

CHAPTER 8 – DIGESTIVE SYSTEM

OBJECTIVES

On completion of this chapter, you will be able to:

- Describe the digestive system.
- Describe the primary organs of the digestive system and state their functions.
- Describe the two sets of teeth with which humans are provided.
- Describe the three main portions of a tooth.
- Describe the accessory organs of the digestive system and their functions.
- Describe digestive differences of the child and older adult.
- Analyze, build, spell, and pronounce medical words.
- Comprehend drugs highlighted in this chapter
- Describe diagnostic and laboratory tests related to the digestive system
- Identify and define selected abbreviations.
- Describe each of the conditions presented in the Pathology Spotlights.
- Complete the Pathology Checkpoint.
- Complete the Study and Review section and the Chart Note Analysis.

OUTLINE

I. Anatomy and Physiology Overview (Fig. 8–1, p. 189)

Also known as the **alimentary canal** and/or **gastrointestinal tract**, this continuous tract begins with the mouth and ends with the anus. Consist of primary and accessory organs that convert food and fluids into a semiliquid that can be absorbed for use by the body.

Three main **functions** of the digestive system are:

1. **Digestion** – the process by which food is changed in the mouth, stomach, and intestines by chemical, mechanical and physical action, so that it can be absorbed by the body.
2. **Absorption** –the process whereby nutrient material is taken into the bloodstream or lymph and travels to all cells of the body.
3. **Elimination** –the process whereby the solid products of digestion are excreted.

A. **Mouth (Fig. 8–2, p. 190)** – a cavity formed by the palate, tongue, lips, and cheeks. Contained within are the teeth and salivary glands. Digestion begins as food is broken apart by the action of the teeth, moistened and lubricated by saliva, and formed into a **bolus (Fig. 8–3, p. 191)**. The following structures are included in the mouth:

1. **Gingivae** – surround the necks of the teeth.
2. **Hard and Soft Palates** – provide a roof for the oral cavity.
3. **Tongue** – at the floor of the mouth, which consists of skeletal muscle that is covered with mucous membrane. On the surface of the tongue are **papillae** and **taste buds**. The tongue can be divided into a:

- a. **Root** – blunt rear portion.
 - b. **Pointed Tip**
 - c. **Central Body**
 - 4. **Lingual Frenulum** – a thin fold of mucous membrane that connects the free portion of the tongue to the underlying epithelium, which prevents extreme movement of the tongue.
 - 5. **Salivary Glands** – secrete fluid into the oral cavity. These glands are the:
 - a. **Parotid**
 - b. **Sublingual**
 - c. **Submandibular**
- B. Teeth (Fig. 8–4, p. 192)** – the function of the teeth is to break apart the food that is eaten. Human beings are provided with two sets:
1. **Deciduous Teeth (20)**– temporary teeth of the primary dentition; also known as *milk or baby teeth*:
 - a. **8 Incisors**
 - b. **4 Canines (cuspids)**
 - c. **8 Molars**
 2. **Permanent Teeth (32) (Fig 8–5, p. 193)** – or secondary dentition teeth consisting of the following:
 - a. **8 Incisors** – the four front teeth in each dental arch, they present a sharp cutting edge for biting the food.
 - b. **4 Canine or Cuspids** – are larger and stronger than incisors and have roots that sink deeper into the bone. The uppers are known as *eye-teeth* and the lowers *stomach teeth*.
 - c. **8 Premolars or Bicuspids** – located lateral to and behind the canine teeth they are smaller than the canine teeth.
 - d. **12 Molars** – largest of the permanent set, their broad crowns are adapted for grinding and pounding food.
 3. Each tooth consists of three main portions: the crown, the root, and the neck.
 - a. **Crown** – the portion that projects above the gum.
 - b. **Root** – embedded in the alveolus. There is a narrow tunnel located here known as the **root canal** in which blood vessels and nerves enter through an opening called the **apical foramen**. A layer of cementum covers the dentin providing protection and firmly anchoring the periodontal ligament. The periodontal ligament consists of collagen fibers and extends from the dentin of the root to the bone of the alveolus.
 - c. **Neck** – constricted portion between the crown and root. The **gingival sulcus** is a shallow groove that surrounds the neck of each tooth.

4. Structures located in, on, or around the crown are:
 - a. **Pulp Cavity** – found in the interior of the crown and the root. It contains **dental pulp**, a loose connective tissue richly supplied with vessels and nerves, which enters the cavity through the small aperture at the point of each root.
 - b. **Dentin** – the solid portion of the tooth, which forms the bulk of the tooth.
 - c. **Enamel** – covering for the exposed part of the crown, is the hardest and most compact part of the tooth.
- C. **Pharynx** – located just beyond the mouth, the pharynx is a passageway for both respiration and digestion.
 1. **Nasopharynx** – the upper portion that lies above the soft palate.
 2. **Oropharynx** – the middle portion that lies between the palate and the hyoid bone. The opening to the oral cavity is found at this level.
 3. **Laryngopharynx** – the lowest portion that lies below the hyoid and opens inferiorly to the larynx anteriorly and the esophagus posteriorly.
- D. **Esophagus** – a muscular tube that leads from the pharynx to the stomach. At the junction of the stomach is the **lower esophageal** or **cardiac sphincter**. Food is carried along the esophagus by a series of wavelike muscular contractions called **peristalsis**.
- E. **Stomach (Fig. 8–6, p. 195)** – a large muscular, distensible saclike organ into which food passes from the esophagus. The early stages of digestion, which consist of converting food to **chyme**, occur here.
- F. **Small Intestine (Fig. 8–7, p. 196)** – digestion and absorption take place chiefly in the small intestine. Nutrients are absorbed into tiny capillaries and lymph vessels in the walls of the small intestine and transmitted to body cells by the circulatory system. The small intestine consists of:
 1. **Duodenum** – the first 12 inches of the small intestine.
 2. **Jejunum** – the next approximately 8 feet.
 3. **Ileum** – the last 12 feet of intestines.
- G. **Large Intestines (Fig. 8–8, p. 197)** – digestion and absorption continue to take place in the large intestine on a smaller scale, along with the elimination of waste products via the rectum and anus. It is approximately 5 feet in length and consists of:
 1. **Cecum** – a pouchlike structure that forms the beginning of the large intestine. The **appendix** is attached to its end.
 2. **Colon** – makes up the bulk of the large intestine and is divided into:
 - a. **Ascending Colon**

- b. **Transverse Colon**
 - c. **Descending Colon**
 - d. **Sigmoid Colon**
- 3. **Rectum**
 - 4. **Anal Canal**

H. Accessory Organs – these organs are not actually part of the digestive tract but are closely related to it in their functions.

- 1. **Salivary Glands** – located in or near the mouth, they secrete **saliva** in response to sight, taste or a mental image of food. All salivary glands secrete through openings into the mouth to moisten and lubricate food. They consist of:
 - a. **Parotid Glands** – located on either side of the face slightly below the ear.
 - b. **Sublingual Glands** – located below the tongue.
 - c. **Submandibular Glands** – located in the floor of the mouth.
- 2. **Liver (Fig. 8–9, p. 198)** – the largest glandular organ in the body is located in the right upper quadrant. The liver does the following:
 - a. **Carbohydrate Metabolism** – changes glucose to glycogen and stores it until needed by body cells. It also changes glycogen back to glucose.
 - b. **Fat Metabolism** – liver serves as a storage place and acts to desaturate fats before releasing them into the bloodstream.
 - c. **Protein Metabolism** – acts as a storage place and assists in protein **catabolism**.
 - d. **Acts as Storage Place** – the liver stores iron, vitamins B₁₂, A, D, E, and K. It also produces body heat.
 - e. **Detoxification** – detoxifies harmful substances such as drugs and alcohol.
 - f. **Manufacturer** – the liver produces the following:
 - **Bile** – a digestive juice.
 - **Fibrinogen and Prothrombin** – coagulants essential for blood clotting.
 - **Heparin** – anticoagulant that helps to prevent the clotting of blood.
 - **Blood Proteins** – albumin, gamma globulin.
- 3. **Gallbladder** – a membranous sac that is attached to the liver in which excess bile is stored and concentrated. Concentration is accomplished by absorption of water from the bile into the mucosa of the gallbladder.
- 4. **Pancreas (Fig. 8–10, p. 198)** – a large, elongated gland situated behind the stomach, which contains cells that produce digestive

enzymes. Other cells secrete the hormones **insulin** and **glucagon** directly into the bloodstream.

II. Life Span Considerations

A. **The Child** – the digestive tract is formed by the embryonic membrane and is divided into the:

- **Foregut** – evolves into the pharynx, lower respiratory tract, esophagus, stomach, duodenum, and beginning of the common bile duct. It also forms the liver, pancreas, and biliary tract.
- **Midgut** – in the fifth week it elongates to form the primary intestinal loop.
- **Hindgut** – the large intestines.

The digestive tract begins to function after birth. The first stool, **meconium**, is a mixture of amniotic fluid and secretions of intestinal gland. It is thick and green, passing 8 to 24 hours following birth. The stomach is small, and the infant produces little saliva. Swallowing is a reflex. Due to insufficient hepatic function, newborns often develop **jaundice**, and fat absorption is poor because of decreased bile production.

B. **The Older Adult** – the digestive system becomes less motile and muscle contractions become weaker. Glandular secretions decrease so mouth is drier and a lesser amount of gastric juices is produced. Nutrient absorption is decreased, teeth wear down, and there is a loss of taste. In the large intestines, blood flow and muscle tone decreases with connective tissue increasing. **Constipation** is a frequent problem due to low fluid intake, lack of dietary fiber, inactivity, medicines, depression, and other health-related conditions.

III. Building Your Medical Vocabulary

A. **Medical Words and Definitions** – this section provides the foundation for learning medical terminology. Medical words can be made up of four types of word parts:

1. **Prefix (P)**
2. **Root (R)**
3. **Combining Forms (CF)**
4. **Suffixes (S)**

By connecting various word parts in an organized sequence, thousands of words can be built and learned. In the text, the word list is alphabetized so one can see the variety of meanings created when common prefixes and suffixes are repeatedly applied to certain word roots and/or combining forms. Words shown in **pink** are additional words related to the content of this chapter that have not been divided into word parts. Definitions identified with an **asterisk icon (*)** indicate terms that are covered in the Pathology Spotlights section of the chapter.

IV. Drug Highlights

- A. **Antacids** – medications that neutralize hydrochloric acid in the stomach. They are either *systemic* or *nonsystemic*.
 - B. **Antacid Mixtures** – products that combine aluminum and/or calcium compounds with magnesium salts.
 - C. **Histamine H₂-Receptor Antagonists** – inhibit both daytime and nocturnal basal gastric acid secretion and inhibit gastric acid stimulated by food, histamines, caffeine, insulin, and pentagastrin. Used in the treatment of active duodenal ulcer.
 - D. **Mucosal Protective Medications** – protects the stomach's mucosal lining from acids but do not inhibit the release of acid.
 - E. **Gastric Acid Pump Inhibitors (Proton-Pump Inhibitor) (PPI)** – antiulcer agents that suppress gastric acid secretion by specific inhibition of the H⁺/K⁺ATPase enzyme at the secretory surface of the gastric parietal cell.
 - F. **Other Ulcer Medications** – 90% of duodenal and 70% of gastric ulcers are caused by the *H. pylori* bacterium; therefore antibiotics along with acid reducers are used for treatment. For successful outcomes, a full treatment of the drugs must be taken for at least two weeks.
 - G. **Laxatives** – used to relieve constipation and to facilitate the passage of feces through the lower GI tract.
 - H. **Antidiarrheal Agents** – used to treat diarrhea.
 - I. **Antiemetics** – prevent or arrest vomiting; also used to treat vertigo, motion sickness, and nausea.
 - J. **Emetics** – used to induce vomiting in people who have overdosed on oral drugs or who have ingested certain poisons. Contraindicated in individuals who have ingested strong caustic substances.
- V. **Diagnostic and Lab Tests**
- A. **Alcohol Toxicology (Ethanol and Ethyl)** – a test performed on blood serum or plasma to determine levels of alcohol.
 - B. **Ammonia (NH₄)** – a test performed on blood plasma to determine the level of ammonia. Increased values may indicate hepatic failure, hepatic encephalopathy, and high protein diet in hepatic failure.
 - C. **Barium Enema (BE)** – a test performed by administering barium via the rectum to determine the condition of the colon. Structure and filling of the colon are determined. Abnormalities may indicate colon cancer, polyps, fistulas, ulcerative colitis, diverticulitis, hernias, and intussusception.
 - D. **Bilirubin Blood Test (Total)** – test done on blood serum to determine if bilirubin is conjugated and excreted in bile. Abnormalities may indicate *obstructive* jaundice, hepatitis, and cirrhosis.
 - E. **Carcinoembryonic Antigen (CEA)** – test performed on whole blood or plasma to determine the presence of CEA. Increased values may indicate stomach, intestinal, rectal, and various other cancers and conditions. Is being used to monitor cancer therapy and must be combined with other test for final diagnosis of any condition.

- F. Cholangiography** – x-ray examination of the common bile duct, cystic duct, and hepatic ducts after introduction of a radiopaque dye. Abnormalities may indicate obstructions, stones, or tumors.
- G. Cholecystography** – x-ray examination of the gallbladder after ingestion of a radiopaque dye. Abnormalities may indicate cholecystitis, cholelithiasis, and tumors.
- H. Colonofiberoscopy or Fiberoptic Colonoscopy** – the direct visual examination of the colon via a flexible colonoscope. Used for diagnoses of abnormalities and for removal of foreign bodies, polyps, and tissue.
- I. Colonoscopy** – the direct visual examination of the colon via a colonoscope; used to diagnose growths and to confirm findings of other tests; can also be used to remove small polyps and to collect tissue samples for analysis.
- J. Endoscopic Retrograde Cholangiopancreatography (ERCP)** – x-ray examination of the biliary and pancreatic ducts after the injection of a radiopaque contrast medium. Abnormalities may indicate fibrosis, biliary or pancreatic cysts, strictures, stones, and chronic pancreatitis.
- K. Esophagogastroduodenalendoscopy** – endoscopic examination of the esophagus, stomach, and small intestines. During the procedure, photographs, biopsy, or brushing may be done.
- L. Gamma-Glutamyl Transferase (GGT)** – test performed on blood serum to determine the level of GGT. Increased values may indicate cirrhosis, liver necrosis, hepatitis, alcoholism, neoplasms, acute pancreatitis, acute myocardial infarction, nephrosis, and acute cholecystitis.
- M. Gastric Analysis** – test performed to determine quality of secretion, amount of free and combined HCl, and the absence or presence of blood, bacteria, bile, and fatty acids.
1. Increased levels may indicate peptic ulcer disease, Zollinger-Ellison syndrome, and hypergastremia.
 2. Decreased levels may indicate stomach cancer, pernicious anemia, and atrophic gastritis.
- N. Gastrointestinal (GI) Series (Fig. 8–21, p. 215)** – fluoroscopic examination of the esophagus, stomach, and small intestine after barium is given orally and is observed as it passes through the digestive tract. Abnormalities may indicate esophageal varices, ulcers, gastric polyps, malabsorption syndrome, hiatal hernias, diverticuli, pyloric stenosis, and foreign bodies.
- O. Hepatitis-Associated Antigen (HAA)** – test performed to determine the presence of the hepatic B virus.
- P. Liver Biopsy** – microscopic examination of liver tissue to diagnose cirrhosis, hepatitis, and tumors.
- Q. Occult Blood** – test performed on feces to determine GI bleeding that is invisible (hidden).. Positive results can indicate gastritis, stomach cancer, peptic ulcers, ulcerative colitis, bowel cancer, bleeding esophageal varices, portal hypertension, pancreatitis, and diverticulitis.
- R. Ova and Parasites (O&P)** – test performed on stool to identify ova and parasites. Positive results indicate protozoa infestation.

- S. **Stool Culture** – test performed on stool to identify the presence of organisms.
- T. **Ultrasonography, Gallbladder (Fig. 8–22, p. 215)** – a test performed to visualize the gallbladder by using high-frequency sound waves. Abnormal results can indicate biliary obstruction, cholelithiasis, and acute cholecystitis.
- U. **Ultrasonography, Liver** – a test performed to visualize the liver by using high-frequency sound waves. Abnormal results can indicate hepatic tumors, cysts, abscess, and cirrhosis.
- V. **Upper Gastrointestinal Fiberoscopy** – direct visualization of the gastric mucosa via a flexible fiberscope when gastric neoplasm is suspected.

VI. Abbreviations (p. 215)

VII. Pathology Spotlights

- A. **Diverticulitis (Fig. 8–23, p. 216)** – an inflammation of diverticula in the colon. Exact cause is unknown, but it generally begins when stool lodges in the diverticula. Pain is a common symptom and infection can lead to swelling or rupturing. Treatment depends on severity of the condition.
- B. **Gastroesophageal Reflux Disease (GERD)** – also known as **esophageal reflux** or **reflux esophagitis**. Occurs when the muscle between the esophagus and the stomach is weak or relaxes inappropriately. This allows the stomach contents to *reflux* into the esophagus (**Fig. 8–24, p. 217**). Symptoms include heartburn, belching, and regurgitation of food. GERD can lead to:
 1. **Barrett’s Esophagus** – a precancerous change in the lining of the esophagus.
 2. **Esophageal Cancer**
 3. **Esophageal Perforation** – hole in the esophagus.
 4. **Esophageal Ulcers**
 5. **Esophagitis**
 6. **Esophageal Stricture** – can be corrected by **dilation**, which stretches the narrowed opening.

GERD can be treated by either medical or surgical treatments.
- C. **Hernia** – an abnormal protrusion of an organ or part of an organ through the wall of a body cavity that normally contains it.
 1. **Hiatal Hernia (Fig. 8–25A, p. 218)** – occurs when the upper part of the stomach moves into the chest through a small opening in the diaphragm. Coughing, vomiting, straining or sudden physical exertion can cause increased pressure in the abdomen that results in hiatal hernia. Obesity and pregnancy can also contribute to the condition. Treatment is not necessary unless **strangulation** (cutting off of blood due to twisting) occurs.
 2. **Inguinal (Fig. 8–25B, p. 218)** – occurs when a loop of intestine enters the inguinal canal; is more prevalent in men than women and also affects infants and children due to a portion of the

peritoneum not closing properly before birth. Treatment is usually a herniorrhaphy.

- D. **Irritable Bowel Syndrome (IBS)** – a disorder that interferes with the normal functions of the large intestine. Characterized by a group of symptoms, including crampy abdominal pain, bloating, constipation, and diarrhea. Symptoms are often worsened by emotional stress. Treatment focuses on treating the symptoms and preventing flareups.
- E. **Peptic Ulcer Disease (PUD) (Fig. 8–26, p. 219)** – occurs when the lining of the esophagus, stomach, or most often, the duodenum, is worn away. In PUD there is an imbalance between acid and pepsin secretion and the defenses of the mucosal lining. This leads to inflammation. It can also be caused by a bacterium called *Helicobacter pylori*, which settles in the lining of the duodenum or stomach. Treatment depends on cause and includes medications, cessation of aspirin intake, tobacco and alcohol. Surgery may be needed for severe ulcers that bleed, are unresponsive to medication, or cause a hole in the stomach.

VIII. Pathology Checkpoint

IX. Study and Review (pp. 221–226)

X. Practical Application: SOAP: Chart Note Analysis