

# Study Outline Chapter 25

## Introduction (p. 658)

- Diseases of the digestive system are the second most common illnesses in the United States.
- Diseases of the digestive system usually result from the ingestion of microorganisms and their toxins in food and water.
- The fecal-oral cycle of transmission can be broken by the proper disposal of sewage, the disinfection of drinking water, and proper food preparation and storage.

## Structure and Function of the Digestive System (p. 658)

- The gastrointestinal (GI) tract, or alimentary canal, consists of the mouth, pharynx, esophagus, stomach, small intestine, and large intestine.
- The teeth, tongue, salivary glands, liver, gallbladder, and pancreas are accessory structures.
- In the GI tract, with mechanical and chemical help from the accessory structures, large food molecules are broken down into smaller molecules that can be transported by blood or lymph to cells.
- Feces, the solids resulting from digestion, are eliminated through the anus.

## Normal Microbiota of the Digestive System (pp. 658- 659)

- A wide variety of bacteria colonize the mouth.
- The stomach and small intestine have few resident microorganisms.
- The large intestine is the habitat of *Lactobacillus*, *Bacteroides*, *E. coli*, *Enterobacter*, *Klebsiella*, and *Proteus*.
- Bacteria in the large intestine assist in degrading food and synthesizing vitamins.
- Up to 40% of fecal mass is microbial cells.

## Bacterial Diseases of the Mouth (pp. 659- 662)

### Dental Caries (Tooth Decay) (pp. 659- 661)

- Dental caries begin when tooth enamel and dentin are eroded and the pulp is exposed to bacterial infection.
- *Streptococcus mutans*, found in the mouth, uses sucrose to form dextran from glucose and lactic acid from fructose.
- Bacteria adhere to teeth and produce sticky dextran, forming dental plaque.
- Acid produced during carbohydrate fermentation destroys tooth enamel at the site of the plaque.
- Gram-positive rods and filamentous bacteria can penetrate into dentin and pulp.
- Carbohydrates such as starch, mannitol, and sorbitol are not used by cariogenic bacteria to produce dextran and do not promote tooth decay.
- Caries are prevented by restricting the ingestion of sucrose and by the physical removal of plaque.

#### Periodontal Disease (pp. 661- 662)

- Caries of the cementum and gingivitis are caused by streptococci, actinomycetes, and anaerobic gram-negative bacteria.
- Chronic gum disease (periodontitis) can cause bone destruction and tooth loss; periodontitis is due to an inflammatory response to a variety of bacteria growing on the gums.
- Acute necrotizing ulcerative gingivitis is caused by *Prevotella intermedia* and spirochetes.

#### Bacterial Diseases of the Lower Digestive System (pp. 662- 672)

- A gastrointestinal infection is caused by the growth of a pathogen in the intestines.
- Incubation times, the times required for bacterial cells to grow and their products to produce symptoms, range from 12 hours to 2 weeks. Symptoms of infection generally include a fever.
- A bacterial intoxication results from the ingestion of preformed bacterial toxins.
- Symptoms appear 1- 48 hours after ingestion of the toxin. Fever is not usually a symptom of intoxication.
- Infections and intoxications cause diarrhea, dysentery, or gastroenteritis.
- These conditions are usually treated with fluid and electrolyte replacement.

#### Staphylococcal Food Poisoning (Staphylococcal Enterotoxigenesis) (pp. 663- 664)

- Staphylococcal food poisoning is caused by the ingestion of an enterotoxin produced in improperly stored foods.
- *S. aureus* is inoculated into foods during preparation. The bacteria grow and produce enterotoxin in food stored at room temperature.
- The exotoxin is not denatured by boiling for 30 minutes.
- Foods with high osmotic pressure and those not cooked immediately before consumption are most often the source of staphylococcal enterotoxigenesis.
- Diagnosis is based on symptoms. Nausea, vomiting, and diarrhea begin 1- 6 hours after eating and last about 24 hours.
- Laboratory identification of *S. aureus* isolated from foods is used to trace the source of contamination.
- Serological tests are available to detect toxins in foods.

#### Shigellosis (Bacillary Dysentery) (p. 664)

- Shigellosis is caused by four species of *Shigella*.
- Symptoms include blood and mucus in stools, abdominal cramps, and fever. Infections by *S. dysenteriae* result in ulceration of the intestinal mucosa.
- Isolation and identification of the bacteria from rectal swabs are used for diagnosis.

#### Salmonellosis (*Salmonella* Gastroenteritis) (pp. 664- 666)

- Salmonellosis, or *Salmonella* gastroenteritis, is caused by many *Salmonella* species.
- Symptoms include nausea, abdominal pain, and diarrhea and begin 12- 36 hours after eating large numbers of *Salmonella*. Septicemia can occur in infants and in the elderly.

- Fever might be caused by endotoxin.
- Mortality is lower than 1%, and recovery can result in a carrier state.
- Heating food to 68°C will usually kill *Salmonella*.
- Laboratory diagnosis is based on isolation and identification of *Salmonella* from feces and foods.

#### Typhoid Fever (pp. 666- 668)

- *Salmonella typhi* causes typhoid fever; the bacteria are transmitted by contact with human feces.
- Fever and malaise occur after a 2-week incubation period. Symptoms last 2- 3 weeks.
- *S. typhi* is harbored in the gallbladder of carriers.
- Vaccines are available for high-risk people.

#### Cholera (pp. 668- 669)

- *Vibrio cholerae* produces an exotoxin that alters the membrane permeability of the intestinal mucosa; the resulting vomiting and diarrhea cause a loss of body fluids.
- The incubation period is approximately 3 days. The symptoms last for a few days. Untreated cholera has a 50% mortality rate.
- Diagnosis is based on the isolation of *Vibrio* from feces.
- *Vibrio cholerae* non-O:1 causes gastroenteritis in the United States. It is usually transmitted via contaminated seafood.

#### *Vibrio* Gastroenteritis (p. 669)

- *Vibrio* gastroenteritis can be caused by *V. parahaemolyticus* and *V. vulnificus*.
- The onset of symptoms begins within 24 hours after eating contaminated foods. Recovery occurs within a few days.
- The disease is contracted by eating contaminated crustaceans or contaminated mollusks.

#### *Escherichia coli* Gastroenteritis (pp. 669- 670)

- *E. coli* gastroenteritis may be caused by enterotoxigenic, enteroinvasive, or enterohemorrhagic strains of *E. coli*.
- The disease occurs as epidemic diarrhea in nurseries, as traveler's diarrhea, as endemic diarrhea in less developed countries, and as hemorrhagic colitis.
- In adults, the disease is usually self-limiting and does not require chemotherapy.
- Enterohemorrhagic *E. coli*, such as *E. coli* O157:H7, produces Shiga-like toxins that cause inflammation and bleeding of the colon.
- Shiga-like toxins can affect the kidneys to cause hemolytic uremic syndrome.

#### *Campylobacter* Gastroenteritis (p. 670)

- *Campylobacter* is the second most common cause of diarrhea in the U.S.
- *Campylobacter* is transmitted in cow's milk.

#### *Helicobacter* Peptic Ulcer Disease (p. 670)

- *Helicobacter pylori* produces ammonia, which neutralizes stomach acid; the bacteria colonize the stomach mucosa and cause peptic ulcer disease.
- Bismuth and several antibiotics may be useful in treating peptic ulcer disease.

#### *Yersinia* Gastroenteritis (pp. 670- 671)

- *Y. enterocolitica* and *Y. pseudotuberculosis* are transmitted in meat and milk.
- *Yersinia* can grow at refrigeration temperatures.

#### *Clostridium perfringens* Gastroenteritis (p. 671)

- A self-limiting gastroenteritis is caused by *C. perfringens*.
- Endospores survive heating and germinate when foods (usually meats) are stored at room temperature.
- Exotoxin produced when the bacteria grow in the intestines is responsible for the symptoms.
- Diagnosis is based on isolation and identification of the bacteria in stool samples.

#### *Bacillus cereus* Gastroenteritis (pp. 671- 672)

- Ingesting food contaminated with the soil saprophyte *Bacillus cereus* can result in diarrhea, nausea, and vomiting.

### **Viral Diseases of the Digestive System (pp. 672- 677)**

#### Mumps (p. 672)

- Mumps virus enters and exits the body through the respiratory tract.
- About 16- 18 days after exposure, the virus causes inflammation of the parotid glands, fever, and pain during swallowing. About 4- 7 days later, orchitis may occur.
- After onset of the symptoms, the virus is found in the blood, saliva, and urine.
- A measles, mumps, rubella (MMR) vaccine is available.
- Diagnosis is based on symptoms, or an ELISA test is performed on viruses cultured in embryonated eggs or cell culture.

#### Cytomegalovirus (CMV) Inclusion Disease (pp. 672- 673)

- CMV (a herpesvirus) causes intranuclear inclusion bodies and cytomegaly of host cells.
- CMV is transmitted by saliva, urine, semen, cervical secretions, and human milk.
- CMV inclusion disease can be asymptomatic, a mild disease, or progressive and fatal. Immunosuppressed patients may develop pneumonia.
- If the virus crosses the placenta, it can cause congenital infection of the fetus, resulting in impaired mental development, neurological damage, and stillbirth.
- Diagnosis is based on isolation of the virus or detection of IgG and IgM antibodies.

#### Hepatitis (p. 673)

- Inflammation of the liver is called hepatitis. Symptoms include loss of appetite, malaise, fever, and jaundice.
- Viral causes of hepatitis include hepatitis viruses, Epstein-Barr (EB) virus, and CMV.

#### *Hepatitis A* (pp. 673- 674)

- Hepatitis A virus (HAV) causes hepatitis A; at least 50% of all cases are subclinical.
- HAV is ingested in contaminated food or water, grows in the cells of the intestinal mucosa, and spreads to the liver, kidneys, and spleen in the blood.
- The virus is eliminated with feces.

- The incubation period is 2- 6 weeks; the period of disease is 2- 21 days, and recovery is complete in 4- 6 weeks.
- Diagnosis is based on tests for IgM antibodies.
- Passive immunization can provide temporary protection. A vaccine is available.

#### *Hepatitis B* (pp. 674- 676)

- Hepatitis B virus (HBV) causes hepatitis B, which is frequently serious.
- HBV is transmitted by blood transfusions, contaminated syringes, saliva, sweat, breast milk, and semen.
- Blood is tested for HBsAg before being used in transfusions.
- The average incubation period is 3 months; recovery is usually complete, but some patients develop a chronic infection or become carriers.
- A vaccine against HBsAg is available.

#### *Hepatitis C* (p. 676)

- Hepatitis C virus (HCV) is transmitted via blood.
- The incubation period is 2- 22 weeks; the disease is usually mild, but some patients develop chronic hepatitis.
- Blood is tested for HCV antibodies before being used in transfusions.

#### *Hepatitis D (Delta Hepatitis)* (p. 676)

- Hepatitis D virus (HDV) has a circular strand of RNA and uses HBsAg as a coat.

#### *Hepatitis E* (pp. 676- 678)

- Hepatitis E virus (HEV) is spread by the fecal-oral route.

#### *Other Types of Hepatitis* (p. 677)

- There is evidence of the existence of hepatitis types F and G.

#### *Viral Gastroenteritis* (p. 677)

- Viral gastroenteritis is most often caused by a rotavirus or the Norwalk agent.

### **Fungal Diseases of the Digestive System (p. 677)**

- Mycotoxins are toxins produced by some fungi.
- Mycotoxins affect the blood, nervous system, kidneys, or liver.

#### *Ergot Poisoning* (p. 677)

- Ergot poisoning, or ergotism, is caused by the mycotoxin produced by *Claviceps purpurea*.
- Cereal grains are the crop most often contaminated with the *Claviceps mycotoxin*.

#### *Aflatoxin Poisoning* (p. 677)

- Aflatoxin is a mycotoxin produced by *Aspergillus flavus*.
- Peanuts are the crop most often contaminated with aflatoxin.

### **Protozoan Diseases of the Digestive System (pp. 677- 679)**

#### *Giardiasis* (p. 678)

*Giardia lamblia* grows in the intestines of humans and wild animals and is transmitted in contaminated water. Symptoms of giardiasis are malaise, nausea, flatulence, weakness, and abdominal cramps that persist for weeks. Diagnosis is based on identification of the protozoa in the small intestine.

#### *Amoebic Dysentery (Amoebiasis)* (pp. 678- 679)

- Amoebic dysentery is caused by *Entamoeba histolytica* growing in the large intestine.
- The amoeba feeds on red blood cells and GI tract tissues. Severe infections result in abscesses.
- Diagnosis is confirmed by observing trophozoites in feces and by several serological tests.

#### Cryptosporidiosis (p. 679)

- *Cryptosporidium parvum* causes diarrhea; in immuno-suppressed patients, the disease is prolonged for months.
- The pathogen is transmitted in contaminated water.
- Diagnosis is based on the identification of oocysts in feces.

#### *Cyclospora* Diarrheal Infection (p. 679)

- *C. cayetanensis* causes diarrhea; the protozoan was first identified in 1993.
- It is transmitted in contaminated produce.
- Diagnosis is based on the identification of oocysts in feces.

### **Helminthic Diseases of the Digestive System (pp. 679-685)**

#### Tapeworm Infestations (pp. 680-681)

- Tapeworms are contracted by the consumption of undercooked beef, pork, or fish containing encysted larvae (cysticerci).
- The scolex attaches to the intestinal mucosa of humans (the definitive host) and matures into an adult tapeworm.
- Eggs are shed in the feces and must be ingested by an intermediate host.
- Adult tapeworms can be undiagnosed in a human.
- Diagnosis is based on the observation of proglottids and eggs in feces.
- Neurocysticercosis in humans occurs when the pork tapeworm larva encyst in humans.

#### Hydatid Disease (p. 681)

- Humans infested with the tapeworm *Echinococcus granulosus* might have hydatid cysts in their lungs or other organs,
- Dogs and wolves are usually the definitive hosts, and sheep or deer are the intermediate hosts for *E. granulosus*.

#### Nematode Infestations (pp. 681-685)

##### Pinworm Infestation (p. 681)

- Humans are the definitive host for pinworms, *Enterobius vermicularis*.
- The disease is acquired by ingesting *Enterobius* eggs.

##### Hookworm Infestation (p. 681)

- Hookworm larvae bore through skin and migrate to the intestine to mature into adults.
- In the soil, hookworm larvae hatch from eggs shed in feces.

##### Ascariases (pp. 681-682)

- *Ascaris lumbricoides* adults live in human intestines.
- The disease is acquired by ingesting *Ascaris* eggs.

##### Trichinosis (pp. 682-685)

- *Trichinella spiralis* larvae encyst in muscles of humans and other mammals to cause trichinosis.
- The roundworm is contracted by ingesting undercooked meat containing larvae.
- Adults mature in the intestine and lay eggs; the new larvae migrate to invade muscles.
- Symptoms include fever, swelling around the eyes, and gastrointestinal upset.
- Biopsy specimens and serological tests are used for diagnosis.