We Move A Lot of Air

- Functions
  - Oxygenation
  - CO₂ & pH
- Basic defenses
  - Nose hairs
  - Cilia
  - Mucus
  - Cough reflex
  - Immune system

Basic Categories

- Congenital
- Infectious
- Neoplastic
- Nutritional
- Trauma
- Immunologic
- Vascular

Developmental

- Diaphragmatic defect
- Intestines in chest
- No room for lung to develop
- The newborn needs two.
- Depending on the degree of lung hypoplasia, may not be compatible with life.
- Today can surgical fix inutero.
Gene Defect Related

- Cystic fibrosis
- Bronchial infections
- Pancreatic destruction
- Thick mucus
- Alpha-1 antitrypsin deficiency
- Emphysema
- Cirrhosis
- Can’t neutralized activated proteases
- Immune system failure

Atelectasis (Collapse)

Obstructive vs. Restrictive

- Obstructive
  - Air passage patency
  - Increased resistance
  - Acute
    - Asthma
  - Chronic
    - Chronic bronchitis
    - Emphysema
- Restrictive
  - Ability of lung to expand
  - Decreased total lung capacity

Chronic Obstructive Pulmonary Disease

- COPD
- Lasting longer than 3 months
- Chronic cough with mucus production
- Restriction to air movement
- Two basic forms
  - Emphysema
  - Chronic bronchitis
- Actually most patients have a mix

Emphysema

- Loss of pulmonary elastic tissue
- Inflammatory
- Smoking
- Can’t keep small airways open
- Reduced surface area
- Reduced air volume exchange
- COPD
Emphysema

- Large airspaces
- Trapped in air the dilated alveoli
  - causes compression of smaller airways
  - Hyperinflation
- Changes are irreversible

Chronic Bronchitis

- Also a chronic obstructive disease
- Chronic cough with mucus production for 3 months.
- May lead to emphysema (especially in smokers).
- COPD
- Larger airway narrowing
- Increased secretions
  - Goblet cell hyperplasia
- Blue bloater
  - Cyanotic

Emphysema

- Pink puffer
- Barrel chest
  - Hyperinflation
  - Trapped air
- Thin
  - Lots of calories just to breathe
- Rapid respirations
- Pursed lips
- COPD

Asthma

- Bronchoconstriction
  - Episodic
  - Reversible
  - Various stimuli
- Extrinsic Asthma
  - Type I hypersensitivity
  - Food
  - Atopic most frequent
  - Other manifestations
- Intrinsic
  - Triggers are nonimmune
    - Azonin
    - Viral infections
    - Cold
    - Stress
Asthma, Sensitization

- Sensitization of CD4 cells
  - The T₄₂ class
- T₄₂ cells release cytokines
  - IL-4, IL-5, & IL-13
  - Cause production of IgE
  - Growth of mast cells
  - Histamine producers
  - Activation of eosinophils
- Typically see 2 phases to an attack
  - Early, 30-60 minutes
  - Late, 4-8 hours

Asthma, Reaction

Asthma, Long-term

Bronchiectasis

- Dilated and inflamed bronchi
- Repeat infections
- Lots of mucus
- Foul smelling breath
- Unbelievable, productive morning cough

Restrictive Lung Disease

- Reduced compliance
  - Acute, surfactant problem
  - Chronic, fibrosis
Acute Respiratory Distress
- Endothelial injury
- Loss of fluid and proteins
- Injury to Type II epithelial cells
- Lack of surfactant
- Accumulation of protein in the form of hyaline membranes within alveoli.

Hyaline Membrane Formation
- Initiation of inflammatory response
- Neutrophils play a significant role
- Oxidant injury
- Leakage of proteins
- Formation of hyaline membrane
  - Reduces O₂ diffusion
  - Reduced surfactant
  - Alveolar wall becomes rigid.

Hyaline Membranes

Chronic Restrictive Lung Disease
- Occupational
  - Asbestos
  - Silicosis
  - Coal miner’s lung
- Chemotherapy
  - Busulfan
- Immunological
  - Rheumatoid arthritis
  - Sarcoid
  - Scleroderma and other collagen vascular diseases
- Idiopathic

Pulmonary Fibrosis

Silicosis
Sarcoidosis

Hypersensitivity Pneumonitis

Idiopathic Pulmonary Fibrosis

Vascular Related Pulmonary Disease

- Acute alterations in blood flow.
- Congestion and edema
- PE
- Chronic congestion
- Eisenmenger reaction
- Primary Pulmonary hypertension
- Inflammatory
- Autoimmune vasculitis
Pulmonary Edema

Pulmonary Embolus

Pulmonary Infarct

Ventricular Septal Defect

- Left to right shunt
- Depending on size will lead to Eisenmenger reaction.
- Later becomes right to left shunt.
- Possible infections.

Pulmonary Hypertension
Pulmonary Infections

- Pneumonia
- Infection in the alveolar spaces
  - Bacteria
  - Virus
  - Mycoplasma
- Abscess
- Bronchitis
- Bronchiolitis
- Pleuritis

Bacterial Pneumonia

- Bronchopneumonia
- Lobar pneumonia

Streptococcal pneumoniae

Acute Bacterial Pneumonia

Gram Negative Bugs

- Typically from body flora
- 'Opportunistic' infections
- Compromised host
  - Alcoholic
  - Aspiration
  - Chemotherapy
  - Tracheostomy
- Broad spectrum antibiotics that change host flora
Klebsiella Pneumonia
- Gram negative rod
- Very mucoid capsule
- Aspiration
  - Head down in the gutter
  - Rusty sputum
  - High fever

Pulmonary Abscess
- Staphylococcus
- Aspiration of gastric material
- Hole with
  - Air-fluid level

Fungal Pneumonias
- Typically means something wrong with immune system
- Histoplasmosis is very common
  - Ohio River valley
  - Virtually all of us beat the bug
- HIV has changed things a lot

Histoplasmosis
- Dimorphic yeast
- Fungal growth phase
- Oral or pulmonary infection
- Granulomas
- Most people lock it down.
- Forms of the disease
  - Pulmonary
  - Systemic

Pneumocystis carinii
- Immune failure
- Organism is very common
- Immunosuppression
  - Starvation
  - HIV
  - Chemotherapy
  - Can’t culture
  - Bronchial wash
  - Stain for the bug

Tuberculosis
- Mycobacterium tuberculosis
  - (most cases)
  - Type IV hypersensitivity
  - Granuloma
- Primary infection
  - Pulmonary
  - Perhaps goes lymphatics
  - Hopefully it stops here.
- Secondary TB
  - Internal reactivation
  - Perhaps years later
  - Not all patients
Granuloma Formation

Type IV Hypersensitivity
(Delayed hypersensitivity)

Primary TB

Secondary or Reactivation TB

Tuberculosis

TB Chest X-Ray

TB Chest X-Ray
Granulomas of TB
- Caseous granulomas
- Giant cells
- Inert bug

Disseminated TB

Skin Test
- PPD
- Injected intradermally
- Read in 2 days
- Measure swelling
  - Not redness
- Positivity maybe life long

CMV Pneumonia
- Common virus
- Infant and neonate
- Immune suppressed
  - HIV
  - Chemotherapy
  - Characteristic inclusion

Lung Tumors
- ‘Mass’ on X-Ray
  - Space occupying lesion
    - Granuloma
  - Neoplasm
  - Benign
  - Malignant
    - Primary vs. Metastatic
Benign

- Rare
- Hamartoma
  - A ‘rest’ of tissue from development
  - Cartilage most times

Malignant

- Primary, so called ‘bronchiogenic’.
  - Squamous cell
  - Small cell
  - Adenocarcinoma
- Metastatic, just about any source
  - Kidney
  - Breast
  - Colon
  - Reproductive
  - Even the other lung

Bronchiogenic Carcinoma

- Squamous in most cases
- Chronic irritant leads to squamous metaplasia.
- Continued exposure leads to dysplasia and eventually cancer.
- Very aggressive.
- Surgery is about it.
- Poor response to chemotherapy and radiation

Pulmonary Cytology

- Exfoliative cytology
- Cough it up
- Wash it out
- Bronchoscopic biopsy

Metaplasia, Dysplasia, Cancer

Basic Patterns of Bronchiogenic Carcinoma
What Lung Cancer Can Do
- Obstruct bronchus causing pneumonia
- Spread widely
- Odd hormonal activity
  - Small cell makes ADH and ACTH
  - Squamous cell makes PTH
- Multiple sclerosis like symptoms
  - Even without brain mets
- Pancoast’s tumor ->
  - Horner’s syndrome

Metastatic Cancer to Lung
- Can come from anywhere
- Microscopic looks like tumor of origin
- Spreads by blood
  - Isolated masses ->
- Spreads by lymphatics
  - Diffuse involvement

Pleura
- Membranes surrounding lung and lining chest cavity
- Inflammation, Pleuritis
  - Sterile
    - Renal failure
  - Infectious
    - Bacteria, Lyme, Virus, TB
  - Either may lead to scarring and trapping of lung
- Hemothorax
- Pneumothorax ->

Pleural Tumors
- Metastatic
  - About anywhere
- Primary, mesothelioma
  - Mesothelial cells
  - Asbestos workers
  - Slow growing
  - Traps & invades lung

Upper Airway
- Allergic disease
- Sinusitis
- Larynx
  - Infections
  - Polyps
  - Squamous cancer