Microorganisms Causing Infection in Ear-Nose-Throat

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External Ear

- Consists of the auricle and EAM (External auditory meatus)
- Skin-lined apparatus
- Approximately 2.5 cm in length
- Ends at tympanic membrane
Anatomy and Physiology

- Auricle is mostly skin-lined cartilage
- External auditory meatus
  - Cartilage: ~40%
  - Bony: ~60%
  - S-shaped
  - Narrowest portion at bony-cartilage junction
Furunculosis

- Acute localized infection
- Lateral 1/3 of posterosuperior canal
- Obstructed apopilosebaceous unit
- Pathogen: *S. aureus*
Furunculosis: Symptoms

- Localized pain
- Pruritus
- Hearing loss (if lesion occludes canal)
Otomycosis

- Fungal infection of EAC skin
- Primary or secondary
- Most common organisms: *Aspergillus* and *Candida*
Otomycosis: Symptoms

- Often indistinguishable from bacterial OE
- Pruritus deep within the ear
- Dull pain
- Hearing loss (obstructive)
- Tinnitus
Otomyocosis: Signs

- Canal erythema
- Mild edema
- White, gray or black fungal debris
Otitis Externa

- Bacterial infection of external auditory canal
- Categorized by time course
  - Acute
  - Subacute
  - Chronic
Acute Otitis Externa (AOE)

- “swimmer’s ear”
- Preinflammatory stage
- Acute inflammatory stage
  - Mild
  - Moderate
  - Severe
Most common pathogens: *P. aeruginosa* and *S. aureus*

Four principles
- Frequent canal cleaning
- Topical antibiotics
- Pain control
- Instructions for prevention
Chronic Otitis Externa (COE)

- Chronic inflammatory process
- Persistent symptoms (> 2 months)
- Bacterial, fungal, dermatological etiologies
Otitis Externa

- **Otitis Externa** - a painful inflammation of the membranous lining of the auditory canal and/or contiguous structures
- **Pathogenesis** - inflammation is most commonly caused by microbial infection.
- **Colonization** of the external ear is prevented by immune and anatomic mechanisms
OE pathogenesis

- Squamous epithelia of the canal constantly slough, while hair follicles sweep laterally, cleaning and act as a barrier.
  - The canal maintains an acidic pH and repels moisture and the presence of normal flora inhibit the overgrowth of virulent bacteria.
  - If any of this is broken compromised there may be colonization by bacteria.
OE pathogenesis

- Bacteria

  - *Pseudomonas aeruginosa* is most common of diffuse infections and most cases of invasive OE
  - *Staphylococcus aureus* typically causes a localized infection from a hair follicle
  - *Streptococcus pyogenes* associated with local infection presenting as folliculitis
  - Polymicrobial infection found in up to 1/3 of cases of diffuse disease
OE pathogenesis

- Other causes of OE
  - Fungal agents
    - *Aspergillus niger-* usually local infection, but can cause invasive infection
    - Pityrosporum
    - *Candida albicans*
  - Hyperkeratotic processes
    - Eczema, psoriasis, seborrheic, or contact dermatitis
OE pathogenesis

- Necrotizing Otis externa is the most severe infectious form of OE
  - Bacterial infection extends from the skin of canal into soft tissue or bone
  - Cranial nerves may be involved
  - Pseudomonas is most common
  - May have bad outcomes
Otitis Externa

Physical findings

- Tenderness with palpation
- Otoscopic exam- canal appears swollen and red with drainage with bacterial infections
- Diffuse cases present with complete involvement
- Localized cases present with focal lesion
- Pseudomonas produces a copious green exudate
- *Staphylococcal* produces yellow crusting in purulent exudate
- Fungal infections presents as a fluffy, white or black malodorous growth
- Except in invasive disease there is no lymphadenopathy
- TMJ pain indicates invasive disease
Otitis Externa

- Diagnostic testing
  - Rarely needed
  - Cultures may be done of discharge if indicated in healthy patients
  - CT or MRI may be needed if suspect invasive disease
Otitis Externa

- Differential Dx
  - OM
  - TMJ
  - Dental disease
  - Trigeminal or glossopharyngeal neuralgia
  - Parotitis
  - Impetigo
  - Herpes zoster
  - Insect bites
  - Mastoiditis
  - Rupture of membrane
  - Excessive cerumen buildup (wax)
Otitis Media

- Otitis Media- OM- inflammation of the structures in the middle ear.
- Otitis media with effusion –OME involves the transudation of plasma from middle ear blood vessels leading to chronic fluid; this can be chronic.
- Acute Otitis Media-AOM is infection in the middle ear.
Otitis Media

- Contributing factors include: allergies, rhinitis, pharyngitis due to swelling of upper airway membranes
- Most common factor is upper airway infections (colds), caused by many different viruses.
  - Influenza, RSV, pneumovirus, adenovirus
Otitis Media

- Patho-bacterial infection (or viral) by nasopharyngeal microorganisms follows eustachian tube dysfunction in which the isthmus becomes obstructed.
- Inflammation results in response to the bacterial products such as endotoxins, creating infection behind the tympanic membrane in the middle ear.
Otitis Media

- OME
  - Patho- caused by collection of plasma fluid from engorged blood vessels resulting from the loss of Eustachian tube patency, either from swelling of the lining or direct blockage
  - Pathogens
    - *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis* are most common
    - Less common are Streptococcus pyogenes and aureus
    - Up to ½ are viral
Otitis Media Effusion

- **Objective**
  - **OME** - mucous membranes of nose and mouth red/swollen, with recent history of URI.
  - Tympani Membrane may be dull
  - **AOM** - yellow-orange, maybe fiery red and bulging with an area of yellow noted.
  - Bone landmarks and cone of light are not seen. Grayish/white collection of tissue on or behind the TM may be a cholesteatoma.
  - There may be adenopathy of the preauricular and/posterior cervical.
  - With an infected ear and pain at the mastoid bone - more work up may be needed
Otitis Media Effusion

- **Diagnostic Tests**
  - Tests are rarely needed.
  - Should use pneumatic otoscopy.
  - Tympanogram may be helpful otitis with effusion.
  - Cultures are rarely done, but are helpful.
  - X-ray or CT of sinuses or of mastoid area maybe indicated.
  - CBC with severe illness maybe indicated. Hearing tests are needed in some cases or at follow-up
Rhinitis or coryza – inflammation of the nasal mucosa with congestion, rhinorrhea, sneezing, pruritus, post nasal drip

- Allergic
  - Seasonal or perennial

- Nonallergic
  - Infectious, irritant related, vasomotor, hormone-related, associated with medication, or atrophic
    - May be chronic or acute

- Most common types
  - Viral
  - Perennial (hay fever)
Rhinitis

- Epidemiology/Causes
  - Actual prevalence is undocumented, but is very common
  - Occurs at least as much as the common cold
  - Allergic occurs in all age groups
    - Most common in adults 30-40 years
  - Non allergic rhinitis may be acute or chronic
    - Chronic maybe associated with bacterial sinusitis
Rhinitis

- Epidemiology/Causes
  - Atrophic rhinitis affects older adults, but symptoms may begin in the teens
  - Viral URI’s are more frequent in families with young children
  - Exposure to offending allergens is the main risk factor of allergic rhinitis
  - Vasomotor rhinitis is aggravated by low humidity, sudden temperature or pressure change, cold air, strong odors, stress, smoke
  - Certain drugs may precipitate rhinitis- ACE, beta-adrenergic antagonists, some anti-inflammatory agents, even asa
Rhinitis

- Rhinitis Pathogenesis
  - Viral
    - Viral replication in the nasopharynx with varying degrees of nasotracheal inflammation. Associated with viral upper respiratory tract infection
    - Etiologic agents
      - Rhinovirus, influenza, parainfluenza, respiratory syncytial, coronavirus, adenovirus, echovirus, coxsackievirus
      - Most rhinosinusitis is viral
        - Bacterial super-infection rarely occurs
Rhinitis

Rhinitis Pathogenesis

- Allergic rhinitis
  - results from immunoglobulin E (IgE) mediated type I hypersensitivity to airborne irritants affecting the eyes, nose, sinuses, throat, and bronchi
  - IgE antibodies bind to eosinophils and basophils in the bloodstream and the mucosal mast cells.
  - These leukocytes degranulate, releasing chemo inflammatory substances including histamine, leukotrienes, prostaglandin's, slow-reacting substance of anaphylaxis, and erythrocyte chemotactic factor, resulting in increased vasodilatation, capillary permeability, mucus production, smooth muscle contraction and eosinophilia
    - May also be caused by food allergies
Rhinitis

- Rhinitis Pathogenesis
  - Vasomotor rhinitis is chronic, noninfectious process of unknown etiology without accompanying eosinophilia, characterized by periods of abnormal autonomic responsiveness and vascular engorgement unrelated to specific allergens.
  - Causes include hormonal changes, medication overuse, bacterial infection—which can cause atrophic rhinitis.
Rhinitis

- Rhinitis – objective findings
  - Viral- nasal mucosa appears erythematous, throat will appear erythematous and edematous, external nose may appear erythematous, with a crease across the nose (allergic salute). May have swollen turbinates and tonsils. On palpation, the nasal mucosa appear friable.
    - With a secondary bacterial infection the discharge may be green/yellow
Sinusitis

- Sinusitis is an inflammation of the mucous membranes of one or more of the paranasal sinuses; frontal, sphenoid, posterior ethmoid, anterior ethmoid, and maxillary
  - Acute-abrupt onset of infection and post-therapeutic resolution lasting no more than four weeks
  - Subacute with a purulent nasal discharge persist despite therapy, lasting 4-12 weeks
  - Chronic, with episodes of prolonged inflammation with repeated or inadequately treated acute infection lasting greater than 12 consecutive weeks
Sinusitis

- Sinusitis – Pathogenesis
  - Vast majority of acute sinusitis are caused by the same viruses found in URI’s
    - Viral rhinosinusitis is most common
      - Which is the most common cause for acute bacterial sinusitis, from complications in about 2%
      - Sneezing sends fluid from the nares and nasal cavity into the sinuses which is a great place for microbial replication
  - The only reliable way of identifying causative organisms in acute sinusitis is direct sinus aspiration
Sinusitis

- Sinusitis Pathogenesis
  - Pathogens
    - *Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis, Streptococcus pyogenes, Staph aureus*
Sinusitis

- **Sinusitis objective findings**
  - Purulent secretions, red swollen nasal mucosa, purulent secretions from middle meatus
  - On palpation there is tenderness

- **Sinusitis testing**
  - None is usually indicated
  - X-rays or CT’s may be very helpful
    - Shows air-fluid levels and more than 4mm of mucosal thickening
  - CBC to look for leukocyte elevation
  - Stains or cultures of mucus may be indicated
  - Allergy testing
Immunology and Function of Tonsil

- Part of secondary immune system
- No afferent lymphatics
- Exposed to ingested or inspired antigens passed through the epithelial layer
- Immunologic structure is divided into 4 compartments: reticular crypt epithelium, extra follicular area, mantle zone of the lymphoid follicle, and the germinal center of the lymphoid follicle
Immunology and Function of Tonsil

- Membrane cells and antigen presenting cells are involved in transport of antigen from the surface to the lymphoid follicle.
- Antigen is presented to T-helper cells.
- T-helper cells induce B cells in germinal center to produce antibody.
- Secretory IgA is primary antibody produced.
- Involved in local immunity.
Adenotonsillitis

- Group A beta-hemolytic is most recognized pathogen
- Associated with a risk of rheumatic fever and glomerulonephritis
- Many other organisms are involved
Adenotonsillitis

- Of particular importance are beta-lactamase producing organisms like *Staphylococcus aureus*, *Moraxella catarrhalis*, and *Hemophilus influenzae*.
- In polymicrobial infections beta-lactamase producing organisms can protect Group A strep from eradication with penicillins.
- 39% of all cultured organisms in one study.
# Infectious Organisms

## Table 8.2. Bacteria and Viruses Commonly Cultured from the Tonsils and Adenoids

<table>
<thead>
<tr>
<th>Category</th>
<th>Organism</th>
</tr>
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<tbody>
<tr>
<td><strong>Bacteria</strong></td>
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<tr>
<td>Aerobic</td>
<td>Group A beta-hemolytic streptococci</td>
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<td></td>
<td>Groups B, C, G streptococcus</td>
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<tr>
<td></td>
<td><em>Haemophilus influenzae</em> (type b and nontypeable)</td>
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<tr>
<td></td>
<td><em>Streptococcus pneumoniae</em></td>
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<tr>
<td></td>
<td><em>Moraxella catarrhalis</em></td>
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<td></td>
<td><em>Staphylococcus aureus</em></td>
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<td></td>
<td><em>Haemophilus parainfluenzae</em></td>
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<tr>
<td></td>
<td><em>Neisseria</em> species</td>
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<td></td>
<td><em>Mycobacteria</em> species</td>
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<tr>
<td>Anaerobic</td>
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<tr>
<td></td>
<td><em>Bacteroides</em> species</td>
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<tr>
<td></td>
<td><em>Peptococcus</em> species</td>
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<tr>
<td></td>
<td><em>Peptostreptococcus</em> species</td>
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<td></td>
<td><em>Actinomyces</em> species</td>
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<tr>
<td>Viruses</td>
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<td></td>
<td>Epstein-Barr</td>
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<td></td>
<td>Adenovirus</td>
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<tr>
<td></td>
<td>Influenza A and B</td>
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<td>Herpes simplex</td>
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<td></td>
<td>Respiratory syncytial</td>
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<td></td>
<td>Parainfluenza</td>
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</table>
Infectious causes of pharyngitis
Viruses

- Major cause of acute respiratory disease
  - Influenza virus
  - Parainfluenza viruses
  - Rhinovirus
  - Adenoviruses
  - Respiratory syncitial virus
  - Coronavirus
Epstein-Barr Virus (EBV)

- Etiologic agent of infectious mononucleosis (IM)
- Herpes virus 4
- Double stranded DNA virus
- Selectively infects B-lymphocytes
Epstein-Barr Virus (EBV)

- Early infections in life are mostly asymptomatic
- Clinical disease is seen in those with delayed exposure (young adults)
- Defined by clinical triad
  - Fever, lymphadenopathy, and pharyngitis combined with +heterophil antibodies and atypical lymphocytes
- Pharyngitis
  - White membrane covering one or both tonsils
  - Petechial rash involving oral and palatal mucosa
Cytomegalovirus (CMV)

- Herpes virus 5
- Ubiquitous
- 50% of adults seropositive
- 10-15% of children seropositive by age 5 yrs
- Etiology of 2/3 of heterophil-negative mononucleosis
CMV

- Clinical manifestation
  - Fever and malaise
  - Pharyngitis and lymphadenopathy less common
  - Esophagitis in HIV infected patients

Diagnosis
- 4-fold rise in antibody titers to CMV
Herpes Simplex Virus (HSV)

- Herpes (Greek word herpein, “to creep”)
- Two antigenic types (HSV-1, HSV-2)
- Both infect the upper aerodigestive tract
- Transmission is by direct contact with mucous or saliva
Clinical manifestations:
- Gingivostomatitis and pharyngitis – most common in first episode
- Usually in children and young adults
- Fever, malaise, myalgias, anorexia, irritability

Physical exam
- Cervical lymphadenopathy
- Pharynx – exudative ulcerative lesions
- Grouped or single vesicles on an erythematous base
  - Buccal mucosa
  - Hard and soft palate
HSV

- Clinical manifestations
  - Acute illness evolves over 7-10 days
  - Rapid regression of symptoms
  - Resolution of lesions

- Immunocompromised patient
  - Persistent ulcerative lesions are common in patients with AIDS
  - Lesions more friable and painful
  - Aggressive treatment with IV acyclovir
Measles

- Paramyxovirus
- Linear, negative-sense, single stranded RNA virus
- Highest incidence in children sparing those under 6 months
- Decline in recent decade from immunization programs
Measles

- **Clinical manifestations**
  - Symptoms 9-11 days after exposure
  - Cough, coryza, conjunctivitis, fever
  - Kopliks spots (3 days after onset)
    - Pinpoint gray-white spots surrounded by erythema
    - Appear on mucous membranes
    - Common on buccal mucosa
Measles

- Diagnosis is clinical
- Further work-up for immunocompromized with more severe manifestations
  - Isolation from oropharynx, urine
  - Grown in cell culture
Human Immunodeficiency Virus (HIV)

- Pharyngitis
  - Usually opportunistic infection
    - HSV
    - CMV
    - Candida

- Viral particles have been detected in lymphoepithelial tissues of the pharynx
Streptococci

- Gram-positive spherical cocci arranged in chains
- Significant portion of indigenous microflora
- Found in oral cavity and nasopharynx
- Classified based on their hemolysis
  - Alpha, beta, or nonhemolytic
- Beta hemolytic bacteria further subdivided based on cell membrane carbohydrates (Lancefield Groups A, B, C, D, F, and G)
**TABLE 16-2. USUAL HEMOLYTIC, BIOCHEMICAL, AND CULTURAL REACTIONS OF COMMON STREPTOCOCCI AND ENTEROCOCCI**

<table>
<thead>
<tr>
<th></th>
<th>Susceptibility to</th>
<th>Bile Solubility</th>
<th>Bile/Esculin Reaction</th>
<th>PYR</th>
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<tbody>
<tr>
<td></td>
<td>Bacitracin</td>
<td>Optochin</td>
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<tr>
<td><strong>Streptococci</strong></td>
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<tr>
<td>β-Hemolytic</td>
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<tr>
<td>Lancefield group A</td>
<td>+</td>
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<td>-</td>
<td>+</td>
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<tr>
<td>Lancefield groups B, C, F, G</td>
<td>-</td>
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<tr>
<td>α-Hemolytic</td>
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<tr>
<td><em>S. pneumoniae</em></td>
<td>-</td>
<td>+</td>
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<tr>
<td>Viridans group</td>
<td>-</td>
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<tr>
<td>Nonhemolytic</td>
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<tr>
<td><strong>Enterococci</strong></td>
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</tbody>
</table>

* All are tests commonly substituted for serological identification in clinical laboratories.
 b Tests for the ability to grow in bile and reduce esculin.
 c PYR = pyrrolidonyl arylamidase test.
Group A Streptococcus (beta-hemolytic)
**Streptococcus**

- **Reasons for treating Group A streptococcus**
  - 1) relief of symptoms related to infection
  - 2) prevent rheumatic fever
  - 3) prevent suppurative sequelae
  - 4) prevent further spread of group A streptococcus in the community
Streptococcus

- Clinical characteristics
  - Sore throat
  - Erythema of the involved tissues with or without purulent exudate
  - Petechiae of the soft and hard palate
Group A Streptococcus

Diagnosis

- All patient with suspected group A streptococcal pharyngitis should be test for the organism.

- Methods include
  - rapid antigen detection tests (RADT) – 10min,
  - slide-culture test using a bacitracin disk - overnight
  - Blood agar culture - overnight
Group A Streptococcus

- Recurrent pharyngitis
  - Bacteria inhibited but not killed
  - Beta-lactamase produced by normal flora (staphylococci and anaerobes)
  - Drug tissue levels (different absorption)
  - Re-infection by family members
Neisseria gonorrhoea

- Gram-negative diplococci
- Two pathogenic types of *Neisseria*
- *N. gonorrhoea* causes pharyngitis with exudate
- Diagnosis requires high index of suspicion in patients with suggestive sexual history
N. gonorrhea

- Diagnosis
  - Gram-stain from swab
    - 95% sensitive
    - 50% specific
  - Culture should always be done
    - Grows on chocolate agar with high CO2
  - Rapid nucleic acid probe tests now available
Neisseria gonorrhoea
**Corynebacterium diphtheriae**

- Causative organism of diphtheria
- Gram-negative bacillus
- Produces exotoxin at site of infection
  - Travels to heart and nervous system
- Spread by close contact via droplets or contaminated articles
- Humans are the sole carriers of the organism
- More common in children < 10 years
- Rare occurrence today because of routine vaccination
C. diphtheria

- Clinical manifestations
  - Systemic symptoms from exotoxin
    - Fatigued
    - Lethargic
    - Tachycardic
    - Toxic
C. diphtheriae

- Clinical characteristics
  - Pharynx
    - grayish membrane (composed of fibrin, leukocytes, and cellular debris)
    - extends from pharynx to larynx
  - Extensive cervical lymphadenopathy (‘bull neck’)
Treponema pallidum

- Causative agent of syphilis
- First recognized in the 16th century
- First isolated by Schaudinn and Hoffman in 1905
- Member of the Spirochete family along with Borrelia, Leptospira, and Fusobacteria
- Endoflagella
Syphilis

- Transmitted by direct sexual contact with individuals with primary or secondary syphilitic lesion
- Organism multiplies locally
- Primary lesion 2-10 days after infection
  - Chancre – hard-based, non-tender ulcer
Syphilis

- **Primary**
  - Single ulcer at the site of infection
  - Resolves in 3-8 weeks if untreated
- **Secondary**
  - Systemic dissemination
  - Symmetric mucocutaneous, maculopapular rash and generalized non-tender LAD
  - 1/3 develop condylomata lata
Diagnosis

- dark field microscopy
- fluorescent antibody microscopy
- Rapid plasma reagin (RPR)
- Fluorescent treponemal antibody absorption (FTA-ABS)
- Microhemagglutinatinoin assay for antibodies to *T. pallidum* (MHA-TP)
Treponema pallidum
Tuberculosis

♦ Pharyngitis
  - Secondary to expectoration of infected sputum
  - Granular or ulcerated surface mucosa

♦ Laryngitis
  - Most common granulomatous disease of the larynx
  - Posterior third of glottis – most common site
Tuberculosis

- **Diagnosis**
  - Demonstrating the tubercle bacilli in the sputum, urine, body fluids, or tissue
  - Acid fast stain allows for quick identification
  - Culture must be done to confirm the specific AFB and to determine sensitivities
Other bacteria

- Mycoplasma pneumoniae
- Chlamydia pneumoniae
- Influenza A and B
Fungal pharyngitis
Candida albicans

- An opportunistic fungus
- Normally present in the oral cavity
- Ability to adhere to mucosa is a distinguishing feature
C. albicans

- Causes of candidiasis
  - Increase relative proportion
    - long term antibiotics
  - Compromise of general immune capacity of host
    - Leukopenia
    - Corticosteroid therapy
  - T lymphocyte dysfunction
    - AIDS
    - Medications – cyclosporin
    - leukemia
  - Diabetes mellitus
Candidiasis

- Clinical manifestations
  - White, cheesy plaque
    - Loosely adherent to mucosa
    - Painless
    - Painful if removed
Candidiasis

- Diagnosis
  - Usually made clinically
  - Exudates or epithelial scrapings may be examined by KOH prep or G-stain
    - Demonstration of budding yeast associated with hyphae and pseudohyphae is diagnostic
Candida
thank you