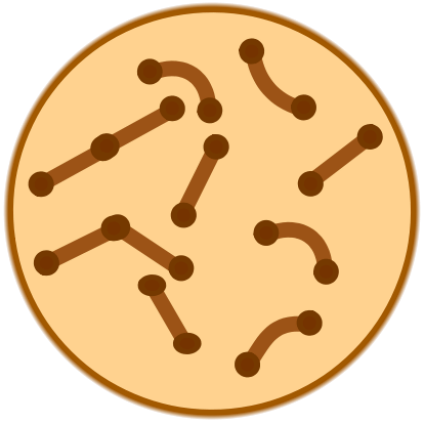
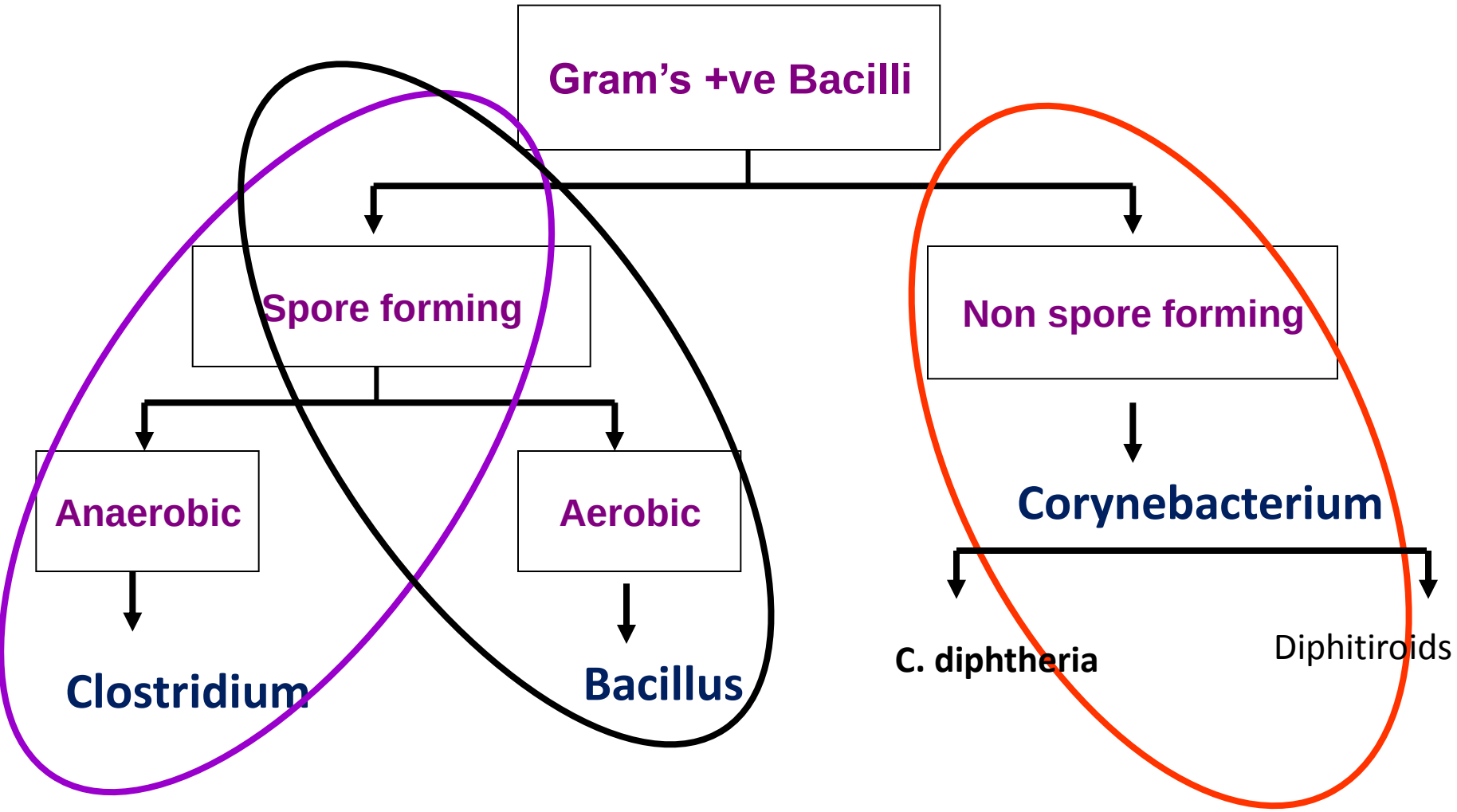
Medical Bacteriology- Lecture 11

Non Spore Forming Gram Positive Rods

Corynebacterium

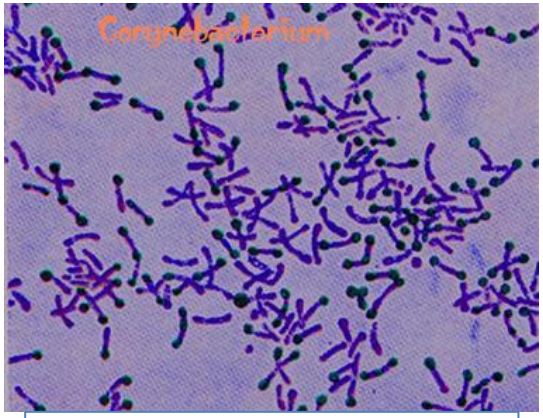


Classification of Gram +ve Bacilli

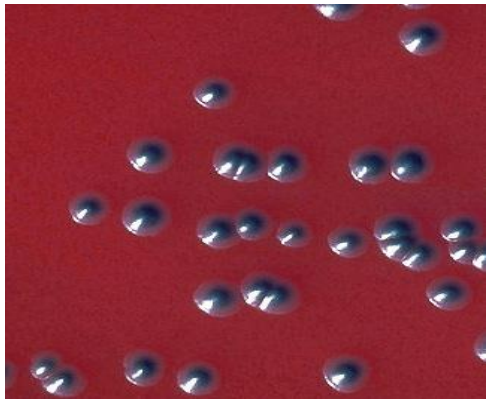


Corynebacteria

- Gram-positive, aerobic, nonmotile, rod-shaped bacteria classified as **Actinobacteria**. related to mycobacteria & actinomycetes.
- They do not form spores or branch as do the actinomycetes, but they have the characteristic of forming irregular**, club-shaped or V-shaped arrangements in normal growth (resembling Chinese letters). Possess metachromatic granules**
- consists of a diverse bacteria including animal and plant pathogens, as well as saprophytes.
- Medical important species is ***Corynebacterium diphtheriae***, the causal agent of the disease **diphtheria**.
- **Diphtheria toxin** is responsible for the signs and symptoms of diphtheria.
- Transmitted from person to person via respiratory droplets or skin contact
- Fastidious, grow slowly in enriched media
- Cell wall containing **unusual lipids**
- Some corynebacteria (Diphitiroids) are part of the normal flora of humans, colonize skin, respiratory tract.



C. diphtheriae **Gram stain**



C. diphtheriae **colonies on blood agar**

Corynebacterium diphtheriae

- **Diphtheria** is an upper respiratory tract illness characterized
- **initially** by **sore throat, low fever, followed by an adherent membrane (called a pseudomembrane on tonsils, pharynx, and nasal cavity).**
- Diphtheria is a rapidly developing, acute infection which involves both **local and systemic pathology**. A local lesion develops in the upper respiratory tract and involves necrotic injury to epithelial cells. As a result of this injury, blood plasma leaks into the area and a fibrin network forms which is interlaced with rapidly-growing *C. diphtheriae* cells. This membranous called a **pseudomembrane**, covers over the site of the local lesion leading to respiratory distress, even suffocation.

- **Later stages** **localized damage, bleeding, difficulty in breathing, myocarditis and peripheral neuritis**

- **Pathogenicity :** The pathogenicity of *C. diphtheriae* includes:

1. Invasion of the local tissues of the throat, which requires colonization and bacterial proliferation. Little is known about the adherence mechanisms of *C. diphtheriae,* but the bacteria produce several types of **pili**. The **diphtheria toxin**, as well, may be involved in colonization of the throat.

2. Toxigenesis: **The diphtheria toxin causes the death of eucaryotic cells and tissues by inhibition protein synthesis in the cells**. the toxin is responsible for the lethal symptoms of the disease. And its play an essential role in the colonization process. Diphtheria toxin produced by *C. diphtheriae*, can cause myocarditis, polyneuritis, and other systemic toxic effects.

Diphtheria is a **contagious disease** spread by direct contact or breathing aerosolized secretions of infected individuals.

- Diphtheria is a **serious disease**, with fatality rates between 5% - 10%. In children under 5 years and adults over 40 years, the fatality rate may be as much as 20%.

Three strains of *Corynebacterium diphtheriae* are recognized, **gravis, intermedius and mitis.**

Cutaneous diphtheria: **Jungle sore - (**extra-respiratory disease): A milde form of diphtheria can be restricted to the skin.

Acquired by wound/skin contact; Chronic non-healing ulcer results- occurs primarily in the tropics, is rarely fatal

- **Two factors effect the ability of *C. diphtheriae* to produce the diphtheria toxin:**

- **(1) low extracellular concentrations of iron**
- **(2) presence of a lysogenic prophage in the bacterial chromosome.**

(High yields of toxin are synthesized only by lysogenic bacteria under conditions of iron deficiency)

Respiratory disease: diphtheria; colonizes the upper respiratory tract
Virulence is due to an **exotoxin- Pilli**
Inhibits protein synthesis → kills cells
Causes necrosis (death) of cells in upper respiratory tract
pseudomembrane
Complications from systemic spread of exotoxin to other target organs in the body.
Most mortality from systemic toxin-mediated heart failure - Toxin can be distributed systemically to cause life-threatening damage to organs
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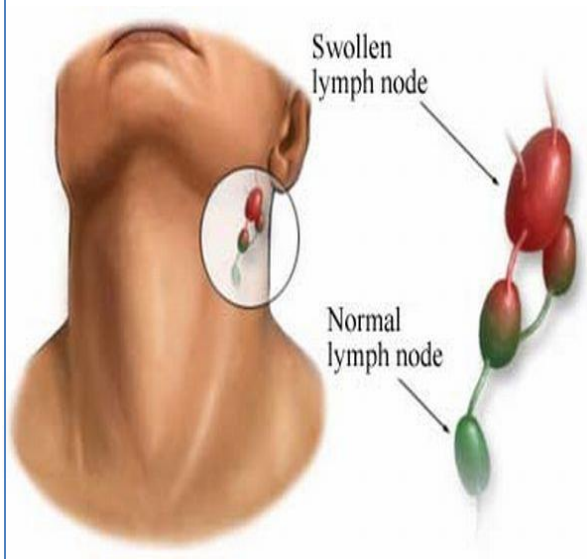
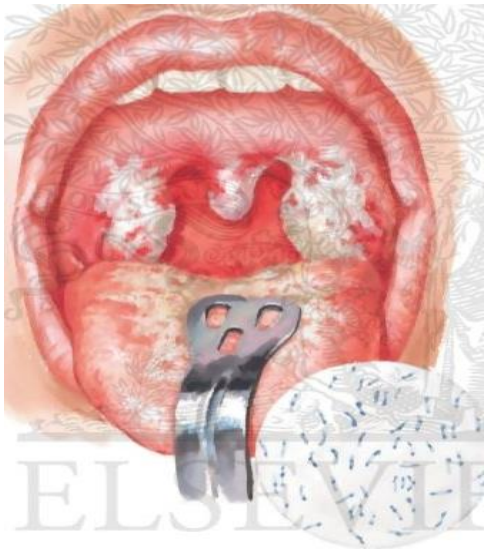




Pseudomembranes

C. diphtheriae

- **Initial diagnosis is based on the presence of pseudomembrane**

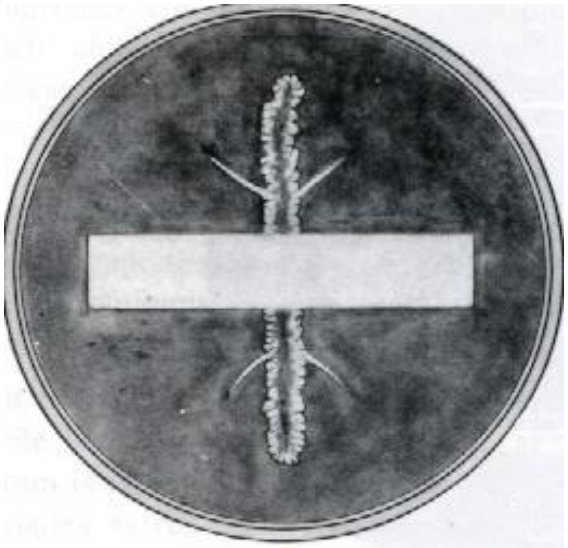
- **Selective media:** 1- Loefflers serum medium
- 2-Blood tellurite agar

- **Toxin Production testing:**
- **1- Guinea pig-inoculation**

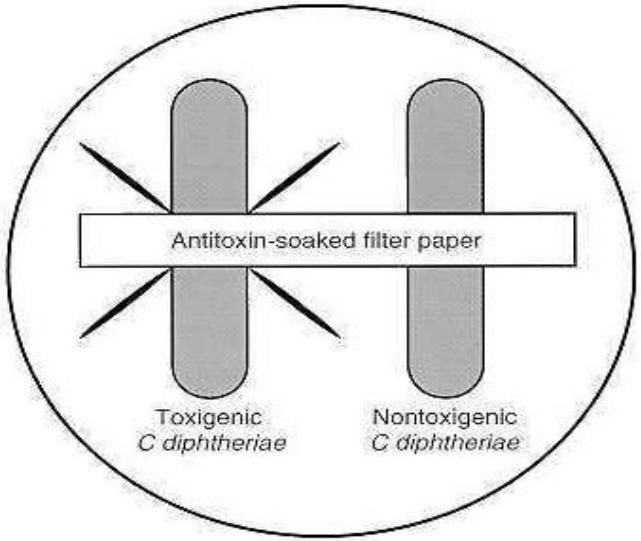
Strain	Unprotected animal	Antitocxin protected animal
Toxigenic	Death in 2-3 days	Survival
Non-toxigenic	Survival	Survival

- **2- Gel Precipitation (Elek test)**
- **Toxin action:**

(elongation factor) EF-2 + NAD **Protein A** **ADP-Ribose-EF-2 +Nicotinamide**



Elek Test



Immunity to Diphtheria (Treatment & Prevention)

- Treatment *Penicillin and erythromycin kill the bacteria
- * Acquired immunity to diphtheria is due to Administration of **antitoxin to neutralize toxin**

- Passive immunity is acquired trans placenta and can last at most 1 or 2 years after birth.

- Individuals that have fully recovered from diphtheria may continue to harbor the organisms in the throat or nose for weeks or months. (**Carrier**)

- Because of the high degree of susceptibility of children, **artificial immunization** at an early age **(Toxoid)** is given in 2 or 3 doses for primary immunization at an age of 3 - 4 months.

- **Trivalent vaccine containing (DPT vaccine): diphtheria toxoid, pertussis vaccine, and tetanus toxoid.**

Reaction to The Schick test

Result	Test arm (toxin) (natural infection)		Control arm (Toxoid) (Immunization)		Interpretation	Immunization
	36 h	120 h	36 h	120 h		
Negative	-	-	-	-	Immune, not hypersensitive	Not required
Positive	-+	+	-	-	Non-immune, not hypersensitive	Required
Negative & pseudo	+	-	+	-	Immune, hypersensitive	Not required
Positive & pseudo combined	+	+	+	-	Non-immune, hypersensitive	Contraindicated

Pseudo reaction is a false reaction due to patient being sensitive to salt the bacteria was grown in

Review Questions

- What is the distinct arrangement in *C. diphtheria*?
- What is the causative agent of Diphtheria, and what is the major virulence factor which responsible of disease and symptoms?
- What do you know about diphtheria symptoms?
- *C. diphtheria* requires factors to able to cause its infection, discus?
- Toxin production by *C. diphtheriae* can be demonstrated by two experimental methods. What are they and how they can be performed?
- Give an example of contagious disease?
- What is the mode of action of Diphtherial toxin?
- What is the DPT vaccine?