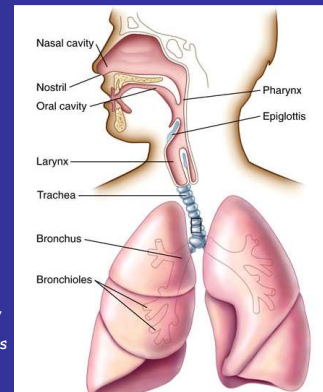


RESPIRATORY TRACT INFECTIONS

nose, nasal cavity, sinuses, mouth, throat, epiglottis and larynx



Trachea, bronchi, bronchioles, and alveoli in the lungs

Protective Mechanisms

- Normal flora:
 - limited to the upper tract
 - microbial antagonist (competition)

commensal organisms:

- *S. epidermidis*, alpha-hemolytic *Streptococci*, *Neisseria sp.*, *Haemophilus sp.*, *E. coli*, *Klebsiella sp.*, *Enterobacter sp.*, *Spirochetes*
- anaerobic bacteria: *Bacteroides sp.*, *Fusobacterium sp.*, *Lactobacillus sp.*, *Veillonella sp.*, *Peptostreptococcus sp.*, *Peptococcus sp.*, *Actinomyces sp.*
- transient: *H. influenzae*, *S. pneumoniae*, *N. meningitidis*, *S. pyogenes*, *S. aureus*

Protective Mechanisms cont.

- Clearance of particles and organisms from the respiratory tract
 - cilia and microvilli
 - alveolar macrophages
 - nasal hair, nasal turbinates
 - mucus
 - involuntary responses (coughing)
 - secretory IgA
 - immune cells

Upper respiratory tract infections

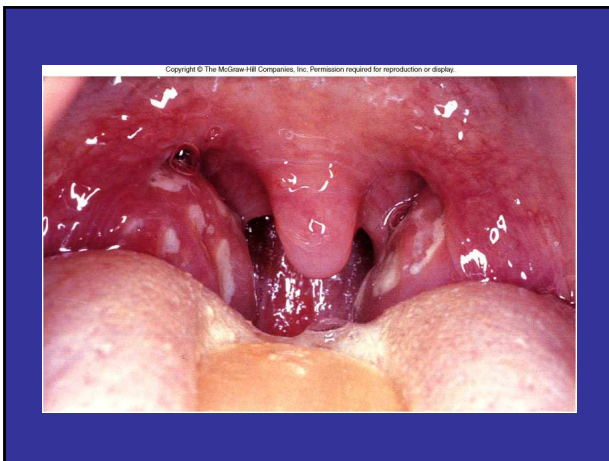
- nasopharynx: mucociliary system
- oropharynx: flushing action of saliva

Pharyngitis, tonsillitis, epiglottitis, laryngitis, otitis media, sinusitis

- most cases are caused by viruses
- secondary bacterial infections
- most frequent causative agents: *S. pyogenes*, *S. pneumoniae*, *H. influenzae*, *Moraxella catarrhalis*
- others: *Corynebacterium diphtheriae*, *N. gonorrhoeae*, *M. pneumoniae*, *C. pneumoniae*, *S. aureus*
- seasonality

Streptococcus pyogenes

- most frequent causative agent of bacterial **pharyngitis, tonsillitis**
- spread by airborne droplets, by contact
- survives in dust
- complications: peritonsillar abscess, otitis media, sinusitis, scarlet fever, rheumatic fever, acute glomerulonephritis
- diagnosis:
 - bacterial culture is the gold standard (throat swab)
 - for poststreptococcal diseases: ASO/ASK
- prevention: no vaccine
- treatment: **penicillin G** /erythromycin, azithromycin (increasing resistance)



Identification of *Streptococcus pyogenes*

beta-hemolysis
sensitivity to bacitracin
CAMP-test

agglutination (group A)

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Positive reaction

Negative reaction

(a)

Bacitracin disc SXT disc

(b)

(c) CAMP test

Haemophilus influenzae

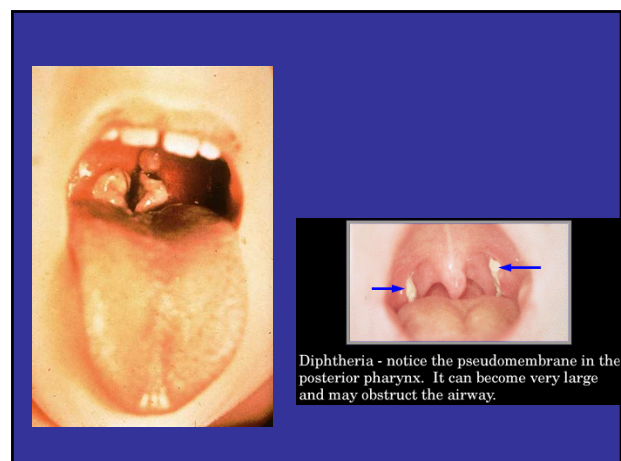
- otitis media, sinusitis, severe epiglottitis (obstruction of the airways)
- complication: pneumonia, meningitis
- diagnosis: throat swab, severe cases: haemoculture
 - culturing: chocolate agar (requires both factor X and V)
 - latex agglutination
- prevention:
 - vaccine: capsular polysaccharide of type b (conjugated to diphtheria toxoid)
 - rifampin: close contacts of patient with meningitis
- treatment: II. or III. generation (in case of meningitis) cephalosporin

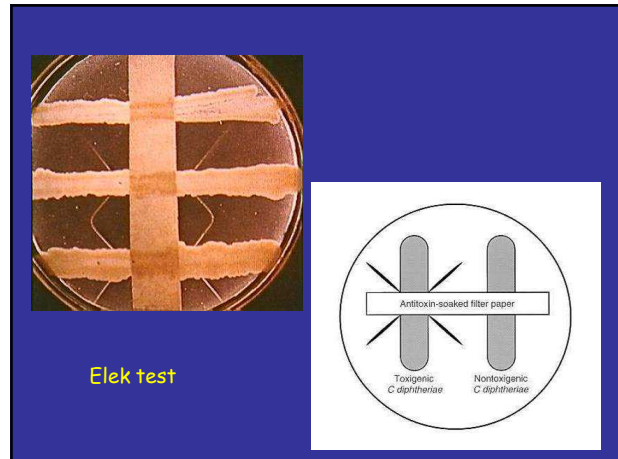
Moraxella catarrhalis

- otitis media, sinusitis, bronchitis, pneumonia
- severe systemic infection: meningitis, endocarditis
- diagnosis: culture: chocolate agar with vancomycin; biochemical reactions
- treatment: amoxicillin+clavulanate, trimethoprim+sulfamethoxazole

Corynebacterium diphtheriae

- diphtheria
- diphtheria toxin: destroys epithelial cells, polymorphonuclear granulocytes; pseudomembrane; distant effects
 - two domain: A, B
 - ADP-ribosilation of EF-2
- diagnosis:
 - culture: Löffler's medium, Clauberg (tellurite) medium
 - demonstration of toxin production (Elek test)
- treatment: antitoxin, penicillin G/erythromycin
- prevention: toxoid vaccine





Elek test

Lower respiratory tract infections

- no normal flora
- acute infections:
 - **acute tracheitis:** (after intubation) *S. aureus*, *S. pyogenes*, *H. influenzae*
 - **acute bronchitis:** most cases are caused by viruses, *M. pneumoniae*, secondary bacterial infections: *S. pneumoniae*, *H. influenzae*, *M. catarrhalis*, *C. pneumoniae*,
 - whooping cough: *B. pertussis*
 - **acute exacerbations of chronic bronchitis:** *H. influenzae*, *S. pneumoniae*, *M. catarrhalis*, *S. aureus*, *Enterobacteriaceae*, *Chlamydia sp.*, *M. pneumoniae*
 - **acute bronchiolitis:** (lymphocyte infiltration) *H. influenzae*, *S. pneumoniae*, *S. aureus*, *P. aeruginosa*
- pneumonia

community acquired pneumonia (CAP):

- newborn: *S. agalactiae*, atypical: *M. hominis*, *C. trachomatis*, *U. urealyticum*
- infant, child: *S. pneumoniae*, *H. influenzae*, *S. aureus*, *M. pneumoniae*
- young adults, adults: *M. pneumoniae*, *C. pneumoniae*, *S. pneumoniae*
- elderly patients: *S. pneumoniae*, *Enterobacteriaceae*
- environmental sources: *Legionella pneumophila*
- zoonosis: *Chlamydia psittaci*, *Coxiella burnetii*
- **Ventilator associated pneumonia (VAP):**
 - Gram - rods, *Enterobacter sp.*, *Klebsiella sp.*, *Serratia sp.*, *Proteus sp.*, *P. aeruginosa*, *S. aureus*
- **Aspiration pneumonia:**
 - anaerobes: *Bacteroides sp.*, *Fusobacterium sp.*, *Peptostreptococcus sp.*, *Veillonella sp.*, *Porphyromonas sp.*

Lung infection in cystic fibrosis: *P. aeruginosa*, *Burkholderia sp.*, *Stenotrophomonas sp.*, *S. aureus*

- chronic infections: tuberculosis, lung abscess, empyema

Diagnosis of lower respiratory tract infections

Sample:

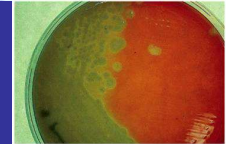
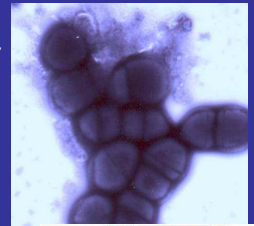
- sputum (microscopic evaluation)
- bronchial washing
- bronchoalveolar lavage
- abscess: puncture
- hemoculture
- direct detection of the causative agent
 - smear: Ziehl-Neelsen staining (*M. tuberculosis*)
 - Gram staining, IFA
- culture
- serologic tests and/or direct demonstration of antigen and/or PCR:
 - *M. pneumoniae*: CF, cold agglut., ELISA
 - *L. pneumophila*: **urinary antigen test**
 - *Chlamydia pneumoniae*, *C. psittaci*: ELISA
 - *Coxiella burnetii*: CF

Bordetella pertussis

- whooping cough
- pertussis toxin and other virulence factors
- diagnosis:
 - nasopharyngeal swab
 - Bordet-Gengou medium
 - direct IFA, PCR
- treatment: erythromycin, supportive care
- prevention: acellular vaccine (5 purified antigens, main: toxoid)

Streptococcus pneumoniae

- Gram staining
- culture: alpha-hemolytic
- biochemical, sensitivity test: inhibited by optochin, bile-soluble
- treatment: penicillin G-amoxicillin- III, generation cephalosporin, meropenem/erythromycin, azithromycin; vancomycin



Pneumonia

Normal CXR

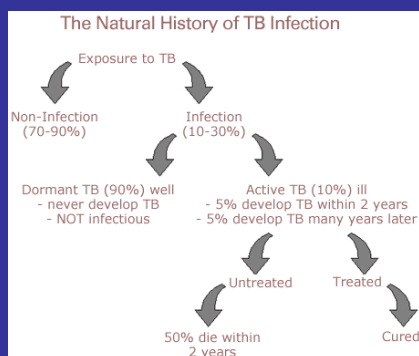
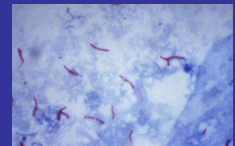
Pleurisy

Pneumonia:

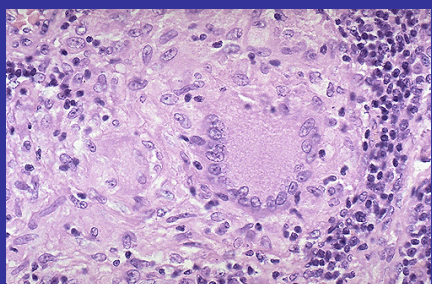
- Growth of *Strep.* on damaged ciliated epithelium
- Growth in alveolar fluid; increased fluid accumulation

Mycobacterium tuberculosis

- Ziehl-Neelsen staining
- culture: Löwenstein-Jensen medium



Primary tuberculosis, Ghon complex



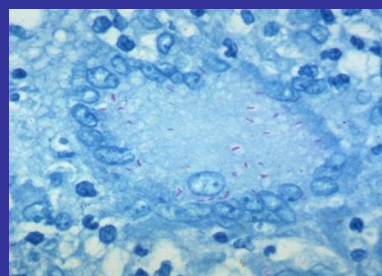
Mycobacterium tuberculosis granuloma



tuberculosis



Miliary tuberculosis - lung



Acid fast stain – several bacilli in giant cell