## CASE 2 – MICROBIOLOGY

### GASTROENTERITIS

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### CAUSES OF ACUTE DIARRHEA

**Infection**
- Gastroenteritis

**Non-infection**
- Milk/food allergies, drug side effects, malabsorption

**Non-enteric**
- Otitis media, Meningitis, sepsis

### TRAVELER’S DIARRHEA

**Agent** *Escherichia coli*
- Multiple antigenic strains (O, H, K)
- Virulent strains have fimbriae, adhesions and multiple toxins

**ETEC** Enterotoxigenic *E. coli*
- Enterotoxins very similar to cholera toxin
- Typically self limiting

**EIEC** Enteroinvasive *E. coli* (EIEC)
- Penetrate & multiply within epithelial cells of colon causing cell necrosis.
- Cause dysentery and fever which is identical to *S. dysenteriae* (S. dysenteriae)

**EHEC** Enterohemorrhagic *E. coli*
- O157:H7
- Produce potent Shiga-like toxins
- Haemolytic uremia

### SALMONELLOSIS

**Agent** *Salmonella enterica*
- 2000 strains (serotypes)
- Typhimurium and Enteritidis commonly cause Salmonellosis
- Typhi and Paratyphi cause Typhoid Fever

**Habitat** Common intestinal flora of human & animals

**Reservoir** Contaminated animal products (Reptiles, eggs and undercooked poultry)

**Pathogenesis**
- Virulent strains tolerate stomach acid and pass to intestine
- Toxin induces phagocytosis in intestinal cells
- Pathogen reproduces inside phagosome killing host cell
- Bacteria (Typhi) may pass through intestinal cells into bloodstream

### SHIGELLOSIS

**Agent** *Shigella* sp. (family Enterobacteriaceae)

**Dose**
- Low infecting dose
  - Bacteria not sensitive to stomach acid
  - As few as 10 organisms.

**Reservoir** Human (1st reservoir)

**Transmission**
- Fingers, food and water contaminated by excreta of infected individuals.

**IP**
- 12hours – 2days

**Pathogenesis**
- Cells of large intestine and initiates intense inflammatory response
- Dead cells slough off
- Produces areas covered with pus and blood
- Enterotoxin
  - *S. dysenteriae* produces powerful endotoxin - shiga-toxin
  - Ciprofloxacin, rifampin or azithromycin may reduce duration and infectivity

**Lab dx**
- Refer Enterobacteriaceae handout*

### COMPYLOBACTERIOSIS

**Agent** *Campylobacter jejuni*

**Dose** Low infecting dose

**Transmission**
- Associated with poultry

**Pathogenesis**
- Virulent strains possess adhesions, cytotoxins and endotoxin
- Induce endocytosis in cells of intestine and initiate inflammation and bleeding lesions
- Non-motile mutants are avirulent
- Severe cases treated with ciprofloxacin or azithromycin

**Lab dx**
- Curved ("seagull" or "comma") shaped gram negative organisms

**Epidemiology**
- Leading cause of bacterial diarrhea in United States
- Estimated 1 million cases annually with ~100 deaths
### Lab Dx

**Diagnosis of first case in non-endemic area**

| a. Specimens: mucus flecks from rice water stools. |
| b. Direct examination of the feces: |
| ▪ Wet smear to detect rapidly motile bacteria on direct bright-field, or dark-field microscopic |
| ▪ By film stained by gram to show the comma shaped gram negative rods. |
| c. Culture: |
| ▪ O2 : Highly aerobic |
| ▪ pH : 8-9 (alkaline) |
| ▪ Grow on simple media |
| ▪ Mucus flecks from stools are inoculated on alkaline peptone water pH 8.5. |
| ▪ Subculture from the surface pellicle after 6-8 hrs on TCBS or alkaline agar. |
| ▪ On TCBS medium (thiosulphate citrate bile sucrose), they give yellow colonies as they ferment sucrose. |
| d. Colonies identification |
| ▪ Film stained by Gram: V.cholera is comma shaped Gram-negative rods motile by single, polar flagellum, (darting motility). |
| ▪ Biochemical reactions: |
| ▪ o ferments glucose, maltose, mannite and sucrose with production of acid only. |
| ▪ o Cholera red +ve |
| ▪ o Oxidase +ve |
| ▪ Agglutination with V.cholera O group 1 polyvalent antiserum |
| e. PCR |

### Cholera

**Agent**

Vibrio Cholera

**Transmission**

water or food contaminated by human feces

**Host**

Humans are the only natural host for this organism.

**Structure**

a. H : Flagellar antigen

b. O : Somatic antigen
   o more than 139 known O serotypes.
   o A single serotype, O1, responsible for epidemic cholera.
   o Two biotypes of V. cholerae are described: Classic and El Tor.
   o The Bengal strain (O139) is a new serological strain with a unique O-antigen (which is "non-O1"), that caused large epidemics of cholera.

d. Colonies identification
   o Film stained by Gram:
     V.cholera is comma shaped Gram-negative rods motile by single, polar flagellum, (darting motility).
   o Biochemical reactions:
     o ferments glucose, maltose, mannite and sucrose with production of acid only.
     o Cholera red +ve
     o Oxidase +ve
   o Agglutination with V.cholera O group 1 polyvalent antiserum

**Dose**

High infecting dose: $10^{8}$-$10^{10}$ organisms

- Bacteria sensitive to stomach acid
- Adheres to small intestine and multiply
- Bacteria don’t enter cells (not invasive)

**IP**

2 hours – 5 days

**Pathogenesis**

- Penetrate the mucus layer covering of intestinal mucosa by secretion of neuraminidase and proteases.
- Adhere to the mucosal cell by fimbriae and OMPs where they subsequently produce toxin.
- Cholera toxin
  o Potent exotoxin
  o Causes intestinal cells to rapidly pump out electrolytes
  o Passive osmotic H₂O loss follows
  o Metabolic acidosis
  o Shock
- Heavy loss of fluid “rice-water stool”
  o Up to 20L of fluids lost per day
  o May discharge 1 million bacteria per ml of feces
- Untreated cases potentially fatal
  o Fluid/electrolyte replacement
  o Tetracycline reduces toxin production

**Ttt**

- Rapid intravenous replacement of the lost fluid and ions.
- Most antibiotics have no value in cholera therapy.
- But moderate or broad spectrum antibiotics may be used to reduce the output of viable organisms.

**Control**

- Sanitary.
- Vaccination:
  o Killed whole cell vaccine: IM
  o Two recently developed oral vaccines for cholera
    1) Whole cell killed vaccine
    2) Live attenuated vaccine:
  o Purified LPS fractions have also been given as vaccines with variable success
## Viral Gastroenteritis

**Agent**
- Rotaviruses (Wheel-like)
- Noroviruses (Star-like)
*Both naked RNA viruses*

**Epidemiology**
- Infect intestinal cells causing cell death
- Typically self-limiting
- Norovirus epidemics cause 90% of cases
- Rotaviruses responsible for 50% of infant cases of serious diarrhea
- 600,000 worldwide annual fatalities
- Oral vaccine available

## Food Intoxication

**Agent**
*Staphylococcus aureus*
- Halotolerant; grows well in foods at room temp
- Associated with cafeterias and social functions

**Toxin**
5 heat stable enterotoxins:
- $100^\circ$ for up to 30 min
- Stimulate muscle contractions, nausea and intense vomiting, diarrhea and cramping
- Acute and self limiting
- Symptoms begin 4-6 hrs after consumption and end within 24 hrs

## Botulism

**Agent**
*Clostridium botulinum*
- Obligate anaerobic, Gram +, spore forming bacillus
- Produce 7 different neurotoxins
- One of most deadly toxins known

**S&S**
- Dizziness, dry mouth, blurred vision
- Abdominal symptoms include pain, nausea, vomiting and diarrhea or constipation
- Progressive paralysis (Paralysis of respiratory muscles most common cause of death)

**Type**
- **Food-borne botulism** – progressive paralysis of all voluntary muscles due to toxin production
- **Wound botulism** – similar symptoms
- **Infant botulism** – bacteria grow in the intestines, producing non-specific symptoms
  - “floppy baby syndrome”

**Epidemiology**
- Food borne botulism
  - Commercial sterilization
  - Toxin destroyed by heating foods
- Wound botulism
  - Deep crushing wounds
- Infant botulism
  - Inhalation or ingestion of spores
  - Commonly associated with honey or juices

**Prevention**
- Proper sterilization and sealing of canned food
- No honey or unpasteurized juices for infants!!

**Treatments**
- Antitoxin
- Gastric washing and surgical removal of tissues
- Artificial respiration may be required
- Anti-microbials given to kill bacteria in infant and wound botulism