# Microbiology -1

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## Lec.1

1- **Diarrheal** disease caused by enteric pathogens, it's the **most common** symptom of GIT infection

2- **Most** of the enzymatic breakdown of **food** occurs in the **small** intestine

3- crypts of Lieberkuhn : stem cells, which give rise to all the IEC lineages ( Intestinal epithelial cells ) for **absorption**

4- Paneth cells: located in the base of the small intestinal crypts where they secrete **antimicrobial molecules**.

5- M cells **lack** a glycocalyx , antigen is collected by specialized epithelial cells called microfold or M cells

6- Bacteroides ( Fragilis which are the **common** commensal bacteria in the **colon** )

7- **Actinobacteria** (**Bifida bacteria** which are the common **feces inhabitants** in **newborns**) (anaerobic, Gram+ branched rod-shaped bacteria )

8- **obese** people have **lower** diversity of microbiota with **increased** proportion of enzymes "" Increased proportion of Firmicutes (more than bacteroids) ""

9- Inflammatory Bowel Diseases IBD : **increased** Proteobacter, **depleted** Firmicutes and Bacteroidetes

10- Segmented Filamentous Bacteria (SFB) are needed for Th17 cells

11- A bacterial **polysaccharide from Bacteroides** fragilis affects T cell population and Th1/Th2 balance

12- Bacterial density increases in the distal small intestine, and in the large intestine increases further more

13- Frimicutes and Bacteroids the main commensal of the gut

14- H. pylori only colonizer in stomach

## Lec.2

## SPORE-FORMING GRAM-POSITIVE BACILLI

1- cereus vs anthracis : both are aerobic or facultatively anaerobic **Bacillus**

- Thuringiensis toxin : is used as a natural insecticide

- cereus : motile , spores are located in the **center** , large square ends , beta hemolytic ( produce licithenase ) , non-capsulated , more resistant to antibiotics .

- anthracis : non-motile , spores are located in the **periphery** , medusa head , non hemolytic ( doesn't produce licithenase ) , capsulated , less resistant to antibiotics .

2- cereus :

- the most common cause of food poisoning

- The most common **extra-intestinal** infection caused by B.cereus is ocular infections (**endophthalmitis**)

- The emetic type, which is associated with **fried rice & cereals ( preformed toxin )** heat **stable** toxins ( Exotoxins ), no fever , like staph aureus infection
  - Exotoxins, emesis producing toxins: hemolysins, distinct phospholipases and cereulide

- The diarrheal type, which is associated with **meat dishes and sauces ( bacteria itself )** Heat **labile** toxins ( Enterotoxins ) “flash frying” , No fever , like C. perfringens infection
  - Enterotoxins, diarrhea producing toxins: HBL, NHE, cytotoxin k

3- clostridia :

- anaerobes , mostly motile **except** Clostridium perfringens

- Clostridium tetani -tetanus, **Rigid** paralysis
  - blocks the release of inhibitory neurotransmitters.

- Clostridium botulinum-botulism, descending **flaccid** paralysis ( **reversible** )

"" Ascending paralysis (guillain barre syndrome) is caused by shigella and campylobacter ""
  - inhibits the release of **acetylcholine ( neurotoxin) ( irreversible binding but the flaccid paralysis reversible by regeneration of the receptors 🤕 )**
  - symmetrical (bilateral)
  - The most common serotypes of toxins affecting humans are A-B-E
  - The most common vehicle associated with botulism is canned food in adults( preformed toxin ), and honey in infants ( bacteria itself ) ' **floppy baby syndrome** ' .... etc
  - CLINICAL FINDINGS : **D**ry mouth , **D**iplopia , **D**ysarthria , **D**ysphagia ( 4Ds )

eventually may cause ventilatory failure

- DIAGNOSIS : Mouse bioassay = mouse lethality assay ( gold standard ), ELISAs and PCR
- TREATMENT : Supportive ... mechanical ventilation (ventilatory failure ) , fluid and electrolyte replacement ( vomiting and diarrhea ) , Surgical debridement ( wound botulism ) and antitoxin therapy is recommended ( trivalent A-B-E )
- NO ANTIBIOTIC TREATMENT
- No honey for the first-year infants

- Clostridium perfringens-gas gangrene(myonecrosis)
  - Type A toxins ( alpha, theta, epsilon)
  - Type C toxins ( beta ) cause necrotizing enteritis or pigbel disease .
  - Produce **stormy fermentation** in a tube of milk agar
  - Alpha and Beta hemolysis ( double zone ) , **alpha** toxin **more potent** than beta and theta in hemolysis
  - Part of **colon** normal flora
  - The main risk factor for C.P food poisoning is the consumption of foods ( meat dishes ) that have been prepared in large quantities and **left to stand at room temperature** for extended periods, providing an ideal environment for the growth of C.P and its toxin production
  - Diagnosed by Naglar test to identify the presence of C.P and its lecithinase activity
  - TREATMENT AND PREVENTION : surgical debridement ( necrosis) , antibiotics, Hyperbaric oxygen and Antitoxins.
  - Food poisoning caused by C perfringens **self-limiting**

- Clostridium difficile
  - Normal flora of the **intestine**
  - pseudomembranous colitis (severest form) while the diarrhea the mild form
  - overgrowth of C. difficile because taking cephalosporins, clindamycin and fluoroquinolones ( treated by metronidazole " the first choice given IV or Oral " And **oral**-vancomycin ) oral vancomycin is **only** prescribed to treatment of C.D infection
  - Toxin A (enterotoxin) induces cytokine production with **hypersecretion** of fluid
  - Toxin B (cytotoxin) induces **depolymerization** of actin with loss of cytoskeleton
  - new strains Hypervirulent and hypertoxin ( ribotype 027, 078 )
  - DIAGNOSIS detection of toxins A and B using ELISA , latex agglutination , and PCR .
  - Autoclave bed pans ( to control transmission)

## Lec.3

## Enterobacteriaceae

General information about Enterobacteriaceae before we start

- Most( not all ) of them intestinal commensal because salmonellae and shigellae, are strictly pathogenic for humans .
- They can cause virtually all kinds of infections

- Gram -ive Rods , facultative anaerobes
- They are all motile with **peritrichous** flagella EXCEPT for **Shigellae , Yersinia** and **Klebsiella** .
- all ferment glucose
- oxidase negative (except for **Plesiomonas , Pseudomonas**), catalase positive, and they can reduce nitrate to nitrite
- lactose fermenters (E. coli) or non-lactose fermenters (shigellae and salmonella).
- heat-stable somatic O (lipopolysaccharide ) the antibodies for this antigens are predominantly IgM
- capsules consisting of polysaccharides (K antigens) **except** the capsular antigen of Salmonella serotype Typhi is called Vi antigen
- flagella ( H antigen) has mainly IgG
- many of them produce Colicins (**bacteriocins**)
- STEC, EIEC , shigellae , Yersinia , Salmonella all cause bloody diarrhea
- inflammatory diarrhea = bloody diarrhea
- non-lactose = late lactose fermenters
- **all produce endotoxin** ( LPS )
- invasive bacteria: Enteroinvasive E.coli , Yersinia , Salmonella , Shigellae . ( Post-infective phenomena of reactive arthritis , Riter syndrome and guillain barre syndrome might be developing Associated with invasive bacteria )

## E. coli :

- positive in Eosin methylene blue (EMB) or MacConkey agar while Shigellae and salmonella negative
- found in small numbers in the upper respiratory and genital tracts
- opportunistics

### 1- Enteropathogenic E coli (EPEC):

- A major cause of infantile diarrhea ( in nurseries )
- Need **high** inoculum
- Pathogenesis :

**attachment** ( to colonic mucosa ) "" Acquired by plasmid ""
**effacement** ( loss of microvilli )

- Clinical picture : **watery diarrhea**, vomiting, and fever

### 2- Enterotoxigenic E coli (ETEC):

- A common cause of “traveler’s diarrhea "
- Very important cause of diarrhea in infants in developing countries
- Pathogenesis : colonization factors ( Acquired by plasmid ) and then produce toxins
- toxins : hypersecretion of fluids and electrolytes
  1- Heat-stable increase cGMP
  2- Heat-labile ( immunogenic ) increase cAMP
- heat-labile **exotoxin** cross-reacts with the **enterotoxin** of Vibrio cholerae

3- Shiga toxin-producing E coli or Verocytotoxin-producing E. coli or Enterohemorrhagic E. coli

- Vero cells are monkey kidney cells which are killed by the toxin.
- Does not ferment sorbitol (unlike **other** E. coli) so we use Sorbitol MacConkey agar).
- Linked to consumption of fresh products (e.g., lettuce, spinach, sprouts), undercooked ground beef (**hamburgers**), apple cider, and unpasteurized milk
- Toxins affect 60S ribosomal subunit
- The most common of all the E coli serotypes that produce Shiga toxin is **O157:H7**
- **Not invasive ( no fever )** Note that absence of fever can incorrectly lead to consideration of noninfectious conditions (e.g., intussusception or ischemic bowel disease)
- Can cause hemolytic-uremic syndrome ( anemia, thrombocytopenia and acute renal failure ) the **antibiotics are contraindicated** in this case .
- **bloody diarrhea** but not initially and abdominal pain
- Diagnosed by detection of both Shiga toxins through: Sorbitol MacConkey agar , enzyme immunoassays (EIAs) , PCR and Vero cells.
- associated with hemorrhagic colitis.

4-Enteroinvasive E coli (EIEC):

- it causes bloody diarrhea and fever ( **invasive**)
- that E. coli are lactose fermenters **EXCEPT** EIEC
- nonmotile
- EIEC requires large inoculum ( but shigella needs much less )

5-Enteroaggregative E coli (EAEC):

- Causes acute and **chronic** diarrhea
- associated with **traveler's diarrhea** and persistent diarrhea in patients with **HIV**.
- characterized by their specific patterns of adherence to human intestine epithelial cells "**stacked brick**"
- Some strains of EAEC produce ST (Shiga toxin)-like toxin (EAST).

Eventually some information about Enterobacteriaceae :

1- Treatment :
A- rapid restoration of fluid and electrolyte balance ( diarrhea).
B- Trimethoprim-sulfamethoxazole, known as cotrimoxazole.

2- Prevention: bismuth subsalicylate , regular doses of tetracyclines ,and People should pay more attention to sanitation, hygiene, sterilization and avoidance of eating undercooked food

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