Gastrointestinal Tract Infections

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Anatomy

• Food → mouth → esophagus → stomach → small and large intestines → finally anus.

• mucosa lining the GI tract varies in their nature in different segments of GI.

• Therefore, specific infectious diseases process tend to occur in each segment.
Fecal-oral cycle can be broken by:

- Proper sewage disposal
- Disinfection of drinking water
- Proper food preparation and storage

Most GIT infections are transmitted by food and water contamination.
Normal flora

Major bacteria present

Lactobacilli

Enterococci, Lactobacilli

Enterobacteria, Enterococcus faecalis, Bacteroides, Bifidobacterium, Eubacterium, Peptococcus, Peptostreptococcus, Ruminococcus, Clostridia, Lactobacilli

Major physiological processes

- Esophagus
  - Secretion of acid (HCl)
  - Digestion of macromolecules
  - pH 12

- Stomach
  - Continued digestion
  - Absorption of monosaccharides, amino acids, fatty acids, water
  - pH 4-5

- Duodenum
  - Absorption of bile acids, vitamin B12
  - pH 7

- Jejunum

- Ileum

- Colon

- Large intestine

- Anus
• The GI tract contain vast, diverse normal flora
• A milliliter of saliva contains millions of bacteria
• The stomach and small intestine have few microorganisms due to the hydrochloric acid produced by stomach and the rapid movement of food through the small intestine.
The large intestine has enormous microbial populations, exceeding 100 billion bacteria per gram of feces (up 40% of fecal mass of healthy human is microbial material).

Most of GI tract normal flora mainly composed of anaerobes and facultative anaerobes, such as *Bacteroides, Clostridium, peptostreptococcus, Bifidobacterium, and Eubacterium*

Aerobes, including *Escherichia coli*, other GNR, enterococci, and streptococci are outnumbered by anaerobes 1000:1.
Primary Pathogenic Mechanisms

Enteric pathogens may cause diseases in one or more of the following three ways:

– Change the balance of water and electrolytes in small intestine, causing massive fluid secretion. This non-inflammatory process is medicated by enterotoxin.

– Cause cell destruction or/inflammatory response after invasion of host cells and possible production of cytotoxin.

– Penetrate the intestinal mucosa, then spread to and multiply in lymphatic or reticuloendothelial cells outside the bowel. This is considered systemic infections.
Enterotoxins:

- Alter metabolic activity of intestinal epithelial cells, causing massive secretion of fluid and electrolytes into lumen.

Cytotoxins:

- Destroy the structure of intestinal epithelial cells, exposing the surface of mucosa and leaving it raw and unprotected. Numerous PMN and blood are seen in patient’s stool.
Neurotoxins:

- Is produced by food poisoning bacterial.
- In *S. aureus* and *B. cereus*, neurotoxin causing vomiting, independent on other actions of the gut mucosa.
- In *C. botulinum*, neurotoxin affects on primarily the peripheral nerves.
Diseases of the Lower Digestive System

Food Poisoning

- Acute enteric infection caused by bacteria or toxins present in food at consumption.
Food poisoning

- **infectious agents**: include viruses, bacteria, and parasites
- **toxic agents**: include fungal toxins (poisonous mushrooms), scombrototoxin (fish from mackerel family) or pesticides on fruits and vegetables.
• symptoms can develop rapidly, within 30 minutes, or slowly, worsening over days to weeks.

• Most of the common contaminants cause:
  
  nausea, vomiting, diarrhea, and abdominal cramping.

• Usually food poisoning is not serious, and the illness runs its course in 24-48 hours.
• If vomiting occurs only an hour or so after food consumption …
• What's the causes?
Staphylococcal Food Poisoning

- **Staphylococcus aureus enterotoxin is a superantigen**
- **Diarrhea is not a typical feature of this kind of food poisoning.**

1. Food containing protein is cooked (bacteria usually killed).
2. Then food is contaminated by worker with staphylococci on hands (competing bacteria have been eliminated).
3. Organisms incubate in food (temperature abuse) long enough to form and release toxins. (Reheating will eliminate staphylococci but not the toxin.)
4. Food containing toxins is eaten.
5. In one to six hours, intoxication occurs.
Bacillus cereus

- *B. cereus*: spore-forming bacillus that associated with reheated fried rice.
- Ingestion of bacterial exotoxin produces mild symptoms
• If the vomiting is less pronounced but there are abdominal pain 12-24 after contaminated food consumption???
Clostridium perfringens

- Grow in intestinal tract producing exotoxin, resulting in diarrhea
- This species is a common member of the colonic normal flora.
Shigellosis

- *Shigella* spp. producing *Shiga* toxin

- *Shiga* toxin causes inflammation and bleeding

1. *Shigella* enter an epithelial cell
2. *Shigella* multiply inside the cell
3. *Shigella* invade neighboring epithelial cells, thus avoiding immune defenses
4. An abscess forms as epithelial cells are killed by the infection. The bacteria rarely spread in the bloodstream.
• High-level contamination with salmonella or campylobacter spp. May result in a food poisoning-like syndrome.

• But, these species are more typically associated with enteritis caused by bacterial invasion of the intestinal mucosa.
Salmonella spp. such as S. enterica Typhimurium

Mortality (<1%) due to septic shock caused by endotoxin
What if Chickens Wanted to Rule the World…would they Sabotage Eggs?

OK, Chickens…phase 1 of our plan for global domination, “Operation Rotten Eggs” is a success!
Campylobacter Gastroenteritis

- *Campylobacter jejuni*
- Usually transmitted in cow's milk and related products.
Infective diarrhea

- gastroenteritis
- Loose and/or watery stools caused by the action of microorganisms or their toxins on the intestine.
- Secretory diarrhea may result in torrential outpouring of fluid into the intestine, with a risk of subsequent hypovolaemic shock and renal failure.
Cholera

- *Vibrio cholerae* serotypes that produce cholera toxin
- Toxin causes host cells to secrete electrolytes, and water, result in diarrheal disease.
Escherichia coli
Gastroenteritis

• Occurs as traveler's diarrhea and epidemic diarrhea in nurseries
• Enterohemorrhagic strains such as *E. coli* O157:H7 produce Shiga toxin
Yersinia Gastroenteritis

- *Y. enterocolitica*
- Can reproduce at 4°C
- Usually transmitted in meat and milk
Viral Gastroenteritis

• **Rotavirus**
  moderate to severe vomiting followed by watery diarrhea and fever.
  It is the most common cause of food poisoning in infants and children

• **Norovirus**
  the most common viral cause of adult food poisoning transmitted from water, shellfish, and vegetables contaminated by feces.

• Treated with rehydration
Giardiasis

- *Giardia lamblia*
- Transmitted by contaminated water
- Diagnosed by microscopic examination of stool for ova and trophozoite
- Treated with metronidazole
Giardia lamblia

- Ingestion of dormant cysts
- Excystation trophozoite emerge to an active state
- Only cysts can survive outside of the host.
- Not Everyone exhibit symptoms.
- Cysts and trophozoites expelled in the feces
Cryptosporidiosis

- *Cryptosporidium parvum*
- Transmitted by oocysts in contaminated water
- Diagnosed by acid-fast staining of stool or ELISA
- Treated with oral rehydration
Helicobacter Peptic ulcer disease

- H. pylori is the most common chronic infection in humans
- *H. pylori* causes stomach cancer
Typhoid Fever

- *Salmonella typhi* and *paratyphi*
- *Bacteria spread throughout body in phagocytes, cause systemic infection*
- *Diarrhea is uncommon in early stage*
Systemic complications

- Despite invasion, bacteria that cause infective diarrhea rarely reach the systemic circulation.

- Gastroenteritis is often self-limiting, and the care is supportive to control symptoms and prevent dehydration.
Colitis

Infective colitis
Ischemic colitis
Inflammatory bowel disease
Pseudomembranous colitis
Microscopic colitis
Infective colitis

- Campylobacter
- Shigella
- E. Coli
- Salmonella

- Giardia or E. histolytica

Bacillus dysentery

Amoebic dysentery
(b) *Entamoeba histolytica*
Pseudomembranous colitis

Antibiotic abuse >> Clostridium difficile

Bloody stools and inflammatory exudate on colonic mucosa
Infected Malabsorption

Malabsorption is difficulty absorbing nutrients (sugars, fats, proteins, or vitamins) from food.

- **Causes**
  - Parasite infection, including *Giardia lamblia*
  - Tapeworm infection (*diphyllobothrium latum*)
  - Biliary atresia
  - Celiac disease
  - Certain medications (tetracycline, some antacids)
  - Certain types of cancer (lymphoma, pancreatic cancer)
  - Cholestasis
  - Chronic liver disease
  - Crohn's disease
  - Vitamin B12 malabsorption may be due to: Pernicious anemia, Bowel resection
Crohn's disease, also known as Crohn syndrome and regional enteritis, is a type of inflammatory bowel disease that may affect any part of the gastrointestinal tract from mouth to anus, causing a wide variety of symptoms. It primarily causes abdominal pain, diarrhea (which may be bloody if inflammation is at its worst), vomiting (can be continuous), or weight loss,[1][2][3] but may also cause complications outside the gastrointestinal tract such as skin rashes, arthritis, inflammation of the eye, tiredness, and lack of concentration.[1] Crohn's disease is caused by interactions between environmental, immunological and bacterial factors in genetically susceptible individuals.[4][5][6] This results in a chronic inflammatory disorder, in which the body's immune system attacks the gastrointestinal tract possibly directed at microbial antigens.[5][7] Crohn's disease has wrongly been described as an autoimmune disease in the past; recent investigators have described it as an immune deficiency state.[7][8][9][10][11][12]
There is a genetic association with Crohn's disease, primarily with variations of the *NOD2* gene and its protein, which senses bacterial cell walls. Siblings of affected individuals are at higher risk. Males and females are equally affected. Smokers are two times more likely to develop Crohn's disease than nonsmokers. Crohn's disease affects between 400,000 and 600,000 people in North America. Prevalence estimates for Northern Europe have ranged from 27–48 per 100,000. Crohn's disease tends to present initially in the teens and twenties, with another peak incidence in the fifties to seventies, although the disease can occur at any age. There is no known pharmaceutical or surgical cure for Crohn's disease. Treatment options are restricted to controlling symptoms, maintaining remission, and preventing relapse. The disease was named after gastroenterologist Burrill Bernard Crohn, who, in 1932, together with two other colleagues at Mount Sinai Hospital in New York, described a series of patients with inflammation of the terminal ileum, the area most commonly affected by the illness.
Symptoms

- Bulky stools
- Chronic diarrhea (may not occur with vitamin malabsorption)
- Failure to thrive
- Fatty stools
- Muscle wasting
- Weight loss
• **Treatment**
  • Vitamin and nutrient replacement is often necessary.

• **Complications**
  • Anemia
  • Gallstones
  • Kidney stones
  • Osteoporosis and bone disease
  • Malnutrition and vitamin deficiencies
Hepatitis

– Viral or Non viral

– HAV, HBV, and HCV cause more than 90% of cases of acute viral hepatitis in the United States.
Hepatitis A

- **Epidemiology:**
  - picornavirus
  - HAV accounts for 25-50% of new cases per year.

- **Transmission**
  - spreads from person to person via the fecal-oral route.
  - Contaminated water and food, including shellfish collected from sewage-contaminated water, have also resulted in epidemics of hepatitis A virus.
HAV (Cont..)

– Clinical course

• Fatigue, nausea, vomiting, fever, hepatomegaly, jaundice, dark urine, anorexia, and rash.

• Occurs as a mild self-limited disease and confers lifelong immunity to hepatitis A virus.

• Chronic infection does not occur.
Hepatitis B

– Epidemiology
  • A major cause of infectious hepatitis worldwide
  • hepadna viruses..
  • Estimates suggest that 350 million people worldwide are hepatitis B virus carriers, The virus leads to 1 million deaths annually as a result of viral hepatitis – induced liver disease.

– Transmission
  • parenterally and sexually
  • perinatal transmission
HBV

Hepatitis B virus
HBV (cont..)

– Clinical course
  • anorexia, malaise, and fatigue.
  • right upper quadrant pain.
  • illness resembling serum sickness
  • fever, arthritis, arthralgias, or an urticarial rash.
  • tender liver >> jaundice develops.
  • Dark urine and pale stool

– Complication
  • development of chronic infection
  • hepatocellular cancer.
  • fulminant hepatic failure.
Hepatitis B Virus
Hepatitis C

– Epidemiology
  • Estimates suggest that 170 million people are chronically infected with hepatitis C virus.
  • Hepatitis C virus causes approximately 20% of acute viral hepatitis cases in the United States per year.
  • About 70-90% of people infected progress to chronic hepatitis C virus infection.

– Transmission
  • parenterally, perinatally, and sexually
HCV ( cont..)

– **Clinical course**
  - symptoms may appear similar to those of hepatitis B virus infection.
  - In up to 80% of cases are asymptomatic!

– **Complications**
  - rarely cause fulminant hepatic failure.
  - Chronic hepatitis
  - May develop cirrhosis. (Take 20 yrs!)
  - strongly linked to the development of hepatocellular cancer,
  - 20-25% may progress to liver failure and death!
  - cirrhosis - HBV infection is a leading indication for liver transplant
Hepatitis D

– Epidemiology
  • Defective >> requires the presence of hepatitis B virus to replicate.
  • co-infection OR super-infection
  • 7500 infections each year!
  • Approximately 4% of cases of acute hepatitis B virus are thought to involve co-infection with hepatitis D virus.

– Transmission:
  • similar to those for hepatitis B virus

– Clinical course
  • Co-infection >> acute, self-limited infection
  • super-infection >> tend to have a more severe acute hepatitis
Hepatitis E

Epidemiology
- Hepatitis E virus is the primary cause of enterically transmitted non-A, non-B hepatitis; most outbreaks occur in developing countries.

Transmission
- Fecal-oral route
- Person-to-person transmission is rare
- Vertical transmission does occur
- Zoonotic spread is possible as some nonhuman primates (cows, pigs, sheep, goats, and rodents) are susceptible to the disease

Clinical course
- acute self-limited disease similar to hepatitis A virus.
- Fulminant disease does occur in about 10% of cases.
- In pregnant women, hepatitis E virus infection has a case-fatality rate of 15-20%
Other types of viral hepatitis

– Hepatitis G virus >> is associated with acute and chronic liver disease. It is transmitted through blood and blood products.

– Other known viruses (eg, cytomegalovirus, Epstein-Barr virus, herpes simplex, varicella-zoster) may also cause inflammation of the liver, but they do not primarily target the liver.
## Hepatitis

<table>
<thead>
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<th>Transmission</th>
<th>Causative agent</th>
<th>Chronic liver disease</th>
<th>Vaccine</th>
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<tbody>
<tr>
<td>Hepatitis A</td>
<td>Fecal-oral</td>
<td>Picornaviridae</td>
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<tr>
<td>Hepatitis E</td>
<td>Fecal-oral</td>
<td>Caliciviridae</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
Mumps

- **Mumps virus**
- Enters through respiratory tract
- Infects parotid glands
- Prevented with MMR vaccine
Liver abcess

- **Bacteria**
  - *E. coli* the most prevalent organism
  - *Klebsiella*
  - *Streptococcus*
  - *Bacteroides species*

- **Parasite**
  - *E. histolytica*
• Diagnostic ultrasound is helpful and shows a focal, fluid-filled lesion.

• If abscess is easily accessible, percutaneous drainage. But complete drainage may require laparotomy.

• Aspirated pus can be sent for bacterial culture and microscopy for ameaba.

Ampicillin, gentamicin, metronidazole for bacteria, metronidazole for amoabic liver abcess
cholangitis

- *Enterobacteriaceae*
- *Enterococci*
- *anaerobic bacteria.*

A high percentage of patients have bacteraemic spread and positive blood culture.

compination of Ampicillin, Gentamicin, Metronidazole,
pancreatitis

- **Mumps** infection in adult.
- Sepsis arise either because of local or haematogenous spread of bacteria from *commensal intestinal flora* or from a *hospital-acquired infection*.

Diagnosis is confirmed by blood culture and specimens from potential foci of infection.

Treatment with intravenous antimicrobial agent
proctitis

- Infective causes less common but include bacteria and parasites that cause colitis (i.e. *shigella*, *Entamoeba* spp.)
- Sexually transmitted infections (*N. gonorrhea*, *C. trachomatis*)

Better to wait for the result of laboratory investigation before commencing treatment.
**Peritonitis**

**Primary**: Caused by the spread of an infection from the blood & lymph nodes to the peritoneum. Very rare < 1%

- *E. coli* is the most frequently recovered pathogen
- followed by *Klebsiella* pneumoniae
- *S. pneumoniae*,
- streptococcal species, including *enterococci*.
- *Anaerobes* and microaerophilic organisms are infrequently reported.
Secondary: Caused by the entry of bacteria or enzymes into the peritoneum from the gastrointestinal or biliary tract.

– an ulcer eating its way through stomach wall or intestine

– injury to an internal organ which bleeds into the internal cavity.
Treatment with Amoxy clavulanic acid, Ceftriaxone
• bad breath
  – Formed by bacterial putrefaction of food debris, cells, saliva and blood.
  – Results from any form of sepsis: increased anaerobic activity of pathogens (inc. Treponema denticola, Porphyromonas Gingivalis and Bacteroides forsythus).

• the cause can associated with *H. Pylori*

Treatment with empirical therapy with metronidazole.
Compounds commonly produced by mouth bacteria and their odours.

- Hydrogen Sulphide (Rotten Eggs)
- Methyl mercaptan (Faeces)
- Skatole (Faeces)
- Cadaverine (Corpses)
- Putrescine (Decaying meat)
- Isovaleric acid (Sweaty Feet)
Thank you