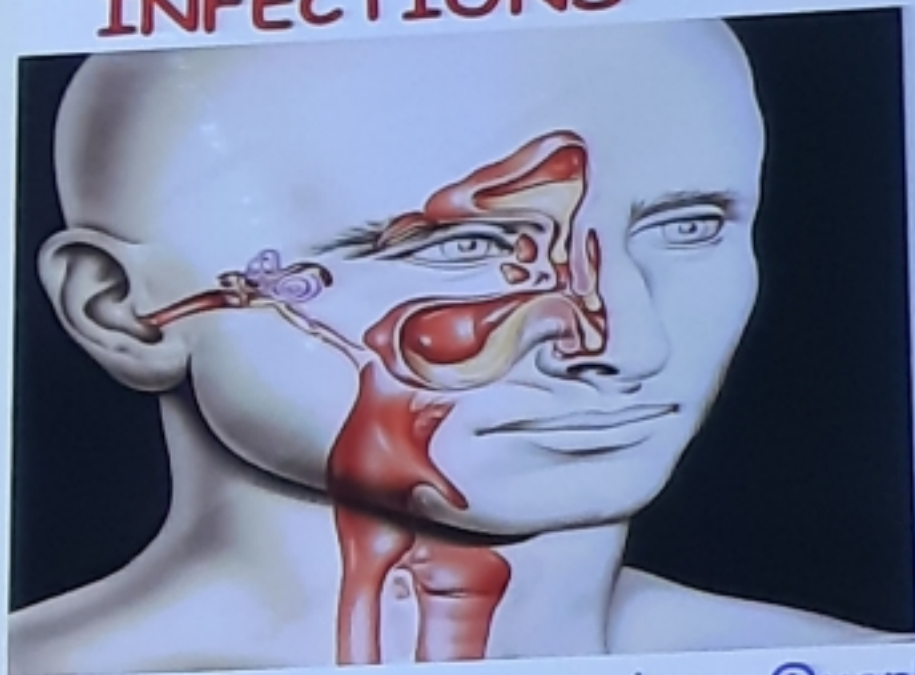


RESPIRATORY TRACT INFECTIONS



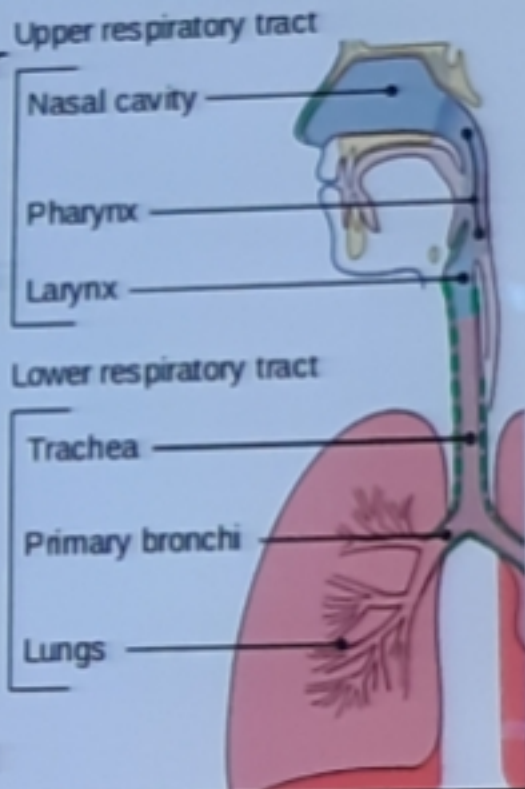
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: @docmureithi



THE RESPIRATORY SYSTEM

- A major portal of entry for infectious organisms
- It is divided into two tracts
 - upper and lower
 - The division is based on structures and functions in each part.
- The two parts have different types of infection



WHY IS THIS IMPORTANT?

- The respiratory system is the most commonly infected system
- Health care providers will see more respiratory infections than any other type.



Learning Objectives

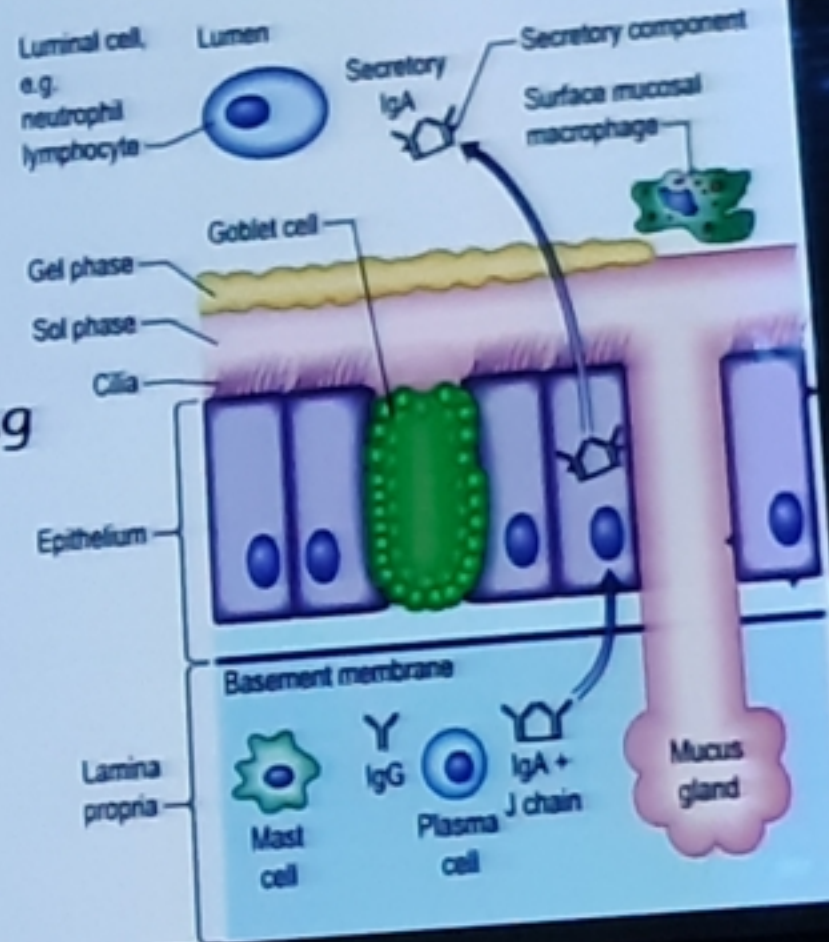


- Describe the general Features of respiratory infections
- Describe in detail the bacterial and fungal causative agents
- List procedures used in the laboratory diagnosis and agents used in the treatment

The Respiratory Tract & its Defenses

- Nasal hair
- Cilia
- Mucus
- Involuntary responses such as coughing, sneezing, swallowing
- Macrophages
- Secretory IgA against specific pathogens

DEFENSE

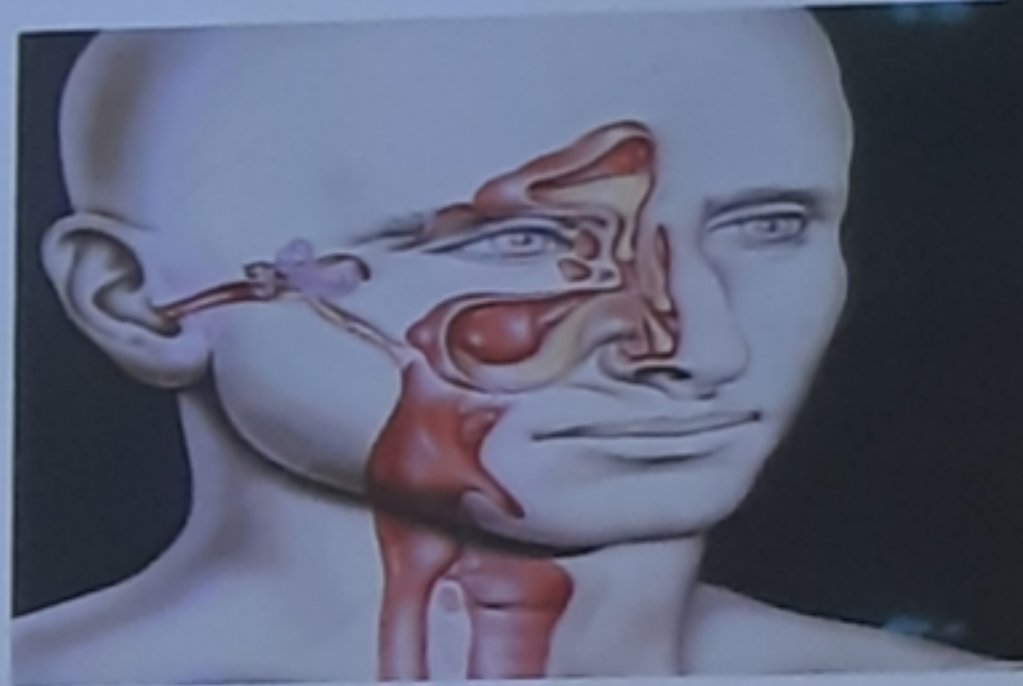


Normal Biota of the Respiratory Tract

- Generally limited to the upper respiratory tract
- Gram-positive bacteria (streptococci and staphylococci) common
- Disease-causing bacteria are present as normal biota;
- Can cause disease if their host becomes **immunocompromised** or if they are transferred to other hosts
- (*Streptococcus pyogenes*, *Haemophilus influenza*, *Streptococcus pneumonia*, *Neisseria meningitides*, *Staphylococcus aureus*)

BACTERIAL INFECTIONS OF THE UPPER RESPIRATORY TRACT (URT)

- Laryngitis & Epiglottitis
- Otitis media, mastoiditis, and sinusitis
- Pharyngitis
- Scarlet fever
- Diphtheria



EAR INFECTIONS

- **External canal** – otitis externa
- **Middle ear** – otitis media
- **Factors in pathogenesis**
 - Local trauma
 - Foreign body
 - Excessive moisture – maceration of external ear epithelium (Swimmer's ear)



....Clinical manifestations

1. Acute otitis media

- Nearly always bacterial
- Potential acute, includes extension into CNS and sepsis



Causative Agents

- **Acute OM**

- *S.pneumoniae*, Grp B Strep, *H.influenzae*,
S.aureus, *P.aeruginosa*, Gram –ve enteric
bacteria

- *H.influenzae*

- *S.pyogenes*, *S.aureus*, *Moraxella catarrhalis*

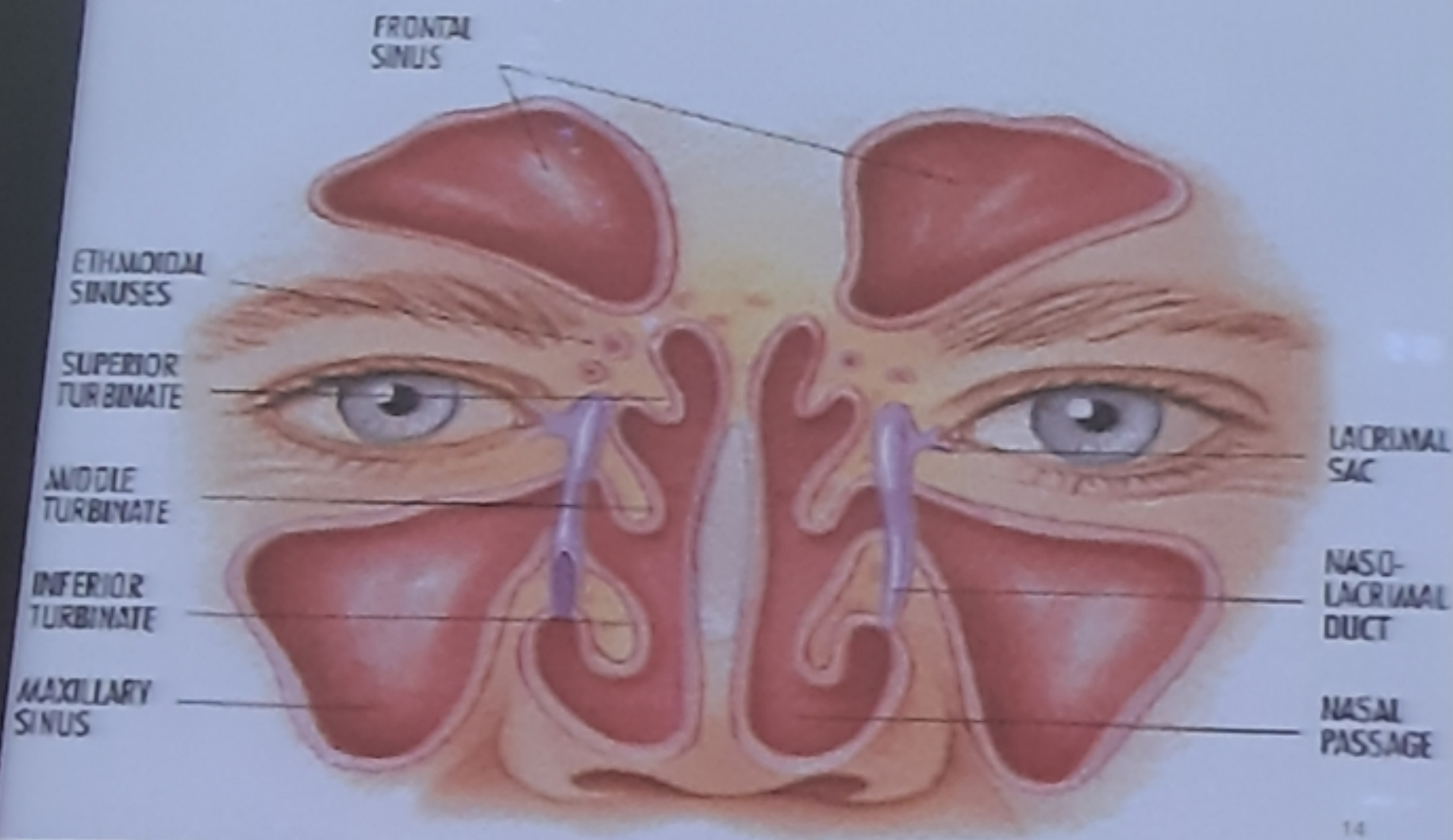
Chronic OM – mixed flora

P.aeruginosa, *H.influenzae*, *S.aureus*, *Proteus*
spp. , *K.pneumoniae*, *M.catarrhalis*, G+ve G-ve
anaerobes

✓ CHECKPOINT 21.3 Otitis Media

Causative Organism(s)	<i>Streptococcus pneumoniae</i>	<i>Haemophilus influenzae</i>	Other bacteria
Most Common Modes of Transmission	Endogenous (may follow upper respiratory tract infection by <i>S. pneumoniae</i> or other microorganisms)	Endogenous (follows upper respiratory tract infection)	Endogenous
Virulence Factors	Capsule, hemolysin	Capsule, fimbriae	-
Culture/Diagnosis	Usually relies on clinical symptoms and failure to resolve within 72 hours	Same	Same
Prevention	Pneumococcal conjugate vaccine (heptavalent)	Hib vaccine	None
Treatment	Wait for resolution; if needed, amoxicillin (are high rates of resistance) or amoxicillin + clavulanate or cefuroxime	Same as for <i>S. pneumoniae</i>	Wait for resolution; if needed, a broad-spectrum antibiotic (azithromycin) might be used in absence of etiologic diagnosis
Distinctive Features	-	-	Suspect if fully vaccinated against other two

NOSE, THE SINUSES



SINUS Causative Agents

- Acute sinusitis
 - ≈60% - *S.pneumoniae*, *H.influenzae*
 - *S.pyogenes*, *S.aureus*, *M.catarrhalis*
- Chronic – as above
 - G-ve enterics
 - G+ve & G-ve anaerobes
 - Mixed aerobes & anaerobes
 - Opportunistic fungi – in DM pts & immunodeficient – *Mucor*, *Aspergillus*, *Rhizopus* spp

SORE THROAT



EPIGLOTTITIS



CANCERS



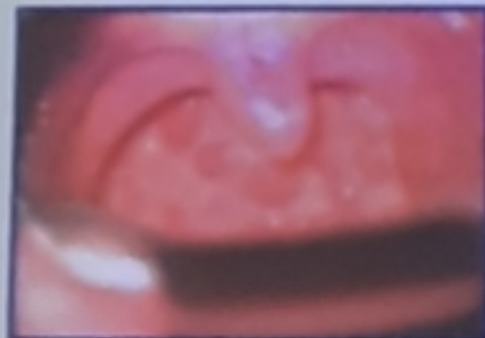
ABSCESS



LARYNGITIS



THYROIDITIS



PHARYNGITIS

PHARYNGITIS (Exudative)



STREPTOCOCCAL



DIPHTHERIA



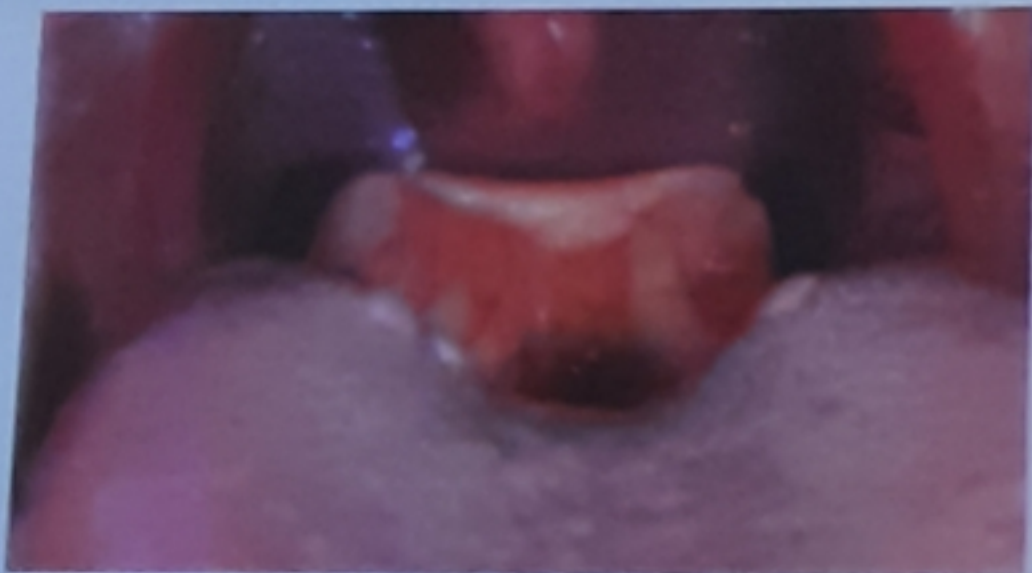
GONOCOCCAL



MONONUCLEOSIS

THROAT

1. *H. influenzae* type b- acute epiglottitis in children



Strep throat

β - hemolytic - Group A (GAS) streptococci: *S. pyogenes*

Droplet Transmission

Symptoms: Sore throat, high fever, coughing, otitis media may also occur



A rapid antigen detection test for group A streptococcus was positive. Throat culture confirmed group A beta-hemolytic streptococcus. "Doughnut" lesions are erythematous papules with a pale center that may be present on both the soft and hard palates.

The presence of these lesions is a clinical sign that has historically been associated with group A streptococcus pharyngitis. The patient was treated with a 10-day course of oral amoxicillin and recovered without complication.

Complications of Strep Throat

S. pyogenes causes two major nonsuppurative autoimmune complications (antibodies cross-react)

1. Acute rheumatic fever:

Short period of arthritis and fever followed in ~ 50% of affected by **rheumatic heart disease**

⇒ heart valve damage ⇒ chronic valvular disease (stenosis and/or incompetence) ⇒ heart failure and/or subacute bacterial endocarditis

2. Acute poststreptococcal *glomerulonephritis*

Laboratory diagnosis

- Specimen: Throat swabs, pus swabs, blood, CSF etc
- Direct Gram stain- Gram-positive cocci in chains, pus cells
- Culture:
 - BA, aerobically, 37°C for 18-24 hours
 - Smooth circular colonies of 2-3 mm diameter, β -haemolysis
- Gram-positive cocci in chains
- Catalase negative

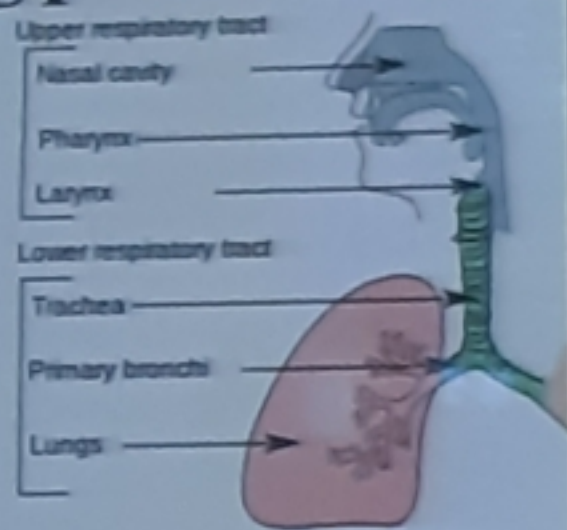


CHECKPOINT 21.5 Diphtheria

Causative Organism(s)	<i>Corynebacterium diphtheriae</i>
Most Common Modes of Transmission	Droplet contact, direct contact or indirect contact with contaminated fomites
Virulence Factors	Exotoxin: diphtheria toxin
Culture/Diagnosis	Tellurite medium—gray/black colonies, club-shaped morphology on Gram stain; <i>treatment begun before definitive identification</i>
Prevention	Diphtheria toxoid vaccine (part of DTaP)
Treatment	Antitoxin plus penicillin or erythromycin

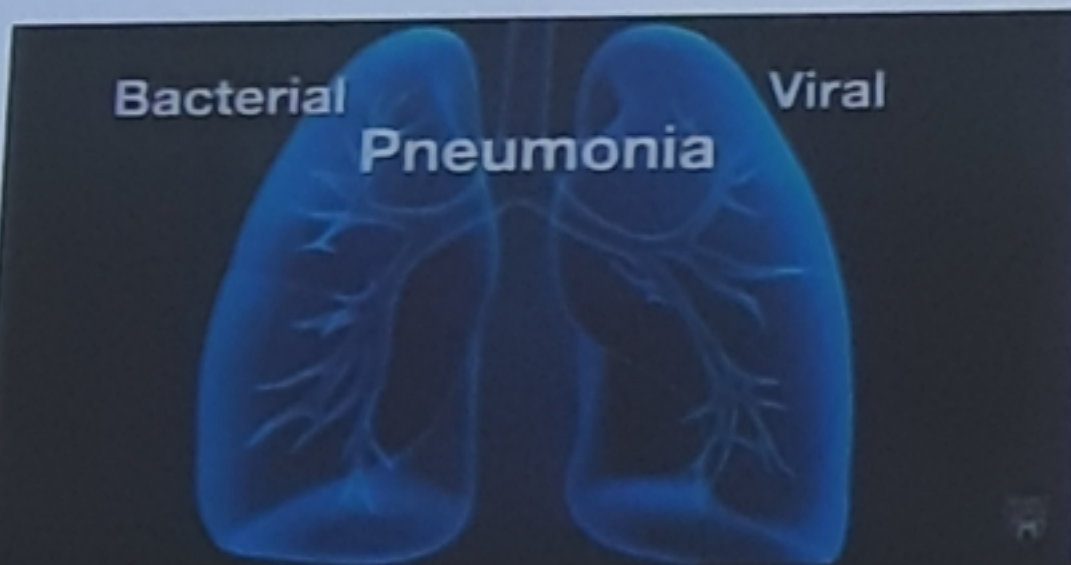
BACTERIAL INFECTIONS OF THE LOWER RESPIRATORY TRACT

1. Bacterial pneumonia
2. Chlamydial pneumonia
3. *Mycoplasma pneumoniae*
4. Tuberculosis
5. Pertussis
6. Inhalation anthrax
7. *Legionella pneumoniae* (Legionnaire's disease)



BACTERIAL PNEUMONIA

- One of the most serious lower respiratory tract infections.



BACTERIAL PNEUMONIA

- Nosocomial pneumonia
 - Occurs approximately 48 hours after admission to hospital
 - Usually associated with *Staphylococcus aureus*
 - Also caused by Gram-negative bacteria
- Community-acquired pneumonia
 - Usually presents as a lobar pneumonia
 - Accompanied by fever, chest pain, and production of purulent sputum
- Usually occurs after the aspiration of pathogens
 - Requires enough pathogens to overwhelm resident defenses

Types of bacteria causing pneumonia

Gram-positive bacteria:

Streptococcus pneumoniae, often called "pneumococcus",
Staphylococcus aureus, with *Streptococcus agalactiae*.

Gram-negative bacteria:

- *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Moraxella catarrhalis*.

.....BACTERIAL PNEUMONIA

Treatment

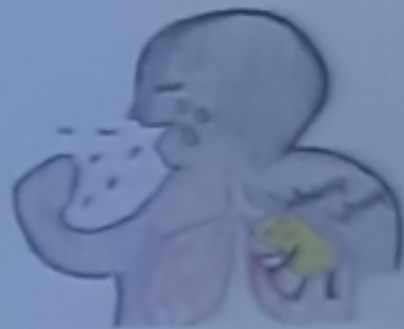
- Course of treatment depends on:
 - Severity of the infection.
 - Type of organism causing the infection.
- Most common pathogen is *Streptococcus pneumoniae*.
 - Treated with penicillin, amoxicillin-clavulanate, and erythromycin.

3. *MYCOPLASMA PNEUMONIA*

- Mild form of pneumonia
- Accounts for about 10% of all pneumonias
- Referred to as *walking pneumonia*
 - No need for hospitalization.

Whooping Cough

- Also known as **pertussis**
- Two distinct symptom phases
 - **Catarrhal stage**
 - After incubation from 3 to 21 days
 - Bacteria in the respiratory tract cause what appear to be cold symptoms (runny nose)
 - Lasts 1 to 2 weeks
 - **Paroxysmal stage**
 - Severe and uncontrollable coughing
 - Violent coughing spasms can result in burst blood vessels in the eyes or even vomiting





CHECKPOINT 21.6

Pertussis (Whooping Cough)

Causative Organism(s)	<i>Bordetella pertussis</i>
Most Common Modes of Transmission	Droplet contact
Virulence Factors	FHA (adhesion), pertussis toxin and tracheal cytotoxin, endotoxin
Culture/Diagnosis	Grown on B-G, charcoal, or potato-glycerol agar; diagnosis can be made on symptoms
Prevention	Acellular vaccine (DTaP), erythromycin or trimethoprim-sulfamethoxazole for contacts
Treatment	Mainly supportive; erythromycin to decrease communicability

...TUBERCULOSIS: Pathogenesis

- Two basic types of tuberculosis
 - Primary
 - Follows initial exposure to the pathogen
 - Secondary
 - Can occur years later

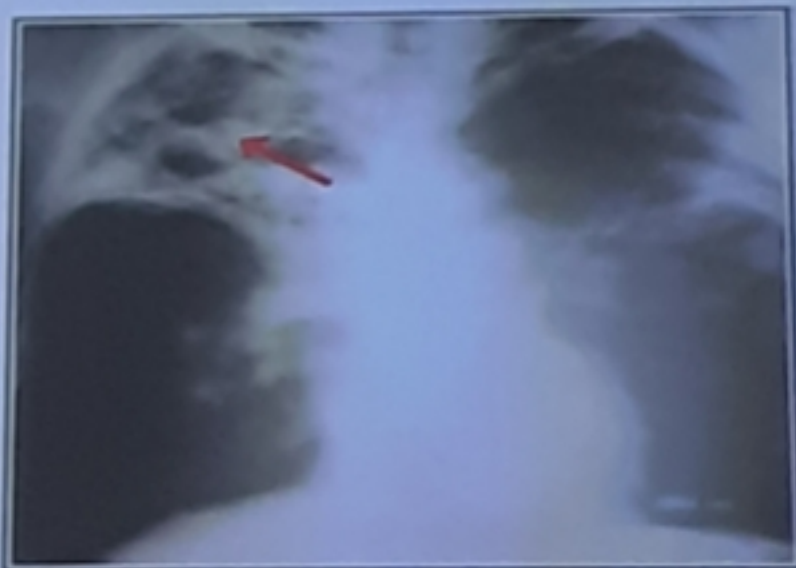
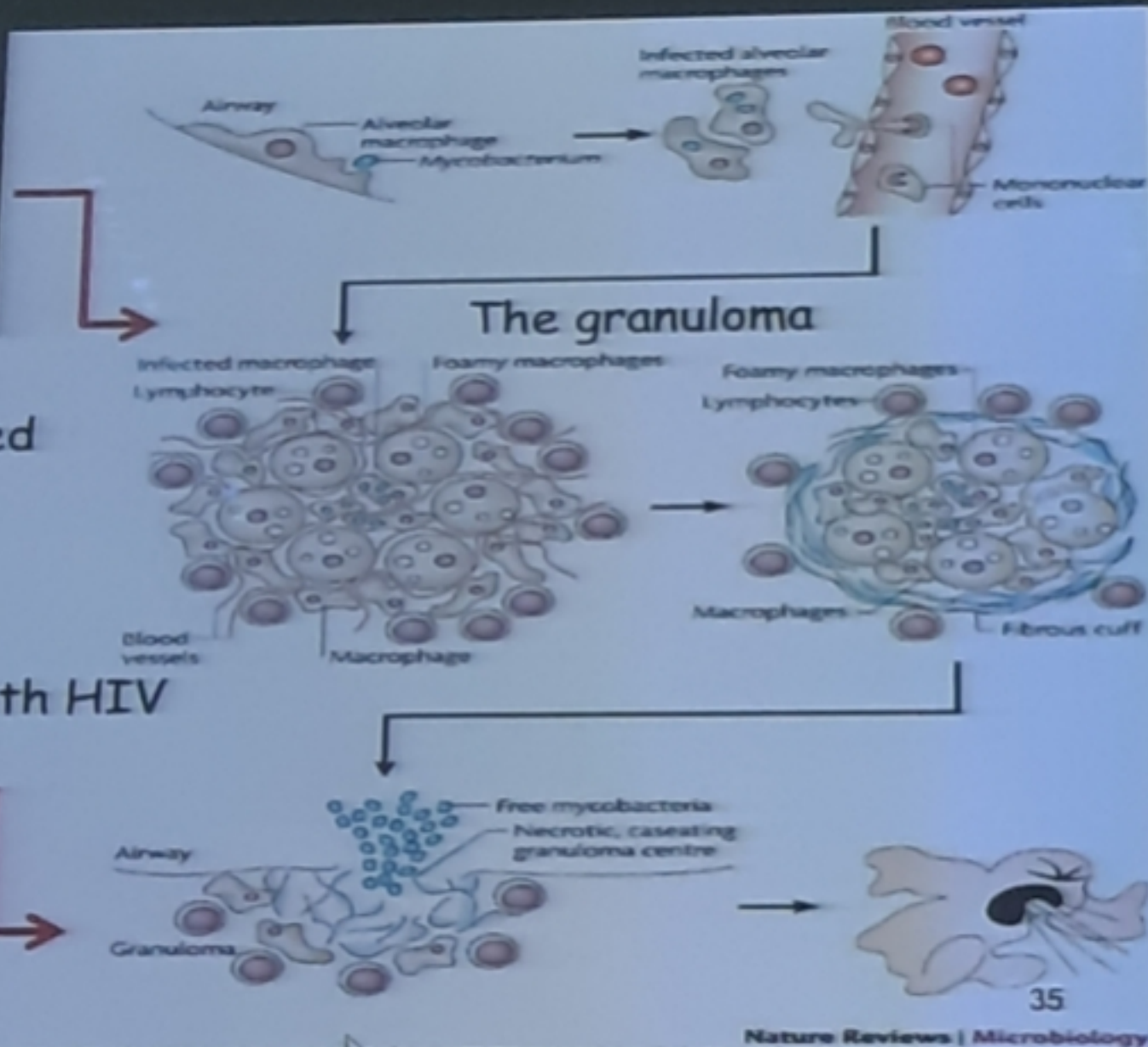


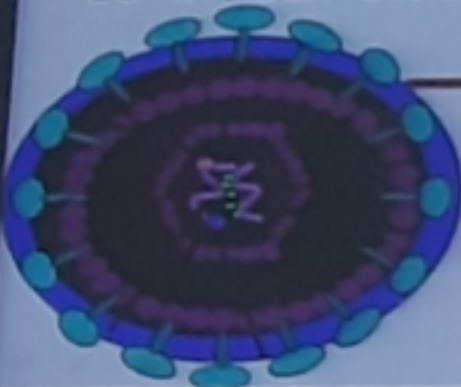
Figure 44.22 Microbiology: A Clinical Approach 10th Edition Tortora



The infectious bacilli are inhaled as droplets



co-infection with HIV

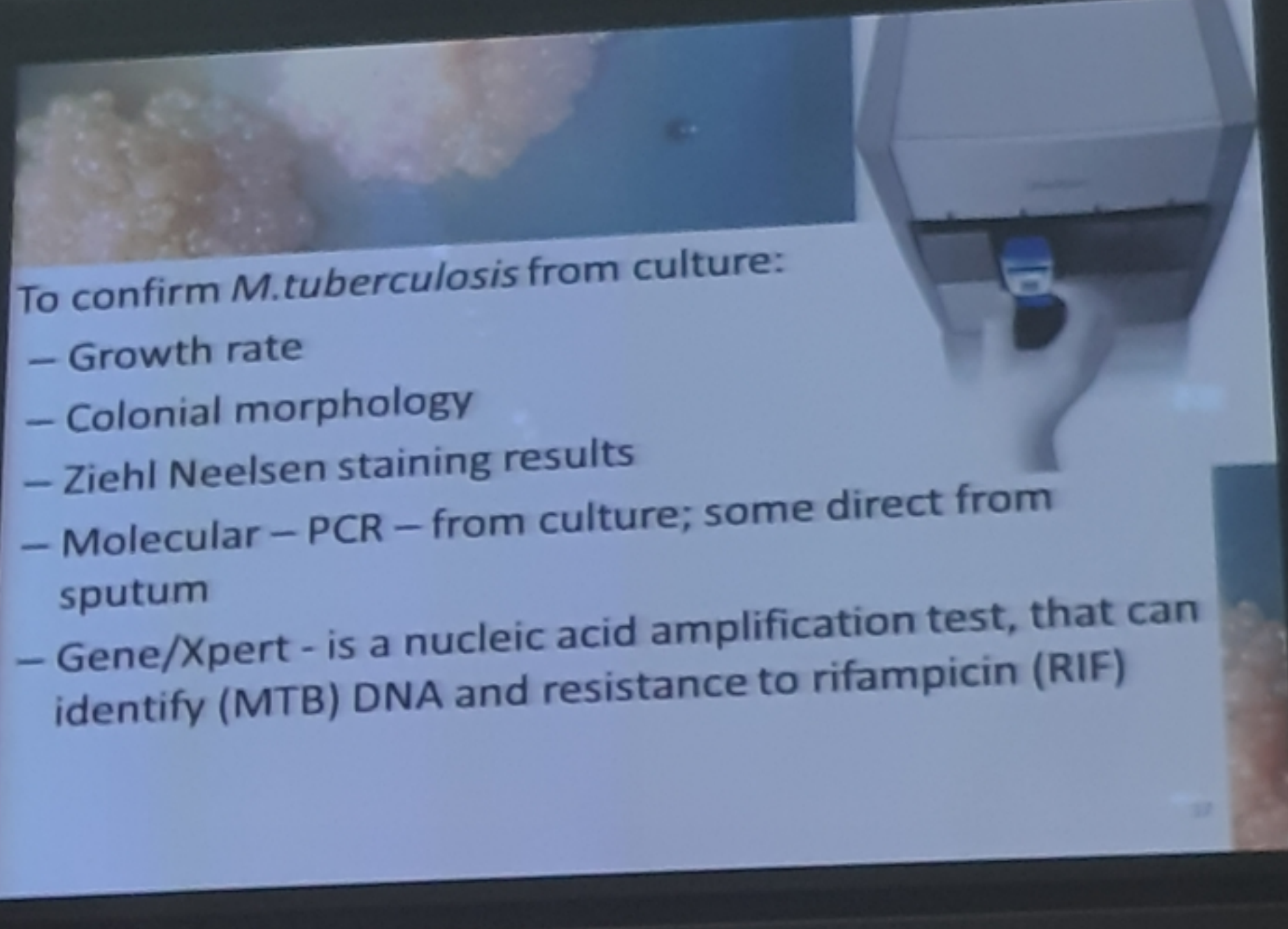


Primary infection

**Latent TB infection
(immunocompetent)**

**Progressive primary TB
(immunocompromised, children)**

**Post-primary TB/ Secondary TB/Adult-type
TB
Reactivation disease
(develops when immunity is suppressed)**

The image is a composite. The top left shows a microscopic view of Mycobacterium tuberculosis colonies, which are small, pinkish, and have a beaded or clumpy appearance. The top right shows a hand in a white glove operating a piece of laboratory equipment, possibly a pipette or a small-scale incubator. The background is a light blue gradient.

To confirm *M.tuberculosis* from culture:

- Growth rate
- Colonial morphology
- Ziehl Neelsen staining results
- Molecular – PCR – from culture; some direct from sputum
- Gene/Xpert - is a nucleic acid amplification test, that can identify (MTB) DNA and resistance to rifampicin (RIF)

ASPERGILLOSIS

*Aspergillus
Fumigatus*

Lungs

Irritated
Airway

Excess
Mucus

Damaged
Cilia

ASPERGILLOSIS

- Invasive aspergillosis shows a rapid progression to death.
- Typically seen in the immunocompromised.
 - Particularly patients with leukemia or AIDS.
 - Patients undergoing bone marrow transplantation.
- Also seen in individuals with preexisting pulmonary disease
 - Chronic bronchitis, asthma, and tuberculosis
 - Fungus produces extracellular proteases, phospholipases, and toxic metabolites.

..ASPERGILLOSIS: Pathogenesis

- Colonization with *Aspergillus* leads to invasion of tissues.
 - Invasion of lung tissue causes penetration of blood vessels.
 - This causes hemoptysis and/or acute pneumonia.
- Pneumonia is accompanied by multifocal pulmonary infiltrates and high fever.
 - Prognosis is grave.
 - Mortality for invasive aspergillosis is 100%.
 - Amphotericin B and itraconazole can be used but are usually ineffective.

CONCLUSIONS

- Describe the structure and main pathogenic features of Respiratory Infections
- Close attention to the lab diagnosis and treatment
- Note any AMR Complications
- Development of Vaccines



Strengthening AMR Surveillance in Kenya.

Fleming Fund Kenya Country Grant



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