



Microbiology

Lecture No:..... **20**.....

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Sheet Slide

Gram Negative Coccobacilli

This lecture contains two topic :

1) Gram Negative Coccobacilli

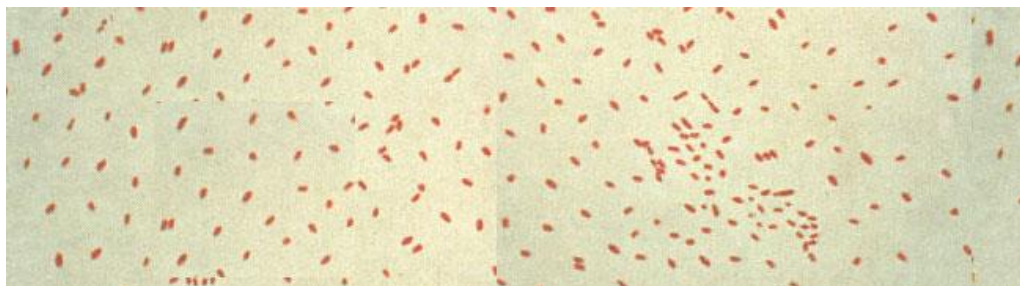
2) Enteric Bacteria

So last time we end the lecture with the first group which is Haemophilus Influenzae Type B so today we gonna start with the second group.

Bordetella Pertussis

General Characteristics

- The word 'Bordetella' comes from a Belgium scientist while the word 'Pertussis' comes from the meaning ; continuous cough in relation to children which is called whooping cough.
- It's a gram negative coccobacilli and the causative agent of the whooping cough.
- Found rarely as the upper respiratory tract flora.
- There is another type of gram negative coccobacilli, might be confused with this organism which is *Bordetella Parapertussis* ;
 - It is not associated with the production of toxins : **Pertussis**.
 - Both (pertussis and parapertussis) can cause inflammatory reactions of the mucosa of tonsil, pharynx and larynx. Can also reach brachia and attach to ciliated epithelial cell and produce some features of cough.
- Coming back to *Bordetella Pertussis*, once it is attached to the ciliated epithelial cell at the brachia, it will produce a form of inflammatory reactions and later release toxins - adding (increasing) the severity of the inflammatory reactions and also can be absorbed by blood stream and produce other side effects (related CNS).



Clinical Features

- Started in form of mild cough in association with the inflammatory reactions in mucosa of respiratory tract esp. in larynx and pharynx.
- Incubation periods : 7-10 days.
- Usually recognized as the viral infection rather than bacterial infection.
- Within short period, esp. in immunocompromised patients, it will produce more serious infection, which is the whooping cough - continuous cough with the release of large amount of mucous membrane, accumulating in respiratory tract esp. lung. Later patient will have shortness in breath.
- In children, vomiting might occur and also sinuses - lack of oxygen absorbed from respiratory tract and at the end, the death of the patient who can't be recovered by the immune system of the body.
- Two stages of infections ;
 - *First stage (catarrhal)* : Mild cough resembling viral infections. If patients receive proper antibiotics, treatment might be recovered.
 - *Second stage (whooping cough/paroxysmal stage)* : Release of pertussis toxins, more severe form and also difficult to treat. Treatment depends on the severity of disease and the immune response.
- Main target is young children, esp. children under 5 years old. Difficult for physician to recognize classical whooping cough due to the problem similar to it which caused by Bordetella Parapertussis.

-When studied 2 years ago, 4000 of children that admitted to the hospital, only 2 cases of infected children that are not immunized with this organism - indicate we have covered this organism :100 %.

-Before development of vaccine, there is very high mortality due to Pertussis/Whooping Cough, reaching 2-3 % (very high in relation to infectious disease) among the children like Diphtheria, indicating it is a very serious disease.

-(esp.) is a written abbreviation for especially.

Treatment and Vaccine

- First developed vaccine, using attenuated bacterial cells (killed bacterial cells, taken by subculture and treated by heat) including cell walls, lipopolysaccharides, cell membrane etc. But this vaccine contribute to side effects affecting brain and central nervous system.
- Later, vaccine that is more purified was developed. This vaccine included only small amounts of proteins, cell walls, lipopolysaccharides resulting better response and less side effects or complications.
- Immunization with triple vaccine (DPT vaccine) : including tetanus and diphtheria (incubated toxin) resulting 99 % of immunization and rarely immunized patient will develop pertussis.
- Treatment : Highly important to give proper antibiotics during the first stage (catarrhal stage). In the second stage, it is hardly to be treated.

Lab Diagnosis

- Not so important because it is hard to culture.
- Look at the presence of specific antibodies by serological means (study of plasma serum and other bodily fluids) or to look at the presence of organism by using molecular techniques ; PCR.



Neisseria and Moraxella

1) Neisseria

General Characteristics

- Found in the upper respiratory tract as flora.
- Gram-negative diplococci/coccobacilli.
- All are catalase and oxidase positive (important to distinguish similar type of organism ; Moraxella) Moraxella ; found in upper respiratory tract but it is oxidase negative.

Moraxella and Neisseria may have interaction according to antigenic structure , Moraxella may contribute to protection and immune response against Neisseria Meningitides but not Neisseria Gonorrhoea - because it is only limited to genital tract.

- Many species can be found, including species that can be found as normal flora (commensal) and also specific type of neisseria might infect our respiratory tract : Neisseria Meningitides (the causative agent of meningitis). Other Neisseria species, only can produced mild localized infections and rarely reach blood stream producing bacteremia (rarely invasive).

2 important pathogenic diseases :

1) *Neisseria Meningitides.*

2) *Neisseria Gonorrhoea (sexually transmitted diseases)(السيلان).*

Neisseria Gonorrhoea

- Causative agent of sexually transmitted disease.
- Mainly in genital tract and can't be considered as commensal organism.
- If it is found in any clinical specimen within vagina, urethra or rectum, it will be considered as infection.
- Rarely, it can reach upper respiratory tract (invasive), because it is restricted to the genital tract.

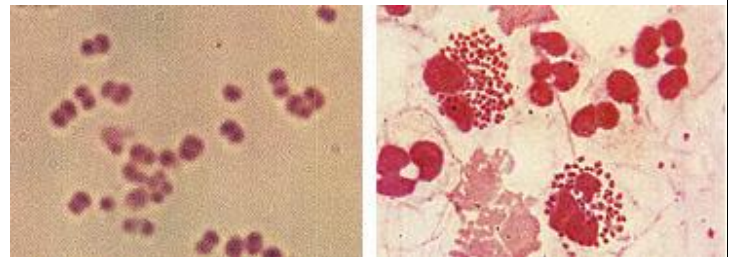
Clinical Features

- Produced severe localized infections in mucosa of genital tract (accumulation of fluid and damaged epithelial cells) in form of vaginal discharge or urethral discharge.

- If males are affected, it is easily recognized with ; urethral discharge (Infection of the genitals can result in a pus-like discharge from the genitals), severe pain during voiding of urine, abdominal pain and fever.(easily diagnosed)
- But in females, up to 80% are asymptomatic(healthy carriers),(difficult to diagnose because the symptoms are not acute like in males, so it requires clinical investigation to tell whether there is infection or not) Clinical symptoms do not occur like in the males.

Lab Diagnosis

- Collecting amount of samples from urethral or vaginal discharge, then prepare the gram stain and culture on specific media like chocolate agar, blood agar or selective medium(Thayer-martin medium) , for detection of this organism.
- If we culture this organism, we can easily recognize the gram negative diplococci which is in kidney shape (on the left side of this picture).
- But it is very susceptible to the environmental factors, within few hours after lab diagnosis it will start to change the morphological structure and it might die also.
- So in this case we should culture it within 20 minutes, otherwise this organism can't be discovered due to damage on the cell wall caused by the activation of autolysis enzyme in Neisseria Gonorrhoea.
- And then after we prepare the gram-stain,we should discover two important features;
 - Presence of the polymorphonuclear cell.
 - Inside this polymorphonuclear cell will be the presence of intracellular gram negative diplococci (Neisseria Gonorrhoea). But if there is no presence of this intracellular organism, then it will not be N.Gonorrhoea and could be the Moraxella or other organism.
- So we should not accept any cases of N. Gonorrhoea without pure culture and without recognizing the presence of the organism inside the polymorphonuclear cell.



Treatment

- Usually we use Penicillin but also it develops resistant towards it. (we should not know the details about this)

Neisseria Meningitidis

- Also like *N. Gonorrhoea*, which is an **obligate** pathogen, if we isolate it from respiratory tract of a person with tonsillitis/pharyngitis, the person should be considered to be contaminated with this organism.
- Patient must be treated immediately with antibiotics because this organism is highly invasive, esp. in children.
- Later after the infection of respiratory tract, this organism may cause invasion to the blood stream, causing meningitis within a short period. Compared to *N. Gonorrhoea* which is only caused localized infections in genital tract, *N. Meningitidis* is more invasive because the presence of ; certain *excreted enzymes* esp. **IgE proteases** and **capsular polysaccharides**.
- IgE proteases will damage the protection within mucosa of respiratory tract .
- In *N. Gonorrhoea*, we can't find this (IgE proteases) in sufficient amounts so it only causes mild infections.
- The cases of *N. Meningitidis* usually happen in outbreak, compared to *N. Gonorrhoea* which only occur in single case.
- So when we detect a single case with *N. Meningitidis*, we should expect at least 100 persons already carry this organism and got the infection.
- Main target is children because adults may develop certain immunization caused by other species of *Neisseria*, but children usually is susceptible to it.
- But in Jordan fortunately it is not very common, thousand cases of infections and death usually happen in certain countries like Africa and Brazil.
- Mortality reach up to 20% if children do not get treated by antibiotics.
- Protective vaccine is available.

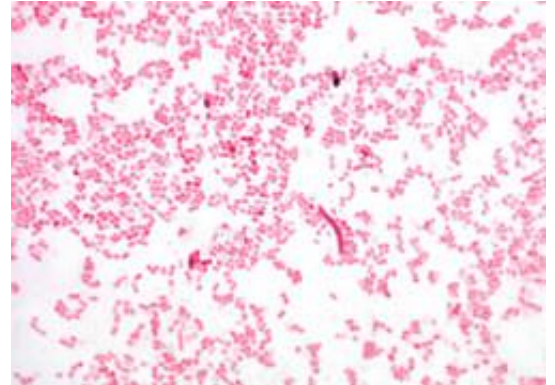
Moraxella Catarrhalis

- Very similar in morphological structure with *N. Meningitidis* but it does not contain IgE proteases and the capsule.
- Part of normal flora.
- Rarely cause complications, if there is complications it is related to lung infections, pneumonia, bronchitis ,this type of complications usually occur in immunocompromised patients or patients have malignancy in lung or suffering from underlying diseases etc.
- Also can be opportunistic in heavy smokers ;because their epithelia cells are less ciliated - which causes less protection in mucosa of lower respiratory tract.

- Moraxella Catarrhalis was previously placed in a separate genus named Branhamella then it became Neisseria Catarrhalis and now the name Moraxella catarrhalis is currently preferred for these bacteria.

Lab Diagnosis

- Using gram-stain, but you must be careful in differentiation between Moraxella and N. Gonorrhoea/Meningitidis, Moraxella is not an intracellular organism like Neisseria. But it is not enough to do only the culture (gram-stain test).
- Must be followed by the biochemical test (biochemical fermentation etc).

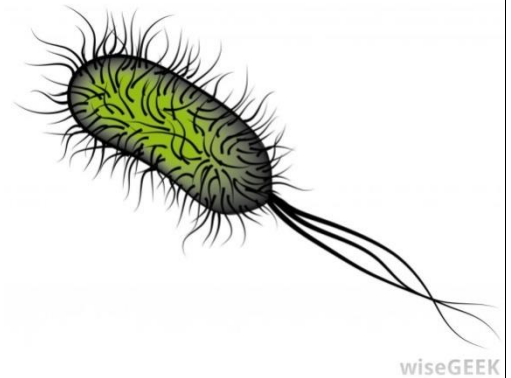


Treatment

- Antibiotics according to susceptibility.
- No vaccine.

Enteric Bacteria

Now we come to a new topic which is the enteric bacteria. It is related to the intestinal tract and could be either commensal, opportunistic or pathogenic in classification. A very large group, originated from the intestinal tract and might reach the gastrointestinal tract, producing diarrhea and vomiting. Also can reach the blood stream and cause the case of septicemia like in Salmonella Typhi, the causative agent of typhoid fever.



General Characteristics

- Include all typical enteric bacteria which belong to the family Enterobacteriaceae.
- Include more than 20 species - Almost consist of 20 genera and from this genus they have many species and many names.

- We will concentrate only with the important species that is associated with clinical features.
- Will divide this organism into two group ;
 - 1) *Obligate pathogens* : Once we isolate them from the feces or any part of the body ;consider it as pathogens.
 - 2) *Opportunistic pathogens* : Found this organisms in the intestine but under certain condition, it might reach urinary tract and cause urinary tract infection or reach blood stream to cause septicemia or any other infections.
- All are gram negative, all considered under certain conditions as opportunistic and some of them are very important as flora in the intestinal tract such as *Escherichia coli*.
- Have certain pathogenic or virulence factors in relation to three important antigens;
 - 1) *Somatic antigens*
 - 2) *H-antigens - Flagella*
 - 3) *K-antigens - Capsule*
- Some of this organisms, like salmonella typhi or paratyphi, causative agent of typhoid fever , when reaching our intestinal tract, will induce our immune system to response and produce antibodies towards somatic antigens or H-antigen. And we can detect the immune response by measuring it, in order to diagnose the case(infection of this type of bacteria).
- All of this organisms, either from the feces of humans, animals or birds can contaminate the water or foods and will be spread by the fecal-oral route.
- Can be obligate only in humans but not in animals.
- Majority of this organisms can also be found in feces of humans, animals and birds- indicates that this species has a very close relation with our environment.

More details will be followed about the enteric bacteria on the next lectures. Sorry for any mistakes :)

Poyonya.

Corrected by Mohammed Nawaiseh .