Microbiology

◉ Sheet ○ Slides

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Done by : Toqa.I.Al-humaidi

Corrected by: Abdullah Qaswal

Subject: Enteric bacteria 2

Doctor: AsemShihabi

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Enteric bacteria:

Gram-ve facultative anaerobic bacteria.

Coliforms –lactose fermenter-:

Lactose fermenter coccobacilli to bacilli Gram-ve bacteria and can be detected using MacConkey agar. Types of coliform bacteria like E-coli and any other coliform type (i.e. Klebsiella-Enterobacter) can be distinguished from one another depending on the ability to ferment lactose (E-coli is strong lactose fermenter).

- *Coliform bacteria are a larger category that includes broad spectrum of Enteric bacteria.*

> ***Remember*** *: MacConkey agar is a differential selective medium that contains lactose (5%), indicator (neutral red dye), minerals, nutrients. If the bacteria cultured in this medium ferment lactose, the colonies will appear red in color whereas the non-lactose fermenter bacteria colonies will be colorless.*

Enteric bacteria species are part of our intestinal tract flora. Of those, Klebsilla- Entrobacter species are found in lower amount (~1%) than all other facultative anaerobes but still excreted with the stool like other species. Enteric bacteria might produce infections mainly those related to wounds and sepsis, a type of it can produce respiratory infection.

Enteric bacteria lactose fermenter species:

- Klebsilla-Enterobacter species.
- E-coli
  We talked about E-coli in last lecture, now we are going to talk about Klebsilla-Enterobacter species:

Klebsilla-Enterobacter species:

Clinically, the most important type is K.pneumoniae, as it is a causative agent of lung pneumonia due to the fact that it is ***encapsulated (polysaccharide capsule)*** which allows it to attach the respiratory tract mucosa inducing lung inflammation and finally pneumonia.

K.pneumoniae usually causes pneumonia in hospitalized patients, in association with respiratory equipments (i.e. endotracheal tubes) use, It can cause ***UTI*** too. It is also ***multi-drug resistant species*** and survives the hospital environment for longer time than other species (common outbreak Nosocomial infection).

Coliform Lactose non-fermenter bacteria:

Three important genera :

- Proteus.
- Morganella.
- Providencia.

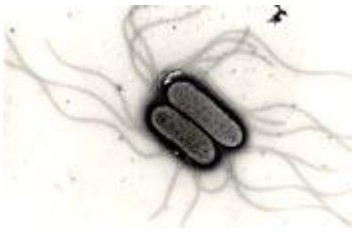
In general, lactose non-fermenter enteric bacteria are found in very low amount (<1%) in the intestinal tract. They cause UTI -mostly in hospitalized patients-. Proteus &Morganella cause urinary distort due to the fact that these two ***produce urease*** which catalyzes the hydrolysis of urea –found in the urine- to produce ammonia that interacts with Cl (chlorine) to give ammonium chloride (NH_4Cl) , and that make them survive the alkaline medium. So, proteus and Morgenella ***cause renal stones.***

Proteus &Morganella produce greater amount of urease than Providencia thus more associated to UTI, the three are less associated to other type of infections.

Pathogenicity of enteric bacteria:

They are considered pathogens due to the following factors:
1-**lipopolysaccharide(LPS**) of the cell wall.
2-presence of ***fimbria*** (adherence to the mucosa causing inflammation) and ***flagella.***
3-***encapsulated*** (mainly Klebsilla as it has large capsule while e-coli and other types have thin layer as capsule / can be demonstrated by ***capsular stains***).

Salmonella:



Not as commensal as other enterobacteria found in intestines, so when found must be considered as pathogens. So, they **are not part of the normal human flora**. It is flagellated (motile) and secrets cell wall enterotoxins that are functional in intestinal tract of humans & animals only. As we have somatic antigen (O-antigen), H-antigen (flagella) & K-antigen (capsule), antibodies are produced in case of infection and can be used for diagnosis purposes.

Salmonella is a large group with about 2000 serotype ,with differences in polysaccharides of the cell wall, but generally Salmonella is divided into two groups:

- ***Non-Typhoidal Salmonella*** (food poisoning salmonellosis/Gastroenteritis/ mostly in animals).
- **Typhoidal Salmonella** (intestinal tract salmonellosis **/ infect only human).**

non- typhoidal Salmonella:

widely distributed in nature , may contaminate food. The most important species is ***Salmonella enteritidis*** , this species include many sub-species. It is associated to GI tract infections (large number of bacterial cells cause infection when reaching intestines with contaminated food). **The infection is zoonosis (chicken is often associated).**

Some species of salmonella infect **animals only**,others like ***Salmonella enteritidis infect both humans & animals***. The infection in animals is characterized by **diarrhea & sepsis and ends with death**, while in **humans GI infection symptoms** (**fever**, diarrhea,vomiting,…etc.) appear. When large number of S.enteritidis (at least 100,000) reach the intestines (via ingestion of contaminated food articles especially eggs & not well cooked chicken) irritations & inflammation in association with diarrhea result. Diarrhea in this case can be mild or sever, watery or bloody depending on factors like age of the patient, degree of inflammation,…etc.

Under certain conditions (infants, elderly patients, patient in late disease stages) S.enteritidis might reach the blood stream causing blood sepsis and meningitis resulting in death. In general antibodies aren't used except with these cases.

Notes:

- *G+ve bacteria infection is due to injection of toxins in food (poisoning the food) resulting in intoxication (symptoms like diarrhea & vomiting appear but with **NO FEVER**).*
- *In our country, S.aureus&B.cereus used to cause 50% of food poisoning cases but now S. enteritidis do.*
- *under normal conditions S.enteritidis species is not invasive.*
- *S.enteritidis is often cultured of stool sample in a selective medium for Salmonella (a medium that inhibits the growth of other bacteria) such as S-S agar (Salmonella- Shigella agar) and **Hektoen enteric (HE) agar**.*
- *Salmonella is H_2S fermenter (H_2S +ve) in the culture media and appears as black colonies.*

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typhoidal Salmonella : (S.typhi&S.paratyphi)

Less common in nature, infect humans only and highly invasive, with incubation period of 1-3 weeks few cells can induce GI infection , septicemia. It can reach any organ in the body (liver, gall bladder,…etc.) ,infect the bone

marrow, cause meningitis or UTI. The clinical feature of typhoidal Salmonella infection is ***enteric fever.***

In the incubation period of this type the multiplication occurs in mesenteric lymph nodes of intestines (few cells → large number of cells) then penetrate sub-mucosa & mucosa to the blood stream (sepsis), then to the liver & spleen producing necrosis and ***hepatosplenomegaly*** (enlargement of liver & spleen) with continuous high fever (above 40^{o} C) so patient will get into coma.

The patient may live with administration of antibiotics, but still the mortality rate high (30% of infected patient). The typhoid fever was the cause of death of thousands in our country (Middle East countries in general).

Note: normally after 1-2 weeks of inducing infection no salmonella released with the feces, but in infections of S.typhi / S.paratyphi 3% of the patient become healthy carriers (typhoid salmonella can reside in the gall bladder or cause necrosis in intestines). In this case, the organism will be excreted with feces becoming a source of infection and contaminating water in the community.

i / S.paratyphi can survive in water for few months, only chlorination or boiling can kill them.

In Jordan we went through out breaks of typhoidal salmonella, one of these was in Al-salt in which 5000 person was infected due to water contamination.

S.typhi / S.paratyphi infection is serious –why so serious :P ?- because the patient will die without antibiotic treatment whereas other salmonella infections are often self-limiting and anti-microbial drugs are used only in certain conditions.

Lab diagnosis of typhoidal salmonella is more complicated than that of GI salmonella:

- ***GI salmonella*** → it is enough to culture stool in a selective medium.

- **Typhoidal salmonella** → in the first stage of infection the organism is excreted with stool and urine (when reaching kidneys), also it might cause meningitis Sooo urine, stool and CSF specimens can be used. In chronic cases we might use bile fluid specimens, if abscess formed in liver a specimen of that can be used too. Sometimes many specimens are used at once.

If a patient typhoidal salmonella test was negative, sometimes due to taking antibiotics, but symptoms (like continuous fever) are there, we have to look

for specific antibodies against O & H antigens (anti-O-antigen / anti-H-antigen) by serological method called ***Widal Test***.

In Widal test we use H&O antigens to detect the corresponding specific antibodies in the blood of the patient. If the titer **is high (160 /mole)** then the patient is already infected with salmonella.

Vaccine is available for humans but it is not recommended to be used normally (used in wars). ***The most important way of protection is to keep water sources clean.***

E-coli is the indicator of fecal contamination, means if you find (one E-coli cell / liter) then other pathogens (i.e. typhoidal salmonella) are expected to be found.

Typhoid fever complications, brain damage, vital organs damage and intestinal perforation (usually due to leak of normal flora) are the causes of death.

In Jordan, typhoid fever cases are rare due to cleaning water sources (99% of our water is clean). Some cases are of refugees.

S.typhi&paratyphi infection **is rarely acquired by direct contact** but patient with low hygiene might be a cause of contaminating food articles. The main way of acquiring **infection is via contaminated water then food -with lower levels-.**

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The End