

Medical Bacteriology –Lecture 15

Gram Negative Coccobacilli

Haemophilus

Bordetella pertussis

Haemophilus "loves heme"

- small gram-negative **coccobacilli**, non-spore forming, non-motile, require enriched media for growth. Growth is enhanced in CO₂. Present in upper respiratory tract as a normal flora in healthy people.
- Fastidious requiring **growth factors present in blood** for isolation. **The growth factors are:**
- **X-factor (Hematin)** and **V-factor (Diphosphopyridine nucleotide) (NAD)**.
- Grown on chocolate blood agar (**X and V factors released from the RBCs**), under aerobic conditions or 5% CO₂.

H. influenzae

- **Extracellular pathogen- not invade into the cells**
- Encapsulated strains of *H. influenzae* isolated from CSF are coccobacilli similar in morphology to ***Bordetella pertussis***, the agent of **whooping cough**
- Non encapsulated strains are less invasive, but they are able to induce an inflammatory response that causes disease.
- It is an important **secondary invader** to the influenza virus
- causes disease commonly in young children (Acute pyogenic meningitis- Acute epiglottitis- Pneumonia- Otitis media- Siusitis- Cellulitis- Acute pyogenic arthritis)
- **Cannot grow on blood agar alone (Satellites test used to identify *H. influenzae* nearest *S. aureus* in blood agar)**
- Capsular Quelling reaction

H. ducreyi causes chancroid (a sexually transmitted disease).

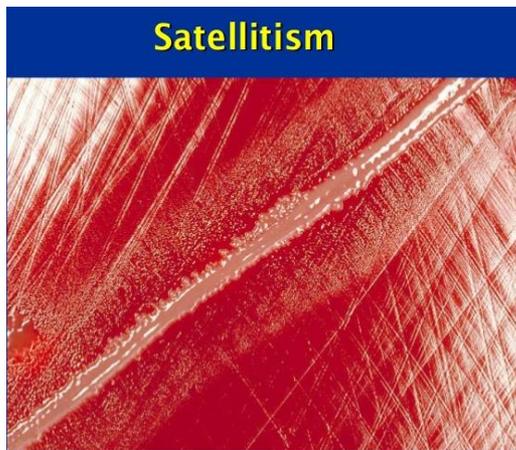
H. aegypticus causes contagious conjunctivitis

Requirement for growth factor helps for differentiation of species.

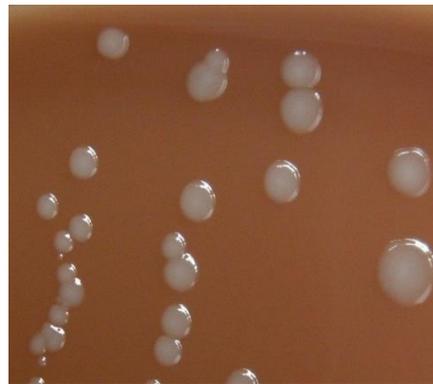
Require X and V	Require V	Require X
<i>H. influenzae</i>	<i>H. parainfluenzae</i>	<i>H. ducreyi</i>
<i>H. haemolyticus</i>	<i>H. parahaemolyticus</i>	
	<i>H. paraphrophilus</i>	
	<i>H. segnis</i>	

H. haemolyticus, *H. paraphrophilus*, and *H. segnis* are part of the human upper respiratory tract flora and very rarely cause infection.

H. Parainfluenzae is part of the commensal flora of the upper respiratory tract. It can be life-threatening pathogen by causing endocarditis. Occasionally it can cause secondary bacteremia and urethritis in adults.



Satellitism



H. influenzae colonies on chocolate agar+ Co2.



H. influenzae requires two growth factors: factor X & V

Bordetella pertussis

- **Whooping cough (pertussis)** is caused by the bacterium *B. pertussis*
- Very small gram-negative aerobic coccobacillus that appears singly or in pairs
- Fastidious
- Colonizes the cilia of the respiratory epithelium
- Whooping cough is a relatively **mild disease in adults but has a significant mortality rate in infants.**
- Incubation period: 2 weeks
- No growth on blood agar



B. Pertussis Gram stain



B. pertussis growing on Charcoal Agar supplemented with Cephalexin

Pathogenesis

- The disease pertussis has two stages:
- **The first stage (Catarrhal), colonization**, is an upper respiratory disease with fever, malaise and coughing, which increases in intensity over about a 10-day period.
- Adherence mechanisms of *B. pertussis* involve a "**filamentous hemagglutinin**" (FHA), which is a fimbrial-like structure on the bacterial surface, and **cell-bound pertussis toxin (PTx)**. play a role as well in invasion during the colonization stage.
- **The second or toxic stage (Paroxysmal)** follows relatively **nonspecific symptoms** of the colonization stage. **Prolonged coughing that often ends in a characteristic inspiratory gasp (whoop)**. During the second stage, *B. pertussis* can rarely be recovered, and antimicrobial agents have no effect. This stage is mediated by a variety of **soluble toxins**

Toxins Produced by *B. pertussis*

- **invasive adenylate cyclase** : enters cells (*B. anthracis* produces a similar enzyme, EF). This toxin reduce phagocytic activity and helps the organism to initiate infection
- **lethal toxin** : causes inflammation and local necrosis
- **Tracheal cytotoxin** Inhibits DNA synthesis in ciliated respiratory epithelial cells. causes fever.
- **Pertussis toxin, PTx**: mediates both the colonization and toxic stages of the disease- cough
- **Unusual LPS endotoxin**: Damages respiratory epithelial cells
- **Neurotoxin**
- **Haemolysins**

B. pertussis (whooping cough) - Disease progression

URT → Encephalitis



Epithelium of trachea + bronchi (Interfere with cilia action- Neurotoxin)



Catarrhal: Irritation (Endotoxin), cough, sneeze, bacteria in droplets



Necrosis of epithelium (secondary pneumonia)



Paroxysmal: Mucous plugs in smaller bronchioles



Explosive cough and (whoop) of inhalation



Cyanosis, exhaustion, convulsions

Virulence determinants:

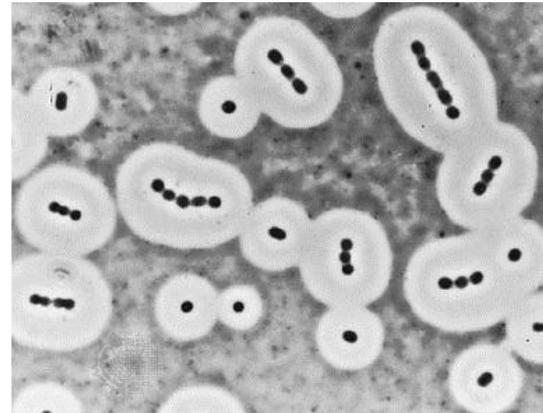
- Neurotoxin- endotoxin – capsule (less importance)- lymphocyte promoting factor - haemagglutinin factor- Histamine sensitizing factor (increase histamine)- Adenylyl cyclase toxin- lethal toxin – Hemolysin- tracheal cytotoxin

Branhamella catarrhalis (Moraxella catarrhalis)

- gram negative diplococci
- Fastidious
- It causes an inflammation of the mucous membranes, otitis media, eye, sinusitis, bronchi-pneumonia, endocarditis, rarely causes meningitis, it is occasionally found in vaginal discharges.
- * ***Moraxella lacunata*** – rarely causes conjunctivitis.
- ***M. nonliquifaciens*** – secondary invader of the URT.
- ***M. osloensis*** – rarely causes meningitis.

Acinetobacter

- usually are saprophytic aerobic gram-negative bacteria, coccobacilli
- **Resistant to most antibiotics**, can cause **severe pneumonie** and infections of the urinary tract, bloodstream and other parts of the body.
- *Acinetobacter baumannii*
- *Acinetobacter calcoaceticus*



The capsule surrounding *Acinetobacter calcoaceticus*

Review Questions

- *Haemophilus* species require two blood factors for growth. What are they, with examples?
- *H. influenza* (loves heme) cannot grow on blood agar alone, why. What is the Satellites phenomenon?
- Give the Latin name of a *Haemophilus* species that causes a venereal disease?
- What is the causative agent of: Whooping cough
- What is the diseases that caused by *H. aegyptius*?
- Compare between first stage (Catarrhal) and second stage(Paroxysmal) of pertussis? Why cannot treatment the later stage by antibiotics?
- Give four example of *Bordetella pertussis* toxins? Its invasive adenylate cyclase is similar with other bacterial toxin. What is it?
- What is the major virulence factor for *B. pertussis*, what its function?
- What is the major virulence factor of *H. influenza*