


University of Jordan
Faculty of Medicine



Medical Committee
The University of Jordan

Introduction to

Microbiology

Title :

Enteric Bacteria

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: 18

Slides

Handout

Sheet

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M.D. Class of 2018

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∴ → therefore

Enteric Bacteria

- This group includes many species of gram –ve , facultative, rapidly-growing anaerobic bacteria.
- They are mostly found in the intestines of humans & animals.
- Many of these species are found in the environment especially in association with water resources, and sewage
∴ this group is always in a close contact with our body and so is important to us.
- Part of the enteric bacteria is considered a part of our commensal flora however under certain circumstances they cause infections and are called opportunistic pathogens (when reaching the blood stream or the urinary tract ..) especially in health conditions related to malignancy or when introducing surgical procedures or during cystoscopy \catheters (endoscopy of the urinary tract) and these infections may be severe due to the fact that:

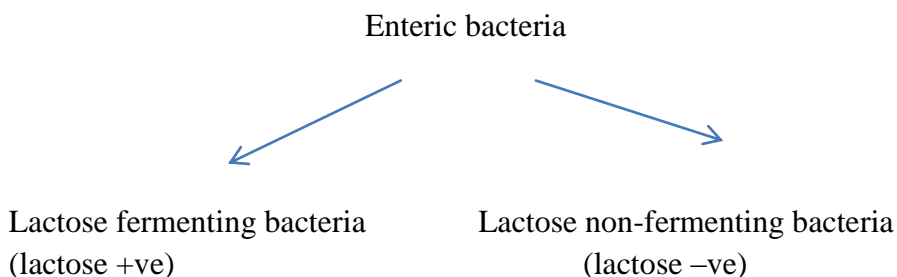
1- enteric bacteria contain lipopolysaccharides \ endotoxins (part of the cell wall) which induce fever & disseminate vascular coagulation.

2-some of these bacteria are capsulated & ∴ inhibit phagocytosis & inhibit also the immune response.

3- some of these bacteria produce extracellular toxins or enterotoxins inside the intestines.

To sum up this group of bacteria have a variety of features that give it the ability to produce a variety of infections.

- Identification of these bacteria in the lab is done by using a special medium called MacConkey agar named after the Scottish scientist who has developed this medium in order to isolate and detect E.coli bacteria which is part of the enteric bacteria group & ∴ this medium can identify all enteric bacteria by a simple characteristic.



The MacConkey agar contains lactose & a neutral red dye , so a colour change from coloreless\rose to red occurs if lactose fermentation products are present .

∴ Red colonies on the surface of the agar indicate the presence of lactose fermenting bacteria which are able to utilize lactose, and if no colour change (transparent colonies) then the bacteria present is lactose –ve, and so this simple test subdivides enteric bacteria into to sub groups.

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Note: the gram stain does not help us in distinguishing between enteric bacteria species because all enteric bacteria are gram –ve coccobacilli to bacilli .

We have many species of enteric bacteria found in intestinal tract such as E.coli, Salmonella, klebsiella, Enterobacter, Providencia , proteus & Serratia .

Enteric bacteria groups :

Ω The Coliform group

- This group includes the part of enteric bacteria that utilizes lactose and are considered lactose +ve.
- One of the most common species of this group which reside in our intestines tract is the E.coli (Eschericia coli).

1- E.coli (Eschericia coli)

- The E.coli is named after its original discoverer the pediatrician Theodor Escherich and the second part of its name ; coli comes from the fact that most of the enteric bacteria are found in the colon and not in the intestine but at that time it was difficult to identify other bacterial species & ∴ was named accordingly.
- The E.coli is one of the most causative agents of UTI especially community acquired UTI, which are contracted at homes and not in hospitals in hospitals they are contracted while using the urinary catheters . The E.coli is found in intestines and excreted with the feces and might manage to reach the opening of the urethra especially in ladies –women have shorter urethra than men and this allows the organism to adhere easily & if there is any change in vaginal flora they may reach the bladder & cause infections- they cause ascending infection (from the opening of the urethra ascending to the upper part of the urethra, up to 70% of UTI in the community (not in hospitalized patients) are caused by E.coli . men develop UTI when they are above the age of 50s & especially in hospitals during cystoscopy. UTI may disseminate from the bladder & go to the kidneys and cause septicemia also the E.coli may succeed to escape from the intestinal barrier & reach the blood stream & cause septicemia in association with other invasive organisms.
- E.coli can easily penetrate the large intestinal mucosa of neonates & reach the blood stream & cause sepsis & meningitis.

Generally E.coli is not considered a pathogen and is part of our commensally intestinal flora, however, there are certain clones/ strains called diarrheagenic E.coli (these cause either bloody or watery diarrhea) and there are 6 important subspecies of diarrheagenic E.coli in people & children are more prone to this type of E.coli than adults:

a- Enteropathogenic E.coli: this is a common cause of diarrhea in infants less than 6 months old

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- b- Enterotoxigenic E.coli :this bacteria produce heat-labile exotoxin & heat-stable enterotoxin & it is a common cause of diarrhea in both adults and children during travelling from countries of high standards of hygiene to countries of low standards of hygiene because of the wide spread of these E.coli in the environment especially in water & food , it causes mild diarrhea and only persisting for a short time.
- c-The other types of diarrheagenic E.coli are very dangerous and might be associated with toxins and these types are to be discussed later in 3rd year

E.coli might be associated in food poisoning due the fact that it produces enterotoxins that might easily contaminate our food and water .

- Water must be free of E.coli to be safe .
- E.coli is considered an indicator pathogen to judge whether water is drinkable or not (if there was 1 E.coli cell in a Liter of water , this water shouldn't be drunk before treating with gamma rays .. etc) .
- Diarrhea to E.coli is self-limited in healthy persons who have no underlying diseases & ∴ there is no need for treatment using antibiotics. But it may be associated with severe complications in children & old patients & immunocompromised patients due to the fact that the diarrhea will result in severe dehydration & ∴ affecting the circulation of blood & ∴ affecting other organs.

2-Klebsiella-Enterobacter species

- These two types are closely related to each other in biochemical reactions & in relation to the appearance in the MacConkey agar , so they are not easily distinguished from each other unless with full biochemical tests.
 - K. pneumoniae is an important species due to its invasiveness especially with relation to the respiratory tract where it may be associated with a severe form of pneumonia , K.pneumoniae's hospital acquired infection is called Nosocomial infection in addition to the development of sepsis and lung infections
- **The pathogenicity of K. pneumoniae is due to:
- a- The presence of large capsules.
 - b- That it releases compounds which enhances its pathogenicity.
 - c- Its multi-resistance to antimicrobial drugs including new drugs of carbamides (imipenem and meropenem), it also has a wide spectrum of resistance to β - lactamases. (extended spectrum of β -lactamases)
- Enterobacter bacteria is considered less pathogenic than K. pneumoniae .

3- Proteus-Providencia species

- It is very common in association with UTI but they are lactose **-ve species.**
- It causes similar infections like the other coliform bacteria like UTI, sepsis & wound infections.
- They are more associated with hospitalized patients than community people , rarely to a UTI in community in relation to proteus -providencia species .
- They are more resistant to antimicrobial drugs than the other enteric bacteria.

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- They are easily distinguished from lactase +ve bacteria by **urease test** which has enzymes which split down urea into ammonium and carbon dioxide, and a colour change occurs. This is another test for distinguishing between lactose +ve and -ve and protease +ve & -ve.

Note: All gram-ve bacteria & especially the enteric bacteria are associated with 2- 3 important antigens:

- a- The H antigen in association present in the flagellum.
- b- The O somatic antigen which is part of the periplasmic space and the cell wall.
- c- The capsule antigen. K antigen

Not all enteric bacteria are capsulated or flagellated

eg. 90% of e.coli are flagellated & Klebsiella-Enterobacter are often associated with capsules rather than flagella & Proteus-Providencia are more associated with flagella and more motile than others & are not capsulated. This helps in understanding the pathogenicity associated with each type of bacteria.

Ω Pseudomonas aeruginosa & Pseudomonas group

- Are not considered part of the classical enteric bacteria although it can be found within the intestine & despite the fact that it is gram -ve facultative anaerobic rapidly growing bacteria (only called gram -ve bacteria but in order to simplify this topic we'll consider it as enteric bacteria group)
- It is found in the environment more than in the intestinal tract of humans and animals, so the presence of Pseudomonas aeruginosa in our intestines is abnormal and is acquired, and coliform bacteria try to get rid of it from our intestine by producing **colistin** which is an antibiotic like substance.
- In healthy people there is a biological equilibrium that tends to make coliform bacteria predominates in the intestines & if there is a change in the flora due to the use of antimicrobial drugs or due to the presence of an underlying disease the Pseudomonas aeruginosa may increase.
- Pseudomonas aeruginosa is highly pathogenic especially if it succeeds to reach sterile parts of our body due to the use of invasive techniques in hospitals, eg. UTI due to E.coli can be easily treated with one course of antibiotics under normal conditions, whereas UTI due to Pseudomonas aeruginosa which is contracted mainly from hospitals is treated by the admission of the patient into the hospital and treating him with IV drugs which usually have greater side effects. And this is because Pseudomonas aeruginosa is difficult to get rid of due to being multi- resistant especially to β -lactamases.
- If Pseudomonas aeruginosa is associated with lung infection or sepsis it might be very severe the patient might die, & if the patient gets infected once they might be long life infected with Pseudomonas aeruginosa because it is highly virulent (repeated UTI).

What Makes Pseudomonas Aeruginosa Highly invasive ??

1) There are many species of Pseudomonas aeruginosa, & Pseudomonas aeruginosa is called aeruginosa because it produces **pyocyanine which is a blue green pigment** which might inhibit other organisms' growth (if there was E.coli and pseudomonas in the same culture media , E.coli will be inhibited by pyocyanine)

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2) it also produces various extracellular enzymes (eg : hydrolase..) & toxins which damages the tissues .

- Pseudomonas aeruginosa is widely distributed in water more than other organisms & so can easily contaminate vegetation & it is not easy to disinfect these solutions
 - eg. 70%-90% alcohol is used as an antiseptic, however Pseudomonas aeruginosa can survive in 70% alcohol & so when using alcohol it must be found in a transparent bottle in order to check for any turbidity, however iodine does not have to be in a transparent bottle.
 - Pseudomonas aeruginosa can produce any type of infection especially wound infections
eg. In burn cases the 1st organism to reside in the damaged tissue is Pseudomonas aeruginosa because it is highly distributed in the environment and if you use alcohol for disinfection it can still survive.
It can easily be identified by a blue green pus in the wound .
Also during swimming , can easily be recognized such as the discharge of a blue –green pus from the ear.
 - Pseudomonas aeruginosa infection can cause sepsis especially in patients who use the respirator and they maybe at a risk of developing pneumonia.
 - Pseudomonas infections are a common nosocomial infections in all hospitals and can easily contaminate water .
 - Pseudomonas are multi-drug resistance especially for β - lactamases but Infections caused by it might be treated by few drugs including **aminoglycosides** and **fluoroquinolones**.
 - They produce transparent colony on MacConkey agar so we have to do further tests .
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In Slide no. 5

The picture on the left shows flagellated E.coli associated with many fimbria for better adherence

If E.coli didn't have fimbriae it might not be associated with UTI (will be flushed out with urine).

The picture on the right shows a demonstration of bacterial capsules using capsule stain (a large empty space that indicated the presence of capsule)

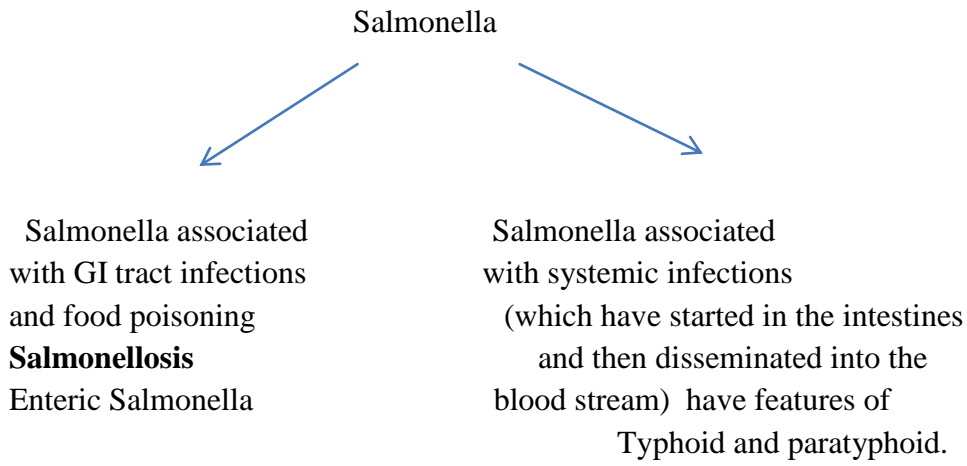
Ω Salmonella

These are a group of gram –ve enteric bacteria, they are called salmonella according to the german scientist who has identified this group as an important cause of infection in the intestinal tract & a cause of diarrhea,

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later more than 2000 Salmonella serotypes were identified (according to the presence of more than 2000 polysaccharides in cell wall)



All Salmonella are gram -ve bacilli similar to enteric bacteria & are all facultative anaerobes but are not part of the commensal flora of our intestine so they are usually acquired, if they are present in the intestines we call it healthy carrier, which are more in animals than in humans ..

Animals might have it without developing a disease . except for chickens

Chicken infected with Salmonella develop sepsis and die.

Done by: Hala Halbony

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