Respiratory System Disorders
Respiratory Control

A. NORMAL CYCLE

- Increased P\textsubscript{CO}_2 in blood and CSF
- Stimulates central chemoreceptors in medulla
- Stimulates inspiratory muscles
- Increases respiratory rate
- Decreased P\textsubscript{CO}_2
- Removes more CO\textsubscript{2} from body
- Decreased chemoreceptor stimulation
- Slow respirations
- Retain more CO\textsubscript{2}
Control of Ventilation

- Hypercapnia
  - Carbon dioxide levels in the blood increase.
  - Carbon dioxide easily diffuses into CSF.
    - Lowers pH and stimulates respiratory center
    - Increased rate and depth of respirations (hyperventilation)
    - Hyperventilation causes respiratory alkalosis // nervous system depression
Control of Ventilation

- Hypoxemia // Marked decrease in oxygen
  - Primary stimulus is high CO2 however
  - Extended period of low oxygen will cause chemoreceptors to react to low PO2
  - Important control mechanism in individuals with chronic lung disease — a move to hypoxic drive
Control of Ventilation

- Hypocapnia

  - Caused by low carbon dioxide concentration (low partial pressure of carbon dioxide) in blood
  - May be caused by hyperventilation which leads to excessive amounts of carbon dioxide expired
  - Causes respiratory alkalosis
Gas Exchange

- Flow of gases between the alveolar air and blood (external respiration)

- Gas exchange depends on the relative concentrations (partial pressures) of the gases.
  - \( \text{PO}_2 \) — partial pressure of oxygen
  - \( \text{PCO}_2 \) — partial pressure of carbon dioxide

- Each gas in a mixture moves along its partial pressure gradient, independent of other gases (Dalton’s law).
Pulmonary Capillaries Around Alveolus
Cross Section of Alveolus
The Respiratory Membrane

B. Cross-section of an alveolus

- Surfactant-producing cell
- Squamous epithelial cell (alveolar)
- Layer of surfactant
- Alveolar macrophage
- Alveolo-capillary interspace
- Capillary
- Squamous endothelial cell (capillary)
- RBC
- Elastic fiber
- Connective tissue cell
Diffusion of Gases

C. Diffusion of gases

<table>
<thead>
<tr>
<th>Inspired air</th>
<th>Expired air</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{O_2} = 160$</td>
<td>$P_{O_2} = 120$ mm Hg</td>
</tr>
<tr>
<td>$P_{CO_2} = 0.3$</td>
<td>$P_{CO_2} = 27$ mm Hg</td>
</tr>
</tbody>
</table>

Lungs

Alveolus

RBC

Pulmonary artery

Pulmonary vein

Diffusion of $CO_2$ into alveolus

Diffusion of $O_2$ into blood
Factors Affecting Diffusion of Gases

- Partial pressure gradient
- Thickness of the respiratory membrane // Fluid accumulation in alveoli or interstitial tissue impairs gas exchange.
- Total surface area available for diffusion // If part of alveolar wall is destroyed, surface area is reduced, so less exchange
- Ventilation-perfusion ratio // Ventilation (air flow) and perfusion (blood flow) need to match for maximum gas exchange.
Transport of Oxygen

- Oxygen

- About 1% of oxygen is dissolved in plasma.

- Most is bound (reversibly) to hemoglobin.

- Binding and release of oxygen to hemoglobin depend on:
  - $PO_2$,
  - $PCO_2$,
  - temperature,
  - plasma pH
Transport of Carbon Dioxide

- Carbon dioxide
  - Waste product from cellular metabolism
  - About 7% dissolved in plasma
  - About 20% reversibly bound to hemoglobin
  - Most diffuses into red blood cells
Oxyhemoglobin Dissociation Curve
Diagnostic Tests

- Spirometry—pulmonary function test (PFT) // Test pulmonary volumes and airflow times

- Arterial blood gas determination // Checks oxygen, carbon dioxide, bicarbonate, serum pH

- Oximetry // Measures O₂ saturation

- Exercise tolerance testing // For patients with chronic pulmonary disease
Diagnostic Tests

- Radiography // Helpful in evaluating tumors and Evaluate infections
- Bronchoscopy // Perform biopsy to check site of lesion or bleeding.
- Culture and sensitivity tests
  - Sputum testing for presence of pathogens
  - Determine antimicrobial sensitivity of pathogen
General Manifestations of Respiratory Disease

- **Sneezing** // Reflex response to irritation in upper respiratory tract
  - Assists in removing irritant
  - Associated with inflammation or foreign material

- **Coughing**
  - Irritation caused by nasal discharge
  - Inflammation or foreign material in lower respiratory tract
  - Caused by inhaled irritants
General Manifestations of Respiratory Disease Sputum

- Yellowish-green, cloudy, thick mucus // Often indication of a bacterial infection

- Rusty or dark-colored sputum // Usually sign of pneumococcal pneumonia

- Very large amounts of purulent sputum with foul odor // May be associated with bronchiectasis

- Thick, tenacious mucus // Asthma or cystic fibrosis, blood-tinged sputum - may result from chronic cough; may also be sign of tumor or tuberculosis

- Hemoptysis // Blood-tinged (bright red) frothy sputum, usually associated with pulmonary edema
Breathing Patterns and Characteristics

- Eupnea // Normal rate

- Kussmaul respirations // Deep rapid respirations
  - typical for acidosis
  - may follow strenuous exercise
Breathing Patterns and Characteristics

- Labored respiration or prolonged inspiration or expiration // Often associated with obstruction of airways

- Wheezing or whistling sounds // Indicate obstruction in small airways

- Stridor // High-pitched crowing noise
  - Usually indicates upper airway obstruction
# Respiratory Patterns

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eupnea</td>
<td>Rhythm is smooth and even with expiration longer than inspiration.</td>
</tr>
<tr>
<td>Tachypnea</td>
<td>Rapid superficial breathing; regular or irregular rhythm.</td>
</tr>
<tr>
<td>Bradypnea</td>
<td>Slow respiratory rate; deeper than usual depth; regular rhythm.</td>
</tr>
<tr>
<td>Apnea</td>
<td>Cessation of breathing.</td>
</tr>
<tr>
<td>Hyperpnea</td>
<td>Increased depth of respiration with a normal to increased rate and regular rhythm.</td>
</tr>
<tr>
<td>Cheyne-Stokes respiration</td>
<td>Periodic breathing associated with periods of apnea, alternating regularly with a series of respiratory cycles; the respiratory cycle gradually increases, then decreases in rate and depth.</td>
</tr>
<tr>
<td>Ataxic breathing</td>
<td>Periods of apnea alternating irregularly with a series of shallow breaths of equal depth.</td>
</tr>
<tr>
<td>Kussmaul's respiration</td>
<td>Deep regular sighing respirations with an increase in respiratory rate.</td>
</tr>
<tr>
<td>Apneusis</td>
<td>Long, gasping inspiratory phase followed by a short, inadequate expiratory phase.</td>
</tr>
<tr>
<td>Obstructed breathing</td>
<td>Long, ineffective expiratory phase with shallow, increased respirations.</td>
</tr>
</tbody>
</table>

General Manifestations of Respiratory Disease

Breath Sounds

- **Rales** // Light bubbly or crackling sounds, with serous secretions

- **Rhonchi** // Deeper or harsher sounds from thicker mucus

- **Absence** // Nonaeration or collapse of lungs
General Manifestations of Respiratory Disease

- **Dyspnea** // Subjective feeling of discomfort
  - May be caused by increased carbon dioxide or hypoxemia
  - Often noted on exertion, such as climbing stairs

- Severe dyspnea indicative of respiratory distress
  - Flaring of nostrils
  - Use of accessory respiratory muscles
  - Retraction of muscles between or above ribs

- **Orthopnea**
  - Occurs when lying down
  - Usually caused by pulmonary congestion
General Manifestations of Respiratory Disease

- **Paroxysmal nocturnal dyspnea**
  - Sudden acute type of dyspnea
  - Common in patients with left-sided congestive heart failure

- **Cyanosis**
  - Bluish coloring of skin and mucous membranes // Caused by large amounts of unoxygenated hemoglobin in blood

- **Pleural pain**
  - Results from inflammation or infection of parietal pleura
General Manifestations of Respiratory Disease

- Friction rub // Soft sound produced as rough, inflamed, or scarred pleural move against each other

- Clubbed digits // Result from chronic hypoxia associated with respiratory or cardiovascular diseases // Painless, firm, fibrotic enlargement at the end of the digit

- Changes in arterial blood gases
  - Hypoxemia—inadequate oxygen in blood
  - Hypercapnea—increased carbon dioxide in blood
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Effect</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid inhaling irritants and maintain good ventilation</td>
<td>Reduce inflammation and infection</td>
<td>Cigarette smoke, industrial pollutants</td>
</tr>
<tr>
<td>Current immunizations</td>
<td>Prevent infection</td>
<td>Influenza and pneumonia vaccines</td>
</tr>
<tr>
<td>Humidify air</td>
<td>Moist mucosa resists damage, thin and remove secretions</td>
<td>Cool-air humidifiers, croup tents</td>
</tr>
<tr>
<td>Moderate exercise</td>
<td>Improves lung function and circulation</td>
<td>Walking, swimming</td>
</tr>
<tr>
<td>Breathing and coughing</td>
<td>Improve lung expansion and remove secretions</td>
<td>Techniques appropriate for specific condition (e.g., pursed-lip breathing)</td>
</tr>
<tr>
<td>Chest physiotherapy</td>
<td>Remove thick secretions and reduce infections</td>
<td>Clapping, postural drainage</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Improve oxygen supply to all body cells</td>
<td>Nasal cannula, face mask or mechanical ventilation</td>
</tr>
</tbody>
</table>

**Drugs**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Effect</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decongestants</td>
<td>Vasoconstriction in nasal mucosa, reduce edema</td>
<td>Phenylpropanolamine, pseudoephedrine</td>
</tr>
<tr>
<td>Expectorants</td>
<td>Thin respiratory secretions for easier removal</td>
<td>Guaifenesin</td>
</tr>
<tr>
<td>Antitussives</td>
<td>Reduce cough reflex</td>
<td>Codeine, dextromethorphan (DM)</td>
</tr>
<tr>
<td>Antihistamines</td>
<td>Block H1 receptors to reduce allergic response</td>
<td>Diphenhydramine, loratadine</td>
</tr>
<tr>
<td>Analgesics</td>
<td>Reduce pain</td>
<td>Acetaminophen, codeine</td>
</tr>
<tr>
<td>Antimicrobials</td>
<td>Prophylaxis and treatment of infection (sputum culture and sensitivity)</td>
<td>Antibacterial—penicillin, antiviral—amantadine, zanamivir, antitubercular—isoniazid rifampin</td>
</tr>
<tr>
<td>Bronchodilators</td>
<td>Stimulate beta-2 adrenergic receptors to open bronchioles</td>
<td>Theophylline (oral) salbutamol (inhaler)</td>
</tr>
<tr>
<td>Glucocorticoids</td>
<td>Anti-inflammatory, antiallergenic</td>
<td>Beclomethasone (inhaler) prednisone (oral)</td>
</tr>
</tbody>
</table>

**Surgical Interventions**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Effect</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thoracentesis</td>
<td>Removal of excess fluid from pleural cavity, prevent atelectasis</td>
<td>Pleurisy, cancer</td>
</tr>
<tr>
<td>Tracheotomy</td>
<td>Incision into the trachea below the larynx to permit air intake</td>
<td>Emergency obstructed airway (e.g., aspiration, edema)</td>
</tr>
<tr>
<td>Surgery</td>
<td>Remove tumor, abscess or damaged tissue</td>
<td>Resection, lobectomy</td>
</tr>
</tbody>
</table>
Infectious Diseases
Upper Respiratory Tract Infections

- Common cold (infectious rhinitis)
  - Viral infection
  - More than 200 possible causative agents
  - Spread through respiratory droplets
  - Hand-washing and respiratory hygiene important in prevention
  - Symptomatic treatment
  - Secondary bacterial infections may occur.
    - Usually caused by streptococci
    - Purulent exudate; systemic signs, such as fever
Complications of Viral Respiratory Infection

PRIMARY VIRAL INFECTION
(e.g., INFLUENZA or COMMON COLD VIRUS)

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

CONGESTION
OBSTRUCTED AIRWAYS

Good air flow
Poor air flow

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

Bacteria invade necrotic area

Purulent exudate

Upper Respiratory Tract Infections

● Sinusitis

- Usually bacterial infection

- Treated with analgesics for headache and pain

- Course of antibiotics often required to eradicate infection
Upper Respiratory Tract Infections

- Laryngotracheobronchitis (croup)
  - Common viral infection, particularly in children
  - Common causative organism // Parainfluenza viruses and adenoviruses
  - Infection usually self-limited
# General Comparison of Respiratory Infections in Children

<table>
<thead>
<tr>
<th></th>
<th>Laryngotracheobronchitis</th>
<th>Epiglottitis</th>
<th>Bronchiolitis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age group</strong></td>
<td>3 months to 3 years</td>
<td>3-7 years</td>
<td>2-12 months</td>
</tr>
<tr>
<td><strong>Cause</strong></td>
<td>Virus</td>
<td><em>Haemophilus influenzae</em></td>
<td>Virus—RSV</td>
</tr>
<tr>
<td><strong>Pathology</strong></td>
<td>Inflammation of mucosa of larynx and trachea obstructs airway</td>
<td>Supraglottic inflammation and swelling of epiglottis obstructs airway</td>
<td>Inflammation of mucosa of bronchioles obstructs small passages</td>
</tr>
<tr>
<td><strong>Onset</strong></td>
<td>Gradual</td>
<td>Rapid</td>
<td>Gradual</td>
</tr>
<tr>
<td><strong>Signs</strong></td>
<td>Hoarse, barking cough</td>
<td>Drooling, dysphagia</td>
<td>Increasing dyspnea</td>
</tr>
<tr>
<td></td>
<td>Inspiratory stridor</td>
<td>High fever, appears ill</td>
<td>Paroxysmal cough, wheezing</td>
</tr>
<tr>
<td></td>
<td>Restlessness</td>
<td>Rapid respirations and pulse</td>
<td>Chest retractions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tripod position</td>
<td>Flared nares</td>
</tr>
</tbody>
</table>
Upper Respiratory Tract Infections: Epiglottitis

- Acute infection  //  Common in children ages 3 to 7 years
- Usually caused by *Haemophilus influenzae* type B
- Rapid onset; fever and sore throat
- Child sits in tripod position
- Drooling and difficulty swallowing
- Heightened anxiety
Upper Respiratory Tract Infections: Epiglottitis

- Swelling of the larynx, supraglottic area, and epiglottis
  - May obstruct airway
  - Spasm of larynx common if area is touched with instruments

- Treatment: Oxygen and antimicrobial therapy
Upper Respiratory Tract Infections: Influenza (Flu)

- Viral infection

- Three groups of influenza viruses
  - Type A (most prevalent), types B and C
  - Viruses constantly mutate.

- Sudden, acute onset with fever, marked fatigue, aching pain in the body
  - May also cause viral pneumonia
  - Mild case of influenza may be complicated by secondary bacterial pneumonia.
  - Commonly, deaths in flu epidemics result from pneumonia.
Upper Respiratory Tract Infections: Influenza (Flu)

- **Treatment**
  - Symptomatic and supportive // Unless bacterial infection develops secondarily
  - Antiviral drugs // May reduce symptoms and duration - Reduces risk to infect others

- **Prevention**
  - Respiratory hygiene!
  - Vaccination is recommended for most individuals.
Type A H1N1 Influenza

- This virus contains genes from pig, bird, and human flu strains.
- Usually affects children and teens younger than 20 years.
- Healthy young adults also at high risk.
- High mortality rate caused by acute respiratory syndrome:
  - Pulmonary edema
  - Pneumonia
  - Requires ICU care
Scarlet Fever

- Caused by group A β-hemolytic Streptococcus (S. pyogenes)

- Symptoms
  - Typical “strawberry” tongue
  - Fever, sore throat
  - Chills, vomiting, abdominal pain, malaise

- Treatment // Antibiotics
Scarlet Fever
Lower Respiratory Tract Infections: Bronchiolitis

- Caused by the respiratory syncytial virus (RSV)
- Transmitted by oral droplet
- Virus causes necrosis, inflammation in small bronchi and bronchioles
- Signs // Wheezing and dyspnea, rapid shallow respirations, cough, rales, chest retractions, fever, malaise
- Treatment // Supportive and symptomatic
Lower Respiratory Tract Infections: Pneumonia

- Classification of pneumonias based on:
  - Causative agent // Viral, bacterial, fungal
  - Anatomical location of infection // Throughout both lungs, or consolidated in one lobe
  - Pathophysiological changes // Changes in interstitial tissue, alveolar septae, alveoli
  - Epidemiological data
    - Nosocomial (hospital-acquired)
    - Community-acquired
### TABLE 13-4 Types of Pneumonia

<table>
<thead>
<tr>
<th></th>
<th>Lobar Pneumonia</th>
<th>Bronchopneumonia</th>
<th>Interstitial Pneumonia (Primary Atypical Pneumonia, PAP)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distribution</strong></td>
<td>All of one or two lobes</td>
<td>Scattered small patches</td>
<td>Scattered small patches</td>
</tr>
<tr>
<td><strong>Cause</strong></td>
<td><em>Streptococcus pneumoniae</em></td>
<td>Multiple bacteria</td>
<td>Influenza virus</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Mycoplasma</em></td>
</tr>
<tr>
<td><strong>Pathophysiology</strong></td>
<td>Inflammation of alveolar wall and leakage of cells, fibrin, and fluid into alveoli causing consolidation Pleura may be inflamed</td>
<td>Inflammation and purulent exudate in alveoli often arising from prior pooled secretions or irritation</td>
<td>Interstitial inflammation around alveoli Necrosis of bronchial epithelium</td>
</tr>
<tr>
<td><strong>Onset</strong></td>
<td>Sudden and acute</td>
<td>Insidious</td>
<td>Variable</td>
</tr>
<tr>
<td><strong>Signs</strong></td>
<td>High fever and chills</td>
<td>Mild fever</td>
<td>Variable fever, headache</td>
</tr>
<tr>
<td></td>
<td>Productive cough with rusty sputum</td>
<td>Productive cough with yellow-green sputum</td>
<td>Aching muscles</td>
</tr>
<tr>
<td></td>
<td>Rales progressing to absence of breath sounds in affected lobes</td>
<td>Dyspnea</td>
<td>Nonproductive hacking cough</td>
</tr>
</tbody>
</table>
Types of Pneumonia

1. Bronchopneumonia (Diffuse — bacterial)
2. Lobar pneumonia (consolidation — bacterial) with pleurisy
3. Primary atypical pneumonia (interstitial — viral/mycoplasmal)

Lobar Pneumonia / Bacterial pneumonia

- Community-based, often in healthy young adults
- Usually caused by *Streptococcus pneumoniae*
- Infection localized in one or more lobes.
  - Inflammation and vascular congestion—exudate forms in the alveoli
  - Exudate contains fibrin and forms a consolidated mass
  - Exudate produces rusty sputum
- Adjacent pleurae frequently involved
- Infection may spread to pleural cavity—empyema
Lobar Pneumonia / Manifestations

- Sudden onset
- Systemic signs // High fever with chills, fatigue, leukocytosis
- Dyspnea, tachypnea, tachycardia
- Pleural pain
- Rales
- Productive cough // Typical rusty-colored sputum
- Confusion and disorientation
Bronchopneumonia

- Diffuse pattern of infection in both lungs
- Several species of microorganisms may be the cause.
- Inflammatory exudate forms in alveoli
- Onset tends to be insidious // Moderate fever, cough, rales
  - Productive cough with purulent sputum—usually yellow or green
- Antibacterial treatment
Legionnaires’ Disease

- Caused by *Legionella pneumophila*
  - Thrives in warm, moist environments
  - Often nosocomial infection
- Difficult to identify - requires special culture medium
- Untreated infections
  - Cause severe congestion and consolidation
  - Necrosis in the lung
  - Possibly fatal
Primary Atypical Pneumonia

- *Mycoplasma pneumoniae* – bacterial
- Common in older children and young adults
- Transmitted by aerosol  //  Frequent cough, antibiotic therapy
  - Viral form caused by influenza A or B, adenoviruses, RSV
  - Unproductive cough, hoarseness, sore throat, headache, mild fever, malaise
- Infection varies greatly in severity.  //  usually self-limiting.
Severe Acute Respiratory Syndrome (SARS)

- Acute respiratory infection
- Causative microbe - SARS-associated coronavirus
  - Transmission by respiratory droplets—close contact
  - First signs // Fever, headache, myalgia, chills, anorexia, possibly diarrhea
  - Later signs // Effect on lungs evident
    - dry cough, marked dyspnea; areas of interstitial congestion, hypoxia; mechanical ventilation may be required.
SARS Treatment

- Antivirals, glucocorticoids

- High fatality rate

- Risk factors (monitored to prevent outbreaks)
  - Travel to endemic or epidemic area
  - Close contact with such a traveler

- Presence of a cluster of undiagnosed atypical pneumonia cases

- Employment involving close contact with the virus
  // Active cases quarantined until clear of infection
Tuberculosis

• Cause

  - *Mycobacterium tuberculosis* transmitted by oral droplets from persons with active infection

  - Occurs more frequently with:

  - People living in crowded conditions
  - Immunodeficiency
  - Malnutrition
  - Alcoholism
  - Conditions of war
  - Chronic disease
  - HIV infection
Tuberculosis

- Usual caused by *M. tuberculosis*
  - Somewhat resistant to drying and many disinfectants
  - Can survive in dried sputum for weeks
  - Destroyed by ultraviolet light, heat, alcohol, glutaraldehyde, formaldehyde
  - Normal neutrophil response does not occur
  - Cell-mediated immunity normally protection
- Primarily affects lungs; other organs may also be invaded.
Tuberculosis

- Primary infection
  
  ➢ When organism first enters the lungs

  - Engulfed by macrophages - local inflammation

  - If cell-mediated immunity is inadequate // Mycobacteria reproduce and begin to destroy lung tissue.

  - This form of disease is contagious!
Tuberculosis

- If cell-mediated immunity is adequate:
  - Some bacilli migrate to lymph nodes – granuloma is formation of tubercle (contains live bacilli) // walled off and calcifying
  - Tubercle may be visible on chest radiograph.
  - Bacilli may remain viable in a dormant stage for years.
  - If individual’s resistance and immune responses high, bacilli remain walled off
  - Primary or latent infection // individual has been exposed and infected, but does not have disease and is asymptomatic // this individual cannot transmit disease
Tuberculosis

- Secondary or re-infection with TB
  - Occurs when client’s cell-mediated immunity is impaired because of:
    - Stress
    - Malnutrition
    - HIV infection
    - Age
  - Mycobacteria begin to reproduce and infect lung.
  - Active TB, which can be spread to others!
Development of Tuberculosis

Inhalation of *Mycobacterium tuberculosis* → Lung

- **Inflammatory response**
  - **Delayed hypersensitivity reaction**
    - Positive tuberculin test
      - Bacilli to lymph nodes
        - Type IV immune response

- Individual with HIGH resistance → **Tubercle formation**
  - Caseation necrosis and granuloma
  - Organisms walled off (Ghon complex)

- Individual with LOW resistance → **Cavitation**
  - Active infection
    - Dissemination through lungs and other organs

- **Primary infection**
  - Secondary or reinfection
    - If resistance decreases later (e.g., immune suppression)
      - Organisms reactivated

Tuberculosis

- Miliary or Extrapulmonary Tuberculosis
  
  ➢ Rapidly progressive form more common in children < 5 years

  • Early dissemination to other tissues

  • If lesions are not found in the lungs, this is not contagious.

  • Common symptoms include weight loss, failure to thrive, and other infections such as measles.
Active Tuberculosis (primary or secondary)

- Organisms multiply, forming large areas of necrosis. // Cause large open areas in lung call cavitation

- Cavitation promotes spread into other parts of lung. // Infection may spread into pleural cavity.

- Cough, positive sputum, radiograph showing cavitation

- Disease in this form is highly infectious when there is close personal contact over a period of time.
Tuberculosis

Tuberculosis

- Diagnostic tests
  - First exposure or primary infection // Indicated by positive tuberculin (skin) test results
  - Active infections
    - Acid-fast sputum test
    - Chest radiograph
    - Sputum culture and sensitivity

- Treatment // Long-term treatment with a combination of drugs
  - Length of treatment varies from 6 to 12 months.
Tuberculosis

- Effective treatment requires monitoring and follow-up and is expensive.

- TB is becoming an increasingly serious problem because of:
  - Homelessness and crowding in shelters
  - HIV infection
  - Lack of health care
  - Multidrug resistant TB
Histoplasmosis

- Fungal infection // Caused by *Histoplasma capsulatum* - Spores can be inhaled on dust particles.

- Common opportunistic infection

- First stage often asymptomatic

- Second stage // Granuloma formation and necrosis - Cough, fatigue, fever, night sweats

- Treatment - antifungal agents
Anthrax

- Bacterial infection by gram-positive bacilli
- Inhalation anthrax
  - Flulike symptoms
  - Severe acute respiratory distress
  - Shock caused by release of toxins
  - High fatality rates
  - Treatment with antimicrobial agent ciprofloxacin
  - Animal vaccine available // Recommended for people working with the organism or in other professions that might cause exposure
Obstructive Lung Diseases
Cystic Fibrosis

- Inherited (genetic) disorder // Gene located on chromosome 7
- Tenacious mucus from exocrine glands
- Primary effects seen in lungs and pancreas
- Lungs // Mucus obstructs airflow in bronchioles and small bronchi.
  - Permanent damage to bronchial walls
  - Infections are common. // Commonly caused by *Pseudomonas aeruginosa* and *Staphylococcus aureus*
Cystic Fibrosis

- **Digestive tract**
  - Meconium ileus in newborns
  - Blockage of pancreatic ducts
  - Obstruction of bile ducts
  - Salivary glands often mildly affected

- **Reproductive tract**
  - Obstruction of vas deferens (male)
  - Obstruction of cervix (female)

- **Sweat glands** // Sweat has high sodium chloride content.
Cystic Fibrosis

Excessive amounts of thick, sticky mucus obstruct ducts of exocrine glands

LUNGS
- Obstruction of airways and frequent infections
  - Fibrosis
  - Cor pulmonale

DIGESTIVE TRACT
- Meconium ileus (intestinal obstruction in newborn)

REPRODUCTIVE TRACT
- Obstruction of vas deferens blocks sperm flow

SWEAT GLANDS
- Excess Na⁺ and Cl⁻ content

- Infertility
- Electrolyte imbalance and dehydration

Obstruction of pancreatic ducts
- Fibrosis
- Diabetes mellitus

Obstruction of bile ducts in liver
- Biliary cirrhosis
- Malabsorption
- Malnutrition

Signs & Symptoms of Cystic Fibrosis

- Meconium ileus may occur at birth.
- Salty skin // May lead to performing sweat test and diagnosis of cystic fibrosis
- Signs of malabsorption // Steatorrhea, abdominal distention
- Chronic cough and frequent respiratory infections // Tend to increase over time
- Failure to meet normal growth milestones
Cystic Fibrosis

- Diagnosis
  - Genetic testing
  - Sweat test
  - Testing of stool
  - Radiography, pulmonary function tests
  - Blood gas analysis

- Treatment // Interdisciplinary approach
  - Replacement therapy and well-balanced diet
  - Chest physiotherapy
Lung Cancer

- About 90% of cases are related to smoking.
- Bronchogenic carcinoma
  - Most common type of primary malignant lung tumor
  - Arises from bronchial epithelium
- Squamous cell carcinoma // Usually develops from epithelial lining of a bronchus
- Adenocarcinomas and bronchoalveolar cell carcinomas // Usually found on periphery of lung
Bronchiogenic Carcinoma
Lung Tumor Effects

- Obstruction of airflow into a bronchus // Causes abnormal breath sounds and dyspnea

- Inflammation and bleeding surrounding the tumor // Cough, hemoptysis, and secondary infections

- Pleural effusion, hemothorax, pneumothorax

- Paraneoplastic syndrome // Occurs when tumor cell secretes hormones or hormone-like substances

- Usual systemic effects of cancer
Lung Cancer’s Early signs

- Persistent productive cough
- Detection on radiograph
- Hemoptysis
- Pleural involvement
- Chest pain
- Hoarseness, facial or arm edema, headache, dysphagia, or atelectasis
Lung Cancer

- Systemic signs // Weight loss, anemia, fatigue

- Paraneoplastic syndrome
  - Indicated by signs of an endocrine disorder
    // Related to the specific hormone secreted

- Signs of metastases
  - Bone pain
  - Cognitive deficits, motor deficits
Lung Cancer

- **Diagnostic tests**
  - Specialized helical CT scans and MRI
  - Chest radiography
  - Bronchoscopy
  - Biopsy and mediastinoscopy

- **Treatment**
  - Surgical resection or lobectomy
  - Chemotherapy and radiation
  - Photodynamic therapy
Aspiration

- Passage of food, fluid, emesis, other foreign material into trachea and lungs

- Common problem in young children or individuals laying down when eating or drinking

- Result may be:
  - Obstruction // Aspirate is a solid object.
  - Inflammation and swelling // Aspirate is an irritating liquid.
  - Predisposition to pneumonia
Aspiration’s Potential Complications

- Aspiration pneumonia // Inflammation - gas diffusion is impaired.

- Respiratory distress syndrome // May develop if inflammation is widespread

- Pulmonary abscess // May develop if microbes are in aspirate

- Systemic effects // When aspirated materials (solvents) are absorbed into blood
Aspiration’s Signs and Symptoms

- Coughing and choking with dyspnea
- Loss of voice if total obstruction
- Stridor // Characteristic of upper airway obstruction
- Wheezing // Aspiration of liquids
- Tachycardia and tachypnea
- Nasal flaring, chest retractions, hypoxia // In individuals with severe respiratory distress
- Cardiac or respiratory arrest
1. The Heimlich maneuver to dislodge the solid object is recommended (stand behind the victim with encircling arms, position a fist, thumb side against the abdomen, below the sternum, place the other hand over the fist and thrust forcefully inward and upward).

2. A foreign object may be ejected from an infant by back blows administered between the infant’s shoulder blades, while the infant’s body is supported over an arm or leg, head lower than the trunk. Sometimes an individual can use a finger probe successfully to access an object at the back of the tongue. Instrumentation may be necessary in some cases to remove the offending object. In case of total obstruction, an emergency tracheotomy is necessary. Patients with widespread inflammation should be monitored for adult respiratory distress syndrome or pneumonia. Oxygen and supportive therapy may be required as well as prophylactic antibiotics.
Obstructive Sleep Apnea

- Result of pharyngeal tissue collapse during sleep
  - Leads to repeated and momentary cessation of breathing
  - Men are affected more often than women.
  - Obesity and aging are common predisposing factors.

- Treatment // Continuous positive airway pressure pump (CPAP machine)
  - Oral appliances that reduce collapse of pharyngeal tissue
Asthma

- Bronchial obstruction
- Occurs in persons with hypersensitive or hyper-responsive airways
- May occur in childhood or have an adult onset
- Often family history of allergic conditions
Asthma

- Extrinsic asthma // Acute episodes triggered by type I hypersensitivity reactions

- Intrinsic asthma // Onset during adulthood
  
  ➢ Hyper-responsive tissue in airway initiates attack.
  
  ➢ Stimuli include:
    
    • Respiratory infections
    • Stress
    • Exposure to cold
    • Inhalation of irritants
    • Exercise
    • Drugs
Asthma

- Pathophysiological changes of bronchi and bronchioles
  - Inflammation of the mucosa with edema
  - Bronchoconstriction // Caused by contraction of smooth muscle // histamine release from mast cells
  - Increased secretion of thick mucus // In airways

- Changes create obstructed airways, partial or total.
Asthma: Signs and Symptoms

- Cough, marked dyspnea, tight feeling in chest
- Wheezing
- Rapid and labored breathing
- Expulsion of thick or sticky mucus
- Tachycardia // Might include pulsus paradoxus - Pulse differs on inspiration and expiration
- Hypoxia
Asthma: Signs and Symptoms

- Respiratory alkalosis // Initially caused by hyperventilation
- Respiratory acidosis // Caused by air trapping
- Severe respiratory distress // Hypoventilation leads to hypoxemia and respiratory acidosis.
- Respiratory failure // Indicated by decreasing responsiveness, cyanosis
Asthma: Acute Episode

- Status Asthmaticus

  - Persistent severe attack of asthma
    - Does not respond to usual therapy
    - Medical emergency!
    - May be fatal because of severe hypoxia and acidosis
Asthma: Treatment

- General measures
  - Skin tests for allergic reactions
  - Avoidance of triggering factors
  - Good ventilation of environment
  - Swimming and walking
  - Use of maintenance inhalers or drugs

- Measures for acute attacks
  - Controlled breathing techniques
  - Inhalers // Bronchodilators
  - Glucocorticoids
Asthma: Treatment

- Measures for status asthmaticus // Hospital care if no response to bronchodilator

- Prophylaxis and treatment for chronic asthma
  - Leukotriene receptor antagonists // Block inflammatory responses in presence of stimulus // Not effective for treatment of acute attacks
  - Cromolyn sodium // Prophylactic medication
    - Inhalation on a daily basis
    - Useful for athletes and sports enthusiasts
    - No value during an acute attack
Chronic Obstructive Pulmonary Disease

- Group of chronic respiratory disorders
- Causes irreversible and progressive damage to lungs
- Debilitating conditions that may affect individual’s ability to work
- May lead to the development of cor pulmonale
- Respiratory failure may occur.
Chronic Obstructive Pulmonary Disease: Emphysema

- Destruction of alveolar walls and septae // reduction of the respiratory membrane
- Leads to large, permanently inflated alveolar air spaces
- Classified by specific location of changes
- Contributing factors
  - Genetic deficiency
  - Genetic tendency
  - Cigarette smoking
  - Pathogenic bacteria
Chronic Obstructive Pulmonary Disease: Emphysema

- Breakdown of alveolar wall results in:
  - Loss of surface area for gas exchange
  - Loss of pulmonary capillaries
  - Loss of elastic fibers
  - Altered ventilation-perfusion ratio
  - Decreased support for other structures

- Fibrosis
  - Narrowed airways
  - Weakened walls
  - Interference with passive expiratory airflow
Chronic Obstructive Pulmonary Disease: Emphysema

- Progressive difficulty with expiration
  - Air trapping and increased residual volume
  - Over inflation of the lungs
  - Fixation of ribs in an respiratory position, increased anterior-posterior diameter of thorax (barrel chest)
  - Flattened diaphragm (on radiographs)
Chronic Obstructive Pulmonary Disease: Emphysema

- Advanced emphysema and loss of tissue
  - Adjacent damaged alveoli coalesce, forming large air spaces.
  - Pneumothorax // Occurs when pleural membrane surrounding large blebs ruptures
  - Hypercapnia becomes marked.
  - Hypoxia becomes driving force of respiration
  - Frequent infections
  - Pulmonary hypertension and cor pulmonale may develop in late stage.
Chronic Obstructive Pulmonary Disease: Emphysema

● Signs and symptoms

➢ Dyspnea // Occurs first on exertion

➢ Hyperventilation with prolonged expiratory phase // Development of barrel chest

➢ Anorexia and fatigue // Weight loss

➢ Clubbed fingers

● Diagnostic tests // Chest radiography and pulmonary function tests
Emphysema Treatment

- Avoidance of respiratory irritants
- Immunization against influenza and pneumonia
- Pulmonary rehabilitation
- Appropriate breathing techniques
- Adequate nutrition and hydration // Improves energy levels, resistance to infection
- Bronchodilators, antibiotics, oxygen therapy as condition advances
- Lung reduction surgery
Emphysema: Normal Alveolus

A. Normal Alveolus

Alveolus

Respiratory bronchiole

Alveolar duct

Courtesy of R.W. Shaw, MD, North York General Hospital, Toronto, Ontario, Canada.
Emphysema

B. Emphysema

- Overinflated alveolus
- Respiratory bronchiole
- Loss of septae and capillaries → decreased surface area
- Loss of elastic fibers → decreased recoil

Courtesy of R.W. Shaw, MD, North York General Hospital, Toronto, Ontario, Canada.
Emphysema: Air Trapping

C. Air Trapping

Normal expiration

Impaired expiration

Recoil

Damaged wall collapses or airway becomes obstructed

Loss of elasticity

Increased residual volume and overinflated lungs

Courtesy of R.W. Shaw, MD, North York General Hospital, Toronto, Ontario, Canada.
Chronic Bronchitis

- Inflammation, obstruction, repeated infection, chronic coughing twice for 3 months or longer in 2 years
  - History of cigarette smoking or living in urban or industrial area
  - Mucosa inflamed and swollen
  - Hypertrophy and hyperplasia of mucous glands
  - Fibrosis and thickening of bronchial wall
  - Low oxygen levels
  - Severe dyspnea and fatigue
  - Pulmonary hypertension and cor pulmonale
Chronic Bronchitis: Signs and symptoms

- Constant productive cough
- Tachypnea and shortness of breath
- Frequent thick and purulent secretions
- Cough and rhonchi more severe in the morning
- Hypoxia, cyanosis, hypercapnia // Caused by airway obstruction
- Polycythemia, weight loss, signs of cor pulmonale possible // Seen as vascular damage and pulmonary hypertension progress
Chronic Bronchitis: Treatment

- Cessation of smoking and reduction of exposure to irritants
- Treatment of infection
- Vaccination for prophylaxis
- Expectorants
- Bronchodilators
- Appropriate chest therapy // Including postural drainage and percussion
- Low-flow oxygen
- Nutritional supplements
Bronchiectasis

- Usually a secondary condition

- Irreversible abnormal dilation of the medium-sized bronchi (primarily) // May be saccular or elongated

- Arises from recurrent inflammation and infection // Leads to obstruction of airways, weakening of muscle and elastic fibers in bronchial walls, or both

- Infecting organisms // Usually mixed
  - Streptococci, staphylococci, pneumococci, H. influenzae
Bronchiectasis: Signs & Symptoms

- Chronic cough
- Production of copious amounts of purulent // foul-smelling sputum

- Treatment
  - Antibiotics
  - Bronchodilators
  - Chest physiotherapy
  - Treatment of primary condition
<table>
<thead>
<tr>
<th>Disease Characteristic</th>
<th>Emphysema</th>
<th>Chronic Bronchitis</th>
<th>Asthma—Acute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Etiology</td>
<td>Smoking, genetic</td>
<td>Smoking, air pollution</td>
<td>Hypersensitivity type I, hyperresponsive tissue</td>
</tr>
<tr>
<td>Location</td>
<td>Alveoli</td>
<td>Bronchi</td>
<td>Small bronchi, bronchioles</td>
</tr>
<tr>
<td>Pathophysiology</td>
<td>Destruction of alveolar walls, loss of elasticity, impaired expiration, barrel chest, hyperinflation</td>
<td>Increased mucous glands and secretion, inflammation, and infection, obstruction</td>
<td>Inflammation, bronchoconstriction, increased mucus produced, obstruction, repeat attacks lead to damage</td>
</tr>
<tr>
<td>Cough, dyspnea</td>
<td>Some coughing, marked dyspnea</td>
<td>Early, constant cough, some dyspnea</td>
<td>Cough and dyspnea, wheezing</td>
</tr>
<tr>
<td>Sputum</td>
<td>Little</td>
<td>Large amount, purulent</td>
<td>Thick, tenacious mucus</td>
</tr>
<tr>
<td>Cyanosis</td>
<td>No</td>
<td>Yes</td>
<td>Yes if status asthmaticus</td>
</tr>
<tr>
<td>Infections</td>
<td>Some</td>
<td>Frequent</td>
<td>Some</td>
</tr>
<tr>
<td>Cor pulmonale</td>
<td>Perhaps late</td>
<td>Common</td>
<td>Rare</td>
</tr>
</tbody>
</table>
Restrictive Lung Disorders

- Group of disorders with impaired lung expansion and reduced total lung capacity

- First group  // Abnormality of chest wall - limits or impairs lung expansion
  - Kyphosis or scoliosis, poliomyelitis, amyotrophic lateral sclerosis, botulism, muscular dystrophy

- Second group  // Diseases affecting the supporting framework of lungs
  - Idiopathic pulmonary fibrosis, occupational diseases
Pneumoconioses

- Chronic restrictive diseases resulting from long-term exposure to irritating particles
- Inflammation - gradual destruction of connective tissue
  - Functional areas of the lungs lost
- Onset insidious // Dyspnea develops first
- Treatment - ending exposure, treatment of infection
<table>
<thead>
<tr>
<th>Disease</th>
<th>Agent</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal workers disease or anthracosis</td>
<td>Coal dust</td>
<td>Coal mines</td>
</tr>
<tr>
<td>Silicosis</td>
<td>Silica</td>
<td>Stone-cutting, sand-blasting, mines</td>
</tr>
<tr>
<td>Asbestosis</td>
<td>Asbestos</td>
<td>Insulation, shipbuilding</td>
</tr>
<tr>
<td>Farmer’s lung</td>
<td>Fungal spores</td>
<td>Hay</td>
</tr>
</tbody>
</table>
Vascular Disorders: Pulmonary Edema

- Fluid collecting in alveoli and interstitial area
  - Can result from many primary conditions
  - Reduces amount of oxygen diffusing into blood
  - Interferes with lung expansion

- May develop when:
  - Inflammation in lungs is present. // Increases permeability of capillaries
  - Plasma protein levels are low. // Decreases osmotic pressure of plasma
  - Pulmonary hypertension develops.
Pulmonary Edema: Signs & Symptoms

- Cough, orthopnea, rales - in mild cases
- Hemoptysis
- Frothy, blood-tinged sputum

Treatment

- Treat causative factors.
- Supportive care
- Possibility of positive-pressure mechanical ventilation
Pulmonary Edema
Vascular Disorders
Pulmonary Embolus

- Blood clot or mass that obstructs pulmonary artery or any of its branches
- Effect of embolus depends on material, size, and location
- Small pulmonary emboli might be “silent” unless they involve a large area of lung.
- Large emboli may cause sudden death.
- 90% of pulmonary emboli originate from deep vein thromboses in legs // are preventable
Pulmonary Embolus: Signs & Symptoms

- Transient chest pain, cough, dyspnea - small emboli

- Larger emboli—increased chest pain with coughing or deep breathing; tachypnea and dyspnea develop suddenly.
  - Later - hemoptysis and fever
  - Hypoxia - causes anxiety, restlessness, pallor, tachycardia

- Massive emboli // Severe crushing chest pain, low blood pressure, rapid weak pulse, loss of consciousness
Pulmonary Embolus

● Prevention
  ➢ Health teaching prior to surgery
  ➢ Antiembolic stockings
  ➢ Exercise to prevent thrombosis
  ➢ Use of anticoagulant drugs

● Diagnosis
  ➢ Radiography, lung scan, MRI, pulmonary angiography
Pulmonary Embolus

- Treatment
  - Assessment of risk factors
  - Prolonged bed rest and compression stockings
  - Surgically Inserted filter into vena cava (some cases)
  - Heparin or streptokinase
  - Mechanical ventilation
  - Embolectomy
Pulmonary Embolus

1. Embolus from leg vein

2. Single small embolus may be "silent"

3. Multiple small emboli equivalent to a large embolus blocking circulation

4. Moderate-size embolus likely to cause respiratory distress and pulmonary infarction

5. Very large embolus blocks all pulmonary circulation leading to shock and cardiac arrest

6. Large embolus causes decreased blood returning in pulmonary vein and decreased cardiac output
Expansion Disorders
Atelectasis

- Non-aeration or collapse of lung or part of a lung // Leads to decreased gas exchange and hypoxia
- Alveoli become airless. // Collapse and inflammation or atrophy occur.
- Process interferes with blood flow through the lung.
- Both ventilation and perfusion are altered. // Affects oxygen diffusion
Atelectasis

- Mechanisms that can result in atelectasis

  - Obstructive or resorption atelectasis // Caused by total obstruction of airway
  
  - Compression atelectasis // Mass or tumor exerts pressure on part of the lung.
  
  - Increased surface tension in alveoli // Prevents expansion of lung
  
  - Fibrotic tissue in lungs or pleura // May restrict expansion and lead to collapse
  
  - Postoperative atelectasis // Can occur after surgery
Atelectasis

B. Compression Atelectasis

C. Obstructive Atelectasis – Absorption Atelectasis

Atelectasis

- Signs and symptoms
  - Small areas are asymptomatic.
  - Large areas
    - Dyspnea
    - Increased heat and respiratory rates
    - Chest pain
Expansion Disorders
Pleural Effusion

- Presence of excessive fluid in the pleural cavity
- Causes increased pressure in pleural cavity // Separation of pleural membranes
- Exudative effusions // Response to inflammation
- Transudate effusions
  - Watery effusions (hydrothorax)
  - Result of increased hydrostatic pressure or decreased osmotic pressure in blood vessels
Pleural Effusion: Signs & Symptoms

- Dyspnea
- Cyclic chest pain
- Increased respiratory and heart rates

Treatment

- Remove underlying cause to treat respiratory impairment.
- Analyze fluid to confirm cause.
- Chest drainage, thoracocentesis to remove fluid and relieve pressure
Pneumothorax

- Air in pleural cavity

- Closed pneumothorax
  - Air can enter pleural cavity from internal airways
    - no opening in chest wall
  - Simple or spontaneous pneumothorax // Tear on the surface of the lung
  - Secondary pneumothorax
    - Associated with underlying respiratory disease
    - Rupture of an emphysematous bleb on lung surface or erosion by a tumor or tubercular cavitation
Pneumothorax

- Open pneumothorax
  - Atmospheric air enters the pleural cavity though an opening in the chest wall.
  - “Sucking” wound // Large opening in chest wall
  - Tension pneumothorax // Most serious form
    - Result of an opening through chest wall and parietal pleura or from a tear in the lung tissue and visceral pleura
    - Air entry into pleural cavity on inspiration but hole closes on expiration
    - Trapping air leads to increased pleural pressure and atelectasis
<table>
<thead>
<tr>
<th></th>
<th>Closed</th>
<th>Open</th>
<th>Tension</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cause</strong></td>
<td>Spontaneous, idiopathic</td>
<td>Puncture wound through chest wall</td>
<td>Open—puncture through thorax</td>
</tr>
<tr>
<td></td>
<td>Ruptured emphysematous bleb</td>
<td></td>
<td>Closed—tear in lung surface</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Both with flap or one-way valve</td>
</tr>
<tr>
<td><strong>Air entry</strong></td>
<td>From inside lung through tear in visceral pleura</td>
<td>From outside body through opening in thorax and parietal pleura</td>
<td>Through the thorax or tear in lung surface</td>
</tr>
<tr>
<td><strong>Effects</strong></td>
<td>Atelectasis</td>
<td>Atelectasis</td>
<td>Atelectasis</td>
</tr>
<tr>
<td></td>
<td>Leak seals as lung collapses</td>
<td>Air enters pleural cavity with each inspiration and leaves with each expiration</td>
<td>Air enters pleural cavity with each inspiration</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Flap closes with expiration, and air pressure increases in pleural cavity pressure</td>
</tr>
<tr>
<td></td>
<td>One lung impaired</td>
<td>Unaffected lung compressed by mediastinal shift on inspiration</td>
<td>Unaffected lung increasingly compressed by mediastinal shift</td>
</tr>
<tr>
<td></td>
<td>No additional cardiovascular effects</td>
<td>Mediastinal flutter impairs venous return to heart</td>
<td>Mediastinal shift reduces venous return to heart</td>
</tr>
<tr>
<td><strong>Signs</strong></td>
<td>All three types: Increased, labored respirations with dyspnea, tachycardia, pleural pain, and asymmetrical chest movements</td>
<td>“Sucking” noise if large Tracheal swing Decreased blood pressure</td>
<td>Breath sounds absent on affected side Tracheal deviation to unaffected side Increasing respiratory distress Shock, distended neck veins, cyanosis Severe hypoxemia</td>
</tr>
</tbody>
</table>

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Emergency Treatment for Pneumothorax

1. Transport to a hospital as soon as possible.
2. An open pneumothorax or sucking wound is covered with an occlusive dressing or covering to prevent the air moving in and out of the pleural cavity. The dressing should be checked to ensure that a tension pneumothorax has not developed.
3. Penetrating objects should not be removed from the chest wall until medical assistance is available.
4. If possible, tension pneumothorax should be converted to an open pneumothorax, by removing loose tissue or enlarging the opening.
Flail Chest

- Results from fractures of ribs, which allow ribs to move independently during respiration

- During inspiration
  - Flail or broken section moves inward rather than outward.
  - Inward movement of ribs prevents expansion of affected lung.
  - Large flail section can compress adjacent lung tissue. Pushing air out of that section—up the bronchus—Air (stale) from damaged lung crosses into the other lung with newly inspired air.
Flail Chest

- During expiration
  - Unstable fail section pushed outward by increasing intrathoracic pressure.
  - Large flail section // Paradoxical movement of ribs alters airflow during expiration.
  - Air from unaffected lung moves across into affected lung.
- Hypoxia results from limited expansion and decreased inspiratory volume.
Flail Chest Injury

A. Injury to thorax

- Multiple fractured ribs cause loss of chest wall rigidity

B. Inspiration

- Low pressure inside lungs pulls flail section inward, compressing lung on affected side

C. Expiration

- High pressure inside lungs pushes flail section outward
Infant Respiratory Distress Syndrome

- Usually related to premature birth
- Lack of surfactant in alveoli
- Poorly developed alveoli are difficult to inflate.
  - Diffuse atelectasis results.
  - Decreased pulmonary blood flow—pulmonary vasoconstriction—severe hypoxia
- Poor lung perfusion and lack of surfactant
  - Increased alveolar capillary permeability
  - Fluid and protein are leaking into the interstitial area and alveoli, hyaline membrane formation
IRDS: Signs & Symptoms

- Respiratory difficulties may be evident at birth or shortly thereafter.
- Respirations rapid and shallow, with chest retractions and flaring of nares.
- Frothy sputum and expiratory grunt
- Blood pressure falls.
- Cyanosis and peripheral edema
- Severe hypoxemia and decreased responsiveness
- Irregular respirations with periods of apnea
- Decreased breath sounds
Infant Respiratory Distress Syndrome

- **Diagnostic tests** // Arterial blood gas analysis

- **Treatment**
  - Glucocorticoids for women in premature labor
  - Synthetic surfactant for high-risk neonate
  - Ventilation using CPAP
  - Oxygen therapy
  - Nitrous oxide drugs
Adult Respiratory Distress Syndrome

- Results from injury to the alveolar wall and capillary membrane
  
  - Causes the release of chemical mediators
    
    - Increases permeability of alveolar capillary membranes
    - Increased fluid and protein in interstitial area and alveoli
    - Damage to surfactant-producing cells
    - Diffuse necrosis and fibrosis if patient survives
  
- Multitude of predisposing conditions

- Often associated with multiple organ dysfunction or failure
Adult Respiratory Distress Syndrome

● Signs and symptoms

- Dyspnea
- Restlessness
- Rapid, shallow respiration
- Increased heart rate
- Combination of respiratory and metabolic acidosis

● Treatment

- Treatment of underlying cause
- Supportive respiratory therapy
Adult Respiratory Distress Syndrome

**ADULT RESPIRATORY DISTRESS SYNDROME (ARDS)**

- **ALVEOLAR OR PULMONARY CAPILLARY WALL INJURY**
  - Increased capillary permeability
  - Fluid and protein leaks into alveoli and interstitial tissue
  - **PULMONARY EDEMA**
  - **DECREASED SURFACTANT PRODUCTION**
  - Decreased compliance, labored inspiration
  - Decreased oxygen exchange
  - Hypoxemia
  - Decreased lung volumes
  - Atelectasis

**CONFUSION AND DECREASED RESPONSIVENESS**
- Severe hypoxemia
- Progressive metabolic and respiratory acidosis
- Cardiac arrhythmias
- Shock

Acute Respiratory Failure

- May result from acute or chronic disorders
  - Emphysema
  - Combination of chronic and acute disorders
  - Acute respiratory disorders
  - Many neuromuscular diseases
  - Signs may be masked or altered by primary problem

- Treatment
  - Primary problem must be resolved
  - Supportive treatment to maintain respiratory function