

**** You don't have to refer to the slides , all of the info are included here ..**

Slides #7,8 :

- **Campylobacter bacteria :**

- Gram negative microaerophilic bacteria.
- Spiral (curved)-shaped as vibrio cholera
- Have bipolar flagella so it is motile and this flagella contribute to the infection by aid in the adherence of campylobacter to the GIT .
- More difficult to be isolated and should be isolated on selective special media, called (campylobacter culture media) that's set at 42 C , and Serological test is not significant in diagnosis of clinical cases.
- Commonly present in the GIT of **domestic animals ; poultry & pets , so** they're a common cause of diarrhea in Western countries (developed) due to the presence of pets (dogs and cats) , Less in Arab countries.
- Contaminate easily the **Meat** and **Dairy products.**
- You get contaminated by **contaminated food** or **direct contact with animals**
- Many species of campylobacter are associated with GIT infections :
campylobacter jejuni (most common – up to 95 % of campylobacter diarrheal cases are caused by C.jejuni) , **campylobacter coli** , and **campylobacter fetus.**

- **campylobacter jejuni :**

- 1- The common cause of **acute enteritis** associated with **bloody diarrhea** which is most common in **infants or children** (more than adult) and in elderly and immune-compromised patients .
- 2- The most invasive compared with salmonella and other diarrheagenic bacteria , and might be associated with sepsis ("rare septicemia" in the slides).
- 3- The pathogenic agents of C.jejuni are **Endotoxin(LPS) & various enterotoxin (cytotoxins).**
- 4- Prolong carriage of C.jejuni is associated with **imunodeficiency.**

- **campylobacter fetus :**

Causes **sepsis** & **abortion** in **animals**. Less common in human.

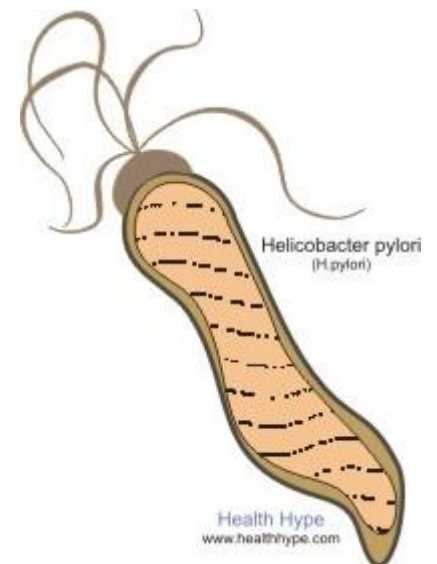
- The infection of campylobacter jejuni is self-limited but can be treated (also C.fetus) by **Macrolides(Azithromycin or erythromycin)** , **Ciprofloxacin** and **Ampicillin** (used less)

Slides #9,10,11 :

- **Helicobacter pylori :**

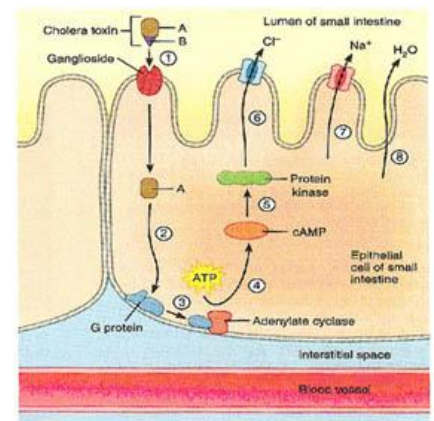
- Gram-ve, Microaerophilic to Anaerobic bacteria .
- Produce potent urease to support its survive in the gastric mucosa.
- Spiral-shaped, and motile with 4-6 polar flagella
- **H. pylori** infection is expected to be present in stomach of **30%-90%** of world's population without any sign or symptoms or clinical manifestations, but under certain condition such as **stress** or **treatment of steroids (or other drugs)** , it might be activated and starts with **chronic gastritis** (H. pylori infection discovered 1983 as cause of **chronic gastritis**).
- **Produce Protease & outer-membrane antigens (Cytotoxins)** Causing chronic inflammation of the inner lining of the stomach mucosa → develop to gastric or duodenal ulcers .
- Complication : # **2%** of the infected person (colonized persons) with H.pylori worldwide may develop **lymphoma** or **stomach cancer** over a long period .
- By the age of 20 , 50% of population are already infected with H.pylori .
- Rarely manage to reach the blood stream and produce sepsis ,but it is localized in the **mucosa** or **submucosa** .
- **urease** : supports its survival in gastric mucous layer near the epithelial surface by its action on amino acid (of the epithelial cells) to produce (**ammonia(NH3) & NaCl**) Which neutralize the stomach acidity and provide a protection near the organism , then it starts producing a form of inflammation which is asymptomatic at the beginning but it cause gastritis and ulceration upon its activation (activation leads to produce cytotoxins which produce more ulceration) .
- Infection is most likely acquired by ingesting contaminated **food, water** , **personal contact** (as it's said that H.pylori can be found in the saliva of the oral cavity), and Re-infection is common.
- **diagnosis of H.pylori is made by:**
 - 1- **Urease breath test** :- giving a patient a liquid containing amino acids (harmless liquid) and then a sample of breath is taken in less than one hour for measuring the ammonia which is converted from amino acids by H.pylori .
 - 2- **Rapid urease test** : Gastric biopsy taken by endoscope and then putted in a medium containing urea . The urease produced by *H. pylori* hydrolyzes urea to ammonia, which raises the **pH** of the medium, and changes the color of the specimen.

- 3- **Giemsa /silver stain**: used on histological biopsy specimens .It can be used to study the adherence of **pathogenic** bacteria to human cells. It differentially stains human and bacterial cells with different colors
- ** In order to have optimal growth for H.pylori , you should have special culture medium with **90% CO2** and incubation temperature of **37 C** .
- **Treatment** of a patient with H.pylori requires 3-4 weeks and often a combination of many drugs are used like , **Metronidazole** + Macrolide: **Clarithromycin, azithromycin** +**Bismuth sulfate** (buffer system drug) + **Amoxicillin** + **H2 Blockers** if necessary (it's an **antacid** drug) . These drugs might relief the patient for few month or few years but the infection can't be eradicated totally as the re-infection is very common , and in some cases surgical treatment is necessary.
 - **No vaccines** for H.pylori are available.



Slides #12,13,14 :

- **Vibrios :**
 - **Gram-negative , straight or curved rods, motile with single polar flagellum & oxidase-positive .**
 - Widely distributed in sea water (aquatic environment), Human pathogenic V.cholera can survive in water containing NaCl with a concentration doesn't exceed 2-3 % . there are species of V.cholera can survive in up 6 % NaCl containing water (halophilic v.cholera).
 - Classical forms of V.cholera according to the somatic antigens (composition of the cell wall) are :
 - 1- **O1** serotype (the first discovered type)
 - 2- **O123** serotype (This serotype is associated with hemolytic V.cholera)
 These two serotypes are associated with the cholera infections in all the world (epidemic & pandemic cholera).
 - Cholera is non-invasive (localized infection) affecting small intestine through secretion of an **Enterotoxin (Heat-labile /Cholera Toxin)** which is similar 99% to the heat-labile enterotoxin of the E.coli (ETEC)in structure and action (these toxins cause an increase in cAMP that inhibits the reabsorption of water and increases the salts and water secretion), but the amount of cholera toxins produced is 10 -100 times the amount of heat-labile toxin produced by E.coli so this play role in the severity of the diarrhea, and the patient within few hours may lose 2-3 L of fluids → acidosis and shock → collapse and kidney failure , and may die within 24 Hours if the fluids weren't replaced.
 - The incubation period is 8-24 hours ,and the main clinical manifestation are : **Severe watery diarrhea, dehydration, shock & acidosis** & might lead to renal failure .
 - Cholera causes only **human** (not animal) infection .
 - Partial immunity is developed following the infection by production of specific antibodies (igA) in the intestine but these antibodies can't prevent the recurrent of the infection and can't interfere with the infection of cholera , and they can only last for 6 months to 1 year .
 - The severity of diarrhea caused by V.cholera is determined by the number of cells that manage to reach the intestine , as the flora



can suppress the few cholera cells , that's why it's not necessary for the infection to be symptomatic (it's in 50% of people asymptomatic).

- V.cholra pathogens are **susceptible** to the stomach **acidity** ,so people with high acidity in stomach don't develop the infection usually (it multiplies at an alkaline pH 8.5-9)
- Other types of cholera :
 - 1) **Non-01 V. cholera** (*it is produced by mutation to the 01 V.cholera*) , it doesn't produce cholera toxins but it produce another type of toxins called **cytotoxin** , **Less virulent** , **mild watery diarrhea due to Cytotoxins** , **found in water with o-1 V.cholerae.**
 - 2) **V. parahaemolyticus** :- **Halophilic** Vibrio (salt loving) , it associated with **gastroenteritis** and this type of cholera is more invasive and can reach blood stream and causing **sepsis** , also it can cause **wound infection** .
 - This infection can be acquired by **contaminated fish** (raw fish or being not cooked well) and also to a lesser extent by water .
- **Lab diagnosis** can be done by using special culture medium called **TCBS (Thiosulfate-citrate-bile salts-sucrose agar)** which inhibit the growth of all types of bacteria except V. cholera . also, we can do biochemical test and serotype test for confirmation .
- **Treatment** :

mainly by **Oral re-hydration** it's the main treatment (Replacement of fluid loss) , if the dehydration is so severe , we should give the patient **water + electrolyte intravenously** as the patient can't drink water due to the irritation of stomach.

 - In addition , we can use antibiotics such as **doxycycline**, **cotrimoxazole** (children), **ciprofloxacin**, But these antibiotics don't decrease the severity of the infection as the toxin have already been secreted , they're are used to reduce the presence of bacterial cells in the feces to reduce the dissemination of the infection among individuals .
 - Oral Vaccine used in endemic areas and in militaries are given and can prevent re-infection up to 50%.
- **Prevention:**
 - The best way to control infection of V.cholera is to disinfect water as the **water** is the most important root of infection . **chlorination** of water is the best way to prevent the infection as it kills the organism easily .
 - Early detection of positive infected cases prevents outbreaks of cholera in the community. (there are **No** Healthy carriers)

Slides 15-20 , Foodborne toxigenic bacteria :

① Staphylococcus aureus :

- associated with particular bacteriophage types
- produce a pre-formed **Heat-stable enterotoxin** in food outside the body. This enterotoxin is stable at 100C until 20 min, so not easily inactivated .
- the enterotoxins are absorbed from the small intestine to reach the blood and CSF **within 30 min to 6 hours** (this is also the incubation period) following the consumption of poisoned food . This incubation period depends on the amount of toxins accumulated in food, if it is high then shorter incubation period.
- Staphylococcal food poisoning is commonly associated with salty foods, cream cakes, grounded meat, Fresh dairy products ,White chesses .
- Symptoms of staph. Aureus poisoning are :- **no fever , no abdominal pain , more vomiting & less diarrhea.**
- These symptoms are self-limited in one day .

② Bacillus cereus :

- **characteristics** :- **G+ve , Aerobic & Spore-Forming Bacilli** , *common in nature.*
 - Spores survive **boiling** and **cooling** in Food.
 - Enterotoxins produced during bacilli sporulation either in Food (outside the body) or in the Intestine . The toxin formed outside the body is called emetic enterotoxin and the one formed inside is the diarrheal toxin.
 - produce Two main toxins associated with two gastrointestinal symptoms :
- 1- **Intoxication** : caused by the **heat-stable** emetic enterotoxin (secreted outside the body), Typically developed within **24 hours** of eating contaminated fried rice or Meat & last for few hours without diarrhea and fever , the main symptom is **vomiting**.
 - 2- **Diarrheal toxin** formed inside the body in the second stage of intoxication after the first stage of vomiting , and the main symptom is **diarrhea** without fever or vomiting .
 - Not all B.cereus produce both toxins , one may produce either toxins and another may produce both , and the symptoms can indicate which toxin is secreted more.
 - Mostly outbreaks in family, schools and Commonly associated with **Chinese food** , **fried Rice** because the Chinese don't' cook food well .

③ Clostridium perfringens :

- Characteristics : **G+ve , Anaerobic , Spore-Forming**
 - It's widely distributed in the environment also Common in Intestines of humans and animals with a few number.
 - Produce Various Enterotoxins, Cytotoxins , Enzyme .
 - There are two types of clostridium perfringens enterotoxins associated with the intestine :
- 1- **Toxin type A** :
 - produced outside the body (Food-poisoning).
 - Incubation Period **8-24 Hours**
 - symptoms :- **Diarrhea , Nausea , Abdominal Pain , Vomiting** with **No Fever**
Mostly Self-limited after 1-2 Days
 - It **doesn't need Antibiotic** treatment as the symptoms caused by the enterotoxin not by the bacteria itself .
 - 2- **Toxin type C** :
 - Released following multiplication of bacteria in the intestine (some antibiotics may support the growth of this bacteria)
 - Symptoms are : severe diarrhea , no vomiting , severe ulceration because of an inflammatory reaction called **Necrotizing Enteritis** , also might associated with **blood sepsis** especially in certain immunodeficient people and with patients with underlying diseases .
 - It's **fatal** in certain conditions , and can be treated with **antibiotic** .
 - Diagnosis of C.perfringens is made by detection of the **toxin in the blood** or taking **food specimens** for test.

④ Clostridium difficile :

- **Characteristics** : **Gram+ve , Anaerobic , spore-forming** & it is often Part of normal intestinal flora (5-20%) in 30 % of the population .
- C. difficile is resistant to many antimicrobial drugs and their growth is supported upon administering penicillin, **clindamycin** and **cephalosporin** , which are **all wide spectrum antibiotics** , for more than one week.
- These antibiotics kill all types of intestinal flora except C.difficile which was suppressed by that flora, this cause the growth of C. difficile (**selective pressure**) .

- This infection often occurs among **hospitalized** patients or **compromised** patients , and called antibiotic associated enterocolitis , it is nosocomial infection.
- C. difficile produce two types of toxins : **toxin type A & toxin type B** which cause ulceration to the intestine called **pseudomembranous colitis** (very dangerous inflammatory reaction) with **bloody diarrhea** . If the patient with **pseudomembranous colitis** is not treated , he will develop mega colon .
- To stop disease complications , you should stop using potential causative antibiotic and treat the patient with C.difficile susceptible antibiotics such as oral **metronidazole** or **vancomycin** .

5 **Clostridium botulinum** :

- characteristics :- **G+ve** , **Anaerobic** , **Spore-Forming**
- The infection cause **botulism** (food-intoxication) . The incubation period is from 1 -24 hours
- Caused by Consumption of improperly or inadequately processed canned foods which have pre-formed toxin outside the body by vegetative cells .
- The contaminated foods have spores and vegetative cells .
- The toxin produced by vegetative cells called **botulinum toxin** which is **heat-labile** neurotoxin and have many types **(A-G)** . The toxin is inactivated by boiling for **30 min.** It is highly potent toxin, kills the patient in Nano grams.
- Botulinum toxin binds to presynaptic nerve ending of peripheral nervous system & cranial nerves and **Inhibits the acetylcholine release** which causes **Flaccid paralysis** , **Respiratory or Cardiac failure** & **Death** if not treated .
- This antitoxin isn't easily available.
- **Treatment** by Specific **Antitoxin** early may help to cure the patient but not with Antibiotics as the manifestations caused by the toxin not by the bacteria itself.
- There is no vaccine for these bacteria.

⑥ Yersinia enterocolitica :

- **Gram-ve bacilli**, common in cold water and found in the intestine of **pigs** but Less in dogs, cats, other animals, the bacteria are most likely to be found on the **tonsils** and **intestines** of the patient .
- Contaminate often dairy products and infect mostly **children younger < 1 year & compromised host** .
- Common symptoms in children are : **fever, abdominal pain, bloody diarrhea**.
- Complications such as **skin rash, joint pains**, or it might reach the blood stream to cause **blood sepsis** in compromised patients.
- Not common in our country, and symptoms are similar to shigella.

⑦ Aeromonas species :

- **Gram-ve bacilli**, common in natural water sources (**underground water** after being contaminated with animal feces) and it associated of **consumption of old fish** (as the bacteria is multiplied and found in high numbers)
- It produce cytotoxins and it is a significant cause of bacterial gastroenteritis
- Common in **young children** and cause **Diarrhea, dehydration** with **Less Fever and vomiting**.

" انك لن تكون جنديا اذا سرقت بدلة جندي وارتديتها ؛ فالعسكرية علم ودرايه , وليس ثوبا يلبس "

محمد الغزالي

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