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RESPIRATORY SYSTEM

HAYAT BATCH



SUBJECT : Microbiology

LEC NO. : 1

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Respiratory System

Respiratory Tract Infections

<p>I- Rhinitis (Common Cold): * Mostly of viral causes Rhinovirus Coronavirus Adenovirus, Parainfluenza virus Influenza virus RSV</p>	<p>III- Infections of the ear: Otitis Externa: - Pseudomonas aeruginosa. - Aspergillus niger (otomycosis). Otitis media: - Streptococcus pneumoniae - Haemophilus influenzae - Moraxella catarrhalis - Streptococcus pyogenes - Staphylococcus aureus</p>	<p>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</p>
<p>II- Sore throat and Pharyngitis: ☺ * Bacteria: - Streptococcus pyogenes. - Corynebacterium diphtheriae. - Vincent's organisms: Borrelia vincenti and Fusobacterium. * Fungi: Candida. * Virus: EBV and Adenoviruses.</p>	<p>IV- Sinusitis: - Streptococcus pneumoniae - Haemophilus influenzae - Moraxella catarrhalis - Streptococcus pyogenes - Staphylococcus aureus</p>	

هون مرجع المادة كاملة بس الفكرة رح ندرس
كل ال bacteriology بعد هيك ال
virology بعد هيك ال fungi يعني ما
رح ندرس على الترتيب

IX- Pneumonia

<p>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</p>	<p>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).</p>
<p>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.</p>	



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Sore throat and Pharyngitis:

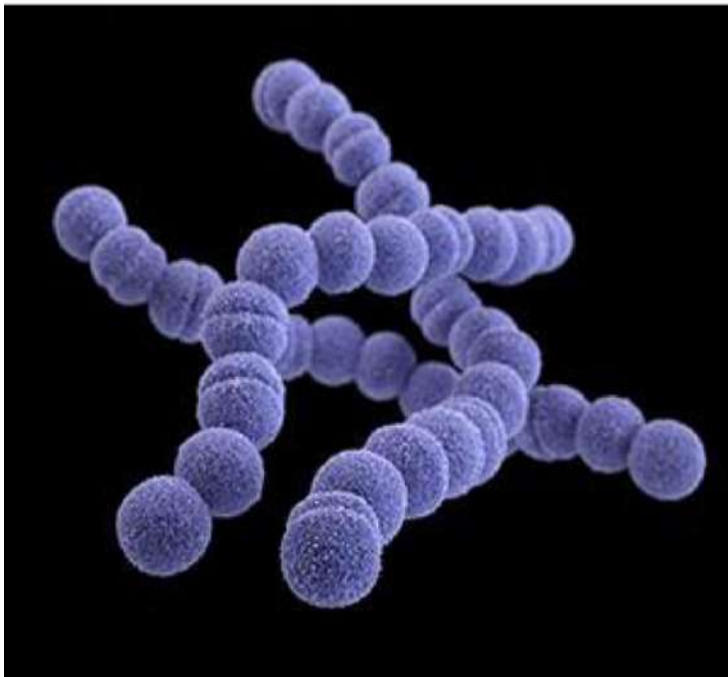
* Bacteria:

- 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 STREPTOCOCCI (STREPTOCOCCUS PYOGENES)



1. Strepto: Refers to a chain, as in the chain-like arrangement of bacterial cells.

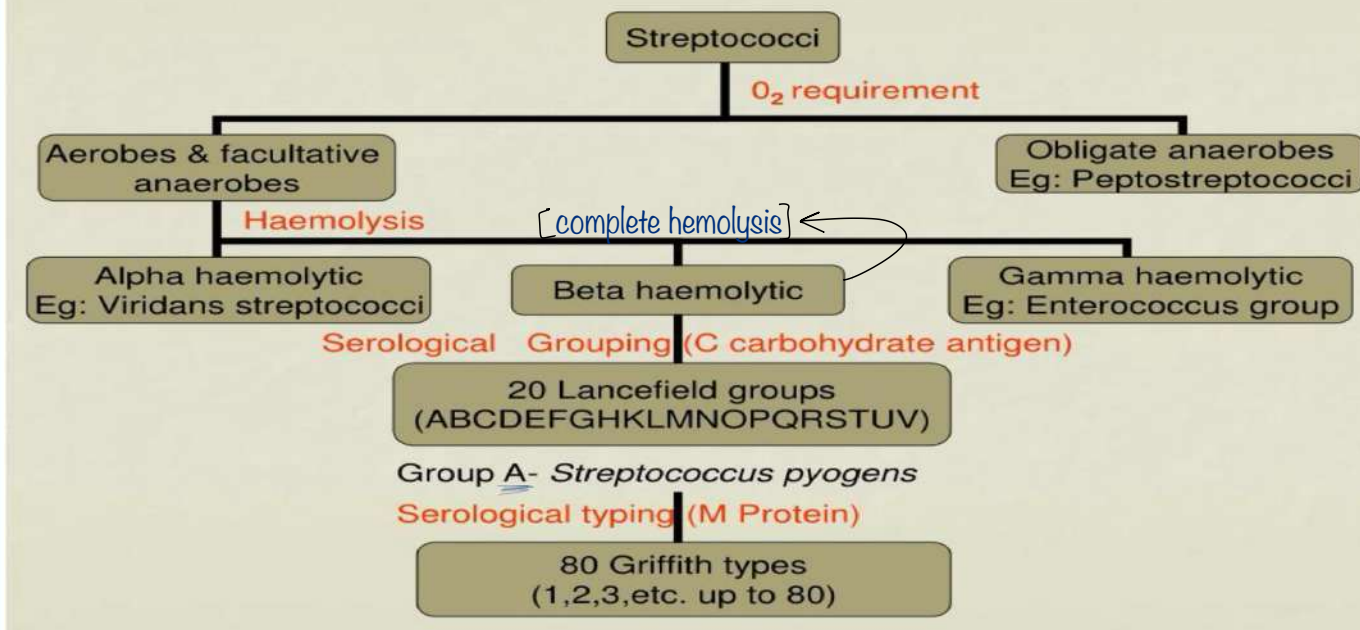
2. Coccus: Denotes a spherical or round shape, describing the bacterial morphology.

3. Pyogenes: Comes from the Greek word "pyon," meaning pus, indicating that this bacterium is often associated with the formation of pus in infections.



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CLASSIFICATION:



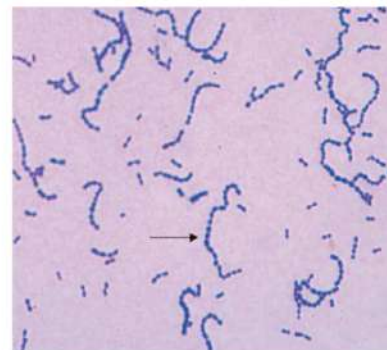
MORPHOLOGY: purple or violet or blue

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

CULTURE:

- **They are facultative anaerobes.** metabolize in both aerobic (with oxygen) and anaerobic (without oxygen) environments
- Fastidious organism grow on **blood agar** and produce **complete (Beta) hemolysis.** Growth and hemolysis are aided by incubation in **10% CO₂.** Best media

clear zone around bacterial colonies on blood agar plates





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BIOCHEMICAL REACTION:

أهمية اني اعرف ال catalase

➤ **Catalase negative** (Differentiate with

Staphylococci which are catalase positive).

Anti-bacterial agent

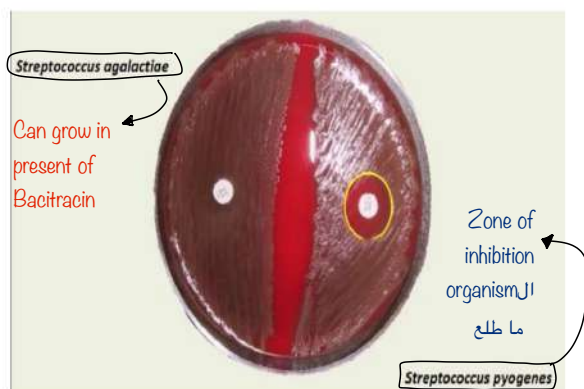
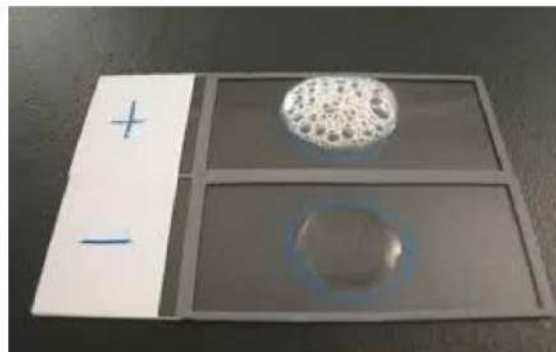
➤ **Bacitracin sensitive** (Differentiate with

other beta hemolytic streptococci such as

من Group B

S. agalactiae which is bacitracin resistant).

“Bacitracin sensitive” refers to the susceptibility of a bacterium to the antibiotic bacitracin. When a bacterium is sensitive to bacitracin, it means that the antibiotic has the ability to inhibit the growth or kill the bacterium



VIRULNCE FACTORS:

الخطوة الاولى حتى يشتغل ال

A) Adherence factors: promotes adherence to epithelial cells.

organism

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

2- M protein: hair like projections covering the cell wall. ①

B) Anti-phagocytic factors: تمنع عملية ال apoptosis ②

أهمية M protein

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. ③

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.

C5a is to attract and activate phagocytes. When C5a is released during an immune response, it acts as a chemoattractant, guiding phagocytes to the site of infection or inflammation. Additionally, C5a stimulates phagocytes to become more active and efficient in engulfing and destroying pathogens.

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

ال fibrin كمان يكون موجود في ال pus

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

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

ال DNA بطلع من ال died cells فهو يزيد من viscosity لل pus و يعيق حركتها فلازم تكسره

So, Streptokinase and streptodornase used in: الاستخدامات في المجال الطبي

- 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: يشتغل على ال host cells

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

a) Streptolysin O: (oxygen labile). Antigenic = stimulant an immune system

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.

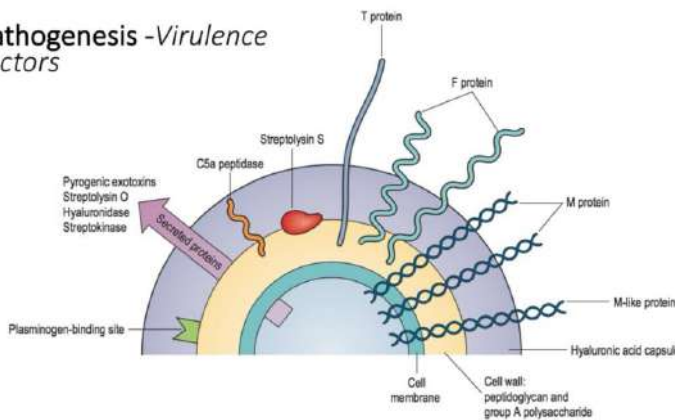
بتحمل برا الجسم
Vitro

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



طبعاً مش كل ال VIRULNCE FACTORS

بكونوا موجودين في نفس البكتيريا

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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) **Toxicogenic** 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).
thick, yellowish or greenish discharge that contains pus
- **Enlarged and tender cervical lymph nodes, painful swallowing.**
- **High fever, sore throat.**



ممکن تتعدى ال 40

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تذكروا مش كل ال strains عندها نفس
VIRULNCE FACTORS

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.



كيف صار عندها erythrogenic toxin

Streptococcus pyogenes can be infected by a **bacteriophage** carrying the gene for **erythrogenic toxin**. This phage integrates its genetic material into the bacterial chromosome, becoming a prophage. Under certain conditions, the prophage can activate, causing the bacteria to produce and release erythrogenic toxin.

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.

ال M protein في منها 80 نوع
في أنواع منها تشبه في تركيبها ال
structure معين موجود في ال heart و
في أنواع تشبه structure موجود في ال
kidney
لما يصير عندي infection و ال
immune system بطلع
ال antibodies مارح تميز بين ال
self و ال foreign
و رح تاثر على ال heart و ال kidney
لهيك اسمها post لانه ال antibody
بدها أسابيع حتى تتكون



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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).

can be commonly found in the sample

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

هيك تاكدت انها مش

staphylococcus

small, translucent β hemolytic colonies which is catalase negative and inhibited by

ما بوقف هون لانه ممكن تكون

staphylococcus

bacitracin (bacitracin sensitive)

ومن ال bacitracin بميزها عن باقي ال

STREPTOCOCCUS ال Groups

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.

The ASO (Anti-Streptolysin O) test detects antibodies produced in response to *Streptococcus pyogenes* infection.

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.

لو كان بتكرر عنده tonsillitis

يعمله Tonsilectomy



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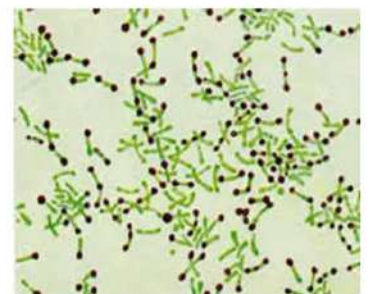
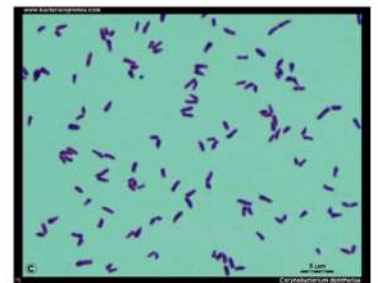
CORYNEBACTERIUM DIPHTHERIAE



****coryne:** means club or mace rod-shaped morphology
****Diphtheria :** was named because the characteristic pseudomembrane formed in the throat during diphtheria infections resembles a tough, leather-like substance.

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

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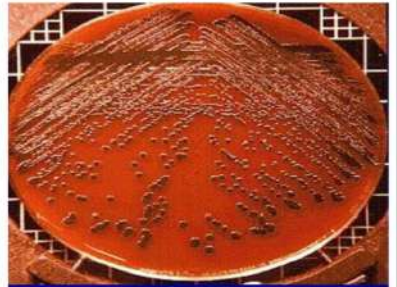
CULTURE:

- Aerobes.
- Do not grow on ordinary media, but grow on enriched media;
- 1- On Loeffler's serum, they give grayish white colonies.



Loeffler's serum slope

- 2- On blood tellurite agar (Selective medium) (blood agar + 0.04% potassium tellurite), they give



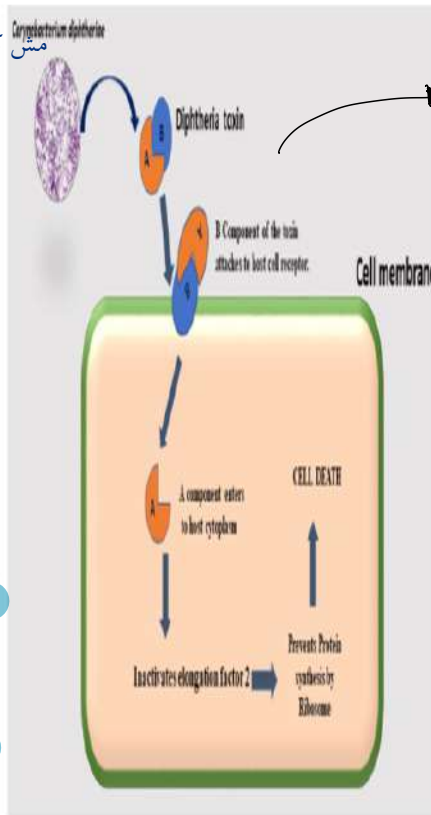
Tellurite blood agar

black colonies.

هو يلبى بعطي ال agar ال Selectively
 لانه يمنع ال growth لل other grams positive and negative
 +
 هو colour indicator يعمل reduction لل organism فرح تعطيني black colonies

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); Mode of action
 - 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).



ال B ال Fragment يعمل
 ال cell ال binding على
 ال membrane وهيك يسمح بدخول
 ال A ال Fragment هيك بعد
 هو يعمل كل الشغل بروج يعمل
 inhibition
 لكل عملية ال protein
 synthesis كيف؟؟
 ال protein تعمل هسا لما كنا
 ال amino synthesis كنا نحيب
 ال acids بنحطهم مع بعض حتى
 تعمل ال long chain
 مين المسؤول عن ال
 ال elongation؟؟؟
 ال 2 ال elongation factor
 ال A ال Fragment يلبى
 ال Inactivate يعمل

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الن دiphtheria لها أنوا بهمنا هون Tonsillar

transmitted through respiratory droplets from infected individuals or carriers (can spread the disease without showing symptoms themselves,)

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** pharynx ال منطقة ال trachea ويمكن ينزل لل larynx
- The **exotoxin** released **diffuses** to the blood stream causing **toxaemia** and affects the **heart, kidneys & nervous tissue.**

Bacteremia X

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.**



لازم نفرقتها عن pharyngitis هون
بكون عندي pseudomembrane
بكون متصل و مغطي كل ال
pharynx وحتى ممكن ينفصل منه
جزء و بروج يسكر اي مكان بال
airways

بتأثر على ال Nerve الي
بتعمل supply لل hard
palate و إلى eyes او
limbs

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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.**

لو negative بنعمل
culture حتى نتأكد

TREATMENT:

عبارة عن 2 lines بنعملهم مع بعض لازم

1- Diphtheriae anti-toxin serum:

- It should be given **without delay** ^{قبل ما أشوف نتيجة المختبر} 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 rule 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.**

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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).

هون بدى احمى يلى خالطوا

C- Passive immunization:

المصاب

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)

pseudomembrane هون كمان في

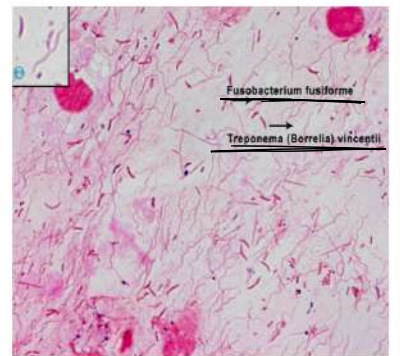
➤ Vincent's angina is **ulcero-membranous** pharyngitis and **tonsillitis**, caused by infection with **two types of bacteria** (Normal mouth commensals):

• Fusiform (Fusobacterium) gram -ve **anaerobic** bacilli

• Spirochaetes (Borrelia vincenti) gram -ve spiral bacilli.

➤ Characterized by **unilateral pseudomembrane**.

➤ It is more pronounced in **Immunocompromized** individuals.



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Bacteria – Gram Positive Cocci



Group A Strep (Strep pyogenes) – The Pie Genies' Bakery

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Pie in glass Capsule – Group A Strep is encapsulated 2. Hot Apple – Capsule made out of Hyaluronic Acid 3. Heating Lamp w/ "B" Light – Beta Hemolytic 4. 1st Baker <ol style="list-style-type: none"> a. Baker Holding Honey Crusted Pie – Impetigo b. Red Handkerchief – Strep throat, red inflamed throat c. Red Mittens on Baker - Erysipelas, red lesion with well demarcated borders, S Pyogenes is the most common cause. 2nd Baker w/ Cape - represents Strep Toxins 3 issues 5. Scarlett Fever <ol style="list-style-type: none"> a. Strawberry Tongue b. Red Handkerchief - Pharyngitis, c. Red Gingerbread Man - widespread rash that spares the face. 6. Cape w/Bolt - Toxic Shock Like Syndrome mediated by a super antigen – SpeA, SpeC 7. Burnt Gingerbread man - Necrotizing Fasciitis –SpeB Master Chef – M Protein in GAS well main virulence factor for Rheumatic Fever, will interfere with opsonization, antiphagocytic, M Protein will mimic antibodies in heart and cause issues with Mitral Valve in heart 8. Chef Swatting away other chef – Antiphagocytic action 9. Miter hat - Very antigenic and elicits a humoral response, creating an antibodies to myosin in cardiac muscle (Molecular mimicry), damages mitral valves 10. Red Handkerchief – Pharyngitis precipitates RF, NOT IMPETIGO | <ol style="list-style-type: none"> 11. Cupcakes w/ JONES on them <ol style="list-style-type: none"> a. J = Joints b. "Heart" = Heart Problems c. Nodules on extensor surfaces d. Erythema marginatum e. Sydenham's Chorea 12. Phone cord that looks like a glomerulus - Post Strep Glomerulonephritis, type III hypersensitivity reaction (deposition of antibodies in glomerulus) <ol style="list-style-type: none"> a. Puffy Cheeks – Puffy Cheeks w/ nephritis b. Bottle of Cola – Cola Colored Urine c. Calendar – Occurs 2 weeks after strep infection d. Can occur after pharyngitis and impetigo e. Pencil – TXT is penicillin 13. Baker on bottom Right 3 more virulence Factors <ol style="list-style-type: none"> a. O Shaped Donuts – Streptolysin O, allows Strep to be Beta Hemolytic, we generate ASO antibodies to this b. Phosphate Cupcakes – Streptokinase, converts plasminogen to plasmin. c. Twists – DNA'ases, depolymerize DNA 14. Basset hound – Bacitracin sensitive 15. Lady checking a box of donuts – Tongs are antibodies, check ASO titers to see if there was a Group A Strep Infection. |
|---|--|

Bacteria – Gram Positive Bacilli



Corynebacterium Diphtheria - Corazon de la Corrida

1. Purple Hues - Gram Pos, non-spore forming
2. Guy playing Morocco's that are blue and red – Bacteria is club shaped and y or v shaped, Metachromatic granules that stain with aniline dyes, Metachromatic granules will stain red and the rest of the cell will stain blue.
3. Zig Zag shape in the morocco - V or y shape the bacteria will form
4. 2 subunits A and B, A is active and B is binding
 1. Man playing an accordion wearing a bow tie - Toxin causes Ribosylation of elongation factor 2, this will inhibit ribosome function inhibiting protein synthesis leading to cell death
 2. Kids in the stand eating grey cotton candy wrapped with a plastic wrap - This will lead to pseudomembranous exudate that will be found in the oral pharynx
5. Bull extending its neck with droplets coming out of the mouth and nose - Found in throat and tonsils because the infection is transmitted by respiratory droplets, Can cause airway obstruction and lymphopathy, this will cause bulls neck (thickening of the neck)
6. Cape in the shape of a heart - Can lead to myocarditis like arrhythmias and heart block. Lethal effect of diphtheria
7. Man eating the sausage links - Will damage the myelin of nerve fibers, the sausage man eating the myelin having a neuropathy.
8. Television and kid laughing - Lab diagnosis -plate on Tellurite and Loefflers media (tele like television and loughlers will be the kid laughing like enjoying a show)
9. Bulls tongue sticking out and licking the matador - Eleks test – in-vitro assay that has antitoxin on it.
10. Why it's in another language - Immigrants most likely to get this
11. Syringes in the bull - DTaP vaccine is used, given with tetanus and pertussis. Toxoid Vaccine