

بسم الله الرحمن الرحيم

## GASTROINTESTINAL INFECTIONS -1-

In the introductory course, we took an idea about types of organisms that reside in our intestinal tract. These organisms, under certain conditions, cause diarrhea. These organisms produce toxins ( responsible for intoxication )

In general, the causative agent of gastroenteritis could be parasites, viruses or bacteria. Fungal infections are very rare.

Fungal overgrowth, candida for example, is associated with features other than gastroenteritis.

\*\*\* gastroenteritis: presence of vomiting and diarrhea , and there are different types of diarrhea: watery diarrhea , watery-bloody diarrhea .

Severe diarrhea could lead to severe necrosis in the large intestines, and might result in the death of the patient. This is related to certain types of organisms that produce specific toxins.

### ***Route of transmission:***

- 1- Water
- 2- Fresh food
- 3- To lesser extent , direct contact with infected person, infected person could spread the infection to his colleagues and family by contaminated hands

But water and food are the most important agents in spreading gastroenteritis.

-The majority of cases are found in the developing countries, especially among children leading to high morbidity and mortality rates.

- According to WHO, there are at least 5-10 million deaths each year due to gastroenteritis (mostly with infants and children).

- One example from Jordan: last week, there was outbreak of food poisoning in دير علا . The Infection was due to eating hummus from a restaurant. This resulted in 177 morbidities. Some of the patients stayed in the hospital for 3 days. The causative agent was a mix of organisms – according to the ministry of health- including salmonella enteritidis and other organisms (the ministry didn't specify) , but the doctor expects staph. Aureus and bacillus cereus, as those organisms are related to the preparation of hummus.

### ***Bacteria that cause gastroenteritis are:***

**A) Gram –ve** : associated with any form of gastroenteritis , some of gram –ve organisms penetrate the intestinal tract causing sepsis, meningitis, ... etc

1- Salmonella spp.

2- Various types of enterotoxigenic E.coli strains, E.coli is the most common facultative anaerobic bacteria in the GIT.

\*\* remember: 95% of intestinal bacteria are anaerobes, 5% are facultative anaerobes  
Among these 5%, E.coli is the commonest.

3- Campylobacter spp.: 2 or 3 types associated with gastroenteritis

4- Vibrio cholera

5- Listeria monocytogenes , associated with cheese consumption (dairy products)

6- Aeromonas, associated with water

**B) Gram +ve :**

- easy to recognize
- these organisms manage to produce extracellular toxins .
- Examples: Cl. Perfringes, bacillus cereus, staph. aureus and , to lesser extent , other Organisms.
- These organisms might reside in the intestinal tract without causing gastroenteritis.  
But, if there's a change in the intestinal flora, Cl. Difficile, for example, causes gastroenteritis .

## salmonella

- Salmonella is an important gram –ve bacilli, facultative anaerobe
- It's divided into 2 major types :

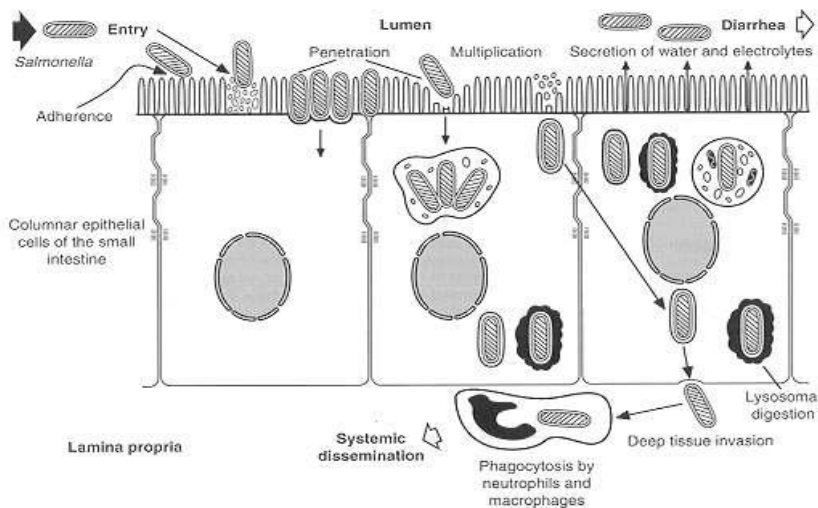
1- Typhoidal salmonella (enteric fever salmonella )

2- gastroenteritis salmonella / food-poisoning salmonella

\*typhoidal salmonella infects humans only , Gastroenteritis salmonella infects humans, animals and birds and is widely distributed in nature .

### THE 1<sup>ST</sup> TYPE : TYPHIODAL SALMONELLA

- This group can cause systemic infections ; blood sepsis and might reach any part of the body.
- As we said before , it only infects humans .
- Mechanism of infection is illustrated in this figure :



- Infection of typhoidal salmonella starts firstly with multiplication in the intestines.
- This bacteria attaches to the surface of small and large intestines,
  - \* Two virulence factors contribute to the attachment :
    - 1- lipopolysaccharide on the surface of the cell wall
    - 2- flagella
- Following attachment , the organism slowly moves to the subcutaneous tissue reaching the lymphatic system , taken by macrophages , but macrophages can't digest the organism , so they carry the organism to the blood .
- Incubation period for salmonella is 1-3 weeks .
- Few cells can be enough to cause infection , that's why contaminated water with only few cells could lead to infection .
- Once the organism reaches the spleen, liver and gallbladder it causes necrosis and inflammation, especially in the liver, then it re-enters the intestinal tract:

IN THE INTESTINAL TRACT: the organism produces cytotoxins → cytotoxins induce the activity of adenylate cyclase → increase the conc. of cAMP → secretion of fluids mainly water and electrolytes;  $Mg^{2+}$ ,  $Cl^-$ ,  $Na^+$  and inhibit the absorption of salts → the end result will be watery-bloody diarrhea .

\*In certain cases, diarrhea is not present. On the contrary, the patient presents with constipation.

\*\*\*\*\*

The presence of salmonella typhi or paratyphi is often associated with systemic infection; blood sepsis, and can disseminate to any internal organ of the body.

For example: in young children or elderly → might cause meningitis

In immune suppressed patients → might manifest in the form of osteomyelitis

- Any part of the body can be infected by salmonella typhi or paratyphi .
- The body produces specific antibodies, these to some extent control the infection, but not in all cases.
- In 30% of cases , infection with typhoidal salmonella results in severe intestinal necrosis and perforation because some people can't produce enough immune response and without antimicrobial drugs , the patient dies .
- That was the case in our countries in the past, where millions of people died because of salmonella typhi and paratyphi .

-Salmonella typhi is more virulent than paratyphi, but we cannot distinguish between them depending on the clinical symptoms because they are similar. The difference is in the severity, that can be recognized by using ultrasound.

-Why is salmonella typhi more virulent than other specie?  
Because it has a special layer (similar to capsule) surrounding the cell wall of salmonella typhi called **Vi antigen** . Vi antigen is responsible for the severity of the infection .

Then the doctor said : {"Salmonella typhi might contain this Vi antigen . But some of them might not be included or not associated with this type of salmonella"}...

### ***Healthy carriers :-***

-This is very important issue  
-3-5% of recovered patients become permanent healthy carriers, either if they have recovered with antibiotics or without antibiotics (if their bodies controlled the organism by immune response)

-Healthy carriers carry the organism in the bile ducts

-What does this mean clinically?

It means that the healthy carriers can excrete salmonella in their feces, finally reaching water or fresh food. That is considered a source of infection in the community .

- Therefore, in the past our country and others have always examined the stool of any person who is in contact with food , e.g. in restaurants, in order to exclude the healthy carriers

- In Jordan we have controlled salmonella typhi and paratyphi . Only very old persons are healthy carriers . Since 1982 , rare cases of typhoid fever have occurred in Jordan . All cases of typhoid fever now are imported cases , especially from Iraq , Syria and other countries. That's because in Jordan water is controlled by chlorination.

### ***How to diagnose a case of typhoid fever?***

- 1- The major symptom is high fever, not less than 40 C .
- 2- Hepatosplenomegaly: enlargement in the spleen and liver
- 3- severe malaise
- 4- Abdominal pain

\*All these symptoms appear in a patient suffering from systemic infections.

\* other organisms can give the same symptoms , but in typhoid salmonella these symptoms appear in addition to problems in the GIT ... vomiting ,diarrhea .

- In order to start effective treatment without delay , we have to know if the patient has typhoid fever or not . This can be done by culturing the organism from :

1- STOOL 2- BLOOD 3- URINE , because during the acute infection , the organism is excreted in the stool , urine and blood .

# If the blood or urine cultures were positive , then this is 100% a case of typhoid salmonella

# If only stool culture is positive, we need to do another test ( serological tests ) ; blood sample is taken from the patient to look for antibodies against specific antigens which are :

**1- somatic O antigen**

**2- H antigen ( the flagellar antigen )**

All salmonella typhi and paratyphi are flagellated and have O antigen

\* O antigen is considered more important than H , because H antigen might be associated with other gastrointestinal bacteria .

- Second , if the infection is related to salmonella , we look for antibodies against **Vi antigen** .

- In Jordan , we have normal levels of antibody titer for salmonella : 160

- During acute infection , after about 2 weeks , the antibody titer will rise ;

For example : 1<sup>st</sup> week :160 ... 2<sup>nd</sup> week : 320 or more ... 3<sup>rd</sup> week : 640  
4<sup>th</sup> : 1280

This rise in the titer indicates infection .

\*\* this test is called **Widel test** .

To sum up , we have two important tests :

- 1- isolation of the organism
- 2- demonstration of specific antibodies

### **Treatment :-**

-Treatment has changed in the last 20 years .

- In Jordan the drug of choice for typhoid salmonella was trimoxazol for children, and chloramphenicol .

- Chloramphenicol is an excellent drug , it results in recovery in few days ,but it may have side effects like aplastic anemia .

The doctor believes that chloramphenicol is the best drug , but huge companies are not interested in cheap drugs , they want to sell the expensive drugs .

- now , we are using :- 3<sup>rd</sup> generation cephalosporins : ceftriaxone , cefotaxime, ...

Quinolones : like ciprofloxacin.

- According to researchers in other countries , it has been proved that the developing of healthy carriers in association with 3<sup>rd</sup> generation cephalosporin and Quinolones is higher than chloramphenicol . Also , the patient recovers faster with chloramphenicol .

By using 3<sup>rd</sup> generation cephalosporin and Quinolones , the patient needs 5 days and may extend to 1 or 2 weeks , and this will cost more money . However , now we are using 3<sup>rd</sup> generation cephalosporin and Quinolones .

- Amoxicillin and Augmentin can also be used if the organism is susceptible, it is preferred for children because of low side effects.

### **Prevention :-**

Control of water and food is important especially in relation to salmonella typhi.

- Vaccination ; there are 2 types of vaccination :

1- oral vaccination

2- injectable vaccination

All vaccinations contain lipopolysaccharide and Vi antigens

- Oral vaccination is used in :

1- Endemic areas

2- For soldiers

- In Jordan , they don't use any type of vaccination , they rely on prevention measurements like control of water and food .

### **Culture :-**

We will talk later about culturing of both types of salmonella.

## THE 2<sup>nd</sup> TYPE : GASTROENTERITIS SALMONELLA / FOOD-POISONING SALMONELLA

The doctor said :-

{ and here we have another species ,despite the fact that they are classified under the term:“salmonella enterica” , that’s only to simplify for the physician to understand the features of salmonella enterica .

Whereas when we use all systems with species, we have about 2000 species , and some of these species are more important than others.

In the past , we were using salmonella enteritidis subtype typhimurium and other subtypes

Now , we refer to all these subtypes by the term : salmonella enterica , subspecies enteritidis

They may be associated with enteritis , the term enteritis is not very specific . In fact all types of salmonella are associated with gastrointestinal signs and symptoms ; may be not only diarrhea , but also vomiting , abdominal pain and fever }

- That is what they observed in دبر علا , the majority of patients suffered from vomiting .

- The problem with this kind of salmonella that it is not specific for humans , it can be found in the intestines of all animals including birds .

The doctor said :-

{ they are carried in the intestines . some of these , for example , in birds might be associated with enteritidis , might even cause septic disease ( blood sepsis ) in chickens.

But others are adapted more for humans as well as certain types of chickens , especially in our country **50%** of all chicken farms are colonized with one or more species of salmonella enteritidis }

### **Source of infection**

1- Eggs , contamination with the shells of eggs , or any products prepared from eggs ,  
e.g. mayonnaise.

2- Meat , ground meat

3- Birds

- As you see , sources of infection are more difficult to control .

\*\*\* Important note about salmonella enteritidis :-

Unlike salmonella typhi and paratyphi, there are no healthy carriers for a long period in salmonella enteritidis .

-This organism rarely penetrates the intestines to cause blood sepsis

-Infants , young children , immune deficient and elderly might suffer from complications of diarrhea or complications following infection of salmonella , but not sepsis .

-Meningitis might happen in infants , because their intestines cannot prevent penetration of the organism .

**Clinical cases are divided into :-**

1- healthy people : children or adults ; if they suffer from gastroenteritis , they should not be treated with antibiotics . If there is a necessity for treatment to control diarrhea and vomiting , rehydration is enough . The infection will be eliminated within 24-48 hours .

2- Infants and susceptible persons :

- here we must be very careful , not just to observe the complications .

- We culture the stool . if it was positive , we give antibiotics to control the replication of the organism and prevent blood sepsis or meningitis . Otherwise , the patient dies .

\*\*\*\*\*

-The mechanism by which diarrhea occurs is similar to typhoidal salmonella ; cytotoxins increases cyclic AMP ...etc

-Contact with salmonella enteritidis often results in intestinal immunity by developing IgA antibodies . This might protect from infection for a short period , 1 year or so .

- Gastroenteritis:

1- fever

2- vomiting , in 90% of patients

3- abdominal pain

4- diarrhea , starts as watery diarrhea but later becomes bloody , which may be confused with shigellosis , but salmonellosis is milder and can be easily controlled .

- The salmonella are flagellated , flagella are responsible for attachment .

There is also lipopolysaccharide .



**Diagnosis :-**

- Widel test cannot help, because infection with salmonella enteritidis does not cause developing of antibodies .
  - only H antigen could be found , but not somatic antigen
  - The only way to indicate a case of salmonella enteritidis is to culture from the STOOL , NOT URINE . If there is a sepsis → blood , meningitis → CSF , But generally from stool .
  - There are two special culture media :-
    - 1- Heckton –enteric agar
    - 2- Salmonella-Shigella agar ( S-S agar )
- ( here the record sound was too low , the doctor talked about the rest of the diagnosis for less than 15 seconds ).

In our country , we always have cases of salmonella enteritidis ; sporadic cases and outbreak . we are not free of this type of organism . We always have to expect cases .

THE END

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