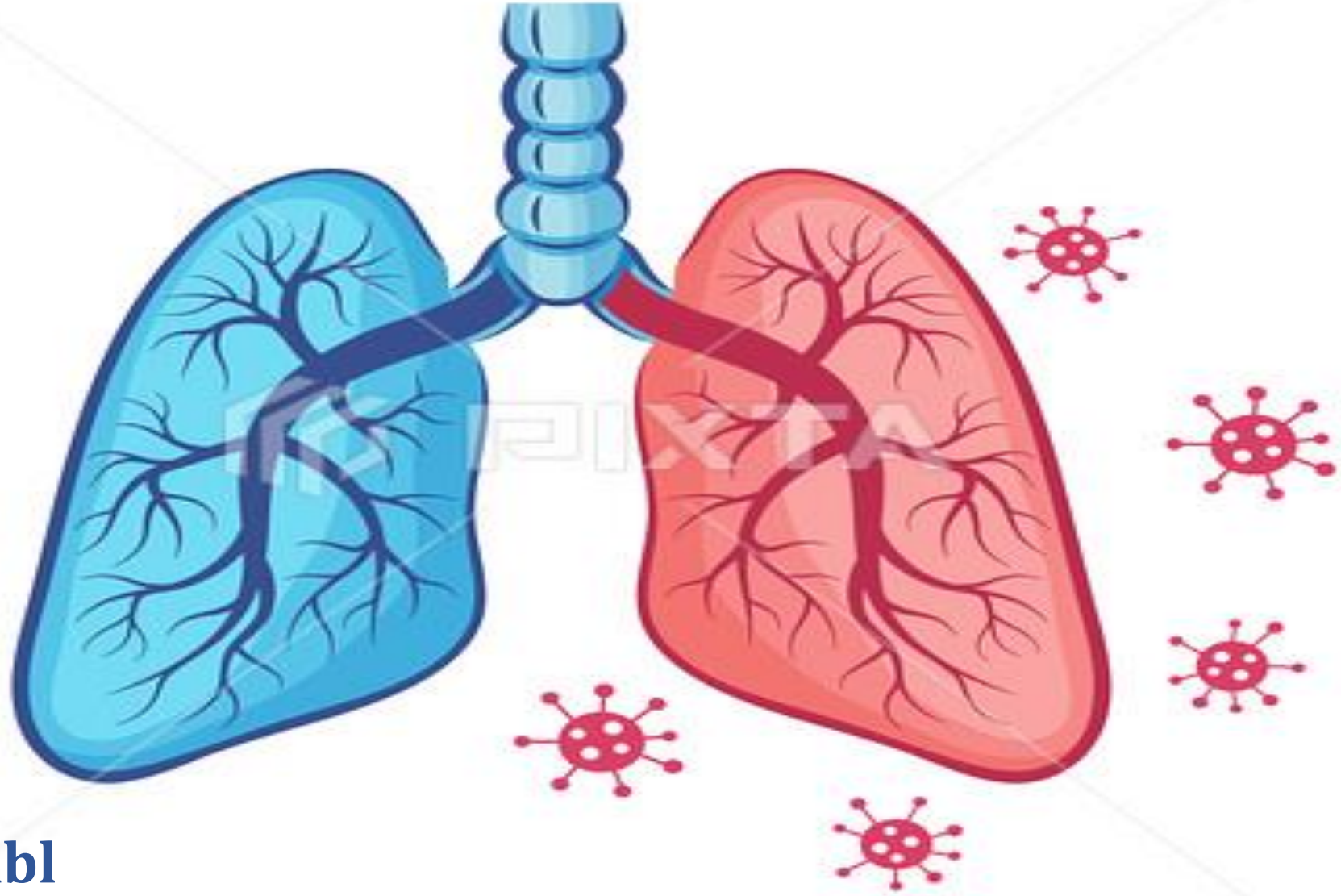
RESPIRATORY TRACT INFECTIONS - I



By
Prof. Hala Tabl

Respiratory Tract Infections

I- Rhinitis (Common Cold):

*** Mostly of viral causes**

Rhinovirus
Coronavirus
Adenovirus,
Parainfluenza virus
Influenza virus
RSV

II- Sore throat and Pharyngitis:

* **Bacteria:**
- Streptococcus pyogenes.
- Corynebacterium diphtheriae.

-Vincent's organisms: Borrelia vincenti and Fusobacterium.

* **Fungi:** Candida.

*** Virus:** EBV and Adenoviruses.

III- Infections of the ear:

Otitis Externa:
- Pseudomonas aeruginosa.
- Aspergillus niger (otomycosis).

Otitis media:
- Streptococcus pneumoniae
- Haemophilus influenzae
- Moraxella catarrhalis
- Streptococcus pyogenes
- Staphylococcus aureus

IV- Sinusitis:
- Streptococcus pneumoniae
- Haemophilus influenzae
- Moraxella catarrhalis
- Streptococcus pyogenes
- Staphylococcus aureus

V- Acute Epiglottitis:

Haemophilus influenza type b

VI- Laryngitis and croup: Mostly viral

Parainfluenza, Influenza, Adenovirus.

VII- Tracheitis & Bronchitis:

*** Mostly viral:** Parainfluenza, Influenza, Adenovirus and RSV.

*** Bacteria:** Bordetella pertussis, Haemophilus influenza, Mycoplasma pneumonia, Chlamydia pneumonia and Streptococcus pneumonia.

VIII- Bronchiolitis:

RSV, Parainfluenza virus

IX- Pneumonia

Community Acquired Pneumonia (CAP):

Bacterial causes:

- **Streptococcus pneumoniae (the commonest** cause of **lobar** pneumonia in young children and elderly**).**
- Haemophilus influenzae
- Staphylococcus aureus
- Streptococcus pyogenes
- Bacillus anthracis (pneumonic anthrax)
- Yersinia pestis (pneumonic plague)
- Mycobacterium tuberculosis & Atypical mycobacteria
- **Atypical pneumonia:**

(Mycoplasma pneumoniae, Legionella pneumophila, Chlamydia psittaci, Coxiella burnetii).

Fungal causes:

- Histoplasma capsulatum, Aspergillus fumigatus, Coccidioides immitis, Blastomyces dermatitis, Cryptococcus neoformans, Pneumocystis jirovecii

Viral causes:

Rarely the primary cause of pneumonia and when they cause pneumonia, it is mainly in infants and immuno-compromised patients.

- Influenza
- Respiratory syncytial virus (predominant in infants).
- Para - influenza virus
- Adenoviruses

Parasitic causes:

- Paragonimus westermani
- Loeffler's syndrome (Ascaris lumbricoides, Strongyloides stercoralis, Ancylostoma duodenale).

Hospital Acquired (Nosocomial) Pneumonia (HAP):

(48hs or more after admission)
(Klebsiella pneumoniae, Pseudomonas aeruginosa and E. coli, Staphylococcus aureus MRSA).

Empyema (a collection of pus in the pleural cavity): Mostly caused by pyogenic G+ve cocci especially **Staphylococcus aureus** and G-ve bacilli especially **Klebsiella pneumoniae.**

Lung Abscess: Anaerobes (Peptostreptococcus spp., Prevotella spp. and Fusobacterium nucleatum) and Staph. aureus.

Sore throat and Pharyngitis:

* **Bacteria:**

- Streptococcus pyogenes (**The most common cause**).

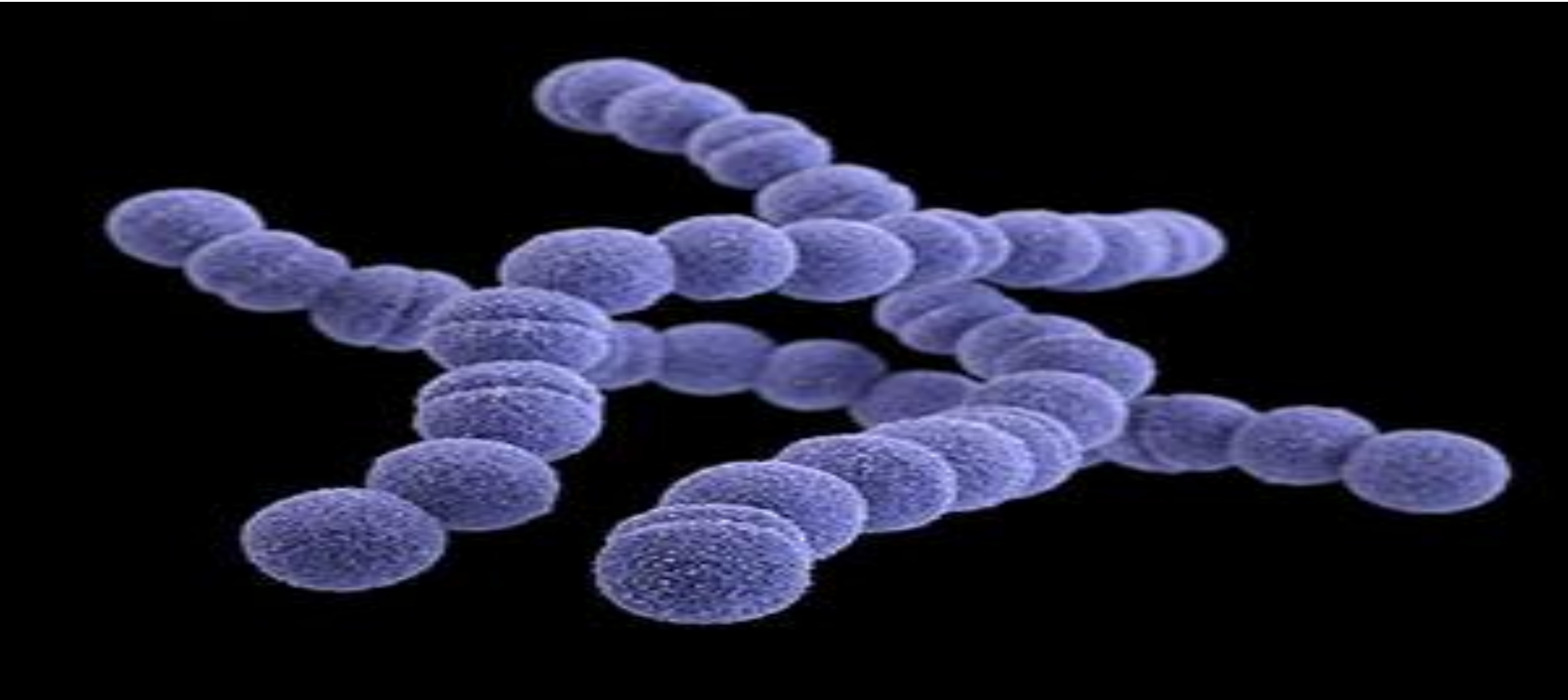
- Corynebacterium diphtheriae.

-Vincent’s organisms: Borrelia vincenti and Fusobacterium.

* **Fungi:** Candida.

*** Virus:** EBV and Adenoviruses.

GROUP A, BETA- HAEMOLYTIC STEREPTOCOCCI (STREPTOCOCCUS PYOGENES)



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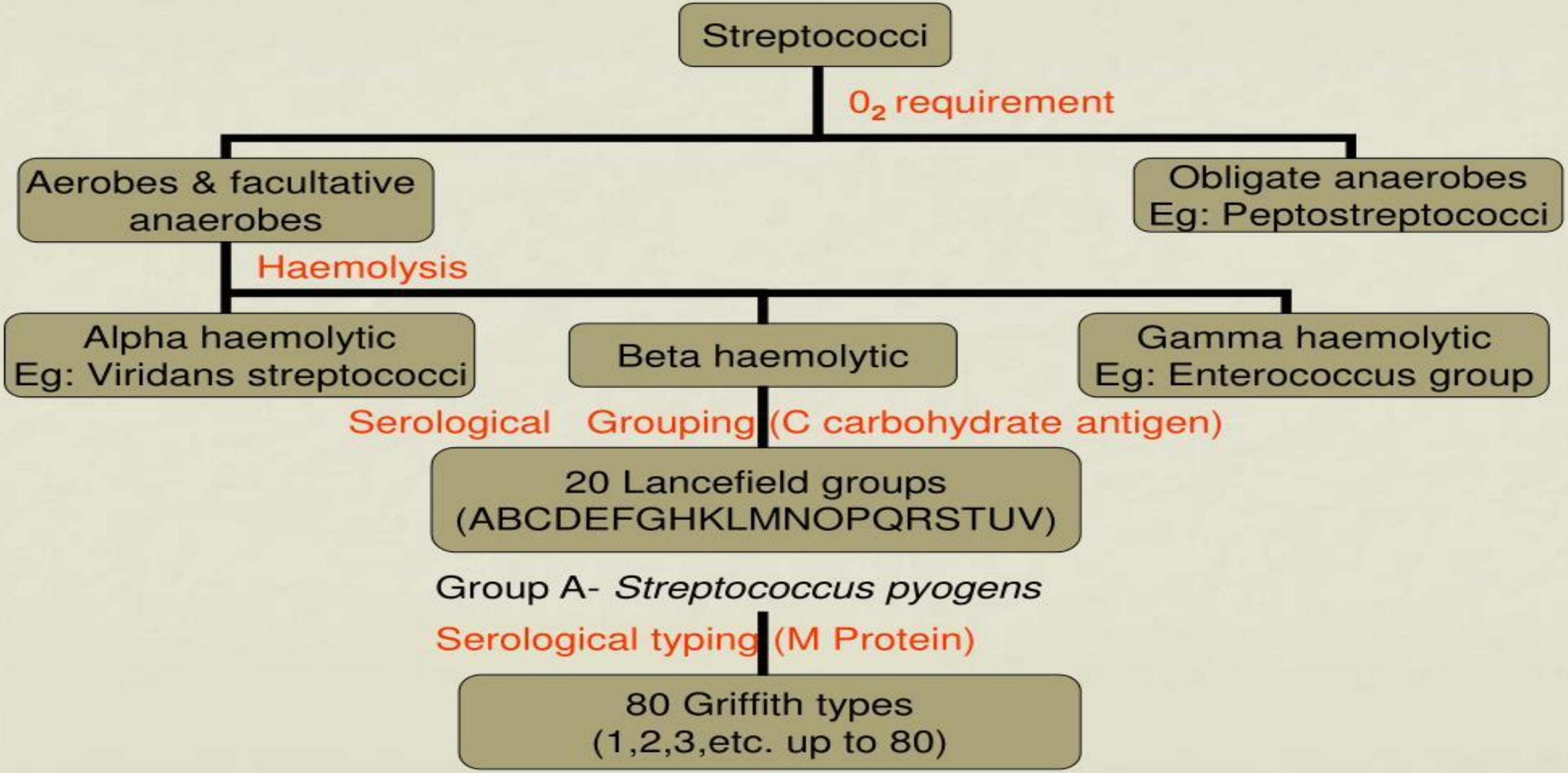
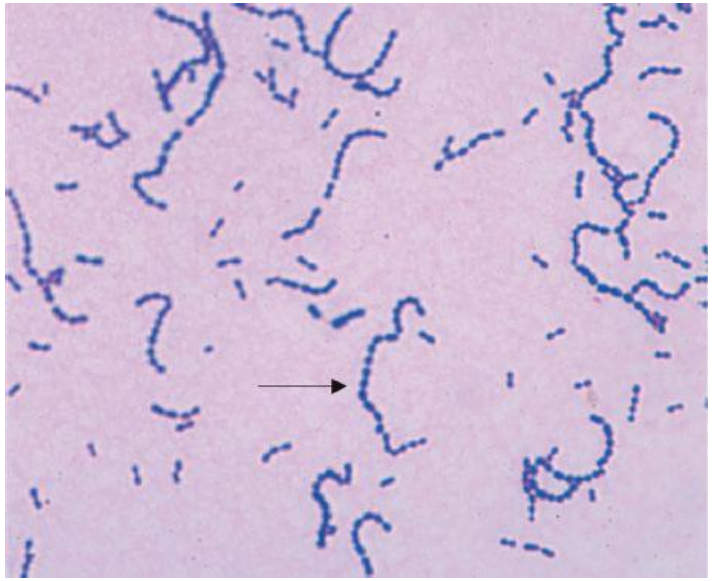


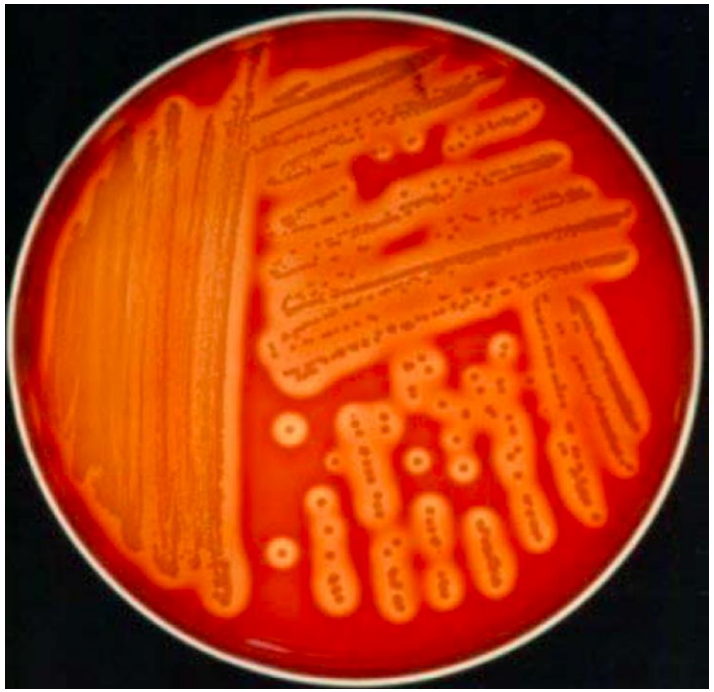
MORPHLOGY:

- **Gram-positive cocci**.
- Arranged in **chains** or pairs.
- Some are capsulated.



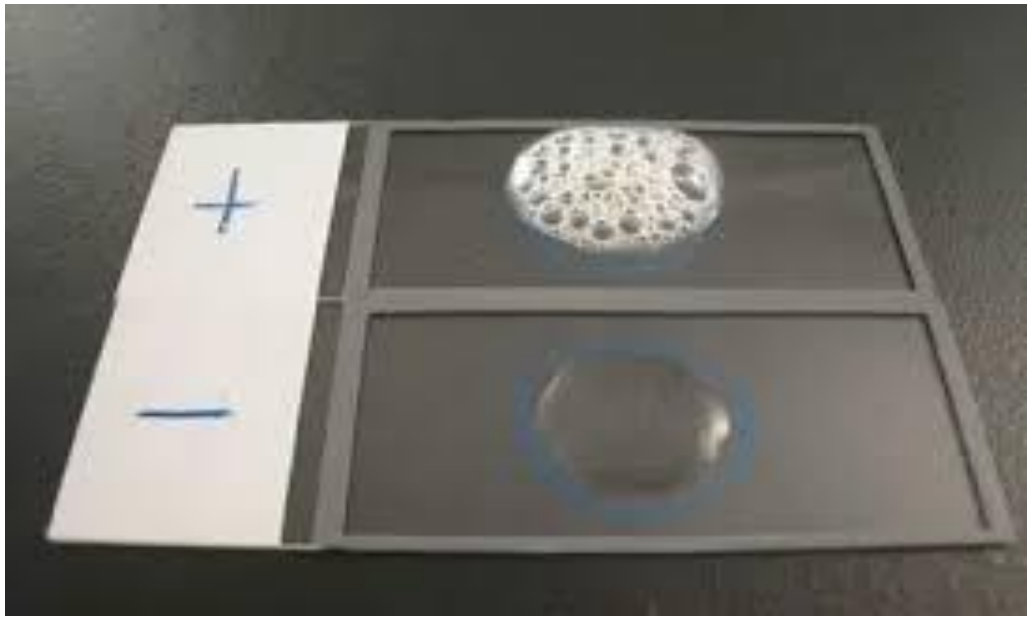
CULTURE:

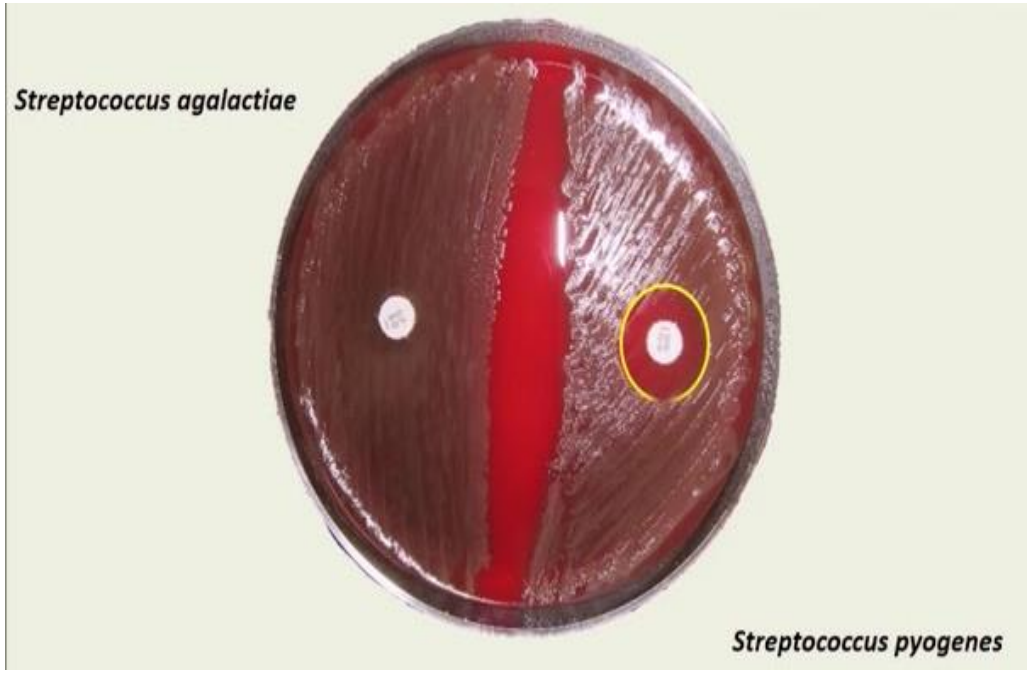
- They are facultative anaerobes.
- Fastidious organism grow on blood agar and produce **complete (Beta) hemolysis**. Growth and hemolysis are aided by incubation in 10% CO2.



BIOCHEMICAL REACTION:

- **Catalase negative** (Differentiate with Staphylococci which are catalase positive).
- **Bacitracin sensitive** (Differentiate with other beta hemolytic streptococci such as S. agalactiae which is bacitracin resistant).





VIRULNCE FACTORS:

A) Adherence factors: promotes adherence to epithelial cells.

1- Fibronectin- binding protein (protein F) and lipoteichoic acids (LTA).

2- M protein: hair like projections covering the cell wall.

B) Anti-phagocytic factors:

1- M protein: it is a **major virulence factor** that resist phagocytosis.

According to M protein, group A are classified to more than 80 types.

2- Hyaluronic acid capsule: acts as immunological mask to avoid phagocytosis.

As it is chemically similar to hyaluronic acid of the host connective tissue, therefore, it is not immunogenic.

3- C5a peptidase: breaks down C5a complement so that it no longer attracts phagocytes.

C) Spreading factors: Group of enzymes that break down the normal host tissues and so, facilitates the rapid spread and invasion of S. pyogenes:

1- Streptokinase (Fibrinolysin):- Dissolves fibrin in clots, thrombi, and emboli.

2- Streptodornase (Deoxynuclease)(DNase):- Depolymrizes and degrades DNA.

So, Streptokinase and streptodornase used in:

- Treatment of pulmonary emboli and coronary artery and venous thrombosis.
- Liquefy exudates and facilitate removal of pus and necrotic tissues.

3- Hyaluronidase: Splits hyaluronic acid, a component of host connective tissue.

D) Toxines:

1- Streptolysins (Hemolysins) (pore forming cytotoxin): lyse red blood cells, white blood cells, and platelets.

a) Streptolysin O: (oxygen labile).

It is **antigenic**, and antibody to it (ASO) develops after group A streptococcal infections.

The titer of ASO antibody is important in the diagnosis.

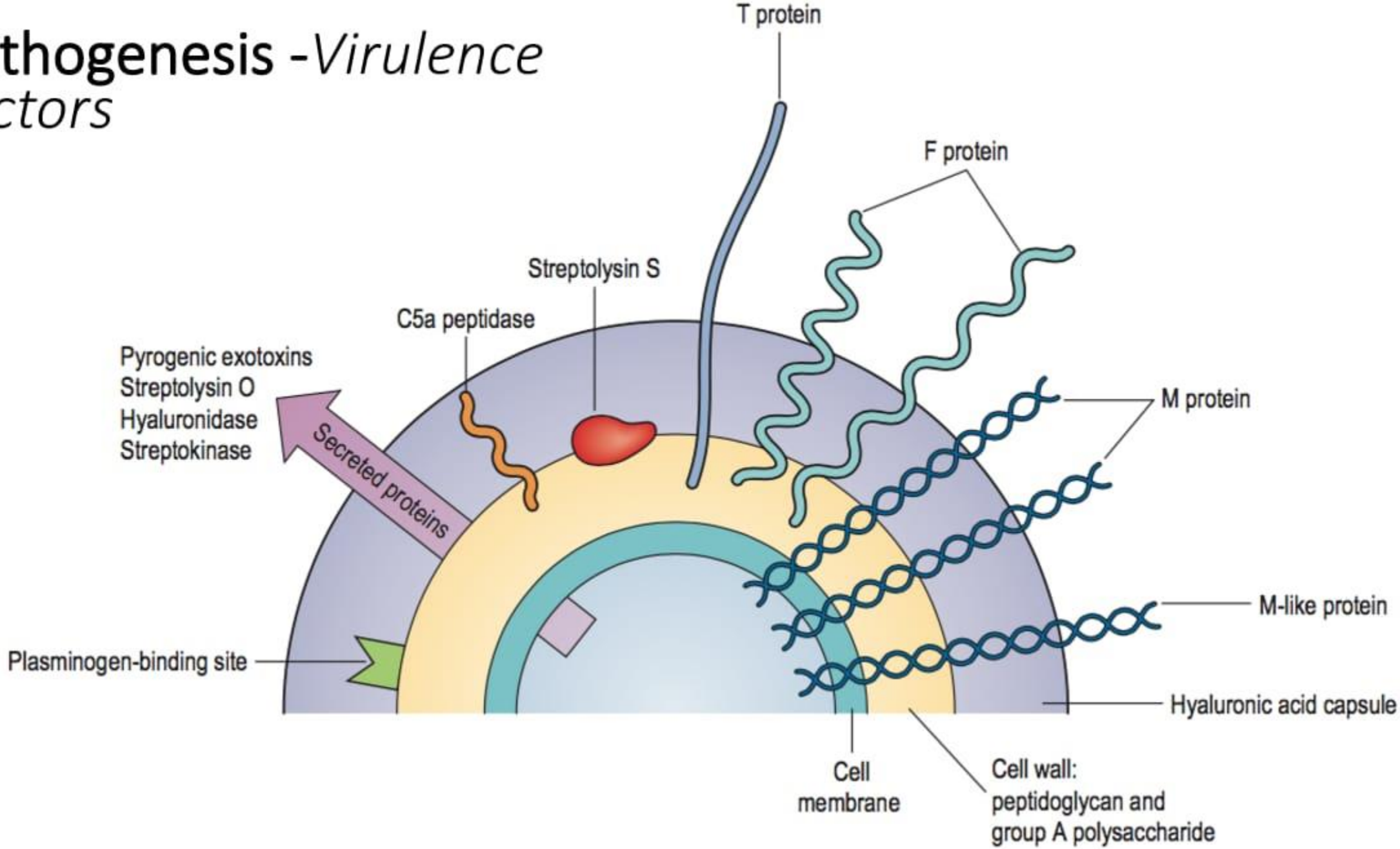
b) Streptolysin S: (oxygen stable), not antigenic.

It is responsible for **β-hemolysis** on the surface of a blood agar plate.

2-Pyrogenic (fever inducing) exotoxins: Three different exotoxins (SPE A, B and C).

SPE A (erythrogenic toxin): It causes the **rash** that occurs in scarlet fever.

Pathogenesis -*Virulence factors*



Diseases caused by Streptococcus Pyogenes:

S. pyogenes causes three types of diseases:

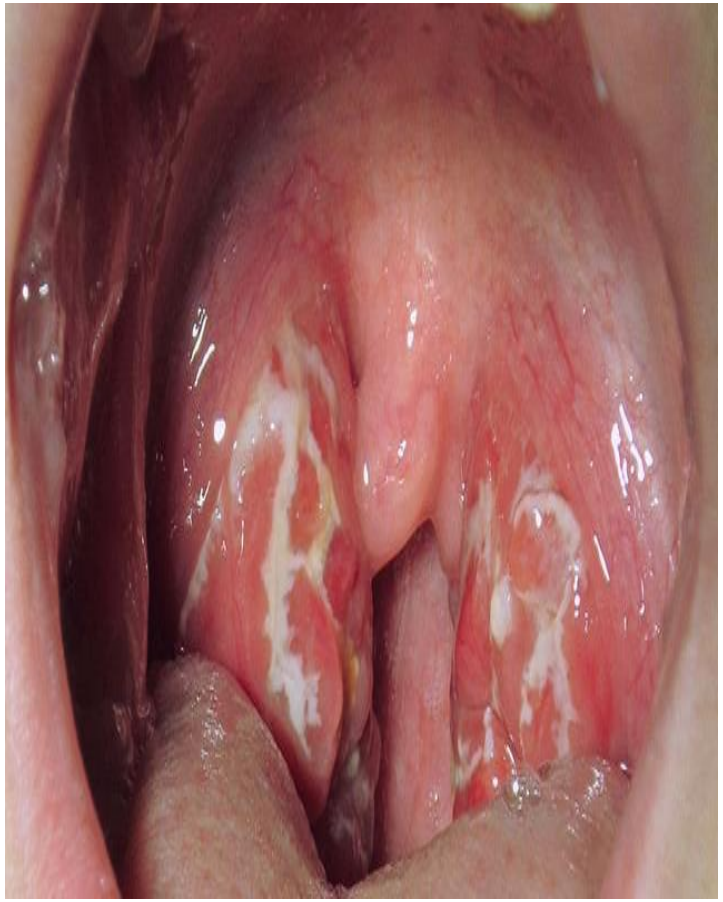
(1) Pyogenic (suppurative) (pus-forming) diseases such as **pharyngitis**, impetigo, cellulitis and puerperal sepsis.

(2) Toxigenic diseases such as **scarlet fever** and toxic shock syndrome.

(3) Immunologic diseases such as rheumatic fever and acute glomerulonephritis (AGN) (post-streptococcal diseases).

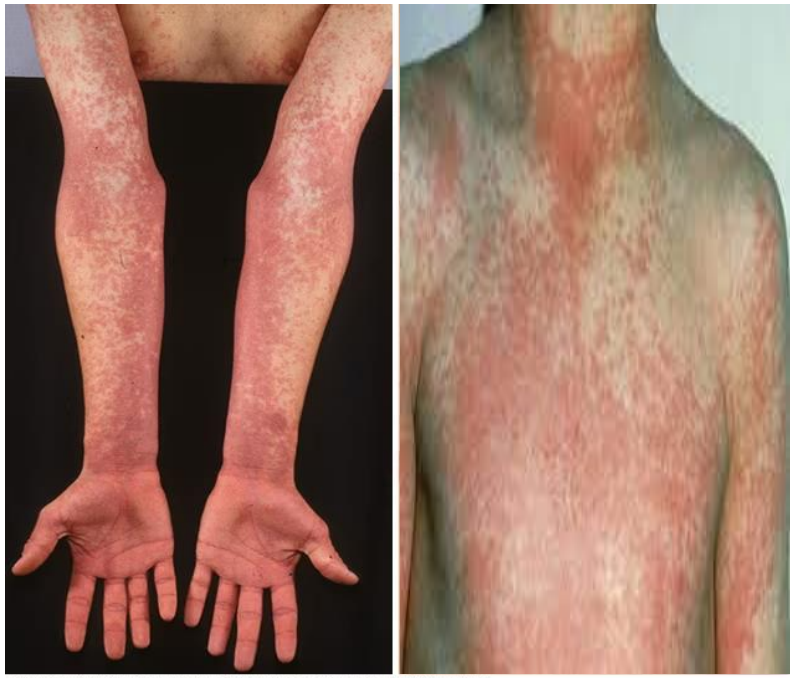
1) Streptococcal pharyngitis (Strep throat) (Acute follicular tonsillitis):-

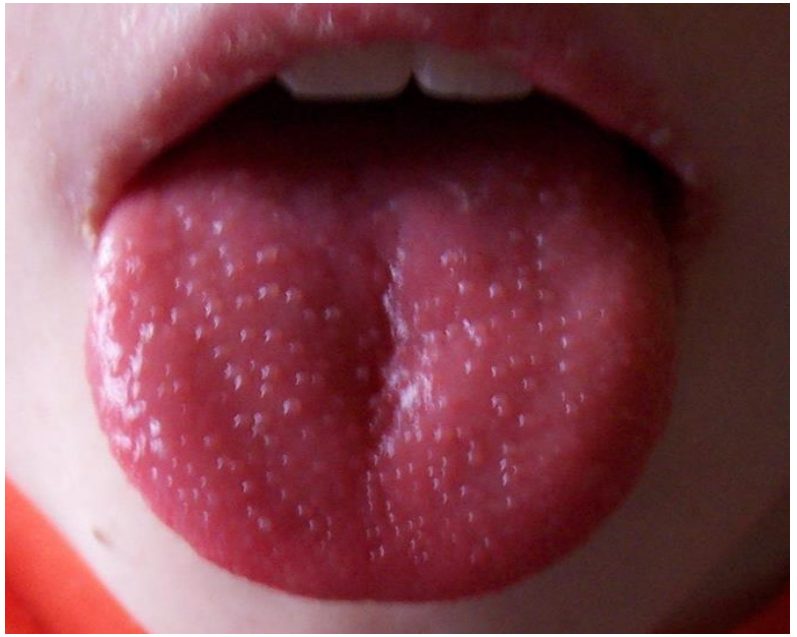
- Affect mainly children (5-15 ys).
- Red swollen tonsils. There is **purulent exudate** (Patches & streaks of pus).
- Enlarged and tender cervical lymph nodes, painful swallowing.
- High fever, sore throat.



2) Scarlet fever (scarlatina):-

- Caused by streptococci that produce **erythrogenic toxin** (strains of S. pyogenes **lysogenized by a bacteriophage** carrying the gene for the toxin).
- Affect children < 10 years.
- It is characterized by **fever, sore throat**, and a **scarlet erythematous rash**.
- Rash first seen on the upper chest, then extremities.
- A **“strawberry” tongue** is a characteristic lesion seen in scarlet fever.





Post-streptococcal diseases :

- Some strains of S. pyogenes bearing certain **M proteins** are nephrogenic and cause glomerulonephritis, while other strains bearing different M proteins are rheumatogenic and cause rheumatic fever.
- These disorders occur **weeks** (time to produce sufficient antibodies) after a local infection with group A streptococci.
- The inflammation is caused by an immunologic (**autoantibody**) response to streptococcal M proteins that **cross-react** with human tissues.
- **Acute Rheumatic fever:** Follows **pharyngitis (not skin infection).**
- **Acute Glomerulonephritis (AGN):** Follows **skin infections** rather than pharyngitis.

DIAGNOSTIC LABORATORY TESTS:

a) Specimens: Throat swab for diagnosis of streptococcal pharyngitis.

b) Gram stained smears: are not useful in streptococcal pharyngitis (S. viridans are members of the normal flora).

c) Culture: on blood agar (10% CO2) show:

small, translucent **β hemolytic** colonies which is **catalase negative** and **inhibited by bacitracin** (**bacitracin sensitive**)

d) Antigen detection tests: ELISA or agglutination tests used for **rapid** antigen detection.

e) Serology (ASO test): (for diagnosis of post-streptococcal diseases)

ASO titers are high soon after infections. In patients suspected of having rheumatic fever, an elevated ASO titer is typically used as evidence of previous infection because throat culture results are often negative at the time the patient presents with rheumatic fever.

TREATMENT:

- All B-haemolytic group A streptococci are sensitive to penicillin G.
- **Treatment of scarlet fever:**

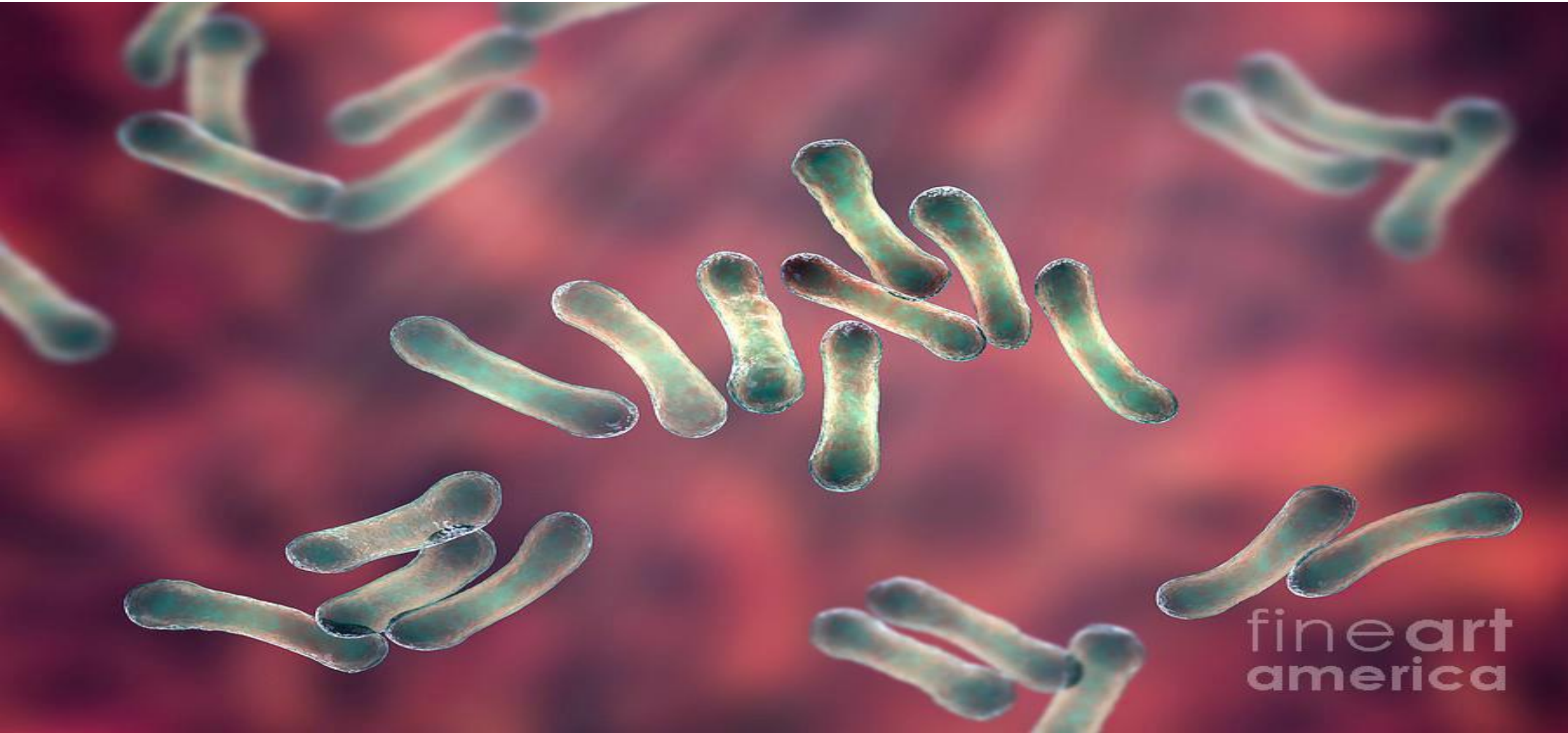
In addition to penicillin, **antitoxin serum** is given. It shortens the course of the disease.

Antitoxin to erythrogenic toxin prevents the rash but not interfere with streptococcal infection.

PREVENTION:

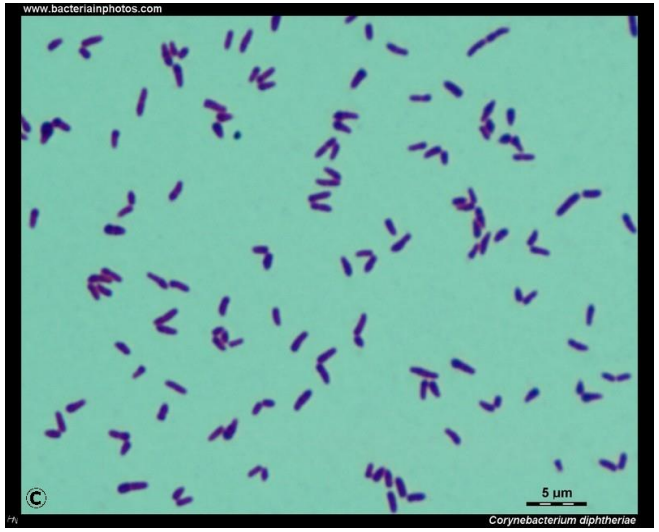
- Rheumatic fever can be **prevented** by adequate treatment of strept. pharyngitis **for 10 days**.
- Prevention of streptococcal infections (usually with long acting penicillin once each month) in persons who have had rheumatic fever is important to prevent recurrence of the disease.

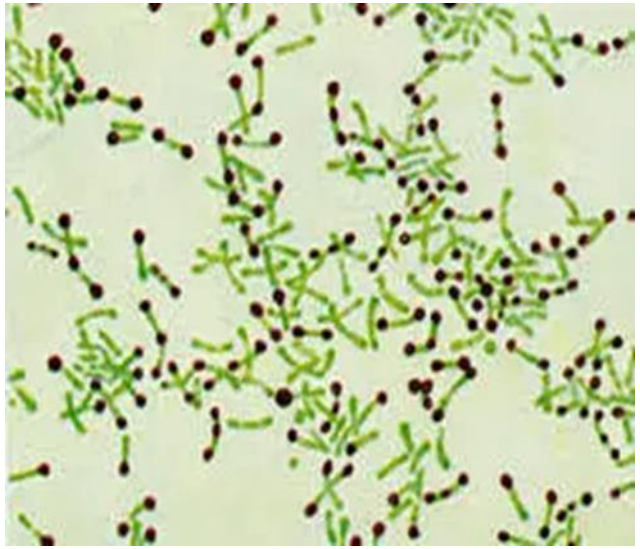
CORYNEBACTERIUM DIPHTHERIAE



MORPHOLOGY:

- Gram **positive rods**.
- **Non-spore-forming**. Non-motile.
- They are **club-shaped** and lie at acute angles to each other giving **V, Y or Chinese-letter appearance**.
- The bacilli have a characteristic beaded appearance due to the presence of inclusion granules called **metachromatic** or **volutin** granules. These granules do not appear by Gram stain but can be seen by **methylene blue** or **Neisser or Albert's** stain.





Albert's stain

CULTURE:

- Aerobes.
- Do not grow on ordinary media, but grow on enriched media;

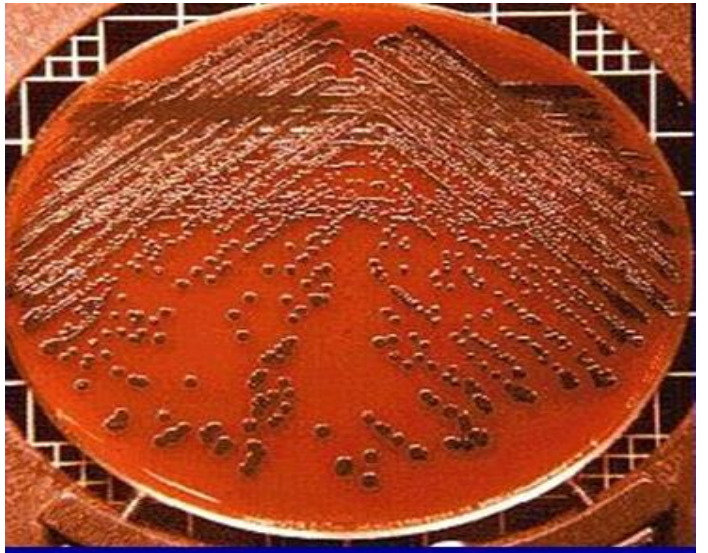
1- On **Loffler's serum**, they give grayish white colonies.

2- On **blood tellurite agar (Selective medium)**

(blood agar + 0.04% potassium tellurite), they give

black colonies.

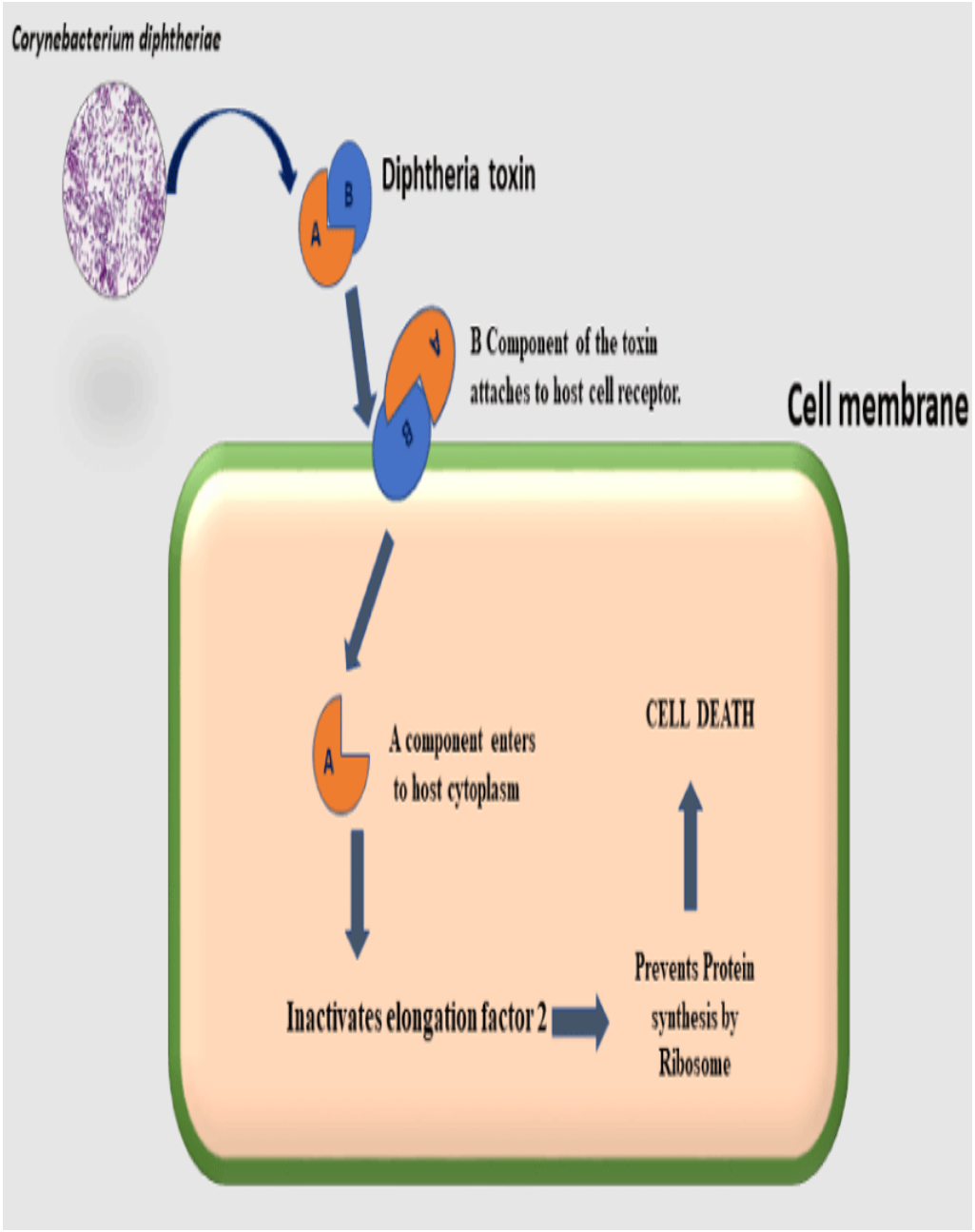
Loeffler's serum slope



Tellurite blood agar

VIRULENCE FACTORS:

- **Diphtheria toxin is the main virulence factor.**
- The toxin is produced **only** by strains of **C. diphtheriae** infected with **bacteriophage** which carry the gene for toxin production. So, only **lysogenic** strains of C. diphtheriae are **toxigenic** and **virulent.**
- It consists of two fragments (A, B);
- Fragment B is responsible for the transport of fragment A into the cell.
- Fragment A is responsible for **inhibition of protein synthesis (Inactivate elongation factor2).**



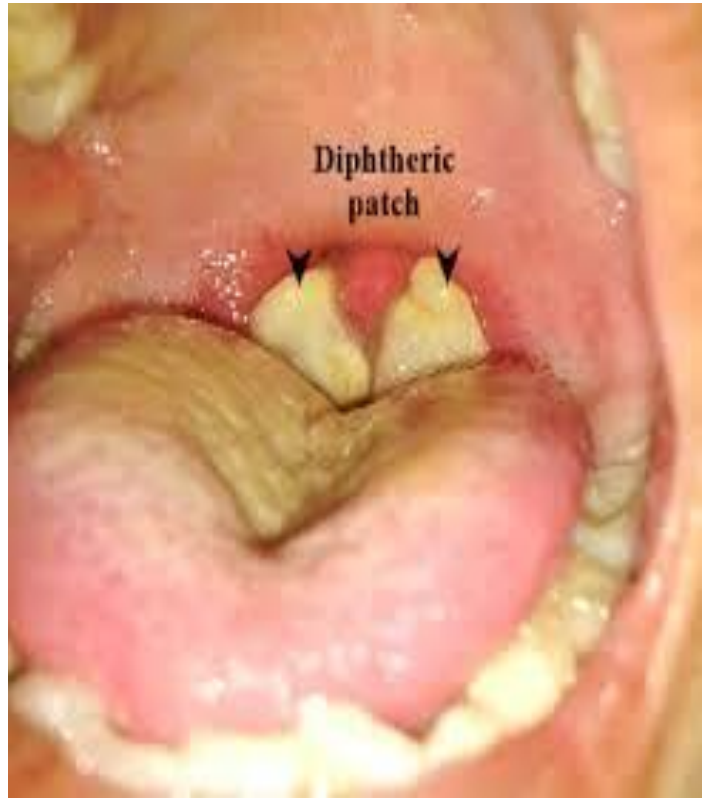
PATHOGENESIS:

A) Tonsillar diphtheria:

- Is the commonest type and is transmitted by **droplets (from case or carrier)**.
- It's a very contagious, life-threatening disease that affect mainly small children but can affect adults.
- The organism **does not invade** the deep tissue and **never** enters the blood stream. The organism **multiply locally**, releasing the toxin causing inflammation of the throat, local necrosis with fibrinous exudate resulting in formation of a spreading grayish white **pseudomembrane** .
- The **exotoxin** released **diffuses** to the blood stream causing **toxaemia** and affects the **heart**, **kidneys** & **nervous tissue**.

B) Nasal infection is also common while **conjunctival** or **skin** diphtheriae is rare and spread by contact.

CLINICAL PICTURE & COMPLICATIONS:



The incubation period is 1-7 days.

The patient presents with mild fever and general ill health.

The tonsils are covered with a **grayish pseudomembrane** which may extend to the posterior laryngeal wall or larynx.

The cervical lymph nodes are enlarged.

Suffocation may occur due to laryngeal obstruction.

Irregularities of cardiac rhythm indicate damage to the heart.

Nerve involvement may lead to **difficulties in swallowing, speech, vision** or paralysis of limbs.

LABORATORY DIAGNOSIS:

- **Mainly clinical diagnosis.**
- Laboratory diagnosis: (to confirm the clinical diagnosis).

Throat swabs (very carefully) from the membrane are examined as follows:

A. Direct smears: are stained with **Gram**, **methylene blue** or **Neisser stains**.

Gram positive bacilli with characteristic morphology of C. diphtheriae may be seen in a small proportion of cases (**negative result cannot exclude diphtheria**).

B. Cultures: are made on **Loeffler's** serum and **blood tellurite** media.

TREATMENT:

1- Diphtheriae anti-toxin serum:

- It should be given **without delay** when there is a strong clinical suspicion of diphtheriae.
- It **neutralizes the free toxin** (Not fixed toxin) before it causes irreversible damage.
- It is produced in **animals** (e.g. horse) by the repeated injection of toxoid.
- It is injected IM or IV after suitable precautions to role out **allergy** to the animal serum.

2- Chemotherapy:

Antibiotics are given **in association with anti-toxic serum**.

They inhibit local multiplications of C. diphtheria so, reduce their number of in throat →→

→ arrest further toxin production.

PREVENTION AND CONTROL:

A- Isolation: Patients with diphtheriae should be isolated.

B- Active immunization (vaccine):

Diphtheriae toxoid (Toxin with removed toxicity but retained antigenicity).

Such toxoid is usually combined with tetanus toxoid and pertussis vaccine and given as follows:

DPT: Primary series: at the age of 2, 4 and 6 months followed by two boosters at 15-18 months and at 4-6 years.

Td: Boosters every 10 years are recommended. (Pertussis vaccine may cause encephalopathy if given after 6 years of age).

C- Passive immunization:

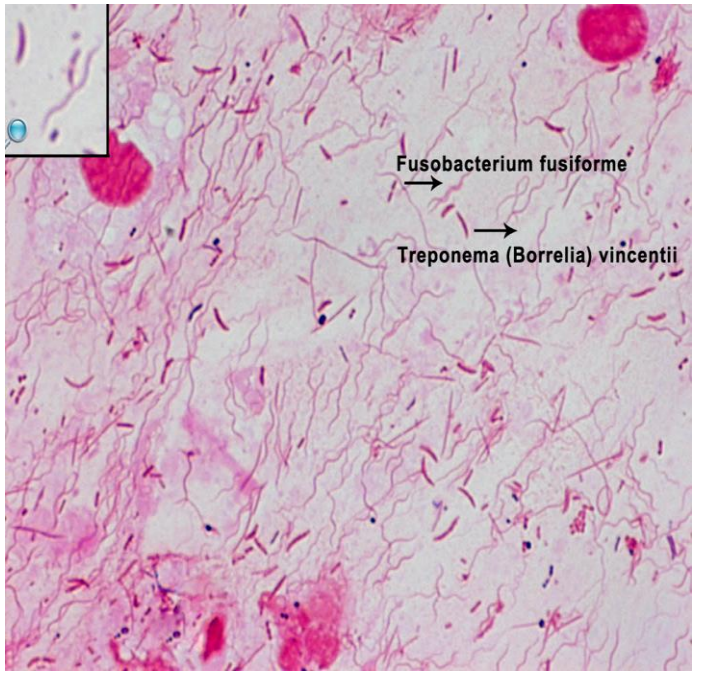
Anti-toxin serum is given to contacts of a case.

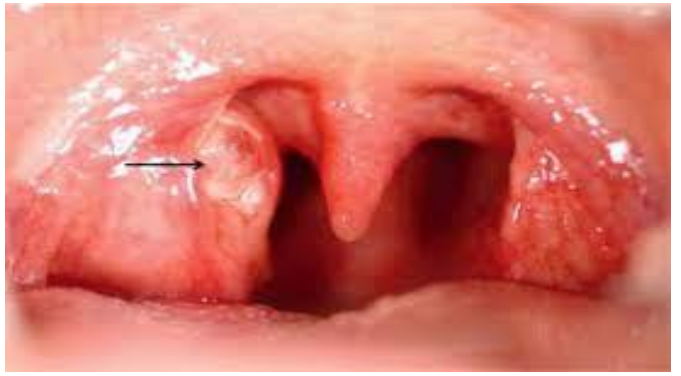
A booster dose of toxoid is given at the same time but at a different site.

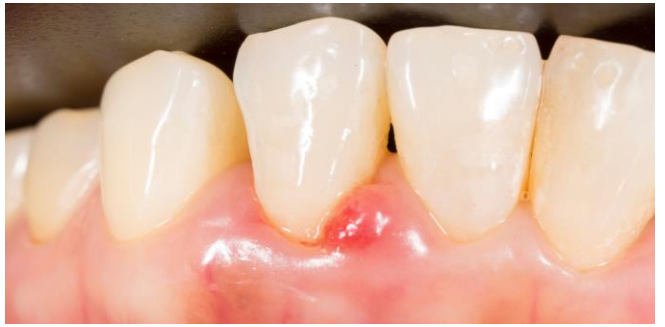
Contacts that were not immunized before should start active Immunization by taking toxoid.

FUSO-SPIROCHETAL DISEASE (Vincent’s angina)

- Vincent's angina is **ulcero-membranous** pharyngitis and gingivo-stomatitis, caused by infection with two types of bacteria (Normal mouth commensals) called:
- Fusiform (Fusobacterium spp.) gram negative **anaerobic** bacilli.
- Spirochaetes (Borrelia vincenti) gram negative spiral bacilli.
- It is more pronounced in **Immunocompromized** individuals especially with **bad oral hygiene**.







Thank you