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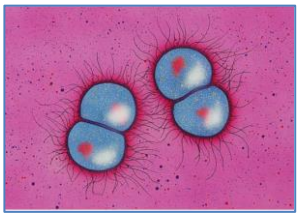
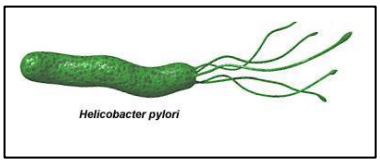
Medical Bacteriology- Lecture 12



Aerobic gram negative diplococci

- *Neisseria*
- *Moraxella*

Helicobacter



Neisseria

- **Gram-negative coccus, often arranged as diplococci (kidney or coffee bean shaped)**
- **Aerobic**
- Oxidase positive
- non motile
- Ferment carbohydrate producing acid but not gas.

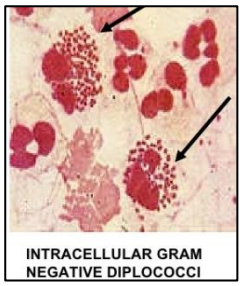
The genus *Neisseria* contain two important human pathogens species:

•***The*** **gonococcus *N. gonorrhoeae* causes gonorrhea (high prevalence and low mortality)**

•***The*** **meningococcus *N. meningitidis* causes of meningitis (low prevalence & high mortality).**

Both pathogenic Neisseria are;

- **Fragile,** susceptible to temperature changes (above or below 37c), drying, U.V light and other environmental stresses
- Fastidious
- grow on enriched media (**chocolate blood agar**)
- selective medium is **Thayer Martin medium** (Chocolate blood agar+ Vancomycin antibiotic inhibitor) for primary Neisseriae isolation.
- require CO_2 for grow the specially up on primary isolation.
- Many normal individuals may **harbor *N. meningitidis* in the upper respiratory tract**, but ***N. gonorrhoeae*** is **never part of the normal flora** and is only found after sexual contact with an infected person (or direct contact, in the case of infections in the newborn).


INTRACELLULAR GRAM NEGATIVE DIPLOCOCCI

- **pyogenic bacteria (**the organism tends to occur **intracellularly** in the **cytoplasm of neutrophils** which are attracted to the site of inflammation in the mininges, so this type of infection is called **pyogenic (pus-forming).**
- Can easily change its surface antigens leading to evasion of the immune responses especially *N. gonorrhoeae* (antigenic variation)
- The only distinguishing structural feature between ***N. meningitidis*** and ***N. gonorrhoeae*** is the presence of a **polysaccharide capsule** in the former. The capsule is antiphagocytic and is an **important virulence factor**.

- **Have wide range of virulence factors which promote virulence;**

- The attachment to epithelial cells via **pili (fimbria)** and **lipopolysaccharide endotoxin (LOS).**
- **LOS endotoxin of the outer membrane is** (highly toxic, responsible for most of the symptoms of disease – damage epithelial cells - intense inflammatory response- lysis of the phagocytes themselves).
- **Leukocyte association factor**
  IgA1 protease; cleaves secretory IgA in mucous, and probably play a role in the colonization stage.

- **Iron acquisition system** that permit them to obtain iron from its host during growth that is necessary to support bacterial invasion.

Neisseria meningitides

- **Causes Meningitides**
- The healthy human nasopharynx is reservoir of *N. meningitidis*
- **Meningococci are transmitted via air borne respiratory droplets or direct contact within infectious respiratory secreations.**
- The major virulence factor is **antiphagocytic capsule**.
- Cause life threating disease when the bacteria invade the blood or CFS
- Most common cause of meningitis in individual under 20
- **Initial symptoms include (**fever, sore throat, headache, stiff neck, vomiting, photophobia, can produce blood coagulation and the formation of hemorrhagic (metastatic) lesions)
- **Metastatic lesions:** Dissemination of meningococci may result in metastatic lesions with the hemorrhage and necrosis in: lungs, Joints, Ears, Vascular system, Skin, Virtually any organ system, Central nervous system (permanent nerve damage)

Treatment, prevention: Penicillin, admistrated intravenously, is the drug of choice

Vaccination

Meningitis: refers to the inflammation the meninges of the brain or spinal cord. (meninges are any of the three membranes that envelope the brain and spinal cord).

• The **meningitis** is caused by a different bacteria and viruses. Bacterial causes include *N. meningitides, Haemophilus influenzae, E. coli, Strep. pneumoniae, Strep. pyogenes and S. aureus.*

Disease progression

Carrier
↓ droplet

Susceptible host
↓
Local nasopharyngeal infection
↓
Lymphatic channels
↓
Blood
↓
Acute meningitis
Fulminating meningococcemia
Chronic meningococcemia
Genital infection

Neisseria gonorrhoeae

- **An obligate parasite of the human urogenital tract**
- **Causes venereal gonorrhoeae**
- ***N. gonorrhoeae*** infections are acquired by **venereal transfer or from mother to fetus.**
- Gonococci adhere to epithelial cells of the mucous membranes lining of the genital, urinary and digestive tracts of humans spreading to deeper tissue as they multiply.
- The infection may disseminate to a various tissues.
- As a few as 100 pairs of cell are enough to cause disease
- strains that cause systemic infection, LOS binds sialic acid from the serum forming a **microcapsule of sialylated LOS**, which allows the gonococci to resist the host immune response and serum bactericidal reaction
- Gonorrhea is difficult to treat because of **resistance to lots of antibiotics**, especially in developing countries
- **Penicillinase-producing *N. gonorrhoea*** (PPNG) strains are resistant to penicillin.
- **Drug of choice:** cephalosporin

Disease progression

Deposit on mucosal surfaces
↓
Adhere to epithelial cells (pili, adhesion factor)
↓
Limited penetration of epithelium
↓
Epithelial cells damaged by endotoxin
↓
Acute inflammatory response
↓
↓ **Resistance to phagocytosis**
↓ (Leukocyte association factor, and pili)
↓ **Protease which cleaves IgA**
Exudate thickness, phagocytosis increase
↓
Over in 30 days (there is no long lasting immunity)
↓
Septicemia 1 % (iron from serum transferrin)
Endocarditis, meningitis, dermatitis and polyarthritis

Comparison on features of *N .meningitides* and *N. gonorrhea*

Feature	*N .meningitides*	*N. gonorrhea*
Site of infection		
Route of infection		
Disease		
Specimen of choice		
Oxidase test		
Virulence factors		
Normal flora		
Penicillinase producing		

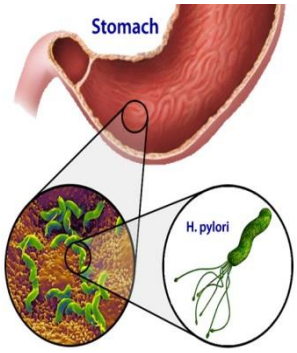
- **Other species of *Neisseria***

- ***N. flavescens*** – rarely can cause outbreak meningitis or septicemia.
- ***N. mucosa*** – commonly normal flora in rhinopharynx.
- ***N. sicca*** – normal flora of naso/rhinopharynx. Also found in sputum/saliva.
- ***N. subflava*** – normal flora of rhino/nasopharynx. Very rarely it will cause meningitis

Moraxella (Branhamella) catarrhalis

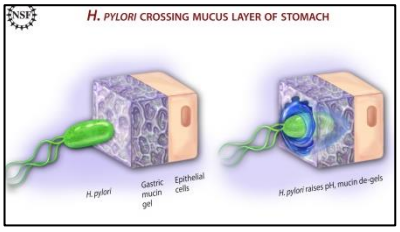
- **Gram negative diplococci (coffee beans)**
- aerobic
- **Fastidious**
- fragile
- **May present in upper respiratory tract in healthy individuals**
- **Opportunistic in children and elderly adults**
- **causes otitis media, sinusitis, pneumonia, acute purulent exacerbation of chronic bronchitis**
- **produce DNase**
- Hockey puck" – colony remains intact when pushed across plate with loop
- Sensitive to many beta lactams antibiotics

Helicobacter pylori



- **Spiral-shaped (curved) gram negative rods**
- Catalase positive
- Oxidase positive
- highly motile with polar flagella
- Optimal growth in microaerophilic environments
- **colonizes the stomach of hosts (**found on surface and deep mucous layers of gastric epithelium**)**
- **Route of entry:** Ingestion of contaminated food and drinks
- **Causes;** Peptic ulcer disease (gastric and duodenal ulcer)

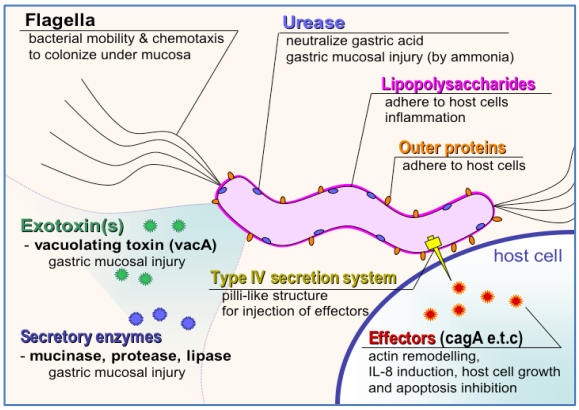
  Gastric cancer



- **Symptoms;** abdominal pain with burning sensation (night time pain is often), poor appetite, weight loss, vomiting, blood in stool, belching.
- Grows on skirrow's media with vancomycin and polymycin.

Virulence factor:

- **Urease (major virulence factor)**
- **Urease produce ammonia that damage gastric mucosa, ammonia also neutralize acid pH; which allows the organism to live in stomach.**
- Flagella for adhesions
- Protease (**modifies gastric mucus and further reduce the ability of acid through the mucus**)
- Exotoxins (inhibit stomach acid production)
- LPS (damage mucosal cells)



Biochemical reaction: **Urease positive (strong producer)**

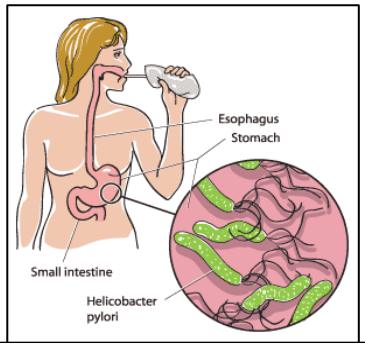
Special test:

- **Urea breath test**
- **Serology:**

  Detection of antibodies in the serum specific for *H. pylori*

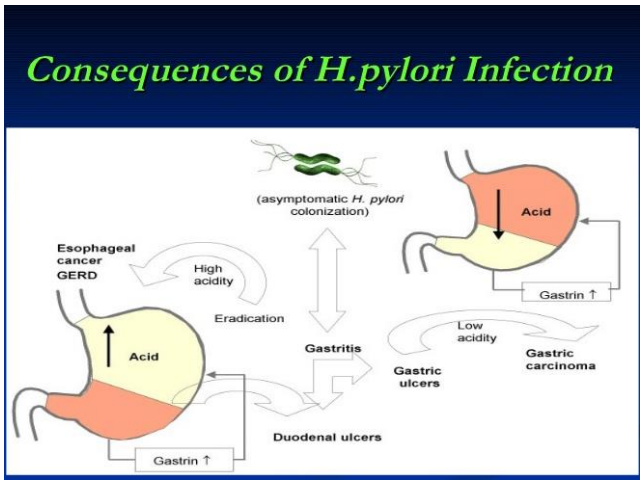
  Detection of *H. pylori* antigen in stool specimen

- **Biopsy urease test**



Urea breath test:

- *H. pylori* produce urease
- Urease hydrolysis ingested urea, produce ammonia and soluble carbon dioxide
- Co_2 diffuses in blood and exerted in the breath
- Test utilizes by patient takes test agent non-radioactive (^{13}C-urea) to label CO_2 gas.
- If the patient is infected with *H. pylori*, the urea will be broken down and a lot of $^{13}CO_2$ will be detected in the breath.



Review Questions

- Write the Latin name of the bacteria that cause stomach ulcer, meningitides, gonorrhoeae?
- What is major characteristics of Neisseria and pathogenic Neisseria ?
- Compare between two pathogenic *N. meningitides* and *N. gonorrhoeae* (both side of similarity & differentiate)?
- Give three examples of bacteria that causes meningitis ?
- Give two examples of non- fragile Neisseria normal flora?
- *Helicobacter pylori* can overcome of stomach acidity. How? two example of infections?
- What is the major virulence factor for *H. pylori*?
- What do you know about microcapsule of sialylated LOS ?.