10.8: Case Study Celiac Conclusion and Chapter Summary

Case Study Conclusion: Please Don’t Pass the Bread

The garlic bread stuffed with spaghetti shown above may or may not look appetizing to you, but for people with celiac disease, it is certainly off limits. Bread and pasta are traditionally made with wheat, which contains proteins called gluten. As you learned in the beginning of the chapter, even trace amounts of gluten can damage the digestive system of people with celiac disease. When Rania and Tui met for lunch, Rania chose a restaurant that she knew could provide her with gluten-free food because she has this disease.

When people with celiac disease eat gluten, it causes an autoimmune reaction that results in inflammation and flattening of the villi of the small intestine. What do you think happens if the villi are inflamed and flattened? Think about what you
have learned about the functions of the villi and small intestine. The small intestine is where most chemical digestion and absorption of nutrients occurs in the body. The villi increase the surface area in the small intestine to maximize the digestion of food and absorption of nutrients into the blood and lymph. If the villi are inflamed and flattened, there is less surface area where digestion and absorption can occur. Therefore, damage from celiac disease can result in inadequate absorption of nutrients called malabsorption.

Malabsorption explains why there can be so many different types of symptoms of celiac disease, ranging from diarrhea and other forms of digestive distress to anemia, nutritional deficiencies, skin rashes, osteoporosis, bone pain, depression, anxiety, and rarer but potentially serious complications such as cancer. Our bodies need to digest and absorb adequate amounts of nutrients in order to function properly and stay healthy. Lack of nutrients can affect and damage cells, tissues, and organs throughout the body, sometimes seriously and irreversibly. A person with celiac disease can limit and often heal intestinal damage just by not eating gluten. In fact, eliminating all gluten from the diet is the main treatment for celiac disease. In some people with celiac disease, a gluten-free diet may not be enough, and steroids and other medications may be used to reduce the inflammation in the small intestine.

Celiac disease is an autoimmune disorder in which the body’s immune system attacks its own tissues. It is thought to be caused by the presence of particular genes in combination with exposure to gluten. What are some other autoimmune disorders that you read about in this chapter that affect the digestive system? The two main inflammatory bowel diseases, Crohn’s disease and ulcerative colitis, are both due to the body’s immune system attacking the digestive system, resulting in inflammation. Crohn’s disease can affect any part of the GI tract, most commonly the ileum of the small intestine, while ulcerative colitis mainly affects the colon and rectum. Similar to celiac disease, treatments for these diseases also focus on reducing GI tract damage through lifestyle changes and medications.

Gluten is clearly dangerous for people with celiac disease, but should people who do not have celiac disease or other diagnosed medical problem with gluten also eliminate gluten from their diet? Many medical experts say no because gluten-free diets are so restrictive, they may cause nutritional deficiencies without providing any proven health benefits. They can also be expensive and, as Tui’s cousin found out, difficult to maintain given that gluten is present in so many foods. It is estimated that only 1% of the population has celiac disease. Most people should enjoy a varied diet and consult with their doctor if they are concerned about celiac disease, other types of gluten intolerance, or food allergies.

Chapter Summary

In this chapter, you learned about the digestive system, which allows the body to obtain needed nutrients from food. Specifically, you learned that:

• The digestive system consists of organs that break down food, absorb its nutrients, and expel any remaining food waste.

• Most digestive organs form a long, continuous tube through which food passes, called the gastrointestinal (GI) tract. It starts at the mouth, which is followed by the pharynx, esophagus, stomach, small intestine, and large intestine.

• Organs of the GI tract have walls that consist of several tissue layers that enable them to carry out digestion and/or absorption. For example, the inner mucosa has cells that secrete digestive enzymes and other digestive substances and also cells that absorb nutrients. The muscle layer of the organs enables them to contract and relax in waves of peristalsis to move food through the GI tract.

• Digestion is a form of catabolism, in which food is broken down into small molecules that the body can absorb and
use for energy, growth, and repair. Digestion occurs when food moves through the GI tract. The digestive process is controlled by both hormones and nerves.

- Mechanical digestion is a physical process in which food is broken into smaller pieces without becoming chemically changed. It occurs mainly in the mouth and stomach.
- Chemical digestion is a chemical process in which macromolecules including carbohydrates, proteins, lipids, and nucleic acids in food are broken down into simple nutrient molecules that can be absorbed into body fluids. Carbohydrates are chemically digested to sugars, proteins to amino acids, lipids to fatty acids, and nucleic acids to individual nucleotides. Chemical digestion requires digestive enzymes. Gut flora carries out additional chemical digestion.

- Absorption occurs when the simple nutrient molecules that result from digestion are absorbed into blood or lymph. They are then circulated through the body.

- Organs of the upper gastrointestinal (GI) tract include the mouth, pharynx, esophagus, and stomach.
  - The mouth is the first organ of the GI tract. It has several structures that are specialized for digestion, including salivary glands, tongue, and teeth. Both mechanical digestion and chemical digestion of carbohydrates and fats begin in the mouth.
  - The pharynx and esophagus move food from the mouth to the stomach but are not directly involved in the process of digestion or absorption. Food moves through the esophagus by peristalsis.
  - Mechanical and chemical digestion continue in the stomach. Acid and digestive enzymes secreted by the stomach start the chemical digestion of proteins. The stomach turns masticated food into a semi-fluid mixture called chyme.

- The lower GI tract includes the small intestine and large intestine. The small intestine is where most chemical digestion and virtually all absorption of nutrients occur. The large intestine contains huge numbers of beneficial bacteria and removes water and salts from food waste before it is eliminated.
  - The small intestine consists of three parts: the duodenum, jejunum, and ileum. All three parts of the small intestine are lined with mucosa that is very wrinkled and covered with villi and microvilli, giving the small intestine a huge surface area for digestion and absorption.
    - The ileum carries out any remaining digestion and absorption of nutrients, but its main function is to absorb vitamin B12 and bile salts.
    - The jejunum carries out most of the absorption of nutrients in the small intestine, including the absorption of simple sugars, amino acids, fatty acids, and many vitamins.
    - The duodenum secretes digestive enzymes and also receives bile from the liver or gallbladder and digestive enzymes and bicarbonate from the pancreas. These digestive substances neutralize acidic chyme and allow for the chemical digestion of carbohydrates, proteins, lipids, and nucleic acids in the duodenum.
  - The large intestine consists of the colon (which in turn includes the cecum, ascending colon, transverse colon, descending colon, and sigmoid colon), rectum, and anus. The vestigial organ called the appendix is attached to the cecum of the colon.
    - The main function of the large intestine is to remove water and salts from chyme for recycling within the body and eliminating the remaining solid feces from the body through the anus. The large intestine is also the site where trillions of bacteria help digest certain compounds, produce vitamins, stimulate the immune system, and break down toxins, among other important functions.

- Accessory organs of digestion are organs that secrete substances needed for the chemical digestion of food, but through which food does not actually pass as it is digested. The accessory organs include the liver, gallbladder, and pancreas. These organs secrete or store substances that are carried to the duodenum of the small intestine as needed for digestion.
  - The liver is a large organ in the abdomen that is divided into lobes and smaller lobules, which consist of metabolic cells called hepatic cells, or hepatocytes. The liver receives oxygen in the blood from the aorta through the
hepatic artery. It receives nutrients in blood from the GI tract and wastes in blood from the spleen through the portal vein.

- The main digestive function of the liver is the production of the alkaline liquid called bile. Bile is carried directly to the duodenum by the common bile duct or to the gallbladder first for storage. Bile neutralizes acidic chyme that enters the duodenum from the stomach and also emulsifies fat globules into smaller particles (micelles) that are easier to digest chemically.

- Other vital functions of the liver include regulating blood sugar levels by storing excess sugar as glycogen; storing many vitamins and minerals; synthesizing numerous proteins and lipids; and breaking down waste products and toxic substances.

- The gallbladder is a small pouch-like organ near the liver. It stores and concentrates bile from the liver until it is needed in the duodenum to neutralize chyme and help digest lipids.

- The pancreas is a glandular organ that secretes both endocrine hormones and digestive enzymes. As an endocrine gland, the pancreas secretes insulin and glucagon to regulate blood sugar. As a digestive organ, the pancreas secretes digestive enzymes into the duodenum through ducts. Pancreatic digestive enzymes include amylase (starches); trypsin and chymotrypsin (proteins); lipase (lipids); and ribonucleases and deoxyribonucleases (RNA and DNA).

- Inflammatory bowel disease is a collection of inflammatory conditions primarily affecting the intestines. The diseases involve the immune system attacking the GI tract, and they have multiple genetic and environmental causes. Typical symptoms include abdominal pain and diarrhea, which show a pattern of repeated flare-ups interrupted by periods of remission. Lifestyle changes and medications may control flare-ups and extend remission. Surgery is sometimes required.

- The two principal inflammatory bowel diseases are Crohn’s disease and ulcerative colitis. Crohn’s disease may affect any part of the GI tract from the mouth to the anus, among other body tissues. Ulcerative colitis affects the colon and/or rectum.

- Some people have little pouches, called diverticula, in the lining of their large intestine, a condition called diverticulosis. People with diverticulosis may develop diverticulitis, in which one or more of the diverticula become infected and inflamed. Diverticulitis is generally treated with antibiotics and bowel rest; sometimes surgery is required.

- A peptic ulcer is a sore in the lining of the stomach (gastric ulcer) or duodenum (duodenal ulcer). The most common cause is infection with the bacterium *Helicobacter pylori*. NSAIDs such as aspirin can also cause peptic ulcers, and some lifestyle factors may play contributing roles. Antibiotics and acid reducers are typically prescribed; surgery is not often needed.

- Gastroenteritis, or infectious diarrhea, is an acute and usually self-limiting infection of the GI tract by pathogens, most often viruses. Symptoms typically include diarrhea, vomiting, and/or abdominal pain. Treatment includes replacing lost fluids; antibiotics are not usually effective.

- Giardiasis is a type of gastroenteritis caused by infection of the GI tract with the protozoa parasite *Giardia lamblia*. It may cause malnutrition. Generally self-limiting, severe or long-lasting cases may require antibiotics.

### Chapter Summary Review

1. Explain how the accessory organs of digestion interact with the GI tract.
2. In which of the following organs is food actually digested?
   A. Pancreas
   B. Small intestine
   C. Gallbladder
   D. A and B
3. **True or False.** Bile is one of the digestive fluids secreted in the stomach.
4. **True or False.** The smell of food can stimulate the release of digestive enzymes.
5. If the pH in the duodenum was too low (acidic), what effect do you think this would have on the processes of the digestive system?
6. Is the stomach involved in chemical digestion, mechanical digestion, or both? Explain your answer.
7. Absorption of most nutrients occurs in the:
   A. Duodenum
   B. Ileum
   C. Cecum
   D. Jejunum
8. Is food passing through the GI tract generally more solid in the small intestine or the large intestine? Explain your answer.
9. The colon is also called the ________________________.
10. Discuss whether digestion occurs in the large intestine.
11. The appendix is attached to:
   A. The large intestine
   B. The small intestine
   C. The pancreas
   D. The liver
12. What is lacteal? In your answer, be sure to describe both its location and function in the digestive system.
13. Lipids are digested at different points in the digestive system. Describe how lipids are digested at two of these points.
14. Describe two different functions of stomach acid.
15. **True or False.** Proteins are only digested in the stomach.
16. **True or False.** A peptic ulcer can occur in the small intestine.
17. Match each of the following organs of the digestive system with the description that best fits it. Each organ is used only once: Organs: pancreas; liver; gallbladder
   A. A small, pouch-like organ that stores and concentrates bile produced by a different organ.
   B. Produces insulin as well as digestive enzymes and other needed substances.
   C. Processes wastes in addition to aiding in digestive functions.
18. What is the name of the rhythmic muscle contractions that move food through the GI tract?
19. What are the major roles of the upper GI tract?
20. Diverticulitis causes infected and inflamed pouches in the ________________.
   A. stomach
   B. small intestine
   C. jejunum
   D. large intestine
21. What is the physiological cause of heartburn?
22. Which disease most commonly affects the ileum of the small intestine?
A. Crohn’s disease
B. Peptic ulcer
C. Ulcerative colitis
D. Gastroenteritis

23. True or False. Smoking does not contribute to digestive system disorders.

24. True or False. In addition to obtaining nutrients, the digestive system plays a role in protecting the body from pathogens.

25. What are two ways in which the tongue participates in digestion?

26. Where is the epiglottis located?

27. If the epiglottis were to not close properly, what might happen?

28. The GI tract goes from the mouth to the __________.

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