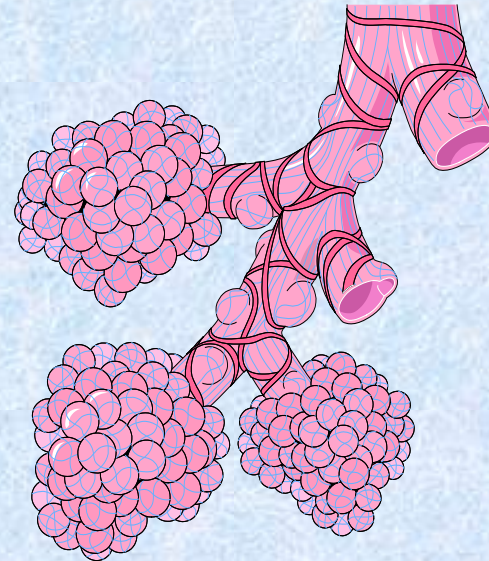
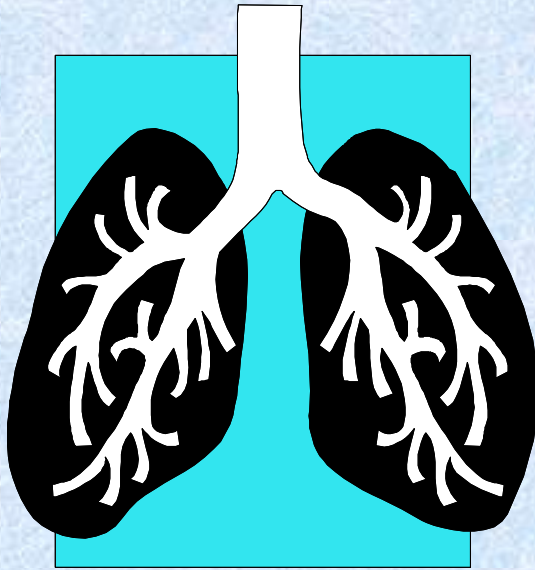
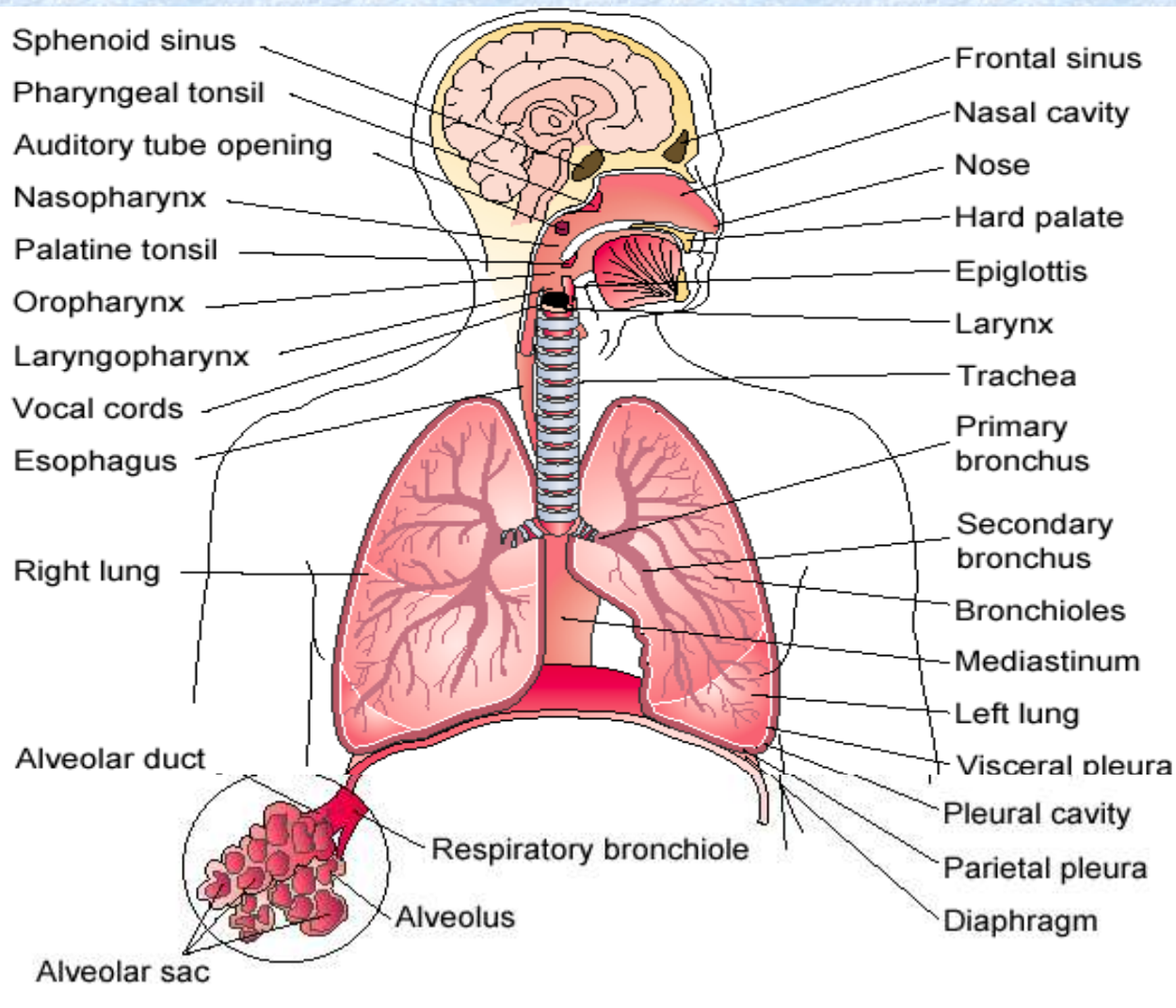


Respiratory System Diseases



Pathophysiology

Review of Anatomy & Physiology



Upper Respiratory Tract

- Respiratory Mucosa

- lined with ciliated mucus producing cells
 - 125cc/ day
- purifies air
- is contiguous with all structures

- Nose

- paranasal sinuses
 - frontal, maxillary, sphenoid, ethmoid
 - lighten skull
 - sound resonant chambers
- conchae (3 pairs)
 - warm & humidify air
- lacrimal ducts
- olfactory receptors

- Pharynx

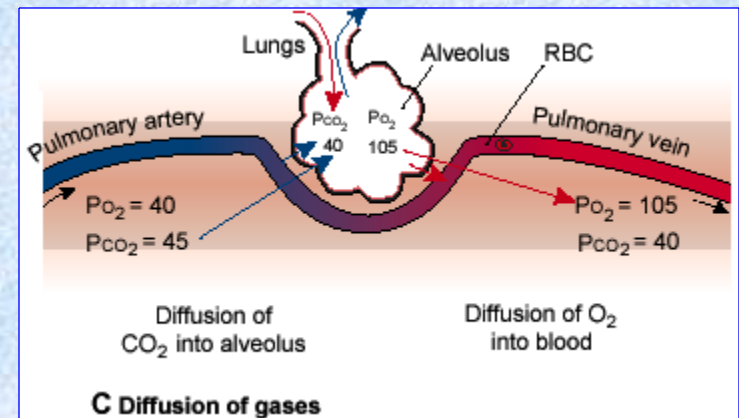
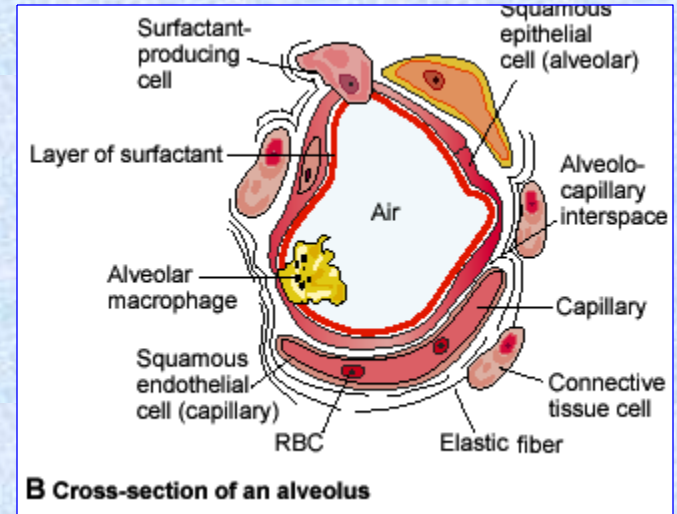
- 3 parts: Nasopharynx, Oropharynx, Laryngopharynx
- Tonsils(3 pairs)
 - pharyngeal (adenoids)
 - palatine
 - lingual
- Eustachian (auditory) tubes open into nasopharynx
 - equalizes pressure between middle ear & the outside

- Larynx

- composed of pieces of cartilage
 - Thyroid cartilage= Adam's apple
- epiglottis & glottis

Lower Respiratory Tract

- Trachea
 - composed of C- shaped cartilaginous rings
 - called windpipe
- Bronchi, Bronchioles, Alveolar Duct, Alveoli
 - gas exchange occurs in alveoli
 - occurs via **Passive Diffusion**
 - Respiratory Membrane
 - 2 cell layers thick
 - » **surfactant = reduces surface tension to keep alveoli distended**
 - » **lining of alveolus (alveolar epithelium)**
 - » **lining of capillary (capillary endothelium)**



- **Lungs & Pleura**

- right lung = 3 lobes; left lung = 2 lobes
- lower part of lung resting on diaphragm = **Base of lung**
- upper part of lung under clavicle = **Apex of lung**
- pleura = serous membrane (i.e. secretes some fluid)
 - **parietal pleura** lines thoracic cavity
 - **visceral pleura** lines organs (viscera)

- **Mechanics of Breathing**

- air moves by differences in air pressure

- **Inspiration**

- » active process; get contraction of **diaphragm** & **external intercostal muscles**
- » results in increase in size of chest cavity

- **Expiration**

- » passive process with normal expiration
- » active process with forced expiration; get contraction of **abdominal** & **internal intercostal muscles**
- » results in decrease in size of chest cavity which increases pressure & forces air out

Manifestations of Pulmonary Disease

- **Sneezing = reflex response to irritation of upper respiratory tract**
- **Coughing = reflex response to irritation of lower respiratory tract**
- **Sputum production**
 - **If yellowish- green ----- infection**
 - **If rusty ----- blood + pus = pneumococcal pneumonia**
 - **If bloody , called “hemoptysis” ---- usually frothy --- seen in pulm. Edema**
 - **Also seen in pulm. TB & cancer**
 - **Large amounts & foul = bronchiectasis**
 - **Thick & sticky = asthma, cystic fibrosis**
- **Breathing patterns**
 - **Eupnia, labored (dyspnea) , wheezing, stridor**
- **Breath sounds**
 - **Normal, rales, rhonchi, decreased breath sounds**
- **Dyspnea --- discomfort feeling when can't get enough air**
 - **Orthopnea = dyspnea lying down**
- **Cyanosis --- not a reliable early indicator of hypoxia**

Respiratory System Diseases

General Outline

- **Infectious diseases**

- **Upper**

- URI
- Croup
- Epiglottitis
- Flu (Influenza)

- **Lower**

- Bronchiolitis (RSV)
- Pneumonia
- SARS
- TB
- Fungal diseases

- **Obstructive lung diseases**

- Cystic fibrosis
- Cancer
- Aspiration pneumonia
- Asthma

- **COPD (chronic obstr. pulm. dis)**

- Emphysema

- Chronic bronchitis

- **Restrictive lung diseases**

- Chest wall abnormalities

- Connective tissue abnormalities

- Pneumoconioses

- **Vascular disorders**

- Pulmonary edema

- Pulmonary embolism

- **Expansion disorders**

- Atelectasis

- Pleural effusion

- Pneumothorax

- Resp. distress syndrome

- Infant
- adult

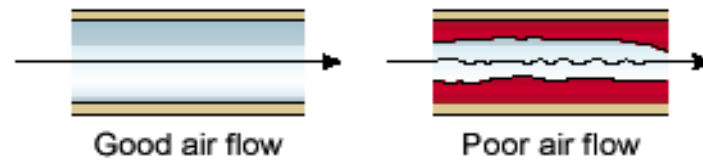
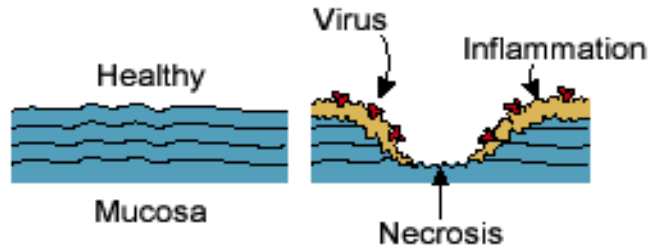
Upper Respiratory Tract Infections

Upper Respiratory Infection (URI)

- **Def = Acute inflammatory process that affects mucus membrane of the upper respiratory tract**
 - **Includes one or more of the following problems**
 - » **Rhinitis ----- also called Coryza**
 - » **Pharyngitis**
 - » **Laryngitis**
 - » **Sinusitis**
- **Pathophysiology ----- see next slide**
- **Sx = low-grade fever, malaise, cephalgia, sore throat, & discharge**
 - **Incubation period short ----- 2-3 days**
 - » **As a rule: bacterial diseases = short incubation**
 - » **viral diseases = long incubation except URI's**
- **Etiol = over 200 different viruses have been implicated**
 - **can get secondary bacterial infection**
- **Tx = symptomatic**

Virus attaches firmly to respiratory mucosa, invades the tissue, causing necrosis, inflammation, and swelling

CONGESTION
OBSTRUCTED AIRWAYS

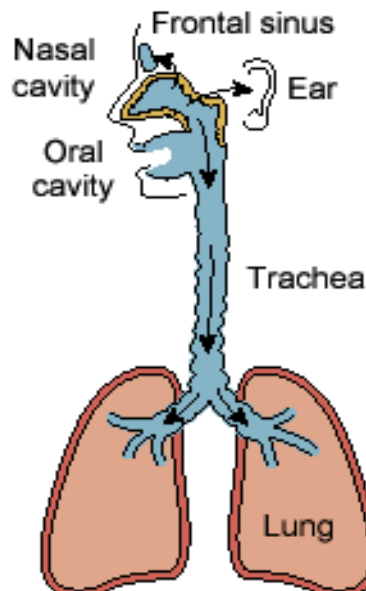


Virus spreads along continuous mucosa invading

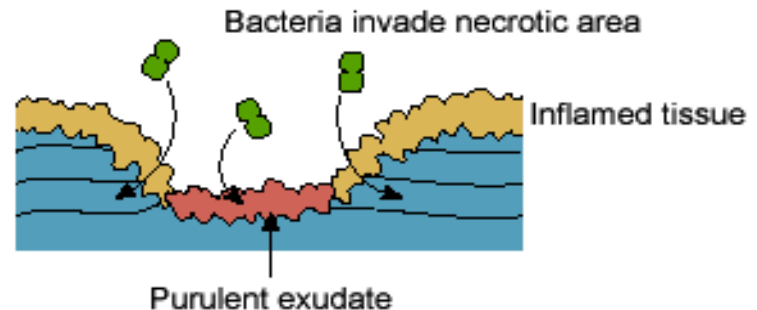
→ EARS – OTITIS MEDIA

→ SINUSES – SINUSITIS

→ BRONCHI AND LUNGS – PNEUMONIA



Bacteria, sometimes resident flora, penetrate the damaged mucous membranes, causing secondary BACTERIAL INFECTION



Influenza

3 viral types---- A,B, &C

They mutate constantly thus preventing effective immune defense for prolonged time periods

short incubation ---- 3 days

distinguishing features from simple URI

high fever in flu (usually lasts 4-5 days)

flu gives both an upper & a lower resp. tract infections at the same time, whereas URI just gives upper tract infection

Death may result from pneumonia

3 Respiratory Infections of Children

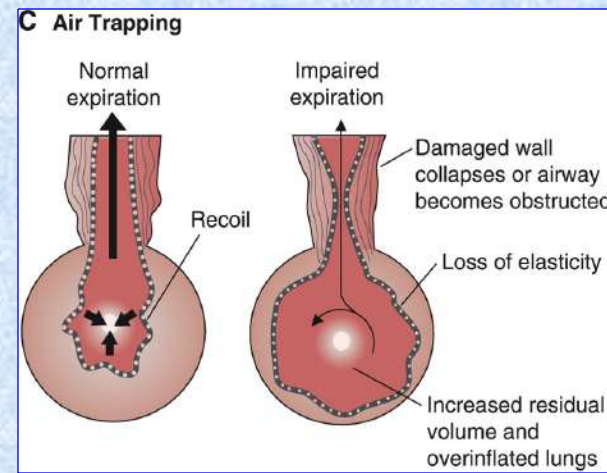
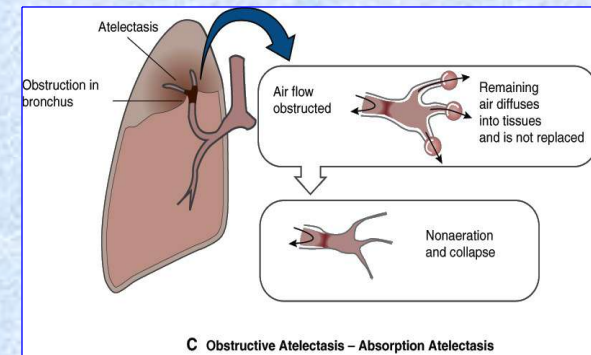
- Laryngotracheobronchitis (croup) ----- upper tract infection
 - Neonate to 3 years
 - Virus --- usually adenovirus
 - Begins as URI; then get inspirational stridor & “barking” cough
 - Self-limited; last 3 days
- Epiglottitis ----- upper tract infection
 - 3 – 7 years
 - Bacterial; H. influenzae
 - Get drooling and dysphagia
 - Med emergency
- Bronchiolitis (respiratory syncytial virus [RSV]) ---- lower tract infection
 - 2 mon - 12 mon (young infants)
 - Virus --- RSV myxovirus
 - Get necrosis & inflammation in small bronchi & bronchioles
 - Get cough, wheezing, and dyspnea
 - If partial obstruction of bronchioles ----- get “air trapping”
 - If complete obstruction of bronchioles ---- get atelectasis
 - Tx = supportive (see next slide)

RSV Infection --- bronchiolitis

- Approx. 50% of all children admitted for lower resp. tract infection have RSV
- By age three, 100% of American kids infected
- Predisposing factors:
 - Family hx of asthma
 - Cigarette smoke
- Treatment:
 - Usually supportive
 - Have antivirals one can use (ribavirin)
 - In late 1990's got updated RSV immune globulin
 - Indicated for prophylaxis against RSV
 - Monoclonal antibody to RSV
 - Indications: high risk kids (prematurity, bronchopulmonary dysplasia, etc)
 - Cost = \$900

– Clinically:

- Can get air trapping (hyper-inflation)
- Can get obstructive atelectasis

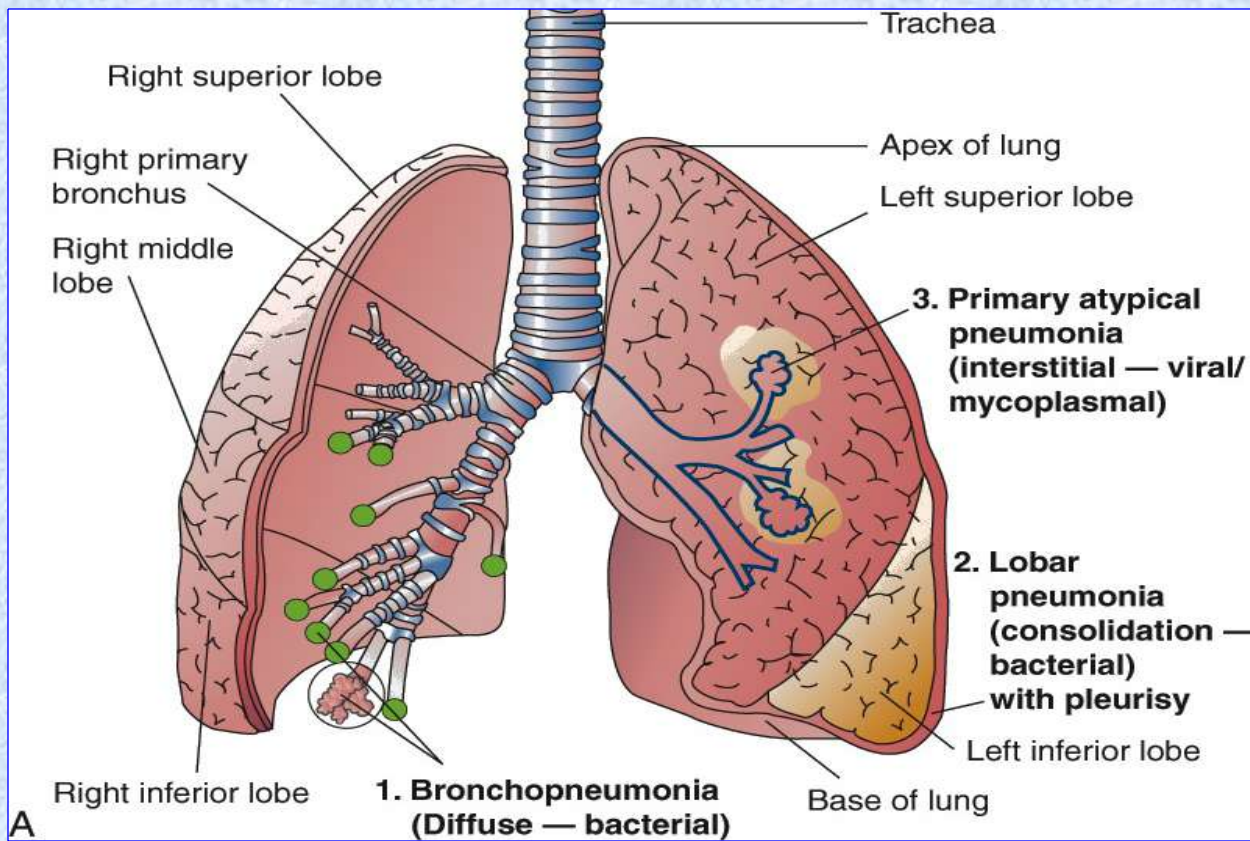


Lower Respiratory Tract Infections

Pneumonia

- 6th leading cause of death in US; incidence highest in elderly
- etiol
 - pathogens ----- bacteria, mycoplasma, viruses, fungi
 - Note: most all cases are preceded by URI
 - Common bacteria: pneumococcus
 - Viral = commonest in children
 - Community acquired:
 - » Pnenmococcus, mycoplasma, Hi-b
 - Nosocomial
 - » Pseudomonas , staph aureus (MRSA)
 - trauma to lungs
 - FB aspiration
 - poison
- Types
 - Bronchopneumonia – diffuse
 - Lobar pneumonia – pneumococcus --- get consolidation & pleurisy
 - Primary atypical pneumonia (PAP) --- interstitial ---- viral & mycoplasma

(see next slide)



Pneumonia (cont)

Some different types

Legionnaires Disease

- etiol = gram negative bacteria (Legionella)
 - thrives in warm moist aquatic environment
 - * cooling towers of air conditioning systems
 - * hot water plumbing of buildings
- spread by inhalation
- Diagnosis difficult since hard to culture & requires special media
- Tx = antibiotics
- Primary atypical pneumonia (PAP)
 - Pathophysiology = interstitial inflammation
 - Etiol = mycoplasma (occasionally viral)
 - Diagnosis = difficult
 - Onset vague with nonproductive cough
 - Commonest = older children & young adults
- Pneumocystis carinii pneumonia (PCP)
 - Opportunistic infection in AIDS
 - Microbe is a fungus
 - Treatment = bactrim or sepra

Pneumonia (cont)

Fungal Pneumonia ----- 3 types

(1) Coccidiomycosis ----- from soil, southwest US

(2) Histoplasmosis ----- from soil, midwest

(3) Blastomycosis ----- from soil, southeast US

grow in soil where there is bird & chicken excretion

spread = airborne (inhalation of fungal spores)

Generally, primary infection is self-limiting & heals spontaneously

may get disseminated disease ---- called secondary stage

Lung granuloma with necrosis & spread to other areas

Can become quite serious

Complication of pneumonia

Pulmonary Abscess

etiol = complication of pneumonia, neoplasm, or aspiration (food)

commonest site = lower lobe right lung

Tx = ? Incision & Drainage (I&D)

Severe Acute Respiratory Syndrome (SARS)

- **First diagnosed in China and reported as a atypical pneumonia (Feb 2003)**
- **Etiol = coronavirus**
- **Transmission: droplets during close contact**
- **Short incubation (1 week)**
- **Type = interstitial pneumonia**
- **Tx: ribavirin & steroids**
- **Mortality: 10% - 50%**
- **Dx: difficult since get no antibodies for 3 weeks (incubation = only 1 week)**

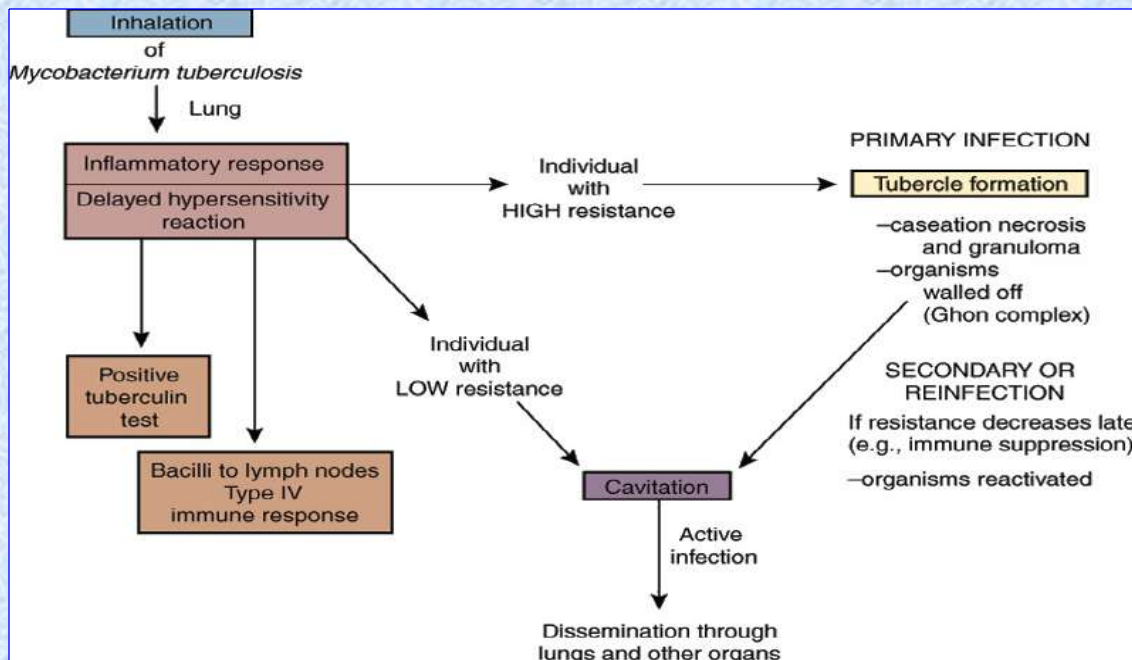
Tuberculosis

- TB was in declining incidence in US until late 1980's when it's incidence began to increase
 - Why?
 1. HIV population & opportunistic infections
 2. homeless population
 3. increase in low socio-economic population
 - These three became new reservoir for the TB bacillus
 4. doctor complacency
 5. drug co. complacency
 6. patient non-compliance
 - » these last 3 led to bacterial resistance (bacteria evolved)
- Etiol = tubercle bacillus which is quite resistant to eradication and can live in a dry form(inactive) for long times --- i.e. a spore-like state
 - ❖ Example = **dried sputum**
 - ❖ very contagious via air droplets
- Course of the Disease
 - Initial Infection (called Primary TB) often asymptomatic
 - » patients are NOT contagious at this time
 - Secondary TB is reactivation and may be years later
 - » **Seen when patient's resistance is lowered**
- Key to diagnosis is a positive culture; skin tests = PPD, Mantoux, Tine
 - **If + Skin test, then do chest x-ray**

TB (cont)

– Signs & symptoms

- **Primary TB = asymptomatic**
- **Secondary TB**
 - **10% of cases will become symptomatic**
 - **Key = night sweats**
 - **Develop productive cough (purulent & bloody)**
 - » **Becomes increasingly severe**



Inhalation
Tubercle formation
Caseation necrosis
Called: Ghon complex
Cavitation



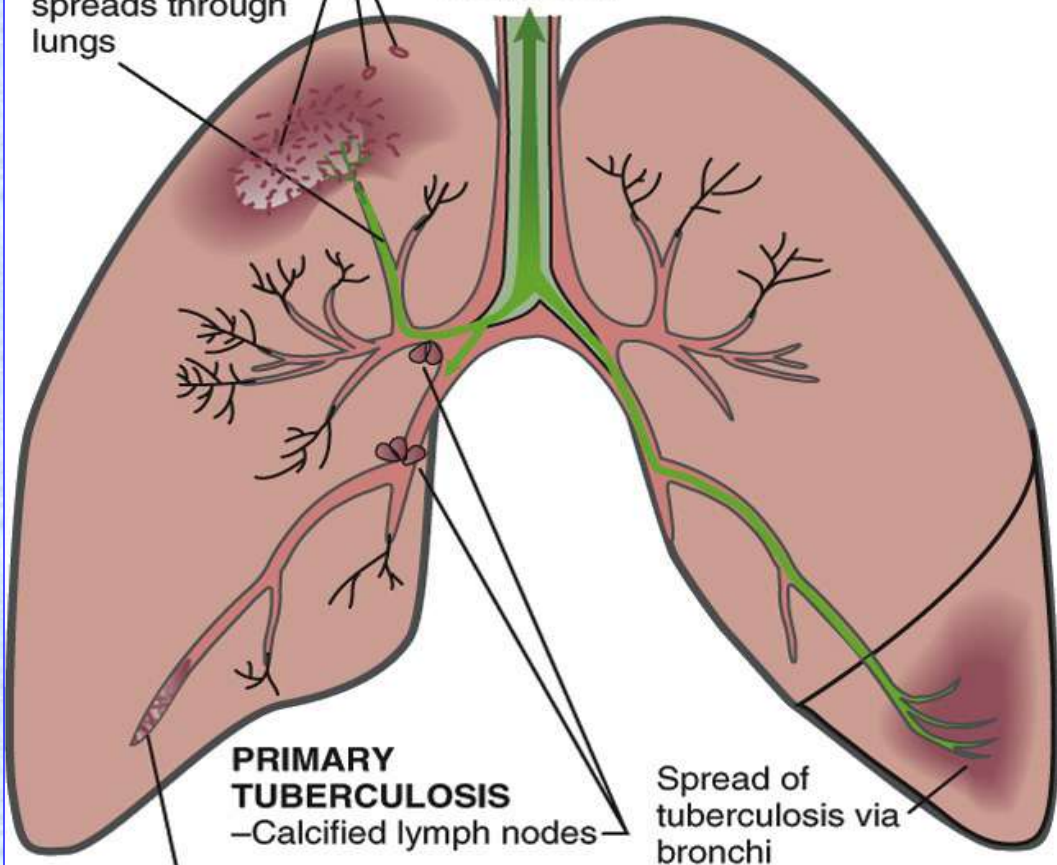
(From Kumar V, Abbas AK, Fausto M: Robbins and Cotran Pathologic Basis of Disease, 7th ed. Philadelphia, WB Saunders, 2005.)

CAVITATION

- *Mycobacterium tuberculosis* erodes into blood vessels and spreads to other organs

- *M. tuberculosis* spreads through lungs

Infected sputum coughed up



PRIMARY TUBERCULOSIS

- Calcified lymph nodes

- Healed tubercle with caseation necrosis (Ghon complex)

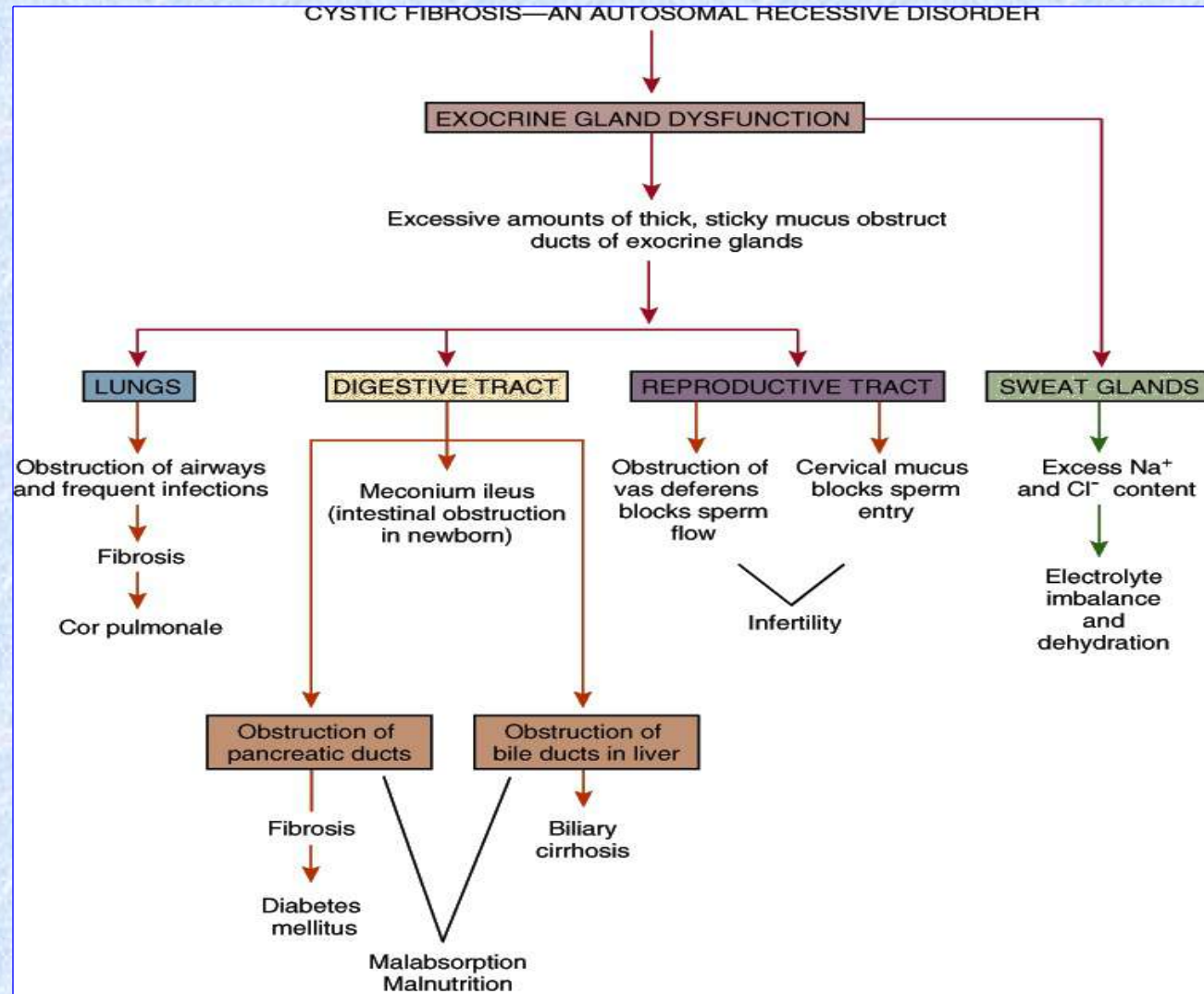
Spread of tuberculosis via bronchi

B

Obstructive Lung Diseases

Cystic Fibrosis

- Also called mucoviscidosis
- Etiol: genetic autosomal recessive
 - Gene on 7th chromosome
- Dx: sweat test

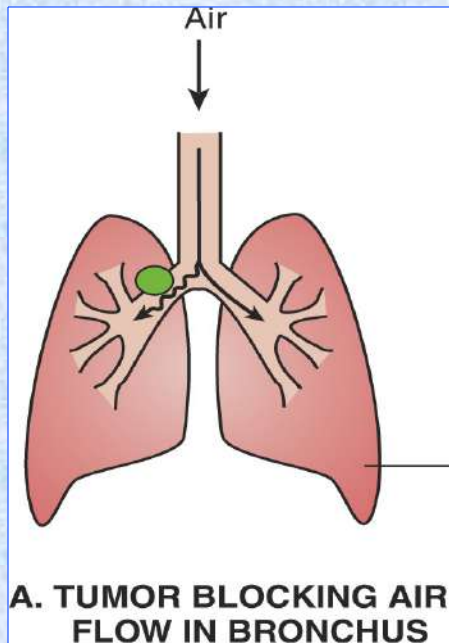


Lung Cancer

- **leading cause of cancer deaths in both men & woman in US**
- **4 cell types**
 - (1) **Oat Cell** (2) **Squamous Cell** (3) **AdenoCa** (4) **Ig cell**
- **Pathophysiology**
 - **Most arise from bronchi or bronchioles**
 - **Squamous cell from large bronchi at hilus of lung**
 - **Slow growing; late metastasis**
 - **Adenocarcinoma (bronchoalveolar)**
 - **Found in periphery**
 - **Present frequently with pleural effusion**
 - **Moderate growth rate**
 - **Oat cell (small cell)**
 - **Found centrally near large bronchus**
 - **Fast growing & early metastasis**
 - **Large cell (undifferentiated)**
 - **Rapid growth & early metastasis**
 - **Found in periphery thus get pleural effusion**

Lung Cancer (cont)

- **Effects from lung cancer**
 - **Obstruction**
 - **Inflammation**
 - **Pleural effusion**
 - **Paraneoplastic syndrome**
 - **The tumor cells secrete hormone-like substances**
 - » **ADH**
 - » **ACTH**



Squamous cell cancer

Oat cell cancer

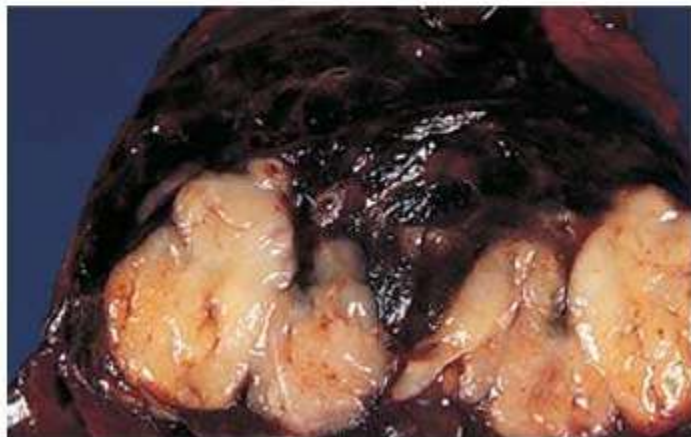


Adenocarcinoma

Large cell cancer



A



C



B

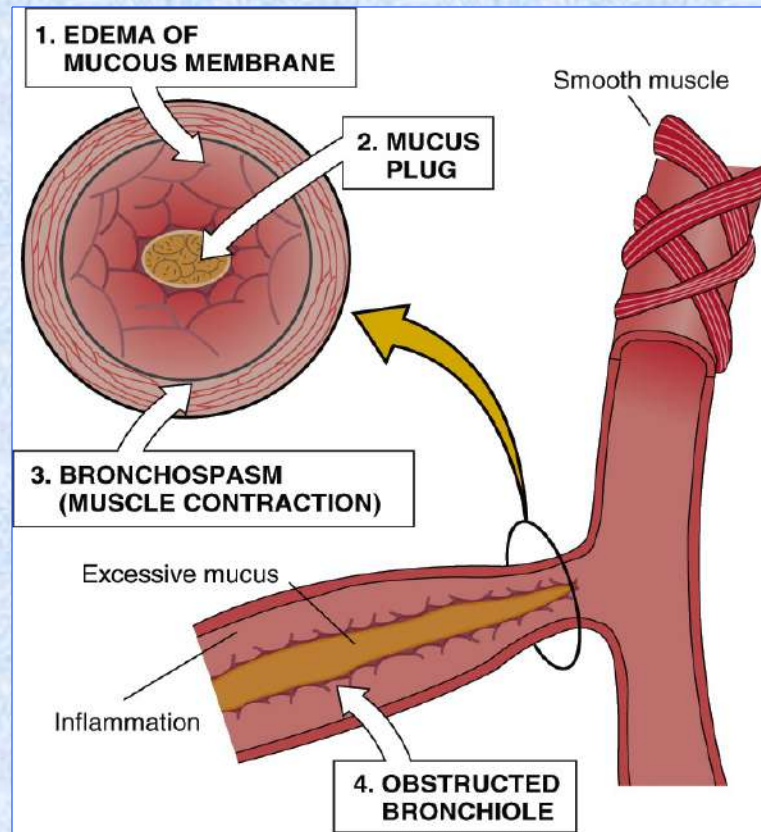
Lung cancer. **A**, Squamous cell carcinoma. This hilar tumor originates from the main bronchus. **B**, Peripheral adenocarcinoma. The tumor shows prominent black pigmentation, suggestive of having evolved in an anthracotic scar. **C**, Small cell carcinoma. The tumor forms confluent nodules. On cross sectioning, the nodules have an encephalid appearance.

Aspiration Pneumonitis

- **Def: passage of foreign material into trachea &/or lungs**
- **Commonest site = right lower lobe (most direct route)**
- **Solid objects produce obstruction**
- **Liquid objects produce inflammation**
- **Complications:**
 - **Acute respiratory distress syndrome**
 - **Pulmonary abscess**
 - **Systemic effects of absorbed material**
- **Etiol:**
 - **Newborn meconium**
 - **Infants & foreign bodies**
 - **Children with congenital abnormalities (e.g. cleft palate)**
 - **Adults at operation**
 - **Adults with “café coronary” --- talking while eating**
 - **Old people with loss of gag reflex**

Asthma

- Def: periodic episodes of reversible bronchial obstruction in people with hypersensitive airways
- Path ----
 1. Bronchospasm & get constricted bronchi , wheezing
 2. Bronchial inflammation & get edema , mucorrhea
 3. Mucorrhea leads to obstructive plugs
- 2 key pathogenetic mechanisms:
 - Bronchospasm & inflammation



Asthma (cont)

- Etiology = immune system gone awry !!!
 - Inflammatory reaction to an antigen from allergen or irritant exposure
 - Then antigen- antibody reaction ; key antibody = IgE
- Allergens & irritants include:
 - » respiratory irritants such as dust & cigarette smoke
 - » exercise, especially in cold weather
 - » allergies
 - » URI & other lung infections
- This causes mast cells to release:
 - » Histamines which constricts bronchi & cause vessels to leak fluid thus producing edema and congestion
 - » Leukotrienes which combine to form SRS-A
 - » Inflammatory cytokines
- » Chronic asthma can lead to irreversible damage to lung tissue from frequent attacks
- » Incidence of asthma has increased over last 10 – 15 years
- » Status asthmaticus

Chronic Obstructive Pulmonary Disease (COPD)

get irreversible progressive obstruction of air flow in lungs

Includes

- (1) Chronic Bronchitis (bronchiectasis)**
- (2) Emphysema**
- (3) Chronic asthma**

General Treatment Plan

- (1) broncodilators(4) anti-inflammatories**
- (2) mucolytic agents(5) antihistamines**
- (3) expectorants(6) antibiotics**

Chronic Bronchitis (COPD)

def = chronic inflammation of mucus membrane

this results in a chronic, deep, productive cough

path = hyperplasia of mucosa & destruction of cilia

**etiol = long term smoking, certain environmental factors such as
textile dust fibers**

Sx = productive cough, SOB, wheezing

Bronchiectasis (COPD)

def = permanent, irreversible dilation & distortion of bronchi

etiol

chronic irritation producing chronic bronchitis

complication of cystic fibrosis

TB

Takes years to develop ; Primarily in the lower lobes

Sx = chronic productive cough, halitosis

Emphysema (COPD)

Def = destructive disease of alveolar septa

**permanent & irreversible
get dilated non-functioning
alveoli**

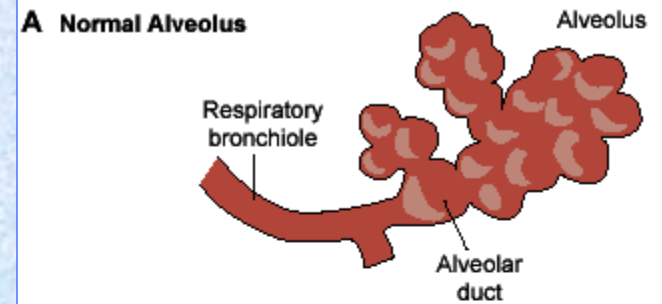
**Etiol = any chronic lung condition,
pollution**

Sx

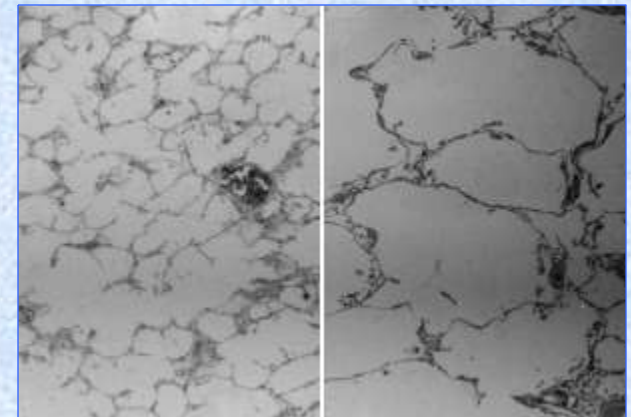
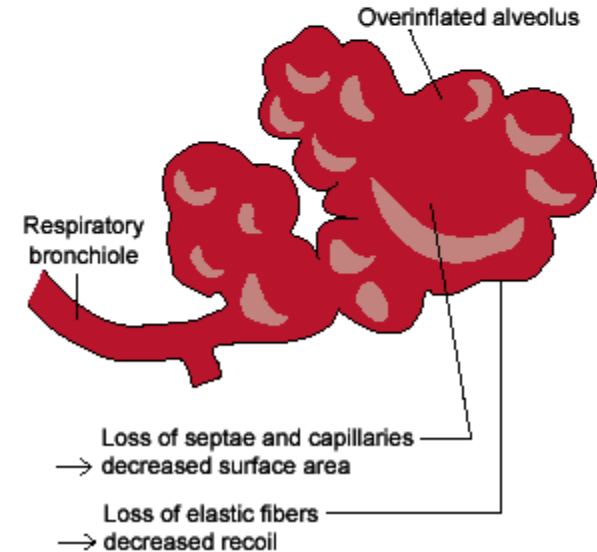
**insidious onset, get progressive
dyspnea
moist productive cough
to exhale must use accessory
muscles, thus get “barrel chest”
patients frequently “purse lips”
to exhale ; this causes
circumoral cyanosis**

Dx

**chest x-ray shows: translucent
appearing lungs, flattened
diaphragm, & cardiomegaly
clubbed fingers
CHF (right sided) with
resultant distended neck
veins and hepatomegaly**



B Emphysema





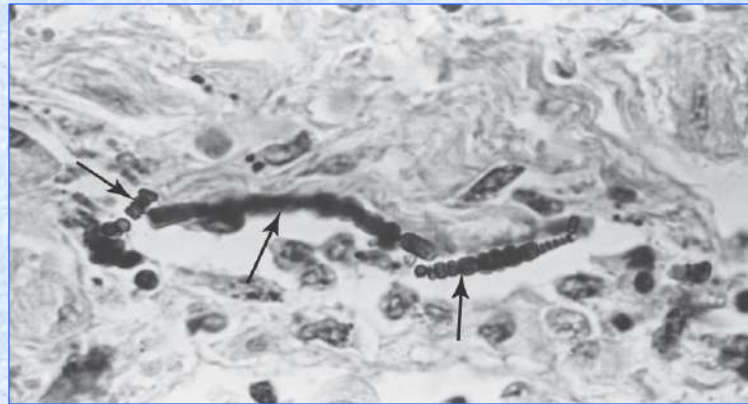
Bullous emphysema & Large subpleural bullae

Restrictive lung disorders

- **2 groups of diseases**
 - 1. Abnormalities of chest wall which limits lung expansion**
 - **Includes:**
 - » **Kyphosis**
 - » **Scoliosis**
 - » **Polio**
 - » **ALS**
 - » **Muscular dystrophy**
 - 2. Disease affecting lung tissue that provides supporting framework**
 - **Includes:**
 - » **Occupational diseases (pneumoconioses)**
 - » **Idiopathic pulmonary fibrosis (autoimmune disease)**
 - » **Pulmonary edema**
 - » **Acute respiratory distress syndrome (ARDS)**

Pneumoconiosis

- Def = occupational diseases from inhaling inorganic dust particles over a long time period (10 years or greater)
- Pathophysiology
 - Get inflammation & fibrosis
 - » This destroys the connective tissue framework of lungs
 - » Lung compliance is lost
 - Of all the causes, asbestosis is worst
 - » Also gives one pleural fibrosis & lung cancer
- Sx :
 - First to appear is dyspnea on exertion
 - Eventually get pulmonary hypertension
- Types
 - **Anthracosis** = black lung disease from coal dust (carbon)
 - **Asbestosis** = from asbestos fibers, most common form
 - **Berylliosis** = from beryllium dust (semiconductors)
 - **Silicosis** = from silica dust (quartz dust) e.g. stone quarries

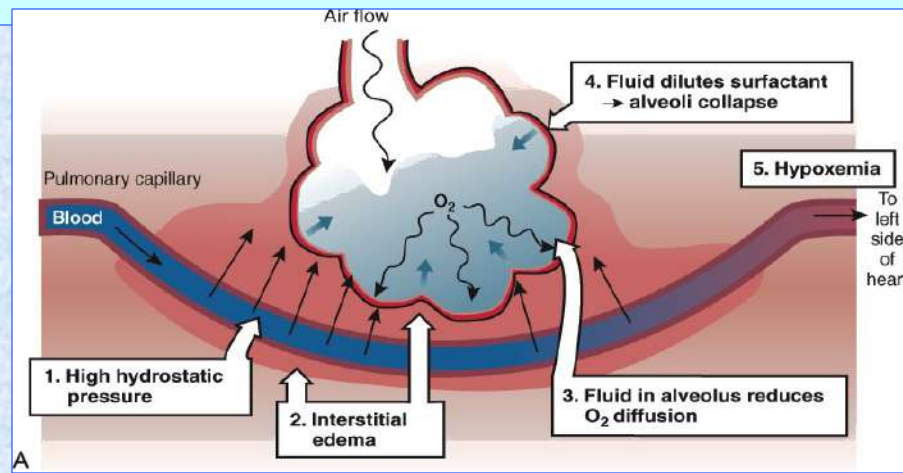


Asbestos bodies in lung

Vascular disorders

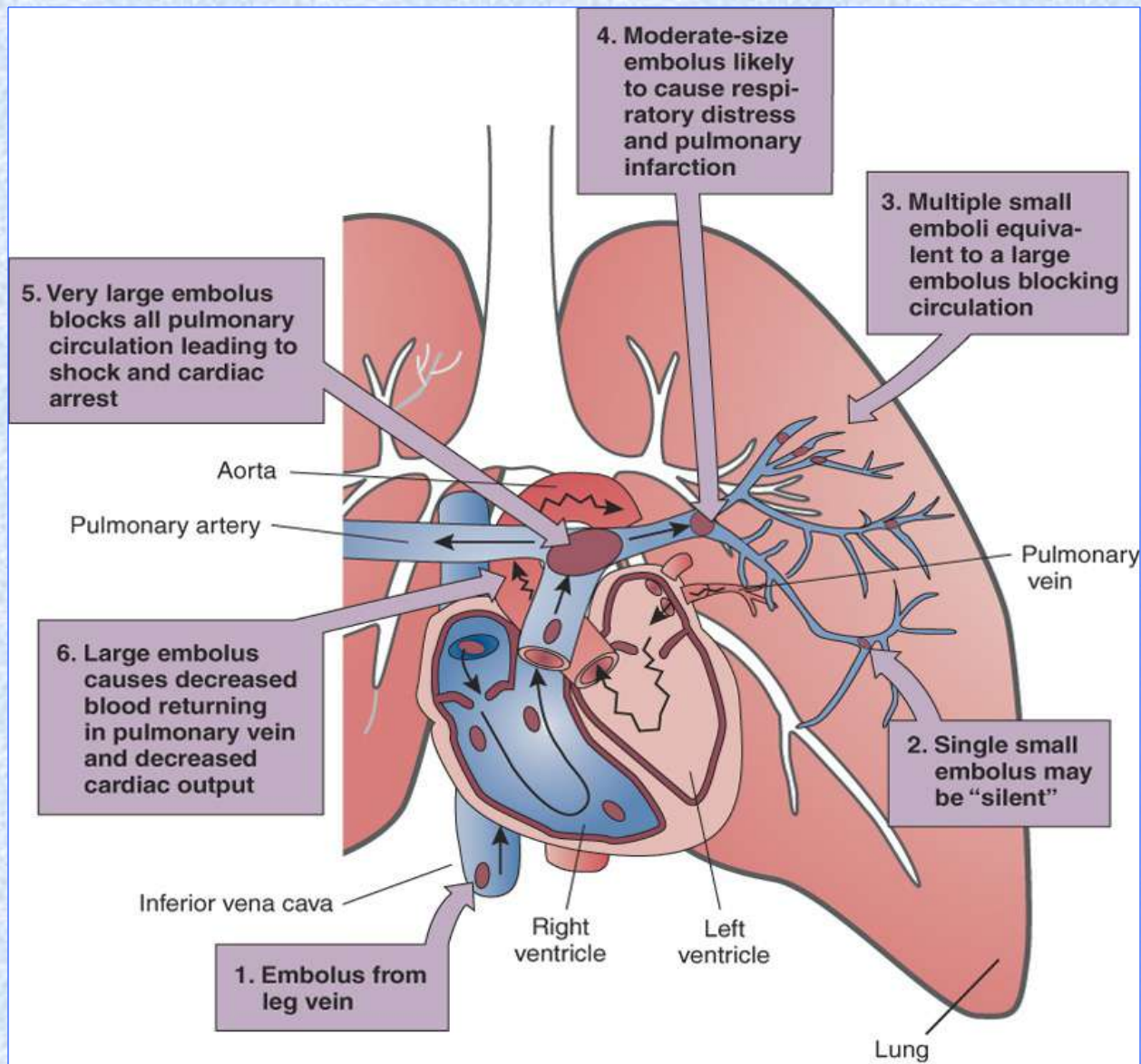
Pulmonary edema

- **Pathophysiology**
 - **Fluid collection (edema) in all lung tissues**
 - **Affects gas exchange**
 - **Affects lung expansion**
 - **Key = pulmonary capillary pressure increases & fluid moves into alveoli**
 - **Capillaries rupture & get bloody sputum (hemoptysis)**
- **True medical emergency**
- **Etiology**
 - **Left sided heart failure**
 - **Hypoproteinemia**
 - **Inhalation of toxic gases**
 - **Lymphatic blockage (e.g. from tumor)**



Pulmonary Emboli

- **def = clot of foreign matter that occludes artery in pulmonary system**
 - » **Size of embolus & general health of patient determine degree of damage and amount of symptoms**
 - » **see next slide for pathophysiology**
- **etiol**
 - **determined by composition of emboli**
 - » **thrombus (most common) , air, fat, bacteria, tissue**
 - **risk increased by CHF, lung disease, stasis with varicosities**
 - **90% originate from deep veins (primarily in leg)**
 - **Old age large bone fractures give fat emboli**
- **Sx**
 - **generally apprehension, cough, chest pain, fever**
 - **if severe ----- dyspnea, tachypnea, hemoptysis**
 - **if massive ----- shock & death**
- **Dx = imaging, blood gases**
- **Tx**
 - **maintain adequate ventilation via O2 & anticoagulants**
 - **? Thrombolytic drugs**
 - **Prevention via early ambulation, TED Stockings**



Pathophysiology of pulmonary embolus

Expansion disorders

Atelectasis

not a disease, but a condition where you get collapsed pulmonary tissue
this condition results in degrees of hypoxia

Sx

dyspnea

if large area involved get anxiety, diaphoresis, substernal retraction,
cyanosis

Etiol

see next slide

(1) obstruction of bronchial tree via, CA, FB, inflammation

Obstruction leads to absorption atelectasis

(2) pleural effusion

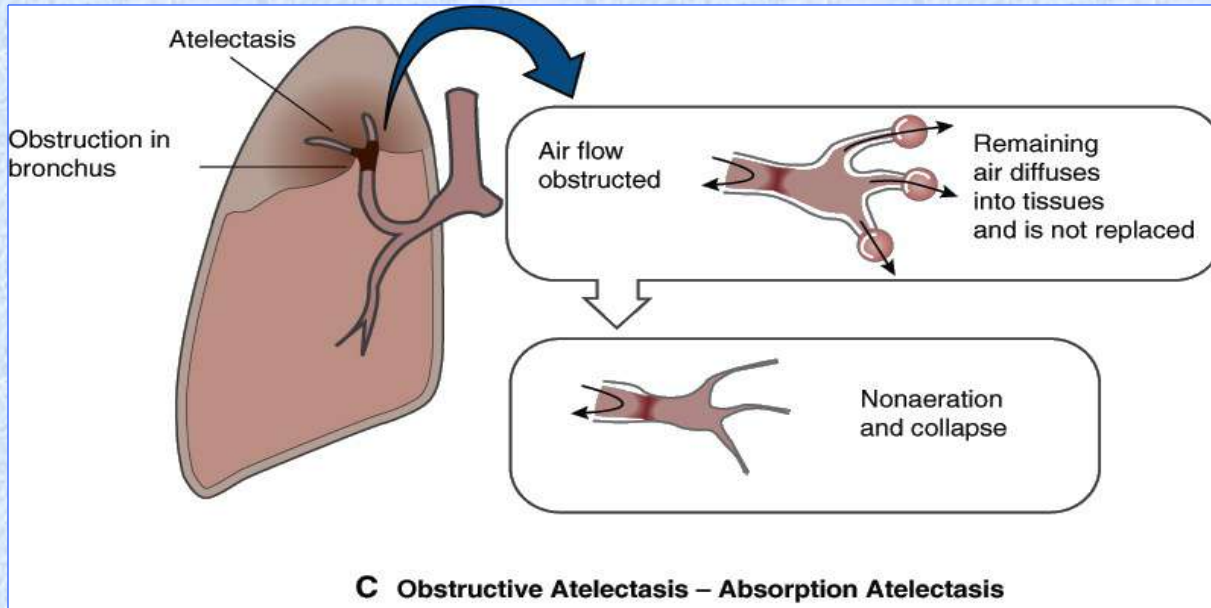
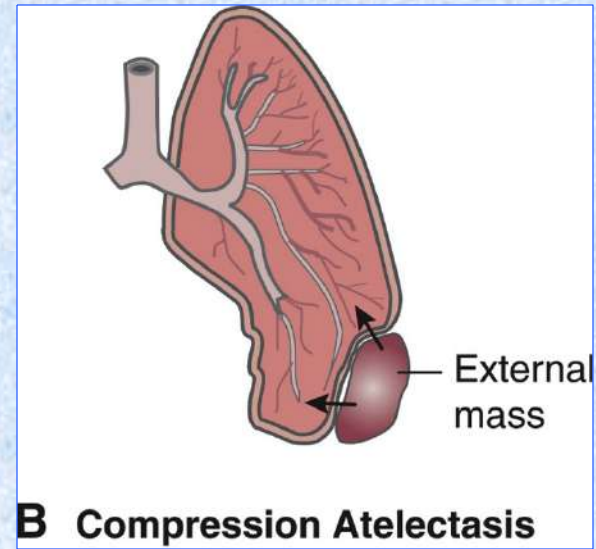
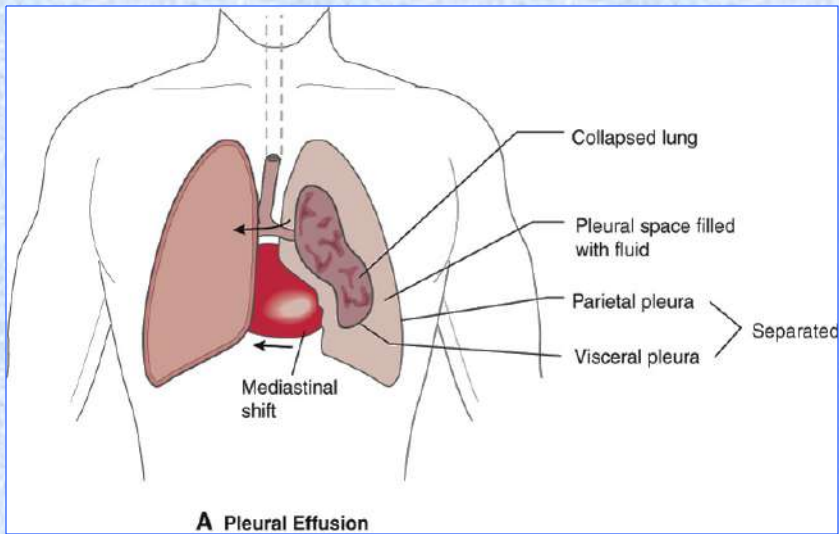
(3) inadequate effort at breathing

in newborn via prematurity or maternal narcosis

Post-op

(4) compression atelectasis

Tx = IPPB, suction & O₂ if obstruction



Pleural effusion & pleuritis

Pleurisy (Pleuritis)

def = inflammation of membranes that surround lungs and pleural cavity---i.e. parietal & visceral pleura

**etiol = secondary to other diseases, esp. pneumonia & cancer
can also be secondary to trauma**

2 types

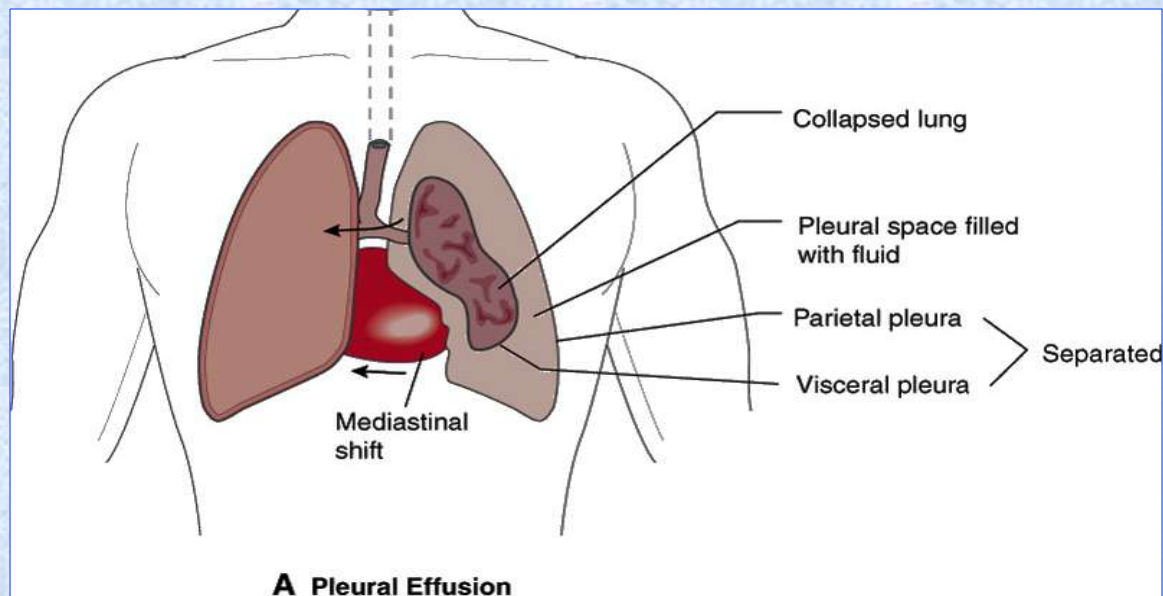
**Wet Type ----- get increase fluid in space & thus lung
compression with pain on inspiration**

**Dry Type ----- get decrease fluid, thus get friction
when breathing (friction rub)**

Sx = pain with inspiration & shallow, rapid breaths

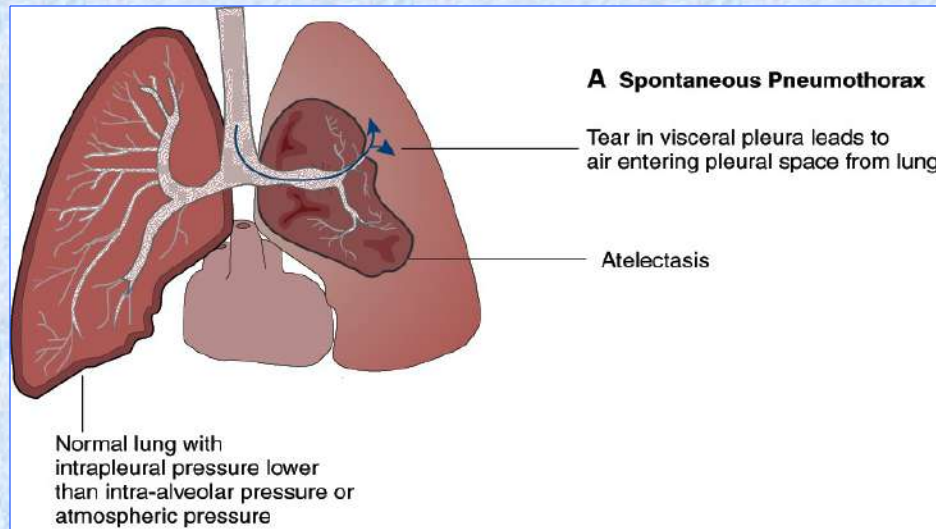
Pleural Effusion

- “wet” pleuritis results in pleural effusion
- **Pathophysiology** = fluid separates the two pleural membranes and thus the lungs do not expand properly during inspiration since no cohesion between ---- lung/visceral pleura/ parietal pleura
- Large effusions give **mediastinal shift**
- Large effusions increase pressure in mediastinum & impair cardiac filling
- Types:
 - Transudates = **hydrothorax**
 - Blood = **hemothorax**
 - Pus = **empyema**



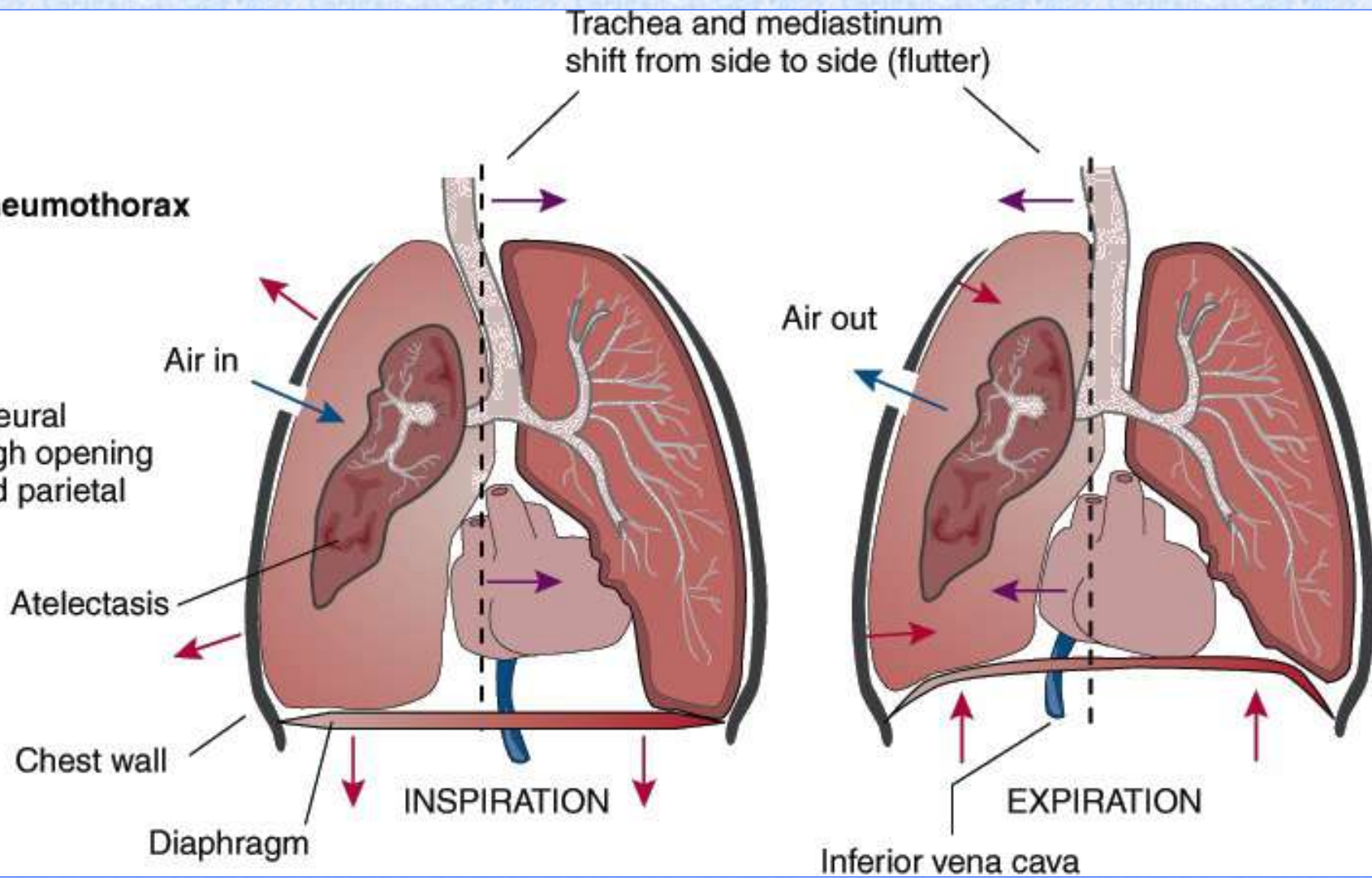
Pneumothorax

- def = collection of air or gas in pleural cavity resulting in collapse (either partial or full) of lung
- Etiol & types
 - Spontaneous pneumothorax
 - » from blebs,
 - » from too much pressure with ventilation,
 - » from tumor
 - Open pneumothorax --- usually secondary to trauma
 - Tension pneumothorax
 - » Both of the above may result in this serious typo
- Sx = sudden pain & shock-like symptoms
- Tx = thoracentesis with chest tube see next slides

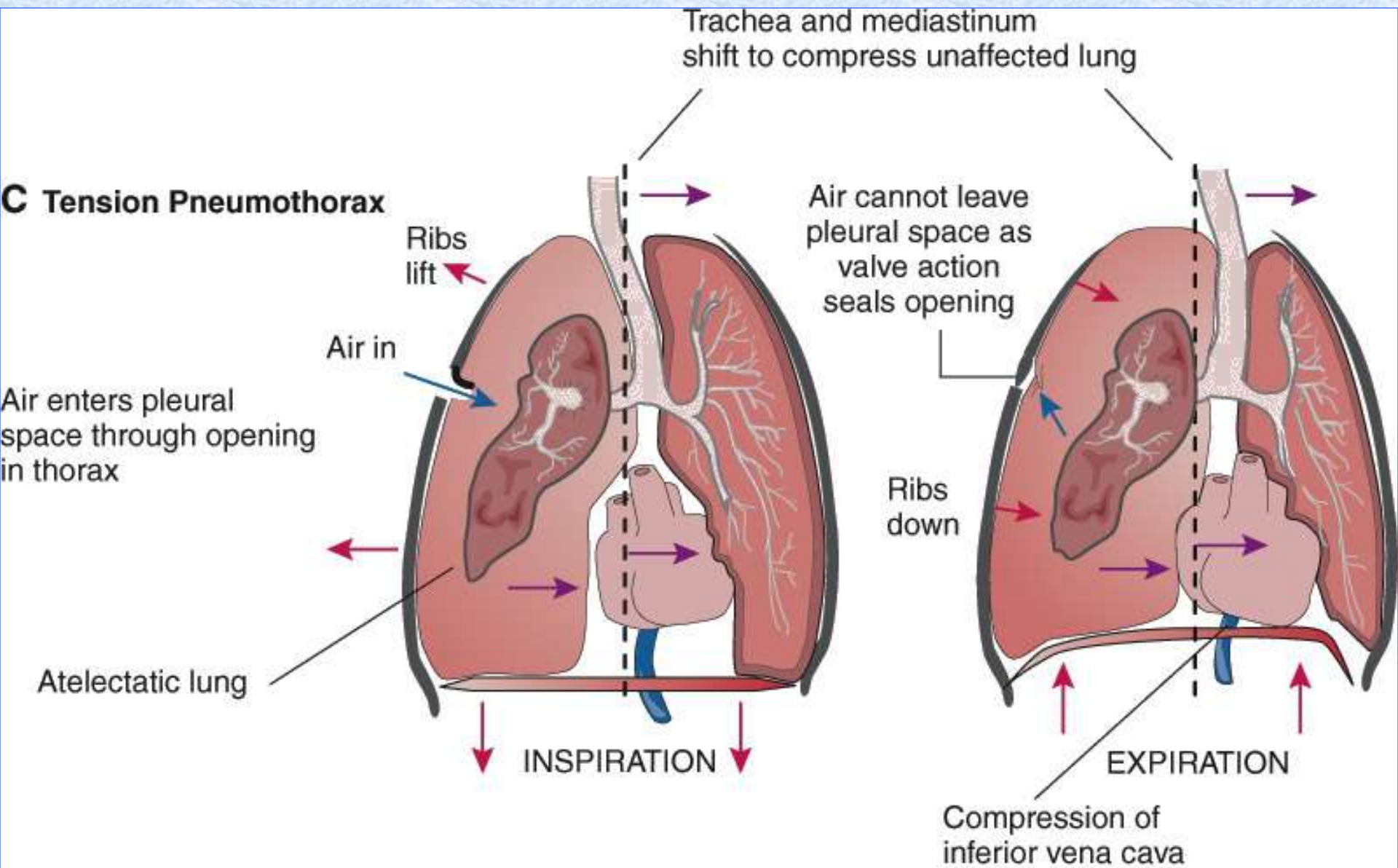


B Open Pneumothorax

Air enters pleural space through opening in thorax and parietal pleura



C Tension Pneumothorax



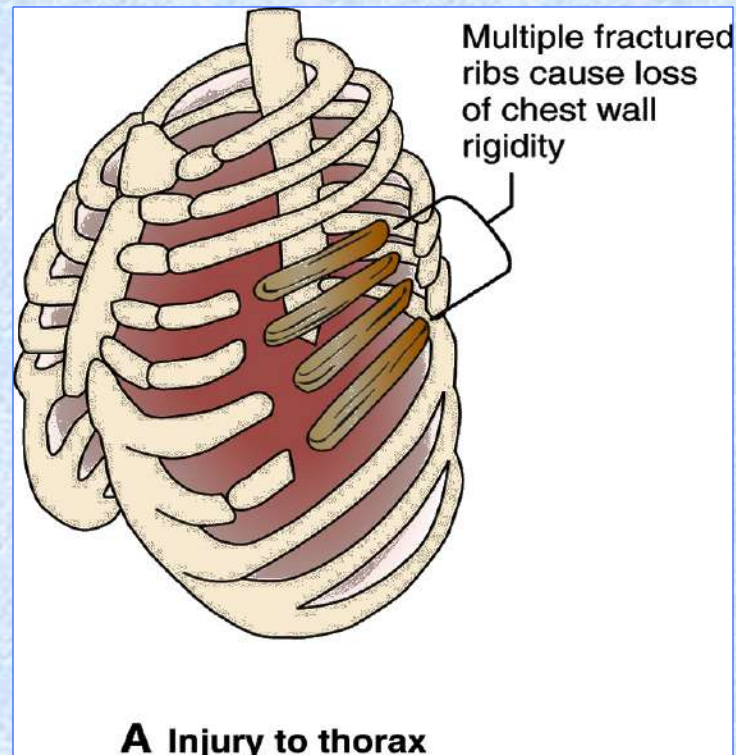
Flail Chest

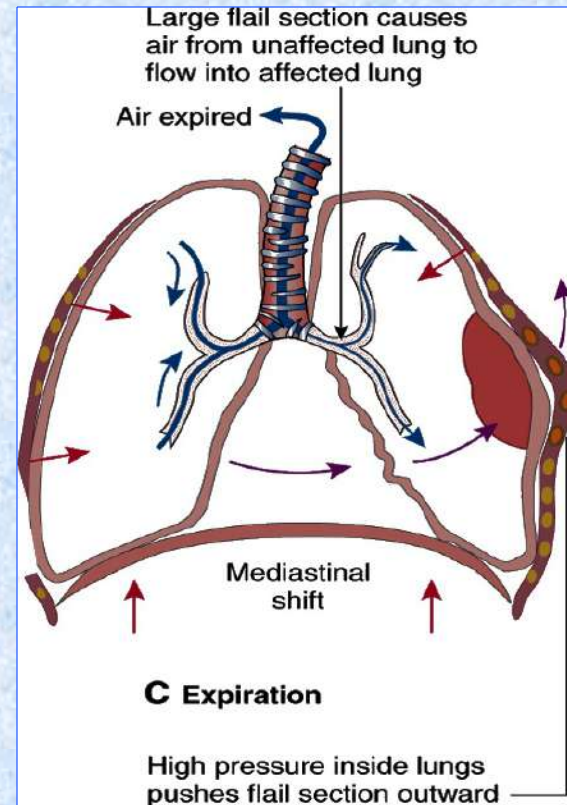
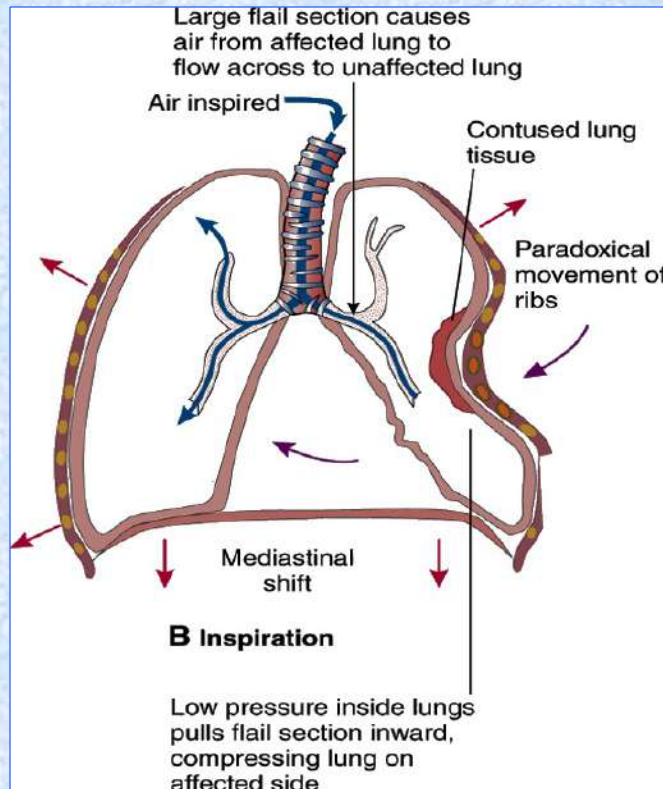
def = double fracture of 3 or more adjacent ribs

Sx = segment involved moves in with inspiration & out with expiration, thus **paradoxical movement of ribs**

etiol = trauma, auto steering wheel

Temporary treatment = stabilize flail section of thorax with heavy object to prevent outward flaring





RDS (Respiratory Distress Syndrome)

- **2 Types:**
 - **Infant RDS(also called: hyaline membrane disease)**
 - leading cause of death in premies
 - etiol = **not enough surfactant**
 - » First appears in early 3rd trimester & is adequate by 37 weeks
 - Amount determined by L/S ratio
 - » lecithin-sphingomyelin
 - » Done via amniocentesis
 - Treatment = synthetic surfactant (Exosurf Neonatal)

2 Types:

Adult RDS (currently called: Acute Respiratory Distress Syndrome (ARDS))

Called “shock lung”

def = alveoli fill with exudate & get respiratory failure

etiol = inhalation of things that **ruin surfactant & inflame endothelium**

exp = water, smoke, vomit, chem fumes

pathophysiology = alveolar & capillary wall injury

Inflammatory reaction to noxious agents that affects:

Type II alveolar cells
(they produce surfactant)

Capillary endothelial cells

