Respiratory tract infections

Introduction
Anatomy of Respiratory Tract:

- Upper respiratory tract includes: nasal cavity, pharynx, and larynx.
- Lower respiratory tract includes: trachea, bronchi, bronchioles, alveoli, and alveolar-capillary membrane.
- Air enters the upper resp. tract & travels to the lower tract where gas exchange takes place.
- Respiratory tract begins with the nasal and ends with alveoli.
Respiratory Tract

- **Respiration** = the process whereby gas exchange occurs at the alveolar-capillary membrane. 3 phases:
  1. **Ventilation** - movement of air from the atmosphere through the upper & lower airways to the alveoli
  2. **Perfusion** - blood from the pulmonary circulation is adequate at the alveolar-capillary bed
  3. **Diffusion** - molecules move from area of higher concentration to lower concentration of gases - O2 passes into the capillary bed to be circulated & CO2 leaves the capillary bed & diffuses into the alveoli for vent. excretion
Anatomy

• The human host has several non-specific defense mechanisms that protect the respiratory tract from infections:
  – The nasal hairs
  – Convoluted passages
  – the mucus lining of the nasal turbinates.
  – Secretory IgA
  – Lysozyme
  – The cilia and mucous lining of the trachea
  – Reflexes such as coughing, sneezing, and swallowing
microbiota

• In addition to *diphtheroids*, *S. viridans*, and *Niesseria spp*, a number of potentially pathogenic microorganisms are part of the normal microbiota in the upper respiratory system such as *S. pneumoniae*, *H. influenzae*, *S. aureus*,

• Under some circumstances, these colonizers can cause diseases thanks to previous damage by a viral infection, loss of some host immunity, or physical damage to the respiratory epithelium (e.g. from smoking).

• The lower respiratory tract is nearly sterile.
Epidemiology/Etiologic agents

• Lower Respiratory tract infections:

• Acute bronchitis:

• Clinical manifestations:
  • Is characterized by acute inflammation of the tracheobronchial tree.
  • Is characterized by cough, variable fever, and sputum production.
Acute bronchitis:

- It is usually caused by viruses.
- however, *Bordetella pertussis* should be considered in infants and preschool children.
Acute bronchitis usually results from an infection such as a cold or flu.
Chronic bronchitis:

- It affects 10% to 25% of adults.
- Patients produce excessive amount of sputum on most days during at least 3 consecutive months for more than 2 years.
- Potentially pathogenic bacteria, such as nonencapsulated strains of *Haemophilus influenzae*, *streptococcus pneumoniae*, and *Moraxella catarrhalis*, are frequently isolated from these patients.
Pneumonia:

• Inflammation of the lower respiratory tract involving the lung’s airways and supporting structures.

• It characterized by fever, chills, and cough.

• Pneumonias can be categorized into:
  – community-acquired.
  – Hospital- or ventilator- associated (with in 2 days from admission).
Pneumonia can be caused by four possible ways:

1. By upper airway colonization
2. By aspiration of organisms (during sleep or alcohol effects)
3. By inhalation of airborne droplets containing organisms.
4. Or by seeding of the lung via the blood from a distant site of infections.

Viruses cause primary pneumonia, as well as inhibit host defenses that can lead to a secondary bacterial infection.
Community-acquired pneumonia

• Is the sixth leading cause of death and the number one cause of death from infectious diseases.

• The etiology is age dependent
  – 80% of pneumonia in infants are caused by viruses
  – 10-20% of pneumonia in adult are viral.
• Pneumonia in children are caused usually by \textit{H. influenzae}, \textit{S. pneumoniae}, or \textit{S. aureus}
• Neonates suffer pneumonia that are caused by \textit{C. trachomatis} and \textit{Pneumocystis jirovecii} (indication of immune defect or immature immune system).
• *Mycoplasma pneumoniae* and *Chlamydia pneumoniae* are common causes of pneumonia in young adult (younger than 30 years)

• Of note, *S. pneumoniae* is the most common cause, causing 15% to 80% of community acquired pneumonia.

• Unusual causes of acute lower respiratory tract infections: *Actinomyces, Nocardia, Y. pestis, brucella, Salmonella, Bacillus anthracis*
Hospital- or ventilator-associated pneumonia:

- Pneumonia is the leading cause of death among patients with nosocomial infections.

- Nosocomical pneumonia is caused by hospital specific organisms such as
  - *P. aeruginosa*, *Enterobacter spp*, *Klebsiella spp*, *Enterobacteriaceae*, *S. aureus* (especially MRSA)
Chronic Lower Respiratory Track Infections

- *Mycobacterium tuberculosis* is the most likely cause of chronic lower respiratory tract infection, but fungal infection and anaerobic pleuropneumonary infection may also run a subacute or chronic course.

- Patient who suffers cystic fibrosis is more likely to be infected with mucoid *P. aeruginosa* (production of copious amount of polysaccharide).
Immunocompromized patients:

- In transplant recipient and HIV-infected patient, pulmonary infection are of importance.
- Some of most common cause of pneumonia include *H. influenzae*, *S. pneumoniae*, and *Pneumoncystis jiroveci*.
- Fungi, such as *Cryptococcus neoformanasa*, *Aspergillus spp*, *Candida spp*, and *Zygomycete* can cause life-threatening infection.
upper Respiratory tract infections

- Diseases of the upper respiratory tract are named according to the anatomic sites involved.
- Most of these infection are self-limiting and caused by viruses.
Laryngitis:

- Patient complains of hoarseness and lowering or deepening of the voice
- If examination reveal an exudate or membrane on the pharyngeal or laryngeal mucosa, streptococcal infection or diphtheria should be suspected.
Epiglottitis

• Infection of the epiglottis and other soft tissue above the vocal cord.
• It is most commonly among children between the age of 2 to 6 years.
• Is a life-threatening disease because the patient’s airway can become blocked if untreated.

• *H. influenzae* type b is the primary cause of epiglottitis.

• Diagnosis is based on clinical ground, it can be isolated from blood in children.
Pharyngitis:

- The inflammation of pharynx, which is associated with pharyngeal pain.
- Pathogenic mechanisms differ and are dependent on the organism causing the pharyngitis.
  - Some organisms directly invade the pharyngeal mucosa
  - Others release toxin and some virulence factor for the site of infection (*C. diphtheriae*)
  - Others release toxin and invade the pharyngeal mucosa (*S. pyogenes* GAS)
Pharyngitis:

• Importantly, group A streptococcal pharyngitis must be recognized because serious complications may follow untreated disease (acute rheumatic fever and gromulonephritis).

• Causes of bacterial pharyngitis - Group A streptococci (approximately 15% of all cases of pharyngitis); group C and G streptococci; N gonorrhoeae, and Corynebacterium diphtheriae.
Tonsillitis:

- Mainly a disease of childhood but is also seen in adults.
- May occur primarily as infection of the tonsils themselves or may secondarily occur as a result of URTI following viral infection.
- **Organisms:**
  - Beta-haemolytic streptococcus
  - Staphylococcus
  - Haemophilus influenzae
  - Pneumococcus
- The part played by viruses in acute tonsillitis is unknown.
Pathology

• The process of inflammation originating within the tonsil is accompanied by hyperemia and oedema with conversion of lymphoid follicles into small abscesses which discharge into crypts.

• When inflammatory exudate collects in tonsillar crypts these present as multiple white spots on inflamed tonsillar surface giving rise to clinical picture of follicular tonsillitis.
Catarrhal tonsillitis

- When tonsils are inflamed as part of the generalised infection of the oropharyngeal mucosa it is called catarrhal tonsillitis.
Summary of some microorganisms:

*Corynebacterium diphtheriae*:

- Small pleomorphic gram-positive rod that form clumps that look like Chinese letters.
- Catalase positive, non-spore-forming.
- It is spread primarily by respiratory droplets.
Corynebacterium diphtheriae:

- Can be cultured aerobically on selective medium such as Tinsdale ager, producing black colonies surrounded by black halo.
Diphtheria:

- It is an acute and contagious infection that produced a distinctive thick, grayish, adherent exudate (called pseudomembranes) that is composed of dead epithelial cells, white blood cells, red blood cells, and fibrin that form around the tonsils and the back of the throat.
Treatment:

- a single dose of horse serum antitoxin to inactivate any circulating toxin
- **Eradication** of the organism is due to the use of antibiotics, such as erythromycin or penicillin
Prevention:

• DPT triple vaccine (diphtheria, Pertussis, and tetanus) should be started in infancy.

• Booster injection of diphtheria toxoid should be given at approximately ten-year intervals throughout life.
DIPHTHERIA AND TETANUS TOXOIDS AND PERTUSSIS VACCINE ADSORBED

5mL Multi-Dose Vial
1 Pediatric Dose = 0.5mL
diagnosis:

- **Throat swab** can be cultured on selective medium, such as Tinsdale agar (contains potassium tellurite, an inhibitor of other respiratory flora)
**Bordetella pertussis**

- Gram negative coccobacilli that grow singly or in pairs.
- Encapsulated.
- Obligatory Aerobic
- Culture on charcoal blood agar such as Regan-Lowe agar and Bordet-Gengou (BG) agar, appearing as a very small colonies.
• *B. pertussis* is transmitted primarily by droplets spread by coughing.

• the organism produce variety of toxins (*tracheal cytotoxin*) and virulence factors that interfere with ciliary activity, eventually causing the death of epithelial cells.
Pertussis (whooping cough):
  • is a highly contagious respiratory tract infection.
  • Incubation period from one to three weeks
  • The disease can be divided into three stages:
    1. Catarrhal stage (1-2 weeks):
       • flu like symptoms with nonproductive cough.
2. **Paroxysmal stage** (2-4 weeks):
   - uncontrollable repetitive cough until breathless followed by “whoop”.
   - Large amount of mucus are typical produced.

3. **Convalescent stage** (3-6 weeks):
   - is a gradual recovery period.
   - However, some complication can occur such as pneumonia.
Diagnosis

• Nasopharyngeal samples (taken by wire swab or aspiration) can be culture on selective media, such as Regan-Lowe or BG agar
Diagnosis

- **Fluorescent antibody** for *B. pertussis* detection in smears of nasopharyngeal specimen is available for rapid diagnosis.

- PCR
Treatment:

• Erythromycin is the drug of choice as chemotherapy.
• It is also used as chemoprophylaxis for household contact.

Prevention:

• Two types of vaccine that are formulated in DTP vaccine
  1. Killed whole cell
  2. Acellular, containing purified proteins
Mycobacterium tuberculosis (MTB)

• Very thin **acid fast rods** that it difficult to be stained with commonly used stains such as gram stain.

• Mycobacteria resist the acid decolonization due to the large amount of lipid in cell wall.

• They survive and grow within the macrophage
• Can be cultured on special media called Lowenstein-Jensen agar (LJ agar) appearing as
  – Buff(هاوي), tough(قاسي), and rough(خشن).
• Catalase and naicin are positive.
Tuberculosis:

- Tubercles (granulomatous lesions) form in the lung due to the TB infection.
- This disease can seed different tissues, causing, for example,
  - Chronic pneumonitis
  - Tuberculous osteomyelitis
  - Tuberculous meningitis
Diagnosis:

• Mantoux test or Tuberculin-skin test (PPD = purified protein derivative).
Diagnosis:

- Direct smear for **Fluorochrome stain** (screening procedure) such as auramine rodamine.
- Ziehl-Neelsen stain or Kinyoun stain is used as a confirmatory procedure.
Figure 45-2  *M. tuberculosis* stained with (A) fluorochrome stain (400× magnification) and (B) Kinyoun acid-fast stain (1000× magnification).
Sterile specimens for culture

• Decontamination and digestion method are not required for these specimen unless there is a sign of contamination by color or foul odor.

• If contamination is suspected, gram stain should be performed to confirm it.

• Once confirmation is made, these sterile specimens should be decontaminated.
• contaminated specimens such as sputum and gastric aspirate, are required to be decontaminated using oxalic acid or N-acetyl-L-cysteine sodium hydroxide (NALC-2% NaOH).

• Then these samples should be concentrated by using centrifuge.
– **NALC** is mucolytic agent that reduces the concentration of **NaOH** and shorten the decontaminating time.

– **NaOH** is decontaminating agent

- Specimens can be cultured on LJ medium for **6-8 weeks** before reporting negative.

- Nucleic acid probes can be used to detect **M. tuberculosis** DNA that has been amplified by PCR
• Broth media system (Mycobacteria Growth Indicator Tube (MIGT 960)) is used to grow MTB in order to reduce the isolation time to approximately 10 days, compared with 17 day to day or longer for solid media.
Treatment:

• A long course (~ 6 months) of a mixture of antibiotics:
  – Streptomycin
  – Isoniazid
  – Rifampin
  – Ethambutol
  – Pyrazinamide (PZA)
Prevention:

- Bacille Calmette-Guerin vaccine (BCG).
- Isoniazid is used prophylactically:
  - Individual with tuberculin-positive but asymptomatic, and who need immunosuppressive therapy.
Fungal agents

Histoplasmosis:

• It is caused by dimorphic fungus called *Histoplasma capsulatum* (*yeastlike* in tissue and *mold* in soil or artificial media)

• Yeastlike form is found in macrophages.

• Resembles tuberculosis.

• The disease is acquired by inhalation of airborne conidia
(a) Yeastlike form typical of growth in tissue at 37°C. Notice that one cell near the center is budding.

(b) Filamentous, spore-forming phase found in soil or at temperatures below 35°C; the spores are usually the infectious particle.
• Although histoplasmosis is worldwide spread, it has a limited geographic range in the US
• The disease is acquired by inhalation of airborne conidia in which droppings from birds and bats accumulated.
• **Tissue specimen** is important for diagnosis.
Coccidioidomycosis:

- Inhalation of the airborne spores by septation of hyphal filaments (arthrospores) of *Coccidioides immitis* can result in coccidioidomycosis.
- Cause respiratory infection resembles tuberculosis.
- It can cause infection in CNS and bone

Coccidioidomycosis:

- Diagnosis is most reliable made by identifying the spherules in tissue or fluids.
- PCR
Lung of a patient with acute coccidioidal pneumonia

Coccidioidomycosis

Spherule
Blastomycosis (North American blastomycosis):

- Is caused by *Blastomyces dermatitidis* (dimorphic fungus)
- Infections begins in the lungs (resembles bacterial pneumonia) and spread rapidly.
• Cutaneous ulcer appears, and there can be extensive abscess formation and tissue destruction.
1- **Sputum:**

- **Expectorated** sputum has been the most common sample collected to diagnose pneumonia.
- However, lower respiratory secretion will be contaminated with upper respiratory secretion, especially saliva.
• For good expectorated sputum collection:
  – Food should be avoided for 1-2 hours
  – Mouth should be rinsed with saline or water
  – Patient should be instructed to provide a deep-coughed specimen.

• **Induced** sputum can be obtained by respiratory therapy technician's assisting patient, who are unable to produce sputum, to stimulate production of acceptable sputum.
- **Gastric** aspirate is used for isolation of acid fast bacilli and may be collected from patients who are unable to produce sputum, particularly young children.

- **Other specimen:**
  - Endotracheal or tracheostomy suction specimen
  - Bronchoscopy help in collecting (bronchial washings, bronchoalveolar lavage [BAL]....)
  - Tracheal aspirate (inserting a small plastic catheter into the trachea via a needle)
Specimen processing

Direct visual examination:

• Bacteria and yeast can be seen by Gram stain.
Figure 53-4  Gram stain of sputum specimens. A, This specimen contains numerous polymorphonuclear leukocytes and no visible squamous epithelial cells, indicating that the specimen is acceptable for routine bacteriologic culture. B, This specimen contains numerous squamous epithelial cells and rare polymorphonuclear leukocytes, indicating an inadequate specimen for routine sputum culture.
Mucus is present
• Acid-fast stain either Ziehl-Neelsen (ZN) or the Kinyoun carbolfuchisn stain is used when specimen submitted for TB.

• Auramine or auramine rhodamine is used to detect acid-fast organism as screening procedure.

• Direct fluorescent antibody (DFA) staining has been used to detect *Legionella spp* in lower respiratory specimen.
Fluorescein-labeled antibody attached to *Legionella* bacilli
Routine culture:

• Most common bacterial pathogen can be isolated on:
  – 5% sheep blood agar
  – MacConkey agar
  – Chocolate agar
  – If legionnaire’s disease is suspected, buffered charcoal-yeast extract (BCYE) agar and selective BCYE is inoculated and kept for 5 days.

• Plates should be streaked in four quadrant to provide semiquantitiation to define the amount of growth.
Throat swab:

- Culture on blood and chocolate to detect:
  - *S. pyogenes* (streptococcal group A)
  - *N. gonorrhoeae*
  - If diphtheria is suspected, Tinsdale agar is used.

- Antigen detection test are used to detect GAS directly on the throat swab.
Drugs for Upper respiratory Infections

- **Upper Respiratory Infections (URI’s)** = common cold, acute rhinitis, sinusitis, acute tonsillitis, acute laryngitis
  - The common cold = most expensive > $500 million spent on OTC preparations
- **Common Cold & Acute Rhinitis** -
  - Common cold caused by the rhinovirus & affects primarily the nasopharyngeal tract.
  - Acute rhinitis (inflammation of mucus membranes of nose) usually accompanies the common cold
  - Allergic rhinitis - caused by pollen or a foreign substance
Drugs for Upper Respiratory Infections

• Incubation period of a cold = 1 to 4 days before onset of symptoms & first 3 days of the cold
  - Home remedies = rest, chicken soup, hot toddies, Vitamins
  - 4 groups of drugs used to manage symptoms = antihistamines (H-1 blocker), decongestants (sympathomimetic amines), antitussives, expectorants
Drugs for Upper Respiratory Infections - Antihistamines

- Antihistamines or H-1 blockers - compete w/ histamine for receptor sites \(\rightarrow\) prevents a histamine response.

2 types of histamine receptors - H-1 & H-2

H-1 stimulation = extravascular smooth muscles (including those lining nasal cavity) are constricted

H-2 stimulation = an inc. in gastric secretions = peptic ulcer disease

Do not confuse the 2 receptors - antihistamines decrease nasopharyngeal secretions by blocking the H-1 receptor
Drugs for Upper Respiratory Infections - antihistamines

- **Histamines** - A compound derived from an amino acid histadine. Released in response to an allergic rxn (antigen-antibody rxn) - such as inhaled pollen
- When released it reacts w/ H-1 receptors = arterioles & capillaries dilate = inc. in bld flow to the area = capillaries become more permeable = outward passage of fluids into extracellular spaces = edema (congestion) = release of secretions (runny nose & watery eyes)
- Large amts. of released histamine in an allergic rxn = extensive arteriolar dilation = dec. BP, skin flushed & edematous = itching, constriction & spasm of bronchioles = SOB & lg. amts. of pulmonary & gastric secretions
Drugs for Upper Respiratory Infections - Antihistamines

• Astemizole (Hismanal), Cetirizine (Zertec), Loratadine (Claritin), Chlorpheniramine (Chlortrimeton), Diphenhydramine (Benadryl)

• Actions = competitive antagonist at the histamine receptor; some also have anticholinergic properties

• Uses = Treat colds; perennial/seasonal allergic rhinitis (sneezing, runny nose); allergic activity (drying & sedation); some are also antiemetic

• SE = Drowsiness, dizziness, sedation, drying effects

• CI = glaucoma, acute asthma
Drugs for Upper Respiratory Infections - Decongestants

• Nasal congestion results from dilation of nasal bld. vessels d/t infection, inflammation, or allergy. With dilation there’s transudation of fluid into tissue spaces → swelling of the nasal cavity

• Decongestants (sympathomimetic amines) - stimulate alpha-adrenergic receptor → vasoconstriction of capillaries w/in nasal mucosa → shrinking of the nasal mucus membranes & reduction in fluid secretion (runny nose)
Drugs for Upper Respiratory Infections - Decongestants

- Naphazoline HCL (Allerest), Pseudoephedrine (Actifed, Sudafed), Oxymetololzone (Afrin), Phenylpropanolamine HCL (Allerest, Dimetapp)
- Use - Congestion d/t common cold, hayfever, upper resp. allergies, sinusitis
- SE = Jittery, nervous, restless, Inc BP, inc. bld. sugar
- CI = Hypertension, cardiac disease, diabetes
- Preparations = nasal spray, tablets, capsules, or liquid
- Frequent use, esp. nasal spray, can result in tolerance & rebound nasal congestion - d/t irritation of nasal mucosa
Drugs for Upper Respiratory Infections - Intranasal Glucocorticoids

- **Beclomethasone** (Beconase, Vancenase, Vanceril), **Budesonide** (Rhinocort), **Dexamethasone** (Decadron), **Fluticasone** (Flonase)

  - **Action** - steroids used to dec. inflammation locally in the nose
  - **Use** - Perennial/seasonal allergic rhinitis (sneezing, runny nose) - May be used alone or w/ antihistamines
  - **SE** - rare, but w/ continuous use dryness of the nasal mucosa may occur
Drugs for Upper Respiratory Infections - Antitussives

- **Action** - Acts on the cough control center in the medulla to suppress the cough reflex
- **Use** - Cough suppression for non-productive irritating coughs
  * Codeine - Narcotic analgesic to control a cough d/t the common cold or bronchitis
  * Dextromethorphan - nonnarcotic antitussive that suppresses the cough center in the medulla, widely used - syrup, liquid, chewable & lozenges
  - SE = drowsiness, sedation
Drugs for Upper Respiratory infections - Expectorants

• Action - Loosens bronchial secretions so they can be eliminated w/ coughing
  * A nonproductive cough becomes more productive and less frequent
• Uses - Nonproductive coughs
• Guaifenesin (Robitussin) = Most common
  * Use alone or in combo w/ other resp. drugs
• Hydration is the best expectorant
Chapter 36

Drugs for Acute and Chronic Lower Respiratory Disorders
Drugs for Lower Respiratory Disorders

- Lung Compliance - Lung volume based on the unit of pressure in the alveoli
  * Determines the lung’s ability to stretch (tissue elasticity)
  * Determined by: connective tissue; surface tension in the alveoli controlled by surfactant
    - surfactant lowers surface tension in alveoli & prevents interstitial fluid from entering
  * Inc. (high) lung compliance in COPD
  * Dec. (low) lung compliance in restrictive pulmonary disease = lungs become “stiff” & need more pressure
Drugs for Lower Respiratory Disorders

- Chronic obstructed pulmonary disease (COPD) & restrictive pulmonary disease = 2 major lower resp. tract diseases
- **COPD** = airway obstruction w/ inc. airway resistance to airflow to lung tissues - 4 causes
  - Chronic bronchitis
  - Emphysema
  - Bronchiectasis
  - Asthma

* Above frequently result in irreversible lung tissue damage. Asthma reversible unless frequent attacks and becomes chronic.
Drugs for Lower Respiratory Disorders

• **Restrictive lung disease** = a dec. in total lung capacity as a result of fluid accumulation or loss of elasticity of the lung.

  * Causes: Pulmonary edema, pulmonary fibrosis, pneumonitis, lung tumors, scoliosis

• **Bronchial Asthma** = 10-12 million people of all ages affected - a chronic obstructive pulmonary disease characterized by periods of bronchospasm resulting in wheezing & difficulty in breathing
Drugs for Lower Respiratory Disorders

- **Asthma** - Bronchospasm or bronchoconstriction results when the lung tissue is exposed to extrinsic or intrinsic factors that stimulate a bronchoconstrictive response

  - Causes: humidity, air pressure changes, temp. changes, smoke, fumes, stress, emotional upset, allergies, dust, food, some drugs

* Pathophys = Mast cells (found in connective tissue throughout the body) are directly involved in the asthmatic response - esp. to extrinsic factors

  - allergens attach themselves to mast cells & basophils = antigen-antibody rxn
Drugs for Lower Respiratory Disorders - Asthma

- Mast cells stimulate release of chemical mediators (histamines, cytokines, serotonin, ECF-A (eosinophils))
- These chemical mediators stimulate bronchial constriction, mucous secretions, inflammation, pulmonary congestion
- Cyclic adenosine monophosphate (cAMP) - a cellular substance responsible for maintaining bronchodilation - When inhibited by histamines & ECF-A $\rightarrow$ bronchoconst.
- Sympathomimetic (adrenergic) bronchodilators inc. amt. of cAMP & promote dilation $\rightarrow$ first line drugs used
Drugs for Lower Respiratory Disorders

• Sympathomimetics: Alpha & Beta-2 Adrenergic Agonists

• Increase cAMP \rightarrow \text{dilation of bronchioles in acute bronchospasm caused by anaphylaxis from allergic rxn}
give nonselective \textbf{epinephrine (Adrenalin)} - SQ in an emergency to promote bronchodilation & inc. BP
SE = tremors, dizziness, HTN, tachycardia, heart palpitations, angina

• For bronchospasm d/t COPD - selective beta-2 adrenergic agonists are given via aerosol or tablet
Drugs for Lower Respiratory Disorders

- **Metaproterenol (Alupent, Metaprel)** - some beta-1, but primarily used as a beta-2 agent - PO or inhaler/nebulizer
- For long-term asthma Rx beta-2 adrenergic agonists frequently given by inhalation
  * more drug delivered directly to constricted bronchial site
  * Effective dose less than PO dose & less side effects
- Action = relaxes bronchial smooth muscle - onset = fast
- SE = Nervousness, tremors, restlessness, insomnia & inc. HR
Drugs for Lower Respiratory Disorders

- **Albuterol (Proventil, Ventolin)** - More beta-2 selective
  - PO or inhaler
  - Used for acute/chronic asthma
  - Rapid onset of action & longer duration than Metaproterenol
  - Fewer SE because more beta-2 specific, but high doses can still effect beta-1 receptors & cause nervousness, tremors & inc. pulse rate
Drugs for Lower Respiratory Disorders - Anticholinergics

- **Ipratropium bromide (Atrovent)** -
  - Action - competitive antagonist (inhibits) of cholinergic receptors in bronchial smooth muscle = bronchiole dilation - Inhaler
  - Use - In combination w/ beta agonist for asthma & for bronchospasm associated w/ COPD
  - Need to teach clients how to use properly: If using Atrovent w/ a beta-agonist, use beta-agonist 5 min. before Atrovent; If using Atrovent w/ an inhaled steroid or cromolyn, use Atrovent 5 min. before the steroid or cromolyn - bronchioles dilate & drugs more effective
Drugs for Lower Respiratory Disorders - Methylxanthine derivatives

• Aminophylline, Theophylline (TheoDur), Caffeine –
  * PO or IV -
  * Use - Treatment of asthma & COPD
  * Action - Inc. cAMP $\rightarrow$ bronchodilation; also - diuresis, cardiac, CNS & gastric acid stimulation
  * When given IV $\rightarrow$ a low therapeutic index & range - Monitor levels frequently
  * PO doses can be given in standard dosages
  * Avoid smoking, caffeine & inc. fluid intake
Methylxanthine derivatives

- Drug Interactions: Inc the risk of dig toxicity, decreases the effects to lithium, dec theophyllin levels with Dilantin, theophyllin and beta-adrenergic agonist given together - synergistic effect can occur → cardiac dysrhythmias. Beta blockers, Tagamet, Inderal and e-mycin decrease the liver metabolism rate and inc. the half-life and effects of theophyllin

- SE: Anorexia, N&V, nervousness, dizziness, palpitations, GI upset & bleeding, HA, restlessness, flushing, irritability, marked hypotension, hyper-reflexia and seizures.

- CI: Severe cardiac dysrhythmias, hyperthyroidism, peptic ulcer disease ( increases gastric secretions)
Drugs for Lower Respiratory Disorders - Leukotrine Receptor Antagonists & Synthesis Inhibitors

- Leukotriene (LT) a chemical mediator that can cause inflammatory changes in the lung. The group cysteinyl leukotrienes promotes and increases eosinophil migration, mucus production, and airway wall edema, which result in broncho-constriction.

- LT receptor antagonists & LT synthesis inhibitors (Leukotriene modifiers) effective in reducing the inflammatory symptoms of asthma triggered by allergic & environmental stimuli - Not for acute asthma
Leucotriene receptor antagonist and synthesis inhibitors

• Zafirlukast (Accolate), Zileuton (Zyflo), Montelukast sodium (Singulair) – PO

• Action - Decreases the inflammatory process Use - prophylactic & maintenance drug therapy for asthma

• Accolate – 1st in group, leukotriene receptor antagonist → reduce inflammation & dec bronchoconstriction, PO-BID-rapidly absorbed

• Singulair – New leukotriene receptor antagonist, short t1/2 (2.5-5.5) Safe for children under 6yo.
Drugs for Lower Respiratory Disorders - Glucocorticoids (Steroids)

- Glucocorticoids have an anti-inflammatory action and are used if asthma is unresponsive to bronchodilator therapy.
- Given: inhaler - beclomethasone (Vanceril, Beclovent); tablet - triamcinolone (Amcort, Aristocory), dexamethasone (Decadron), prednisone; injection - dexamethasone, hydrocortisone.
- SE significant w/ long-term oral use - fluid retention, hyperglycemia, impaired immune response.
- Irritating to the gastric mucosa - take w/ food.
- When d/c’ing taper the dosage slowly.
Drugs for Lower Respiratory Disorders - Cromolyn & Nedocromil

- **Cromolyn (Intal)** - for prophylactic Rx of bronchial asthma & must be taken on a daily basis - NOT used for acute asthma - Inhaler
  * Action - inhibits the release of histamine that can cause an asthma rxn
  * SE - mouth irritation, cough & a bad taste in the mouth
** Caution - rebound bronchospasm is a serious side effect do not d/c the drug abruptly

- **Nedocromil sodium** - action & uses similar to Intal - prophylactic usage - inhalation therapy - may be more effective than Intal
Drugs for Lower Respiratory Disorders - Mucolytics

• **Acetylcysteine (Mucomyst)** - nebulization
  * Action - liquefies & loosens thick mucous secretions so they can be expectorated
  * Use - dissolves thick mucous, acetaminophen overdose (bonds chemically to reduce liver damage)
  * SE - N & V, chest tightness, bronchoconstriction
  * Use w/ a bronchodilator

• **Dornase alfa (Pulmozyme)** - an enzyme that digests the DNA in thick sputum of cystic fibrosis (CF) clients
You need to prepare 30 mg. How much solution will you need?

\[
\frac{30 \text{ mg}}{60 \text{ mg}} \times 6 \text{ ml} = \frac{1}{2} \times 6 \text{ ml} = \frac{6}{2} = 3 \text{ ml}
\]