incidentally on CXR
  - Most common symptoms are cough, dyspnea and chest pain (resembles mild asthma)
  - Classic radiographic finding is **bilateral hilar adenopathy**
    - parenchymal findings next most common
    - pleural abnormalities are rare
  - Pulmonary disease is staged (0-IV) based on CXR findings
    - CT imaging yields more abnormalities
Common Sarcoidosis Signs & Symptoms

• **Skin**
  o Cutaneous involvement occurs in 20-35% of patients with systemic sarcoidosis and may occur without systemic involvement
  o Maculopapular lesions are most common, but plaques also occur
    • face, posterior hairline, previous trauma sites
  o Erythema Nodosum
  o Lupus Pernio
    • chronic persistent violaceous plaques with a predilection for nasal mucocutaneous junction
Uncommon Sarcoidosis Signs & Symptoms

- **Musculoskeletal**
  - Occurs in approximately 10% of patients
  - Can be acute or chronic
    - acute: usually involves the ankles and accompanied by EN, fever, ± uveitis
    - chronic: knees, ankles, wrists and elbows
  - No correlation between osseous lesions and the concentration of calcium in the serum.

- **Cardiac**
  - Occurs in about 5% of patients
  - Cardiomyopathy, arrhythmias and sudden cardiac death can occur due to disruption of conducting system by granulomatous infiltration
  - Accounts for a significant proportion of death due to sarcoidosis

- **Neurological**
  - Occurs in about 5% of patients
  - CN palsies or headache may be a sign of neurosarcoidosis
  - CN VII palsy is the most common neurologic finding in sarcoidosis
  - **Heerfordt Syndrome**
    - Fever, uveitis and parotitis with or without VII nerve palsy
Diagnosis (cont.)

- Labs
  - Anemia & Leukopenia can be present
  - Hypercalcemia (10% of patients) and hypercalciruria (30% of patients)
  - Elevated alkaline phosphatase, transaminase levels, hyperbilirubinemia

- Bronchoscopy
  - Falling out of favor since yield depends on presence of pulmonary infiltrates and 10% risk of PTX with procedure

- Lymph node biopsy via EBUS-TBNA
  - Transbronchial needle aspiration with endobronchial endoscopic ultrasonography
  - Sensitivity 79-94%
Treatment-Pulmonary Sarcoidosis

• No evidence based guidelines on timing or indications for starting therapy in pulmonary sarcoidosis

• Many patients do not require treatment because disease will resolve spontaneously or remain stable
  o 30% of patients have chronic progressive disease, some patients will develop pulmonary fibrosis or end organ damage

• **Goals:** decrease number of granulomas, decrease inflammation and prevent fibrosis

• Pulmonary sarcoidosis
  o oral steroids are mainstay
  o 30-60mg/day tapered over 6-12 months
  o alternate day steroid therapy
Part VI
Pleural Diseases

- Pleural effusion
- Pneumothorax
Pleural Effusion

• **Background**
  o Abnormal accumulation of fluid in the pleural space
  o About 25% are malignant
  o 5 processes amount for most pleural effusions:
    • Transudate
    • Exudate from increased fluid
    • Exudate from decreased lymphatic clearance
    • Empyema (infection)
    • Hemothorax (i.e. bleeding)

• **Clinical Presentation**
  o May be asymptomatic and first discovered on routine CXR
  o CXR reveals blunting of costophrenic angle, loss of demarcation of the heart, mediastinal shift to the uninvolved side
Pleural Effusion

• **Clinical Features**
  - Patients with pleural effusions most often report dyspnea, cough or chest pain.
  - Dullness to percussion may be detected or absent breath sounds.
  - CXR +/- CT scan
    - Lateral decubitus films
  - **Diagnostic Thoracentesis** is the gold standard
    - Fluid sent for protein, LDH, pH, WBC, glucose, cytology, gram stain, culture
    - **Light’s Criteria** (transudate vs. exudate)

• **Treatment**
  - Treat the underlying cause
  - Thoracentesis can lead to improvement of symptoms

**Light’s Criteria (exudate if one is +)**
- Pleural fluid protein to serum protein: >0.5
- Pleural fluid LDH to serum LDH: >0.6
- Pleural fluid LDH greater than 2/3 upper limit normal for serum LDH

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Pneumothorax

• **Background**
  - Accumulation of air in the pleural space
  - Can be spontaneous, traumatic, or iatrogenic
  - Tall, thin males are at greatest risk
  - Tension PTX is due to chest wound and pulmonary laceration

• **Clinical Features**
  - Sudden onset of ipsilateral chest pain and dyspnea, findings depend on the size of the PTX
  - Can include chest expansion, tactile fremitus, hyperresonance, and decreased breath sounds

• **Treatment**
  - Small PTX resolve spontaneously (observation appropriate)
  - Chest tube is needed for severe cases
  - Tension PTX is a medical emergency
  - CXR every 24 hours until resolved
Part VII
Pulmonary Circulation

- Pulmonary HTN
- Cor pulmonale
- PE
Pulmonary HTN

• **Background**
  o Present when the pulmonary arterial pressure rises to a level inappropriate for a given cardiac output
  o Secondary pulmonary HTN has many causes

• **Clinical Features**
  o SOB, angina like chest pain, weakness, fatigue, edema, ascites, cyanosis, and syncope.
  o May hear abnormal heart sounds or clicks
  o CXR may show enlarged pulmonary arteries, ECG may show right ventricular hypertrophy, atrial hypertrophy and right ventricular strain
  o May use echocardiogram

• **Treatment**
  o May include chronic anticoagulation, calcium channel blockers.
  o Despite these measures, heart-lung transplant usually is needed
  o Treatment of secondary pulmonary HTN consists of treating the underlying disorder
Cor pulmonale

• **Background**
  o Cor pulmonale is a common complication of pulmonary hypertension
  o Cor pulmonale is the most common cause of hospitalization among patients with pulmonary arterial hypertension.
  o Refers to the altered structure (hypertrophy or dilatation) and/or impaired function of the right ventricle that results from pulmonary hypertension that is associated with
    • diseases of the lung (i.e. COPD) vasculature (e.g., idiopathic pulmonary arterial hypertension), upper airway (e.g., obstructive sleep apnea), or chest wall (e.g., kyphoscoliosis)
    • Right-sided heart disease due to left-sided heart disease or congenital heart disease is NOT considered cor pulmonale
    • Diseases complicated by cor pulmonale have worse survival than the same disease without cor pulmonale

• **Clinical Features**
  o Cor pulmonale symptoms are often not recognized as being due to right-sided heart failure because many of the symptoms are caused by the underlying disease
  o Dyspnea on exertion, fatigue, lethargy, exertional syncope, and exertional angina
  o Patients with cor pulmonale have physical findings related to both pulmonary hypertension and right-sided heart disease.
Cor pulmonale

**Clinical Features**

- Findings in pulmonary HTN (splitting, murmurs, clicks)
- Jugular venous pulsations
- Edema
- Liver enlarged and pulsatile
- Patients with end-stage cor pulmonale may develop signs of cardiogenic shock, including hypotension, tachycardia, oliguria, and cool extremities due to low poor stroke volume.
- CXR shows enlargement of central pulmonary arteries due to pulmonary HTN.
- EKG may show RBB, right axis deviation, RVH, RAE
Cor pulmonale

• **Treatment**
  
  o The treatment of cor pulmonale can be conceptualized as having three major physiological goals: reduction of right ventricular afterload (i.e., reduction of the pulmonary artery pressure), decrease of right ventricular pressure, and improvement of right ventricular contractility

• **Reduce RV afterload**
  
  o Oxygen
  
  o Treating underlying cause of pulmonary HTN

• **Decrease RV pressure**
  
  o Diuretics

• **Improve RV contractility**
  
  o Digoxin helps left side dysfunction NOT right side (DON’T USE)
  
  o IV agents are usually used
    
    • Dobutamine, milrinone
Pulmonary Embolism

• **Background**
  - PE is the third leading cause of death in hospitalized patients
  - DVT and PE are as high as 1 case/1000 persons
  - VTE (venous thromboembolism) higher in Men, African-Americans
  - PE arises from thrombi in the venous circulation or the right side of the heart, from tumors and from other sources
  - More than 90% originate in the deep veins of the lower extremities
  - Risk factors include Virchow’s triad: hypercoagulable state, venous stasis and vascular intimal inflammation or injury
  - Other risks include hypercoagulable states

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Pulmonary Embolism

- **Clinical features**
  - Classic symptoms are dyspnea and pleuritic chest pain
  - Other symptoms include cough, hemoptysis and even syncope
  - Symptoms of DVT are present in 10-20% of patients
  - Signs include tachycardia, tachypnea, crackles, fever

- **Diagnosis**
  - EKG
    - The most common finding on EKG is sinus tachycardia
    - Other changes suggest right ventricular strain
      - S1Q3T3 pattern is seen in less than 20%
      - Right axis deviation
      - Right bundle branch block
  - CXR nonspecific
  - D-dimer useful for rule out (high negative predictive value
  - Should use
  - V/Q scan or CT diagnostic
Wells’ Criteria

- [https://www.mdcalc.com/wells-criteria-pulmonary-embolism](https://www.mdcalc.com/wells-criteria-pulmonary-embolism)

- The Wells’ Criteria risk stratifies patients for pulmonary embolism (PE) and provides an estimated pre-test probability.

- Wells’ is not meant to diagnose PE but to guide workup by predicting pre-test probability of PE and appropriate testing to rule out the diagnosis.
Pulmonary Embolism

- **Treatment**
  - Anticoagulation
    - Heparin (UFH, LMWH)
    - Warfarin
    - Apixaban, dabigatran, rivaroxaban, and edoxaban are alternatives to warfarin for prophylaxis and treatment of PE
  - Duration of therapy depends on situation
    - The current ACCP guidelines recommend all patients with unprovoked PE receive three months of treatment and have an assessment of the risk-benefit ratio of extended therapy at the end of three months
    - First thromboembolic event with reversible risk factors = warfarin therapy for at least 3 months.
    - Second unprovoked episode of venous thromboembolism and low or moderate risk of bleeding = extended anticoagulant therapy
    - Second episode of venous thromboembolism and a high risk of bleeding = three months of anticoagulation is over extended anticoagulation
    - Patients who have PE and preexisting irreversible risk factors, = long term .
  - Vena cava filter can be used for patients at high risk of reoccurrence.
  - Prevention is key
Part VIII
Neoplastic Diseases

- Pulmonary Nodules
- Lung CA
- Carcinoid tumors
Pulmonary Nodules

• **Background**
  - Nodule = less than 3 cm
  - Greater than 3 cm = mass
  - Most are infectious granulomas from old or active TB, fungal infection or foreign body reaction
  - 40% are malignant

• **Clinical Features**
  - Most pulmonary nodules are found unexpectedly on CXR and are asymptomatic
  - Lesions that don’t enlarge are considered benign
  - If malignant, it will likely become symptomatic
  - The probability of malignancy rises with increasing patient age
    - 35 to 39 years: 3 percent
    - 40 to 49 years: 15 percent
    - 50 to 59: 43 percent
    - ≥60 years: >50 percent

• **Treatment**
  - Watchful waiting
    - Serial CT scans (3 or 6 months)
  - Biopsy (usually via bronchoscopy)
  - Resection

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Lung Carcinoma

• **Background**
  o Bronchogenic CA is the leading cause of cancer deaths in men
  o Lung cancer is the 4th most common cancer in women (breast, colon, cervix)
  o Smoking is #1 risk factor

• **Divided into 4 major histologic types**
  o Adenocarcinoma (including bronchioalveolar carcinoma) — 38 percent
  o Squamous cell carcinoma — 20 percent
  o Large cell carcinoma — 5 percent
  o Small cell carcinoma 13 percent

• **Clinical Features**
  o Symptoms include cough, hemoptysis, pain, decreased appetite, weight loss
  o Patients may also exhibit lymphadenopathy, hepatomegaly, and clubbing
  o Lung cancer can spread to any part of the body
    • The most frequent sites of metastasis are 1) liver 2) adrenal 3) bones 4) brain

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**Lung CA**

**Clinical Features**
- Paraneoplastic syndromes occur in 10-20%
  - Paraneoplastic effects of tumor are remote effects that are not related to the direct invasion, obstruction, or metastasis
    - Endocrine (hypercalcemia, Cushing’s, or SIADH are examples)
    - Hematologic (anemia, leukocytosis, thrombocytosis, hypercoagulability, etc.)
    - Neuromuscular
    - Cardiovascular

**Treatment**
- For non small cell, surgery remains the treatment of choice
- For small cell, depends on staging, combination chemotherapy is the treatment of choice
- CXR and CT scan
- Cytological examination of sputum
- Bronchoscopy
- PET scans

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Carcinoid Tumors

• Background
  o Carcinoid tumors start from cells of the neuroendocrine system.
    • Carcinoids can arise at a number of sites throughout the body, including the thymus, lung, gastrointestinal tract, and ovary. The gastrointestinal tract is the most frequently involved site, while lung is the second most common.
  o Bronchial carcinoid tumors are an uncommon group of pulmonary neoplasms that are characterized by neuroendocrine differentiation and relatively indolent clinical behavior.
    • Bronchial carcinoid tumors account for approximately 1 to 2 percent of all lung malignancies in adults
    • Bronchial carcinoids are the most common primary lung neoplasm of children, typically presenting in late adolescence.

• Clinical Features
  o The majority of tumors arise in the proximal airways, and most are symptomatic from an obstructing tumor mass or bleeding due to hyper vascularity.
  o Patients may have a cough or wheeze, hemoptysis, chest pain, or recurrent pneumonia in the same pulmonary segment or lobe due to bronchial obstruction
Lung Carcinoid Tumor

- Approximately 75 percent of bronchial carcinoids present with an abnormal chest x-ray.
- Most tumors appear as round or ovoid opacities that range in size from 2 to 5 cm, and may be associated may be a hilar or perihilar mass.

(Panel A) Posterior-anterior (PA) chest radiograph demonstrating a nodular opacity (white arrow) in the right middle lobe with volume loss on the right. The nodule is better visualized on the axial CT image of the chest (Panel B) just below the level of the carina (black arrow). At surgical resection the nodule proved to be a typical carcinoid.

Courtesy of Charles F Thomas, Jr, MD.
Carcinoid tumors

- **Clinical Features**
  
  - Carcinoid syndrome is caused by systemic release of vasoactive substances such as serotonin and other bioactive amines.
  
  - Acute symptoms include cutaneous flushing, diarrhea, and bronchospasm;
  
  - Atypical symptoms include disorientation, anxiety tremor, periorbital edema, lacrimation, salivation, hypotension, tachycardia, diarrhea, dyspnea, asthma, and edema.
  
  - The majority of bronchial carcinoids present in a manner that is similar to other primary lung malignancies, with cough or hemoptysis, or as an asymptomatic peripheral pulmonary nodule.
  
  - CT is the most useful imaging procedure, and the diagnosis is generally confirmed either by bronchoscopy biopsy or by transthoracic needle biopsy for peripheral lesions.
Part IX: Other Pulmonary Diseases

- ARDS
- FB aspiration
- Hyaline membrane disease
• **Background**
  o Three settings account for most of ARDS
    • Sepsis
    • Trauma
    • Aspiration
  o Other causes include shock, toxic inhalation, near-drowning, and multiple transfusions

• **Clinical Features**
  o Rapid onset of dyspnea occurring within 24 hours after the precipitating event
  o Physical exam shows tachypnea, pink or red sputum and diffuse crackles
  o Many patients are cyanotic with severe hypoxemia that is refractory to oxygen
  o CXR may be normal at first, infiltrate tend to be peripheral
  o Multiple organ failure

• **Treatment**
  o Identify underlying problem
  o Supportive care
  o Oxygen via PEEP
  o Mortality is very high and 1/3 of deaths occur within 3 days of onset of symptoms
FB aspiration

- An episode of choking, coughing, wheezing suddenly should raise the suspicion
- Asphyxia may result
- Pneumonia can develop
- Bronchoscopy is needed to help establish the diagnosis and can be the treatment of choice
Hyaline Membrane Disease

- Most common cause of respiratory disease in the pre-term infant
- Caused by a deficiency in surfactant
- Infant demonstrates signs of respiratory distress
- CXR reveals air bronchograms, atelectasis and a ground glass appearance, and doming of the diaphragm
- Ventilation intermittently should be used
- Exogenous surfactants in the delivery room can be used

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Pre Test Case #1

• A 65-year-old female, PMH of HTN, OA, and GERD presents to your clinic for hospital follow up 1 week after her discharge following elective knee surgery. She is complaining of cough and shortness of breath. Her post surgical course required a 1 day stay in the ICU due to a difficult extubation, but she quickly improved. Her total stay was 5 days and there were no further complications.

• Today, she reports 2 days ago of temperature to 39.1°C (102.4°F), a cough with sputum production, and shortness of breath. Her vital signs reveal mild tachycardia and fever, but normal blood pressure. A CXR in your office reveals a LLL infiltrate. What is the most likely cause of this patient’s symptoms?

A. C. pneumoniae
B. M. catarrhalis
C. Legionella species
D. P. aeruginosa
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A. C. pneumoniae
B. M. catarrhalis
C. Legionella species
D. P. aeruginosa (Nosocomial Pneumonia)
Pre-Test Case #2

- A 23-year-old male, no PMH, presents to the emergency department with the sudden onset of moderate to severe right-sided chest pain and shortness of breath. No trauma or accident. His vital signs are normal. Physical exam reveals diminished breath sounds on the right and hyper resonance. CXR reveals a loss of markings along the right lung margins, involving about 10% of the lung space. The mediastinum has not shifted. What is the most appropriate management plan?

A. Decompression of the chest by insertion of a large-bore intravenous catheter into the right second intercostal space at the midclavicular line
B. Oxygen supplementation and close observation with bed rest
C. Pleurodesis
D. Wedge resection
Pre-Test Case #2

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B. Oxygen supplementation and close observation with bed rest (Spontaneous Pneumothorax)

C. Pleurodesis

D. Wedge resection
A 4 year old presents to the clinic with a fever to 104, sore throat, low appetite and difficulty breathing. The family recently immigrated to the United States. He was apparently fine yesterday. Mom says that she left him in his playroom for a few minutes this morning and he seemed fine but over the last few hours, his condition has worsened. On physical exam, the patient appears ill, is cyanotic, tachypneic and sitting upright with his neck extended. He is drooling. His lung exam reveals wheezing and retractions. What is the first step in the management of this patient?

A. Perform oral exam and visualize the foreign body he swallowed
B. Immediate intubation and protection of his airway (Acute epiglottitis)
C. IV antibiotics
D. X-ray of the neck
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References

• CMDT 2017: Pulmonary Disorders (Disorders of the Airways, Disorders of the Upper Airways, Disorder of the Lower Airways, Asthma) Pgs. 241-257
Thank you.

NCAPA PANRE
Pulmonology Review

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