Topic: Diseases of the Digestive System

Structures of the Digestive System

• 2 groups
  – Gastrointestinal tract (GI tract)
    • The pathway from the mouth to the anus
    • Most organs of the GI tract protected by a membranous covering called the peritoneum
  – Accessory digestive organs
    • Organs involved in grinding food or providing digestive secretions

Components of the GI Tract

– Digests food, absorbs nutrients and water into the blood, and eliminates waste
– Components of the gastrointestinal tract
  • Mouth – site where food is moistened and chewed
  • Esophagus – tube leading to the stomach
  • Stomach – secretes chemicals that work to digest foods
  • Small intestine – responsible for the majority of digestion and absorption of nutrients
  • Large intestine (colon) – completes absorption of nutrients and water
  • Rectum and anus – store and eliminate waste
Accessory Organs
– Components of the accessory digestive system
  • **Tongue and teeth** – chew food into small pieces
  • **Salivary glands** – secrete saliva that moistens food to allow it to be swallowed
  • **Liver** – neutralizes or removes harmful substances from the body and produces bile that aids in digestion
  • **Gallbladder** – concentrates and stores bile that is made in the liver
  • **Pancreas** – produces pancreatic juice that neutralizes stomach acid as it enters the intestine and further digests food

Normal Flora of the Digestive System

• **Esophagus, Stomach, Duodenum**
  – These regions are almost free of microbes
  – Peristalsis and the rapid transport of food helps prevent colonization by microbes

• **Tongue, Teeth, Jejunum, Ileum, Colon, Rectum**
  – Tongue and teeth
    • *Viridans streptococci* are most prevalent in this region
  – Lower small intestine and colon
    • Microbiota here are microbial antagonists
    • Mucous membrane prevents microbes entering the bloodstream
Dental Caries, Gingivitis, and Periodontal Disease

- Signs and symptoms
  - Caries – appear as holes or pits in the teeth
  - Periodontal disease – gums that are swollen, tender, bright red, or that bleed
- Pathogen and virulence factors
  - Caries – *Streptococcus mutans* is a frequent cause
    - Dextran and pili allow biofilm formation on the tooth
  - Periodontal disease – *Porphyromonas gingivalis*
    - Proteases break down gingival tissue

Bacterial Diseases of the Digestive System

- **Plaque (biofilm)**

- **Dental Caries, Gingivitis, and Periodontal Disease**
  - Epidemiology
    - Most adults have experienced dental caries
    - Diets high in sucrose increase the risk of decay
  - Diagnosis, treatment, and prevention
    - Caries
      - Diagnosed by visual inspection
      - Treated by filling cavities if caught early
    - Gingivitis
      - Diagnosed by inspection of gums
      - Treated by removal of plaque and tartar and sometimes antibacterial rinses
    - Prevention involves good oral hygiene
Bacteria on the Tooth Surface

Ulcers and Heliobacter p.

Bacterial Gastroenteritis

- Inflammation of the stomach or intestines due to the presence of bacteria
- Associated with contaminated foods or water and poor living conditions
- General features
  - Similar manifestations despite different causative agents
  - Symptoms include nausea, vomiting, diarrhea, abdominal pain, and cramps
  - Dysentery, a severe gastroenteritis, produces loose, frequent stool containing mucus and blood
Cholera – *(Vibrio cholera)*

- Bacterial infection of small intestine characterized by copious diarrhea
- *Vibrio cholera* (G-, curved rod, flagellated, non-capsulated, anaerobic)
- Ingestion, embeds in villi, releases toxin
- Cramps, dry mucus membranes, excessive thirst, lethargy, low urine output, nausea, elevated pulse, rice-water stool
Some Cholera Outbreaks

Bacterial Gastroenteritis: Shigellosis

- Pathogen and virulence factors
  - Caused by *Shigella dysenteriae*, *S. flexneri*, *S. boydii*, and *S. sonnei*
  - Virulence factors include enterotoxins such as shiga toxin

- Pathogenesis and epidemiology
  - Pathogen colonizes cells of the small, then large intestine

- Diagnosis, treatment, and prevention
  - Diagnosis based on symptoms and presence of *Shigella* in stool
  - Supportive treatment and administration of antimicrobials

How Shigellosis Progresses
E. coli and Traveler’s Diarrhea
- Pathogen and virulence factors
  - Caused by *Escherichia coli*
  - Virulence factors include adhesins, fimbriae, toxins (including the shiga-like toxin)
- Pathogenesis and epidemiology
  - Diarrhea mediated by enterotoxins
- Diagnosis, treatment, and prevention
  - Diagnosis based on signs and symptoms
  - Treatment based on fluid and electrolytes replacement

Campylobacter Diarrhea
- Pathogen and virulence factors
  - Caused by *Campylobacter jejuni*
  - Virulence factors include adhesins, cytotoxins, endotoxin
- Pathogenesis and epidemiology
  - Virulence factors produce bleeding lesions and trigger inflammation
- Diagnosis, treatment, and prevention
  - Diagnosis based on signs and symptoms
  - Most cases resolve without treatment
  - Proper hygiene after handling raw poultry

The most common cause of gastroenteritis in the US?
The culprit: *Campylobacter jejuni*!!
How Salmonella causes trouble

1. Salmonella is ingested in contaminated water or food, particularly in uncooked eggs.
2. Bacteria pass through the stomach, attaches to cells lining the small intestine, and invades enterocytes.
3. The pathogen eventually kills host cells.
4. This triggers fever, abdominal cramps, and diarrhea.
5. E. coli or salmonella T Lynch can subsequently enter the blood, where they may be disseminated but not multiplying.
6. Progression to a bloody diarrhea can lead to a systemic febrile illness.
7. Salmonella can cause enteric fever.
8. Salmonella can cause typhoid.
10. Salmonella can remain infected for years even with treatment.
11. Salmonella is shed in feces.
Staphylococcal **Food Poisoning (Intoxication)**

- Signs and symptoms
  - Nausea, vomiting, diarrhea, cramping
- Pathogen and virulence factors
  - Caused by *Staphylococcus aureus*
  - Virulence factors include five enterotoxins
- Pathogenesis and epidemiology
  - Outbreaks associated with social functions
- Diagnosis, treatment, and prevention
  - Diagnosis based on signs and symptoms
  - Treatment based on fluid and electrolytes replacement
  - Proper hygiene can reduce incidence
Viral Diseases of the Digestive System

- **Oral Herpes**
  - Signs and symptoms
    - Presence of cold sores
  - Pathogen and pathogenesis
    - Caused by *Herpes simplex virus* type 1 (HSV-1)
    - Virions avoid host's immune system by forming syncytia
  - Epidemiology
    - Infections occur by casual contact in childhood
  - Diagnosis, treatment, and prevention
    - Diagnosis based on characteristic lesions
    - Topical acyclovir limits duration of lesions
    - Avoid direct contact with infected individuals

Herpes – Example Viral Disease of the Digestive System

Latency and Reactivation of Oral Herpes
Mumps Virus

- Mumps virus- enveloped, helical, ssRNA
- Saliva contact through mucus membranes
- Parotitis, face pain, fever, Headache, sore throat
- Can infect other organs- testes, meninges, pancreas, deafness
- 12-24 day incubation

Viral Gastroenteritis

- Signs and symptoms
  - Similar to bacterial gastroenteritis
  - Abdominal pain, cramping, diarrhea, nausea, vomiting
- Pathogens and pathogenesis
  - Caused by caliciviruses, astroviruses, and rotoviruses
- Epidemiology
  - More cases occur in winter
- Diagnosis, treatment, and prevention
  - Serological test distinguishes between viruses
  - Treatment is based on fluid and electrolytes replacement
  - Vaccine for rotavirus exists

Example Viral Diseases of the Digestive System

- Calcivirus (norovirus, astrovirus)
- Rotavirus
Viral Hepatitis

- Signs and symptoms
  - Jaundice, abdominal pain, fatigue, nausea, vomiting, appetite loss
  - Symptoms may occur years after initial infection
  - Host immune responses are responsible for much of the liver damage seen with hepatitis

- Pathogen and pathogenesis
  - Hepatovirus: Hepatitis A virus (HAV)
  - Orthohepadnavirus: Hepatitis B virus (HBV)
  - Hepacivirus: Hepatitis C virus (HCV)
  - Deltavirus: Hepatitis delta virus (HDV)
  - Hepevirus: Hepatitis E virus (HEV)

Hepatitis Viruses

<table>
<thead>
<tr>
<th>Family</th>
<th>Hepatitis A virus (HAV)</th>
<th>Hepatitis B virus (HBV)</th>
<th>Hepatitis C virus (HCV)</th>
<th>Hepatitis Delta virus (HDV)</th>
<th>Hepatitis E virus (HEV)</th>
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<tbody>
<tr>
<td>Virus</td>
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<tr>
<td>Incubation period</td>
<td>2-6 weeks</td>
<td>1-6 months</td>
<td>1-6 months</td>
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<td>Severity (mortality)</td>
<td>mild (5%)</td>
<td>severe (5-10%)</td>
<td>moderate (5-10%)</td>
<td>severe (5-10%)</td>
<td>severe (5-10%)</td>
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<td>Chronicity</td>
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<td>Common names of disease</td>
<td>infectious hepatitis</td>
<td>liver failure</td>
<td>risk factor for liver cancer</td>
<td>viral hepatitis</td>
<td>acute hepatitis</td>
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<td>Other disease associations</td>
<td>cancer</td>
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</tbody>
</table>

Hepatitis Viruses

Viral Hepatitis

- Diagnosis
  - Initial diagnosis includes observation of jaundice, enlarged liver, or fluid in the abdomen
  - Serological testing can identify viral antigens
  - HBV is diagnosed by presence of viral proteins in body fluids

- Treatment
  - Supportive care for symptoms

- Prevention
  - Avoiding exposure by practicing good hygiene and protected sex or abstinence
  - Vaccines are available against HAV and HBV
Example Particles Produced by Hepatitis B

About Hepatitis
• A & E: ingestion (fecal-oral)
  B, C, D (delta): parenteral (blood and fluid borne)

Hepatitis A Jaundice
Jaundice, fatigue, abdominal pain, loss appetite, nausea, diarrhea
(B joint pain)(C dark urine)(D&E vomiting & dark urine)
Incubation period ranges (depending on type): 7 – 100 days

Giardia- Example Protozoan Disease of the Intestinal Tract
Cryptosporidiosis

- Signs and symptoms
  - Severe watery diarrhea
  - Life-threatening complications can occur
- Pathogen and pathogenesis
  - Caused by *Cryptosporidium parvum*
  - Pathogenicity of *C. parvum* unclear
- Epidemiology
  - Infection results from drinking contaminated water
- Diagnosis, treatment, and prevention
  - Treated with fluid and electrolytes replacement
  - Prevented with proper hygiene
Amebiasis

- Signs and Symptoms
  - Luminal amebiasis – asymptomatic
  - Invasive amebic dysentary – symptoms include severe diarrhea, colitis, appendicitis
  - Invasive extraintestinal amebiasis – necrotic lesions in the liver, lungs, spleen, kidneys, or brain

- Pathogen, virulence factors, and pathogenesis
  - Caused by *Entamoeba histolytica*
  - Trophozoites in the peritoneal cavity or blood cause symptoms
  - Difference in severity due to virulence factors

Helminthic Infestations of the Intestinal Tract

- Helminths are macroscopic, multicellular worms
- Helminths can infest the GI tract as non-disease-causing parasites
  - Tapeworm is the common name for a cestode
    - Flat, segmented, parasitic helminth
    - Tapeworms exist as intestinal parasites that lack their own digestive systems

Tapeworm – close up
Tapeworm (Taenia sp. --cestode) Infestations

– Signs and symptoms
  • Usually asymptomatic
  • Rarely, nausea, abdominal pain, weight loss, and diarrhea occur

– Pathogens
  • Taenia saginata – beef tapeworm
  • Taenia solium – pork tapeworm
    – Taenia life cycle divided between a primary and intermediate host

Taenia solium Life Cycle

Tapeworm Infestations (cont.)

– Epidemiology
  • Highest incidence in regions of inadequate sewage treatment and where humans live in close contact with livestock

– Diagnosis, treatment, and prevention
  • Diagnosed by presence of proglottids in fecal sample
  • Treated with niclosamide or praziquantel
  • Prevention relies on thorough cooking of meats
### Pinworm Infestations
- **Pinworms are nematodes**
  - Long, thin, unsegmented, cylindrical helminth
- **Signs and symptoms**
  - Asymptomatic infections result in one-third of the cases
  - Symptomatic infection includes perianal itching, irritability, decreased appetite
    - Itching results from the presence of eggs deposited in the perianal region at night by female pinworms
- **Pathogen**
  - *Enterobius vermicularis*

### Pinworm Infestations (cont.)
- **Epidemiology**
  - Infections commonly occur in children
  - *Enterobius* is the most common parasitic worm in the United States
- **Diagnosis, treatment, and prevention**
  - Diagnosis made based on identification of eggs microscopically or presence of adult pinworms
  - Treatment with pyrantel pamoate or mebendazole
  - Prevention requires strict personal hygiene

### Helminthic Infestations of the Intestinal Tract
- **Adult Female Pinworm**
- **Pinworm eggs in stool**