

38 Assessment of Digestive and Gastrointestinal Function

LEARNING OUTCOMES

On completion of this chapter, the learner will be able to:

1. Describe the structure and function of the organs of the gastrointestinal tract.
2. Explain the mechanical and chemical processes involved in digesting and absorbing nutrients and eliminating waste products.
3. Discriminate between normal and abnormal assessment findings of the gastrointestinal system.
4. Recognize and evaluate the major symptoms of gastrointestinal dysfunction by applying the patient's health history and physical assessment findings.
5. Identify the diagnostic tests used to evaluate gastrointestinal tract function and related nursing implications.

NURSING CONCEPTS

Assessment
Elimination

GLOSSARY

absorption: phase of the digestive process that occurs when small molecules, vitamins, and minerals pass through the walls of the small and large intestine and into the bloodstream

amylase: an enzyme that aids in the digestion of starch

anus: last section of the gastrointestinal (GI) tract; outlet for waste products from the GI system

chyme: mixture of food with saliva, salivary enzymes, and gastric secretions that is produced as food passes through the mouth, esophagus, and stomach

digestion: phase of the digestive process that occurs when digestive enzymes and secretions mix with ingested food and when proteins, fats, and sugars are broken down into their component smaller molecules

dyspepsia: indigestion; upper abdominal discomfort associated with eating

elimination: phase of the digestive process that occurs after digestion and absorption, when waste products are evacuated from the body

esophagus: collapsible tube connecting the mouth to the stomach, through which food passes as it is ingested

hydrochloric acid: acid secreted by the glands in the stomach; mixes with chyme to break it down into absorbable molecules and to aid in the destruction of bacteria

ingestion: phase of the digestive process that occurs when food is taken into the GI tract via the mouth and esophagus

intrinsic factor: a gastric secretion that combines with vitamin B₁₂ so that the vitamin can be absorbed

large intestine: the portion of the GI tract into which waste material from the small intestine passes as absorption continues and elimination begins; consists of several parts—ascending segment, transverse segment, descending segment, sigmoid colon, and rectum (*synonym:* colon)

lipase: an enzyme that aids in the digestion of fats

microbiome: the collective genome of all microbes in a microbiota

microbiota: the complement of microbes in a given environment

pepsin: a gastric enzyme that is important in protein digestion

small intestine: longest portion of the GI tract, consisting of three parts—duodenum, jejunum, and ileum—through which food mixed with all secretions and enzymes passes as it continues to be digested and begins to be absorbed into the bloodstream

stomach: distensible pouch into which the food bolus passes to be digested by gastric enzymes

trypsin: enzyme that aids in the digestion of protein

Abnormalities of the gastrointestinal (GI) tract are numerous and represent every type of major pathology that can affect other organ systems, including bleeding, perforation, obstruction, inflammation, and cancer. Congenital, inflammatory, infectious, traumatic, and neoplastic lesions have been encountered in every portion and at every site along the length of the GI tract. As with all other organ systems, the GI tract is subject to circulatory disturbances, faulty nervous system control, and aging.

Apart from the many organic diseases to which the GI tract is susceptible, many extrinsic factors can interfere with its normal function and produce symptoms. Stress and anxiety, for example, often find their chief expression in indigestion, anorexia, or motor disturbances of the intestines, sometimes producing constipation or diarrhea. In addition, factors such as fatigue and an inadequate or abruptly changed dietary intake can markedly affect the GI tract. When assessing and educating the patient, the nurse should consider the variety of mental and physical factors that affect the function of the GI tract.

Anatomic and Physiologic Overview

The GI tract is a pathway 7 to 7.9 m (23 to 26 feet) in length that extends from the mouth to the esophagus, stomach, small and large intestines, and rectum, to the terminal structure, the **anus** (Fig. 38-1). The **esophagus** is located in the mediastinum, anterior to the spine and posterior to the trachea and heart. This hollow muscular tube, which is approximately 25 cm (10 inches) in length, passes through the diaphragm at an opening called the *diaphragmatic hiatus*.

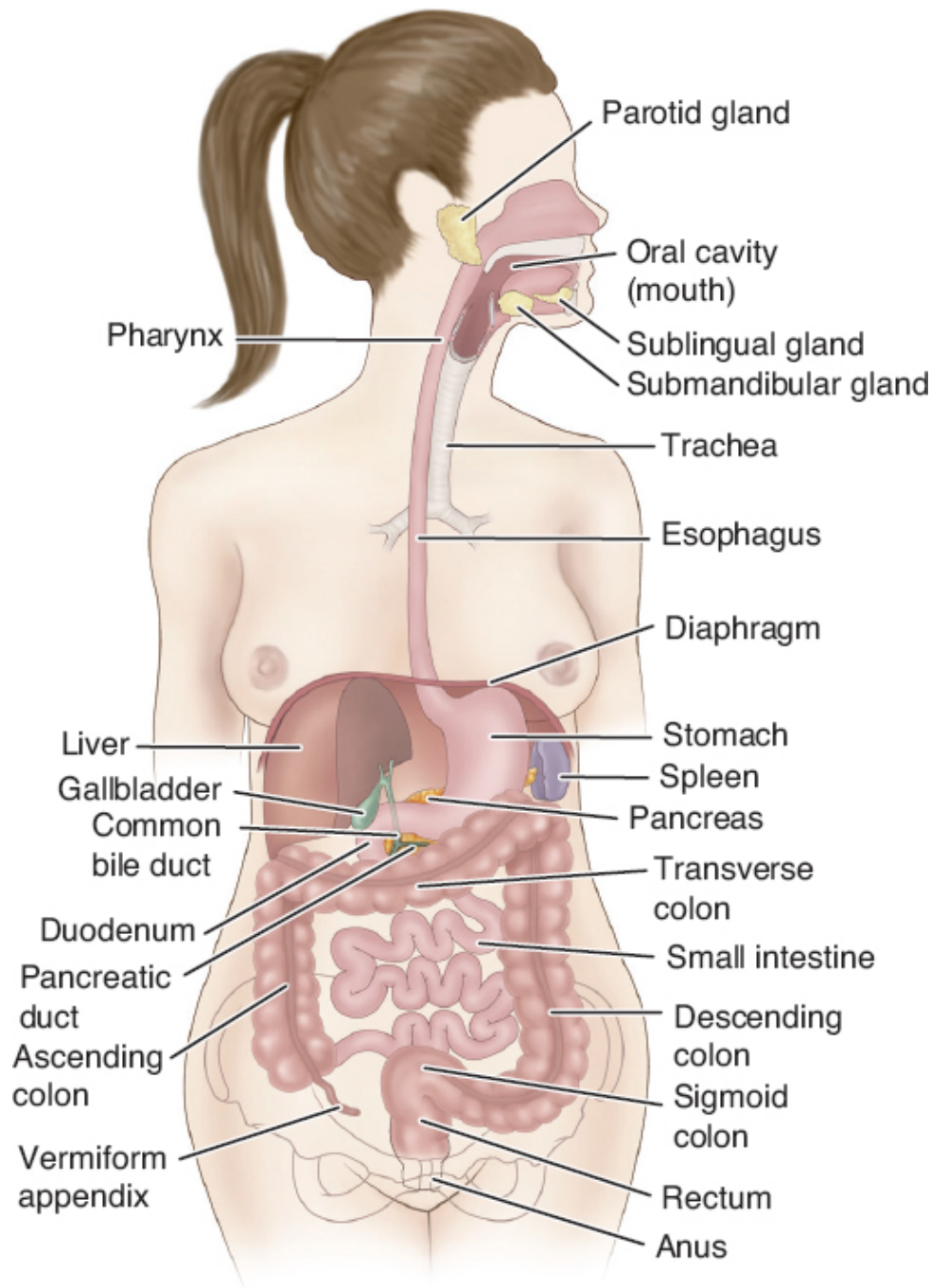


Figure 38-1 • Organs of the digestive system and associated structures.

The remaining portion of the GI tract is located within the peritoneal cavity. The **stomach** is situated in the left upper portion of the abdomen under the left lobe of the liver and the diaphragm, overlaying most of the pancreas (see [Fig. 38-1](#)). A hollow muscular organ with a capacity of approximately 1500 mL, the stomach stores food during eating, secretes digestive fluids, and propels the partially digested food, or chyme, into the small intestine. The gastroesophageal junction is the inlet to the stomach. The stomach has four anatomic regions: the cardia (entrance), fundus, body, and pylorus (outlet).

Circular smooth muscle in the wall of the pylorus forms the pyloric sphincter and controls the opening between the stomach and the small intestine.

The **small intestine** is the longest segment of the GI tract, accounting for about two thirds of the total length. It folds back and forth on itself, providing approximately 70 m (230 feet) of surface area for secretion and **absorption**, the process by which nutrients enter the bloodstream through the intestinal walls. It has three sections: The most proximal section is the duodenum, the middle section is the jejunum, and the distal section is the ileum. The ileum terminates at the ileocecal valve. This valve, or sphincter, controls the flow of digested material from the ileum into the cecal portion of the large intestine and prevents reflux of bacteria into the small intestine. Attached to the cecum is the vermiform appendix, an appendage that has little or no physiologic function. Emptying into the duodenum at the ampulla of Vater is the common bile duct, which allows for the passage of both bile and pancreatic secretions.

The **large intestine** consists of an ascending segment on the right side of the abdomen, a transverse segment that extends from right to left in the upper abdomen, and a descending segment on the left side of the abdomen. The sigmoid colon, the rectum, and the anus complete the terminal portion of the large intestine. A network of striated muscle that forms both the internal and the external anal sphincters regulates the anal outlet.

The GI tract receives blood from arteries that originate along the entire length of the thoracic and abdominal aorta and veins that return blood from the digestive organs and the spleen. This portal venous system is composed of five large veins: the superior mesenteric, inferior mesenteric, gastric, splenic, and cystic veins, which eventually form the vena portae that enters the liver. Once in the liver, the blood is distributed throughout and collected into the hepatic veins that then terminate in the inferior vena cava. Of particular importance are the gastric artery and the superior and inferior mesenteric arteries. Oxygen and nutrients are supplied to the stomach by the gastric artery and to the intestine by the mesenteric arteries (Fig. 38-2). Venous blood is returned from the small intestine, cecum, and the ascending and transverse portions of the colon by the superior mesenteric vein, which corresponds with the distribution of the branches of the superior mesenteric artery. Blood flow to the GI tract is about 20% of the total cardiac output and increases significantly after eating.

Both the sympathetic and parasympathetic portions of the autonomic nervous system innervate the GI tract. In general, sympathetic nerves exert an inhibitory effect on the GI tract, decreasing gastric secretion and motility and causing the sphincters and blood vessels to constrict. **Parasympathetic nerve stimulation causes peristalsis and increases secretory activities.** The sphincters relax under the influence of parasympathetic stimulation, except for the sphincter of the upper esophagus and the external anal sphincter, which are under voluntary control (Norris, 2019).

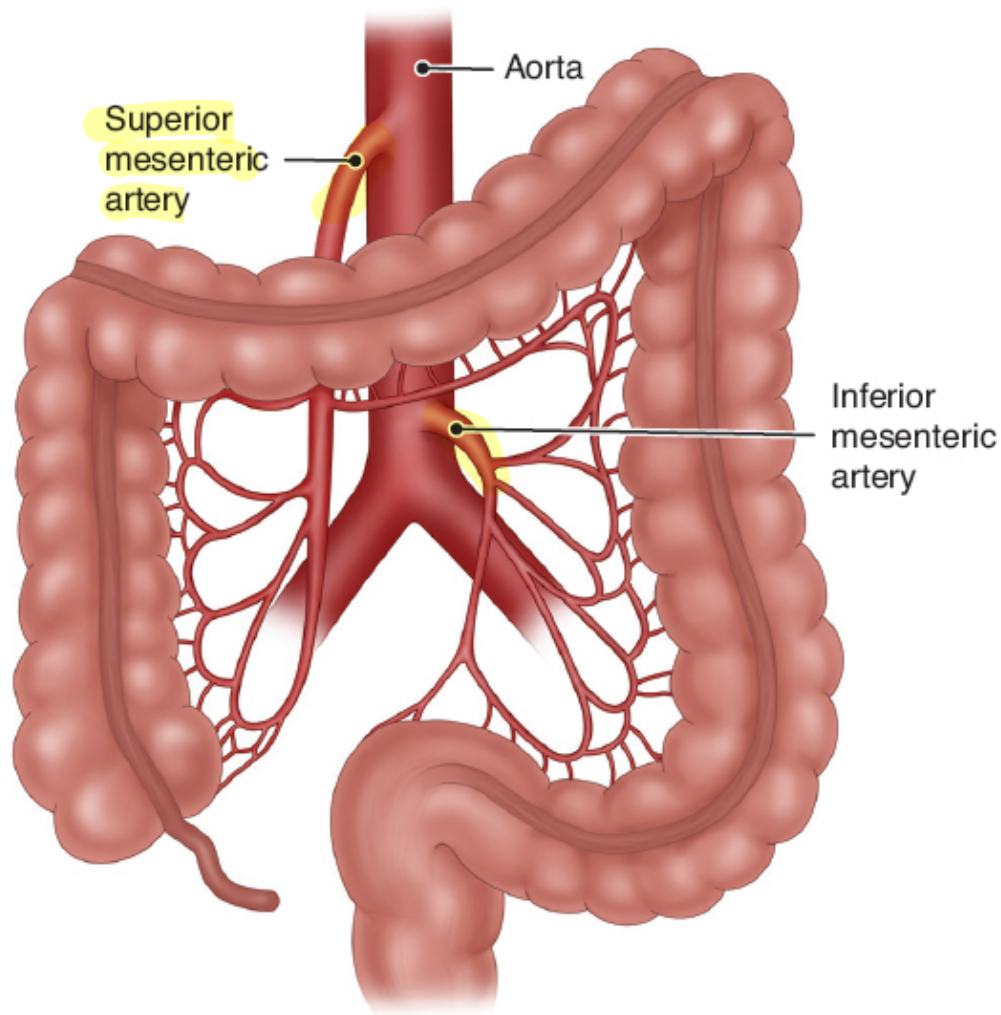


Figure 38-2 • Anatomy and blood supply of the large intestine.

Function of the Digestive System

All cells of the body require nutrients. These nutrients are derived from the intake of food that contains proteins, fats, carbohydrates, vitamins, minerals, and cellulose fibers and other vegetable matter, some of which has no nutritional value. Major functions of the GI tract include:

- Breakdown of food particles into the molecular form for **digestion**
- Absorption into the bloodstream of small nutrient molecules produced by digestion
- **Elimination** of undigested unabsorbed foodstuffs and other waste products

After food is ingested, it is propelled through the GI tract, coming into contact with a wide variety of secretions that aid in its digestion, absorption, or elimination from the GI tract.

Chewing and Swallowing

The process of digestion begins with the act of chewing, in which food is broken down into small particles that can be swallowed and mixed with digestive enzymes. Eating—or even the sight, smell, or taste of food—can cause reflex salivation. Approximately 1.5 L of saliva is secreted daily from the parotid, the submaxillary, and the sublingual glands. Ptyalin, or salivary **amylase**, is an enzyme that begins the digestion of starches. Water and mucus, also contained in saliva, help lubricate the food as it is chewed, thereby facilitating swallowing.

Swallowing begins as a voluntary act that is regulated by the swallowing center in the medulla oblongata of the central nervous system (CNS). As a bolus of food is swallowed, the epiglottis moves to cover the tracheal opening and prevent aspiration of food into the lungs. Swallowing, which propels the bolus of food into the upper esophagus, thus ends as a reflex action. The smooth muscle in the wall of the esophagus contracts in a rhythmic sequence from the upper esophagus toward the stomach to propel the bolus of food along the tract. During this process of esophageal peristalsis, the lower esophageal sphincter relaxes and permits the bolus of food to enter the stomach. Subsequently, the lower esophageal sphincter closes tightly to prevent reflux of stomach contents into the esophagus.

Gastric Function

The stomach, which stores and mixes food with secretions, secretes a highly acidic fluid in response to the presence or anticipated **ingestion** of food. This fluid, which can total 2.4 L/day, can have a pH as low as 1 and derives its acidity from **hydrochloric acid** (HCl) secreted by the glands of the stomach. The function of this gastric secretion is twofold: to break down food into more absorbable components and to aid in the destruction of most ingested bacteria.

Pepsin, an important enzyme for protein digestion, is the end product of the conversion of pepsinogen from the chief cells (Table 38-1). **Intrinsic factor**, also secreted by the gastric mucosa, combines with dietary vitamin B₁₂ so that the vitamin can be absorbed in the ileum. In the absence of intrinsic factor, vitamin B₁₂ cannot be absorbed, and pernicious anemia results (see Chapter 29).

Peristaltic contractions in the stomach propel the stomach's contents toward the pylorus. Because large food particles cannot pass through the pyloric sphincter, they are churned back into the body of the stomach. In this way, food in the stomach is mechanically broken down into smaller particles. Food remains in the stomach for a variable length of time, from 30 minutes to several hours, depending on the volume, osmotic pressure, and chemical composition of the gastric contents. Peristalsis in the stomach and contractions of the pyloric sphincter allow the partially digested food to enter the small intestine at a rate that permits efficient absorption of nutrients. This partially digested food mixed with gastric secretions is called **chyme**. Hormones,

neuroregulators, and local regulators found in the gastric secretions control the rate of gastric secretions and influence gastric motility (Table 38-2).

Small Intestine Function

The digestive process continues in the ^{pt 2 (1st part of the small intestine)} duodenum. Duodenal secretions come from the accessory digestive organs—the pancreas, liver, and gallbladder—and the glands in the wall of the intestine itself. These secretions contain digestive enzymes: amylase, lipase, and bile. Pancreatic secretions have an alkaline pH due to their high concentration of bicarbonate. This alkalinity neutralizes the acid entering the duodenum from the stomach. Digestive enzymes secreted by the pancreas include **trypsin**, which aids in digesting protein; amylase, which aids in digesting starch; and **lipase**, which aids in digesting fats. These secretions drain into the pancreatic duct, which empties into the common bile duct at the ampulla of Vater. Bile, secreted by the liver and stored in the gallbladder, aids in emulsifying ingested fats, making them easier to digest and absorb. The sphincter of Oddi, found at the confluence of the common bile duct and duodenum, controls the flow of bile. Hormones, neuroregulators, and local regulators found in these intestinal secretions control the rate of intestinal secretions and also influence GI motility. Intestinal secretions total approximately 1 L/day of pancreatic juice, 0.5 L/day of bile, and 3 L/day of secretions from the glands of the small intestine. Tables 38-1 and 38-2 give further information about the actions of digestive enzymes and GI regulatory substances.

TABLE 38-1 The Major Digestive Enzymes and Secretions

Enzyme/Secretion	Enzyme Source	Digestive Action
Enzymes That Digest Carbohydrates		
Ptyalin (salivary amylase)	Salivary glands	Starch→dextrin, maltose, glucose
Amylase	Pancreas and intestinal mucosa	Starch→dextrin, maltose, glucose Dextrin→maltose, glucose
Maltase	Intestinal mucosa	Maltose→glucose
Sucrase	Intestinal mucosa	Sucrose→glucose, fructose
Lactase	Intestinal mucosa	Lactose→glucose, galactose
Enzymes/Secretions That Digest Protein		
Pepsin	Gastric mucosa	Protein→polypeptides
Trypsin	Pancreas	Proteins and polypeptides→polypeptides, dipeptides, amino acids
Aminopeptidase	Intestinal mucosa	Polypeptides→dipeptides, amino acids
Dipeptidase	Intestinal mucosa	Dipeptides→amino acids
Hydrochloric acid	Gastric mucosa	Protein→polypeptides, amino acids
Enzymes/Secretions That Digest Fat (Triglyceride)		
Pharyngeal lipase	Pharynx mucosa	Triglycerides→fatty acids, diglycerides, monoglycerides
Steapsin	Gastric mucosa	Triglycerides→fatty acids, diglycerides, monoglycerides
Pancreatic lipase	Pancreas	Triglycerides→fatty acids, diglycerides, monoglycerides
Bile	Liver and gallbladder	Fat emulsification

→, converts to.

Two types of contractions occur regularly in the small intestine: segmentation contractions and intestinal peristalsis. *Segmentation contractions* produce mixing waves that move the intestinal contents back and forth in a churning motion. *Intestinal peristalsis* propels the contents of the small intestine toward the colon. Both movements are stimulated by the presence of chyme.

Food, ingested as fats, proteins, and carbohydrates, is broken down into absorbable particles (constituent nutrients) by the process of digestion. Carbohydrates are broken down into disaccharides (e.g., sucrose, maltose, galactose) and monosaccharides (e.g., glucose, fructose). Glucose is the major carbohydrate that tissue cells use as fuel. Proteins are a source of energy after they are broken down into amino acids and peptides. Ingested fats become monoglycerides and fatty acid through emulsification, which makes them

smaller and easier to absorb. Chyme stays in the small intestine for 3 to 6 hours, allowing for continued breakdown and absorption of nutrients.

TABLE 38-2 The Major Gastrointestinal Regulatory Substances

Substance	Stimulus for Production	Target Tissue	Effect on Secretions	Effect on Motility
Neuroregulators				
Acetylcholine	Stomach distention, vagal and local nerves in the stomach	Gastric glands, other secretory glands, gastric and intestinal muscle	↑ Gastric acid	Generally increased
Norepinephrine	Stress, other various stimuli	Secretory glands, gastric and intestinal muscle	Generally inhibitory	Generally decreased; increased sphincter tone
Hormonal Regulators				
Gastrin	Vagal stimulation, calcium containing foods	Gastric glands, stomach antrum, duodenum	↑ Secretion of gastric acid and pepsinogen	Increased motility of stomach; stimulates smooth muscle contraction
Cholecystokinin	Protein digestion products, long-chain fatty acids, presence of chyme in duodenum	Gallbladder Pancreas Stomach	Release of bile into duodenum ↑ Production of enzyme-rich pancreatic secretions	Slows gastric emptying
Secretin	pH of chyme in duodenum (pH <3)	Pancreas Stomach	Inhibits gastrin and gastric acid secretion	Decreases GI motility
Local Regulator				
Histamine	Unclear; substances in food	Gastric glands	↑ Gastric acid production	

HCl, hydrochloric acid; ↑, increased.

Adapted from McCance, K. L., & Huether, S. E. (2019). *Pathophysiology: The biologic basis for disease in adults and children* (8th ed.). St. Louis, MO: Elsevier; Norris, T. L. (2019). *Porth's pathophysiology. Concepts of altered health states* (10th ed.). Philadelphia, PA: Wolters Kluwer.

Small, fingerlike projections called *villi* line the entire intestine and function to produce digestive enzymes as well as to absorb nutrients. **Absorption is the major function of the small intestine.** Vitamins and minerals are absorbed essentially unchanged. Absorption begins in the jejunum and is accomplished by active transport and diffusion across the intestinal wall into the circulation. Nutrients are absorbed at specific locations in the small intestine and duodenum, whereas fats, proteins, carbohydrates, sodium, and chloride are absorbed in the jejunum. Vitamin B₁₂ and bile salts are absorbed in the ileum. Magnesium, phosphate, and potassium are absorbed throughout the small intestine.

Colonic Function

Within 4 hours after eating, residual waste material passes into the terminal ileum and slowly into the proximal portion of the right colon through the ileocecal valve. With each peristaltic wave of the small intestine, the valve opens briefly and permits some of the contents to pass into the colon.

Gut microbes (bacteria), a major component of the contents of the large intestine, assist in completing the breakdown of waste material, especially of undigested or unabsorbed proteins and bile salts. Two types of colonic secretions are added to the residual material: an electrolyte solution and mucus. The **electrolyte solution** is chiefly a bicarbonate solution that acts to **neutralize** the end products formed by the colonic bacterial action, whereas the **mucus** protects the colonic mucosa from the intraluminal contents and provides adherence for the fecal mass.

Slow, weak peristalsis moves the colonic contents along the tract. This slow transport allows for efficient reabsorption of water and electrolytes, which is the major function of the colon. Intermittent strong peristaltic waves propel the contents for considerable distances. This generally occurs after another meal is eaten, when intestine-stimulating hormones are released. The waste materials from a meal eventually reach and distend the rectum, usually in about 12 hours. As much as one fourth of the waste materials from a meal may still be in the rectum 3 days after the meal was ingested.

Waste Products of Digestion

Feces consist of undigested foodstuffs, inorganic materials, water, and bacteria. Fecal matter is about 75% fluid and 25% solid material (Norris, 2019). The composition is relatively unaffected by alterations in diet because a large portion of the fecal mass is of nondietary origin, derived from the secretions of the GI tract. The brown color of the feces results from the breakdown of bile by the intestinal bacteria. Chemicals formed by intestinal bacteria are responsible in large part for the fecal odor. Gases formed contain methane, hydrogen sulfide, and ammonia, among others. The GI tract normally contains approximately 150 mL of these gases, which are either absorbed into the portal circulation and detoxified by the liver or expelled from the rectum as flatus *what*

Elimination of stool begins with distention of the rectum, which initiates reflex contractions of the rectal musculature and relaxes the normally closed internal anal sphincter. The internal sphincter is controlled by the autonomic nervous system; the external sphincter is under the conscious control of the cerebral cortex. During defecation, the external anal sphincter voluntarily relaxes to allow colonic contents to be expelled. Normally, the external anal sphincter is maintained in a state of tonic contraction. Thus, defecation is seen to be a spinal reflex (involving the parasympathetic nerve fibers) that can be inhibited voluntarily by keeping the external anal sphincter closed. Contracting the abdominal muscles (straining) facilitates emptying of the colon. The average frequency of defecation in humans is once daily, but this varies among people.

Gut Microbiome

In addition to assisting in the breakdown of waste material, the gut **microbiota** (the complement of microbes in the GI tract) also has a role in vitamin synthesis and immune function, including protection against invading pathogens, regulatory influences on innate and adaptive immune responses, and inflammation. Colonization of the GI tract begins shortly after birth; the normal gut microbiota is established by 2 years of age. Several factors over time affect the composition of normal gut microbiota including genetics, diet, personal hygiene, infection, and vaccinations. The number and diversity of

microbes within the gut change with aging and are influenced by diet, chronic disease, and medications. Additionally, administration of broad-spectrum antibiotics can disrupt the gut microbiota and lead to overgrowth of potentially pathogenic species (McCance & Huether, 2019; Norris, 2019).

The gut **microbiome**, the collective genome of the microbiota, protects the host against invasion by pathogenic organisms; it produces anti-inflammatory metabolites, destroys toxins, prevents colonization of pathogens, and provokes an immune response (McCance & Huether, 2019; Norris, 2019). The intestinal epithelium is the first line of defense against pathogenic microbes and microbial agents, as it contains innate immune cells such as macrophages, dendritic cells, granulocytes, and mast cells, and has a role in T-cell responses (Günther, 2018; Haller, 2018; Pezoldt, Yang, Zou, et al., 2018; Strowig, Thiemann, & Diefenbach, 2018). In addition, Peyer's patches (gut-associated lymph tissue) also have a role in antigen processing and immune defense (McCance & Huether, 2019). Collectively, the gut microbiome serves the roles of protection and defense.



Gerontologic Considerations

Although an increased prevalence of several common GI disorders occurs in the older adult population, aging per se appears to have minimal direct effect on most GI functions, in large part because of the functional reserve of the GI tract. Normal physiologic changes of the GI system that occur with aging are identified in [Table 38-3](#). Careful assessment and monitoring of signs and symptoms related to these changes are imperative. Although irritable bowel symptoms decrease with aging, there seems to be an increase in many GI disorders of function and motility. Older adult patients frequently report dysphagia, anorexia, dyspepsia, and disorders of colonic function (Eliopoulos, 2018).

Assessment of the Gastrointestinal System

The nursing assessment of the GI system involves obtaining a focused health history and physical examination.

TABLE 38-3**Age-Related Changes in the Gastrointestinal System**

Structural Changes	Implications
Oral Cavity and Pharynx	
• Injury/loss or decay of teeth • Atrophy of taste buds • ↓ Saliva production • Reduced ptyalin and amylase in saliva	Difficulty chewing and swallowing
Esophagus	
• ↓ Motility and emptying • Weakened gag reflex • ↓ Resting pressure of lower esophageal sphincter	Reflux and heartburn
Stomach	
• Degeneration and atrophy of gastric mucosal surfaces with ↓ production of HCl • ↓ Secretion of gastric acids and most digestive enzymes • ↓ Gastric motility and emptying	Food intolerances, malabsorption, or ↓ vitamin B ₁₂ absorption
Small Intestine	
• Atrophy of muscle and mucosal surfaces • Thinning of villi and epithelial cells	↓ Motility and transit time, which lead to complaints of indigestion and constipation
Large Intestine	
• ↓ Mucus secretion • ↓ Elasticity of rectal wall • ↓ Tone of internal anal sphincter • Slower and duller nerve impulses in rectal area	↓ Motility and transit time, which lead to complaints of indigestion and constipation ↓ Absorption of nutrients (dextrose, fats, calcium, and iron) - Fecal incontinence

↓, decreased; HCl, hydrochloric acid.

Adapted from Eliopoulos, C. (2018). *Gerontological nursing* (9th ed.). Philadelphia, PA: Wolters Kluwer.

Health History

A focused GI assessment begins with a complete history. Information about abdominal pain, dyspepsia, gas, nausea and vomiting, diarrhea, constipation, fecal incontinence, jaundice, and previous GI disease is obtained (Weber & Kelley, 2018).

Common Symptoms

Common GI symptoms that may lead patients to seek health care referrals include pain, dyspepsia, gas, nausea and vomiting, diarrhea, and constipation.

Pain

Pain can be a major symptom of GI disease; in particular, abdominal pain is a frequent presenting problem in general practice (Babakhanlou, 2018). The character, duration, pattern, frequency, location, distribution of referred abdominal pain (Fig. 38-3), and time of the pain can vary greatly depending on the underlying cause. Other factors such as meals, rest, activity, and defecation patterns may directly affect this pain (Weber & Kelley, 2018).

Dyspepsia

Dyspepsia—upper abdominal discomfort associated with eating (commonly called *indigestion*)—is the most common symptom of patients with GI dysfunction. Indigestion is an imprecise term that refers to a host of upper abdominal or epigastric symptoms such as pain, discomfort, fullness, bloating, early satiety, belching, heartburn, or regurgitation. Annually, dyspepsia affects approximately 25% of Americans (Longstreth & Lacy, 2019) while gastroesophageal reflux disease (GERD), which increases with age and manifests with dyspepsia (most frequently with heartburn), affects approximately 20% of adults in western cultures (Antunes & Curtis, 2019). Typically, fatty foods cause the most discomfort because they remain in the stomach for digestion longer than proteins or carbohydrates. Salads, coarse vegetables, and highly seasoned foods may also cause considerable GI distress. In some cases, health care providers make a distinction between gastroesophageal reflux (GER) and GERD; GERD is the more serious and longer-lasting condition (Mayo Clinic, 2019).

Intestinal Gas

The accumulation of gas in the GI tract may result in belching (expulsion of gas from the stomach through the mouth) or flatulence (expulsion of gas from the rectum). Usually, gases in the small intestine pass into the colon and are released as flatus. Patients often complain of bloating, distention, or feeling “full of gas” with excessive flatulence as a symptom of food intolerance or gallbladder disease.

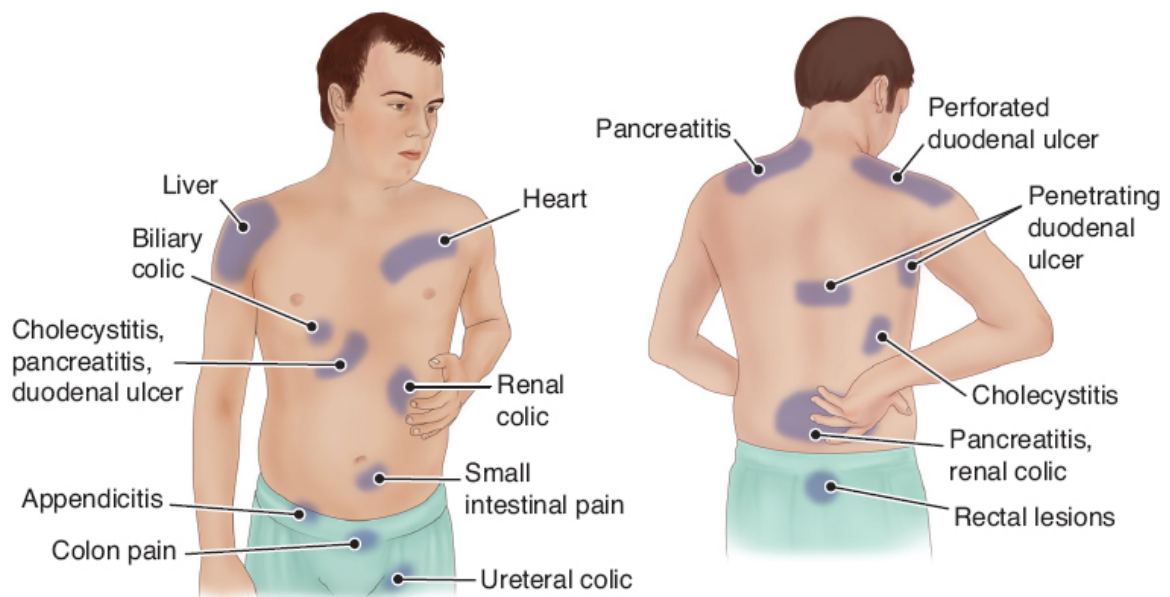


Figure 38-3 • Common sites of referred abdominal pain.

Nausea and Vomiting

Nausea is a vague, uncomfortable sensation of sickness or “queasiness” that may or may not be followed by vomiting. Distention of the duodenum or upper intestinal tract is a common cause of nausea; it may also be an early warning sign of a pathologic process. Nausea can be triggered by odors, activity, medications, or food intake. Vomiting is the forceful emptying of the stomach and intestinal contents through the mouth (McCance & Huether, 2019). The emesis, or vomitus, may vary in color and content and may contain undigested food particles, blood (hematemesis), or bilious material mixed with gastric juices. An acute onset of emesis that appears bright red or as coffee grounds is characteristic of a Mallory-Weiss tear (i.e., a laceration in the mucosal lining of the gastroesophageal junction) and indicates upper GI bleeding (Rich, 2018).

The causes of nausea and vomiting are many and may include visceral pain; motion or motion sickness; anxiety; several types of intestinal, vagal or sympathetic input including side effects of medications; and torsion or trauma of the ovaries, testes, uterus, bladder or kidney (McCance & Huether, 2019). Pathways for initiation of the vomiting reflex include medication therapy, metabolic abnormalities (chemoreceptor trigger zone), ingested toxins, chemotherapy, radiation therapy (vagal and splanchnic receptors), inner ear disorders, motion sickness (vestibular center), and anticipatory emesis (cerebral cortex) (Hainsworth, 2020).

Change in Bowel Habits and Stool Characteristics

Changes in bowel habits may signal colonic dysfunction or disease. Diarrhea, an abnormal increase in the frequency and liquidity of the stool or in daily stool weight or volume, commonly occurs when the contents move so rapidly

through the intestine and colon that there is inadequate time for the GI secretions and oral contents to be absorbed. This physiologic function is typically associated with abdominal pain or cramping and nausea or vomiting. Constipation—a decrease in the frequency of stool, or stools that are hard, dry, and of smaller volume than typical—may be associated with anal discomfort and rectal bleeding, and is a frequent reason patients seek health care referrals (see the Nursing Research Profile in [Chart 38-1](#)) (Shen, Zhu, Jiang, et al., 2018). See [Chapter 41](#) for further discussion of diarrhea and constipation.

The characteristics of the stool can vary greatly. Stool is normally light to dark brown; however, specific disease processes and ingestion of certain foods and medications may change the appearance of stool ([Table 38-4](#)). Blood in the stool can present in various ways and must be investigated. If blood is shed in sufficient quantities into the upper GI tract, it produces a tarry-black color (melena), whereas blood entering the lower portion of the GI tract or passing rapidly through it will appear bright or dark red. Lower rectal or anal bleeding is suspected if there is streaking of blood on the surface of the stool or if blood is noted on toilet tissue. Other common abnormalities in stool characteristics described by the patient may include:

- Bulky, greasy, foamy stools that are foul in odor and may or may not float
- Light gray or clay-colored stool, caused by a decrease or absence of conjugated bilirubin
- Stool with mucus threads or pus that may be visible on gross inspection of the stool
- Small, dry, rock-hard masses occasionally streaked with blood
- Loose, watery stool that may or may not be streaked with blood

Past Health, Family, and Social History

The nurse asks about the patient's normal toothbrushing and flossing routine; frequency of dental visits; awareness of any lesions or irritated areas in the mouth, tongue, or throat; recent history of sore throat or bloody sputum; discomfort caused by certain foods; daily food intake; the use of alcohol and tobacco, including smokeless chewing tobacco; and the need to wear dentures or a partial plate. For information about denture care, see [Chart 38-2](#).

Chart 38-1



NURSING RESEARCH PROFILE

Nurse-Led Educational Intervention for Patients with Functional Constipation

Shen, Q., Zhu, H., Jiang, G., et al. (2018). Nurse-led self-management educational intervention improves symptoms of patients with functional constipation. *Western Journal of Nursing Research*, 40(60), 874–888.

Purpose

Functional constipation (FC) is described as a persistent problem with defecation that may be characterized by a decrease in bowel movements, a feeling of incomplete bowel emptying post defecation, or difficulty having bowel movements. The purpose of the study was to investigate the effects of a self-management educational intervention on patients with FC and to compare outcomes to a control group that received routine nursing care.

Design

The pretest/posttest scores of *The Constipation Assessment Scale* and *The Constipation Cognition Scale* were collected on admission, discharge, and 1-month post discharge for 66 eligible participants who were randomly assigned to either an intervention group or a control group. Both groups received routine nursing care for constipation. In addition, the intervention group received the following support: visits from the multidisciplinary intervention team, dietary and lifestyle evaluation, education, assistance in developing a self-management plan, timely consultations and weekly group meetings both inpatient and outpatient, and the option to include family members in sessions. Patients in the intervention group were also encouraged to maintain a diary to document food and lifestyle choices. Members of the educational intervention team checked the diaries daily during hospitalization and provided follow-up via a phone call 1 week and then 1 month after discharge.

Findings

The constipation scores of all clinical symptoms were lower (improved) in the intervention group at 1 month after discharge ($p < 0.05$). Additionally, the intervention group had a higher number of patients with good health habits, including diet, exercise, and defecation habits, and proper use of laxatives ($p < 0.05$).

Nursing Implications

The findings of this study suggest that a multifaceted educational intervention can improve clinical symptoms and adherence behaviors, and promote healthy lifestyle choices in patients with FC. Nurses can apply findings to better manage FC, educate patients to improve outcomes, and tailor interventions to best meet the needs of this patient population.

TABLE 38-4 Foods and Medications That Alter Stool Color

Altering Substance	Color
Leafy green vegetables, spinach, kale	Green
Beets, red gelatin, tomato soup, food coloring	Red
Bismuth, iron, black licorice	Black
Barium	Milky white

Adapted from McEvoy, G. E. (Ed.). (2020). *AHFS Drug Information*®. Bethesda, MD: American Society of Health-System Pharmacists. *STAT!Ref Online Electronic Medical Library*. Retrieved on 2/14/2020 at: www.ahfsdruginformation.com/ahfs-drug-information; Wedro, B. (2019). Stool color, changes in color, texture, and form. *MedicineNet*. Retrieved on 1/14/2020 at: www.medicinenet.com/stool_color_changes/article.htm

Past and current medication use and any previous diagnostic studies, treatments, or surgery are noted. Current nutritional status is assessed via history; laboratory tests (complete metabolic panel including liver function studies, triglyceride, iron studies, and complete blood count [CBC]) are obtained. History of the use of tobacco and alcohol includes details about type, amount, length of use, and the date of discontinuation, if any. The nurse and patient discuss changes in appetite or eating patterns and any unexplained weight gain or loss over the past year. The nurse also asks questions about psychosocial, spiritual, or cultural factors that may be affecting the patient.

Physical Assessment

The physical examination includes assessment of the mouth, abdomen, and rectum and requires a good source of light, full exposure of the abdomen, warm hands with short fingernails, and a comfortable and relaxed patient with an empty bladder.

Oral Cavity Inspection and Palpation

Dentures should be removed to allow good visualization of the entire oral cavity.

Lips

The examination begins with inspection of the lips for moisture, hydration, color, texture, symmetry, and the presence of ulcerations or fissures. The lips should be moist, pink, smooth, and symmetric. The patient is instructed to open the mouth wide; a tongue blade is then inserted to expose the buccal mucosa for an assessment of color and lesions. Stensen duct of each parotid gland is visible as a small red dot in the buccal mucosa next to the upper molars.

Chart 38-2 HEALTH PROMOTION

Denture Care

- Brush dentures twice a day.
- Clean well under partial dentures, where food particles tend to get caught.
- Consume nonsticky foods that have been cut into small pieces; chew slowly.
- Remove dentures at night and soak them in water or a denture product. Never put dentures in hot water, because they may warp.
- Rinse mouth with warm salt water in the morning, after meals, and at bedtime.
- See dentist regularly to assess and adjust fit.

Gums

The gums are inspected for inflammation, bleeding, retraction, and discoloration. The odor of the breath is also noted. The hard palate is examined for color and shape.

Tongue

The dorsum (back) of the tongue is inspected for texture, color, and lesions. A thin white coat and large, vallate papillae in a “V” formation on the distal portion of the dorsum of the tongue are normal findings. The patient is instructed to protrude the tongue and move it laterally. This provides the examiner with an opportunity to estimate the tongue’s size as well as its symmetry and strength (to assess the integrity of the 12th cranial nerve [hypoglossal nerve]).

Further inspection of the ventral surface of the tongue and the floor of the mouth is accomplished by asking the patient to touch the roof of the mouth with the tip of the tongue. Any lesions of the mucosa or any abnormalities involving the frenulum or superficial veins on the undersurface of the tongue are assessed for location, size, color, and pain. This is a common area for oral cancer, which presents as a white or red plaque, lesions, ulcers, or nodules (Weber & Kelley, 2018).

A tongue blade is used to depress the tongue for adequate visualization of the pharynx. It is pressed firmly beyond the midpoint of the tongue; proper placement avoids a gagging response. The patient is told to tip the head back, open the mouth wide, take a deep breath, and say “ah.” Often, this flattens the posterior tongue and briefly allows a full view of the tonsils, uvula, and posterior pharynx. These structures are inspected for color, symmetry, and

evidence of exudate, ulceration, or enlargement. Normally, the uvula and soft palate rise symmetrically with a deep inspiration upon saying “ah”; this indicates an intact vagus nerve (10th cranial nerve).

A complete assessment of the oral cavity is essential because many disorders, such as cancer, diabetes, and immunosuppressive conditions resulting from medication therapy or acquired immunodeficiency syndrome, may be manifested by changes in the oral cavity, including stomatitis.

Abdominal Inspection, Auscultation, Percussion, and Palpation



The patient lies supine with knees flexed slightly for inspection, auscultation, percussion, and palpation of the abdomen. For the purposes of examination and documentation, the abdomen can be divided into either four quadrants or nine regions (Fig. 38-4).

Consistent use of one of these mapping methods results in a thorough evaluation of the abdomen and appropriate documentation. The four-quadrant method involves the use of an imaginary line drawn vertically from the sternum to the pubis through the umbilicus and a horizontal line drawn across the abdomen through the umbilicus. Inspection is performed first, noting skin changes, nodules, lesions, scarring, discolorations, inflammation, bruising, or striae. Lesions are of particular importance, because GI diseases often produce skin changes. The contour and symmetry of the abdomen are noted, and any localized bulging, distention, or peristaltic waves are identified. Expected contours of the anterior abdominal wall can be described as flat, rounded, or scaphoid.

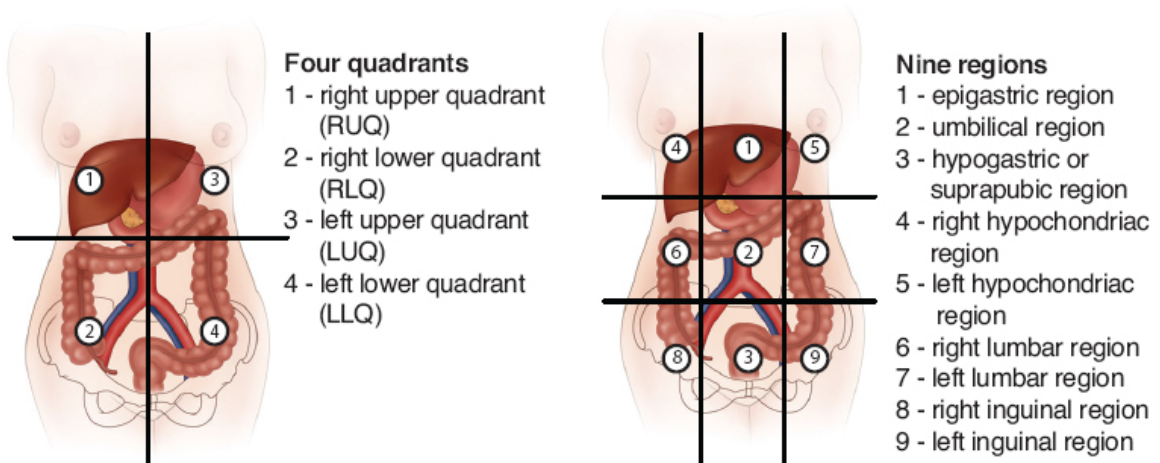


Figure 38-4 • Division of the abdomen into four quadrants or nine regions.

Auscultation always precedes percussion and palpation, because they may alter sounds. Auscultation is used to determine the character, location, and

frequency of bowel sounds and to identify vascular sounds. Bowel sounds are assessed using the diaphragm of the stethoscope for soft clicks and gurgling sounds (Weber & Kelley, 2018). The frequency and character of the sounds are usually heard as clicks and gurgles that occur irregularly and range from 5 to 30 per minute. Bowel sounds are designated as normal, hyperactive, hypoactive, or absent. The nurse should auscultate for a minimum of 5 minutes; listening for at least 1 minute in each quadrant to confirm the absence of bowel sounds (Weber & Kelley, 2018). Using the bell of the stethoscope, any bruits in the aortic, renal, iliac, and femoral arteries are noted. Friction rubs are high pitched and can be heard over the liver and spleen during respiration. Borborygmus (“stomach growling”) is heard as a loud prolonged gurgle.

Percussion is used to assess the size and density of the abdominal organs and to detect the presence of air-filled, fluid-filled, or solid masses. Percussion is used either independently or concurrently with palpation because it can validate palpation findings. All quadrants are percussed for overall tympani and dullness. Tympani is the sound that results from the presence of air in the stomach and small intestines; dullness is heard over organs and solid masses. The use of light palpation is appropriate for identifying areas of tenderness or muscular resistance, and deep palpation is used to identify masses. Testing for rebound tenderness is not performed by many examiners because it can cause severe pain; light percussion is used instead to produce a mild localized response when peritoneal irritation is present.

Rectal Inspection and Palpation

The final part of the examination is evaluation of the terminal portions of the GI tract, the rectum, perianal region, and anus. The anal canal is approximately 2.5 to 4 cm (1 to 1.6 inches) in length and opens into the perineum. Concentric rings of muscle, the internal and external sphincters, normally keep the anal canal securely closed. Gloves, water-soluble lubrication, a penlight, and drapes are necessary tools for the evaluation. Although the rectal examination is generally uncomfortable and often embarrassing for the patient, it is a mandatory part of every thorough examination. For women, the rectal examination may be part of the gynecologic examination. Positions for the rectal examination include knee-chest, left lateral with hips and knees flexed, or standing with hips flexed and upper body supported by the examination table. Most patients are comfortable on the right side with knees brought up to the chest. External examination includes inspection for lumps, rashes, inflammation, excoriation, tears, scars, pilonidal dimpling, and tufts of hair at the pilonidal area. The discovery of tenderness, inflammation, or both should alert the examiner to the possibility of a pilonidal cyst, perianal abscess, or anorectal fistula or fissure. The patient’s buttocks are carefully spread and visually inspected until the patient has relaxed the external sphincter control.

The patient is asked to bear down, thus allowing the ready appearance of fistulas, fissures, rectal prolapse, polyps, and internal hemorrhoids. Internal examination is performed with a gloved lubricated index finger inserted into the anal canal while the patient bears down. The tone of the sphincter is noted, as are any nodules or irregularities of the anal ring. Because this is an uncomfortable part of the examination for most patients, the patient is encouraged to focus on deep breathing and visualization of a pleasant setting during the brief examination.

Diagnostic Evaluation

GI diagnostic studies can confirm, rule out, stage, or diagnose various disease states, including cancer. After the diagnosis, time should be allotted for discussion with the patient, in addition to offering resource materials for information.

Many modalities are available for diagnostic assessment of the GI tract. The majority of these tests and procedures are performed on an outpatient basis in special settings designed for this purpose (e.g., endoscopy suite or GI laboratory). Preparation for many of these studies includes either a clear liquid or low residue diet, fasting, ingestion of a liquid bowel preparation, the use of laxatives or enemas, and ingestion or injection of a contrast agent or a radiopaque dye. These measures are poorly tolerated by some patients and are especially problematic in older adults or patients with comorbidities because bowel preparations can significantly alter the internal fluid and electrolyte balance. If further assessment or treatment is needed after any outpatient procedure, the patient may be admitted to the hospital.

Specific nursing interventions for each test are provided later in this chapter. General nursing interventions for the patient who is undergoing a GI diagnostic evaluation include:

- Establishing the need for more information
- Providing education to patients and families on the diagnostic test, and pre- and postprocedure restrictions and care
- Helping the patient cope with discomfort and alleviating anxiety
- Informing the primary provider of known medical conditions or abnormal laboratory values that may affect the procedure
- Assessing for adequate hydration before, during, and immediately after the procedure, and providing education about maintenance of hydration

Serum Laboratory Studies

Initial diagnostic tests begin with serum laboratory studies, including but not limited to CBC, complete metabolic panel, prothrombin time/partial thromboplastin time, triglycerides, liver function tests, amylase, and lipase; possibly, more specific studies may be indicated, such as carcinoembryonic antigen (CEA), cancer antigen (CA) 19-9, and alpha-fetoprotein, which are sensitive and specific for colorectal and hepatocellular carcinomas, respectively. CEA is a protein that is normally not detected in the blood of a healthy person; therefore, when detected it indicates that cancer is present, although not what type of cancer is present. CA 19-9 is also a protein that exists on the surface of certain cells and is shed by tumor cells, making it useful as a tumor marker to follow the course of the cancer. Tumor markers (e.g., mCEA and CA 19-9), along with other tests, are used in patients diagnosed with colorectal cancer to demonstrate the effectiveness of treatment or to provide an early warning that the cancer has returned (American Cancer Society [ACS], 2018).

Stool Tests

Basic examination of the stool includes inspecting the specimen for consistency, color, and occult (not visible) blood. Additional studies, including fecal urobilinogen, fecal fat, nitrogen, *Clostridium difficile*, fecal leukocytes, calculation of stool osmolar gap, parasites, pathogens, food residues, and other substances, require laboratory evaluation.

Stool samples are usually collected on a random basis unless a quantitative study (e.g., fecal fat, urobilinogen) is to be performed. Random specimens should be sent promptly to the laboratory for analysis; however, the quantitative 24- to 72-hour collections must be kept refrigerated until transported to the laboratory. Some stool collections require the patient to follow a specific diet or refrain from taking certain medications before the collection; patient education is important.

Guaiac-based fecal occult blood testing (gFOBT) is one of the most commonly performed stool tests. It can be useful in initial screening for several disorders, although it is used most frequently in early cancer detection programs. gFOBT can be performed at the bedside, in the laboratory, or at home. It is inexpensive, noninvasive, and carries minimal risk to the patient. However, it should not be performed when there is hemorrhoidal bleeding. Patients are advised to avoid ingesting red meats, aspirin, and nonsteroidal anti-inflammatory drugs for 72 hours prior to the study because it is thought that these factors are associated with false-positive results; likewise, patients are advised to avoid ingesting vitamin C from supplements or foods as it is believed that this is associated with false-negative results (ACS, 2019). A small amount of the specimen is applied to the guaiac-impregnated paper slide. If the test is performed at home, the patient mails the slide to the primary

provider or the lab in an envelope provided for that purpose. The ACS (2019) recommends using the highly sensitive versions of this type of test (e.g., fecal immunochemical test [FIT], FIT-fecal DNA test) for screening.

The FIT reacts to the human hemoglobin protein. The stool sample can be obtained at home, and dietary or medication restrictions are not required prior to collecting the stool specimen. This test is less likely to react to bleeding from other areas of the digestive tract and is done annually (ACS, 2019).

FIT-fecal DNA testing can detect abnormal sections of DNA from cancer or polyp cells (ACS, 2019). The Centers for Medicare & Medicaid Services approved this test for reimbursement and recommends performing the test every 3 years (Rex, Boland, Dominitz, et al., 2017). The FIT-fecal DNA test does not require any dietary or medication restrictions and can detect neoplasia anywhere in the colon.

Breath Tests

The hydrogen breath test was developed to evaluate carbohydrate absorption, in addition to aiding in the diagnosis of bacterial overgrowth in the intestine and short-bowel syndrome. This test determines the amount of hydrogen expelled in the breath after it has been produced in the colon (on contact of galactose with fermenting bacteria) and absorbed into the blood.

Urea breath tests detect the presence of *Helicobacter pylori*, the bacteria that can live in the mucosal lining of the stomach and cause peptic ulcer disease. After the patient ingests a capsule of carbon-labeled urea, a breath sample is obtained 10 to 20 minutes later. Because *H. pylori* metabolizes urea rapidly, the labeled carbon is absorbed quickly; it can then be measured as carbon dioxide in the expired breath to determine whether *H. pylori* is present. Prior to urea breath testing, the patient is instructed to avoid antibiotics or bismuth subsalicylate for 1 month before the test; proton pump inhibitors for 2 weeks before the test; and cimetidine and famotidine for 24 hours before the test (HealthLinkBC, 2018). *H. pylori* also can be detected by assessing serum antibody levels without requiring medication therapy adjustments.

Abdominal Ultrasonography

Ultrasonography is a noninvasive diagnostic technique in which high-frequency sound waves are passed into internal body structures, and the ultrasonic echoes are recorded on an oscilloscope as they strike tissues of different densities. It is particularly useful in the detection of an enlarged gallbladder or pancreas, the presence of gallstones, an enlarged ovary, an ectopic pregnancy, or appendicitis. Ultrasonography can be limited by patient body type, bowel gas patterns, and operator experience (Babakhanlou, 2018).

Advantages of abdominal ultrasonography include an absence of ionizing radiation, no noticeable side effects, relatively low cost, and almost immediate results. It cannot be used to examine structures that lie behind bony tissue, because bone prevents sound waves from traveling into deeper structures. Gas and fluid in the abdomen or air in the lungs also prevent transmission of ultrasound. An ultrasound produces no ill effects. However, some patients, such as pregnant women, have concerns regarding the energy emitted by the probe.

Endoscopic ultrasonography (EUS) is a specialized enteroscopic procedure that aids in the diagnosis of GI disorders by providing direct imaging of a target area. A small high-frequency ultrasonic transducer is mounted at the tip of the fiberoptic scope, which displays images that are of higher-quality resolution and definition than regular ultrasound imaging. EUS may be used to evaluate submucosal lesions, specifically their location and depth of penetration. In addition, EUS may aid in the evaluation of Barrett esophagus, portal hypertension, chronic pancreatitis, suspected pancreatic neoplasm, biliary tract disease, and changes in the bowel wall due to ulcerative colitis. Intestinal gas, bone, and thick layers of adipose tissue that hamper conventional ultrasonography are not problems when EUS is used.

Nursing Interventions

The patient is instructed to fast for 8 to 12 hours before ultrasound testing to decrease the amount of gas in the bowel. If gallbladder studies are being performed, the patient should eat a fat-free meal the evening before the test. If barium studies are to be performed, they should be scheduled after ultrasonography; otherwise, the barium could interfere with the transmission of the sound waves. Patients who receive moderate sedation are observed for about 1 hour to assess for level of consciousness, orientation, and ability to ambulate. Patients treated on an outpatient basis are given instructions regarding diet, activity, and how to monitor for complications (National Institute of Diabetes and Digestive and Kidney Diseases [NIDDK], 2017).

Genetic Testing

Researchers have refined methods for genetics risk assessment, preclinical diagnosis, and prenatal diagnosis to identify people who are at risk for certain GI disorders (e.g., gastric cancer, lactose deficiency, inflammatory bowel disease, colon cancer) ([Chart 38-3](#)). People who are identified as being at risk for certain GI disorders may choose to have genetic counseling to learn about the disease and options for preventing and treating the disease, and to receive support in coping with the situation. Lynch syndrome is inherited in an autosomal dominant manner and is associated with colonic and extracolonic cancers; 3% of new cases of colon cancer are attributed to Lynch syndrome

(Kohlmann & Gruber, 2018; Sinicrope, 2018). See [Chapter 6](#) for further discussion of genetic counseling.

Chart 38-3 **GENETICS IN NURSING PRACTICE**

Digestive and Gastrointestinal Disorders

Several digestive and gastrointestinal disorders are associated with genetic abnormalities. Some examples include:

Autosomal dominant:

- Hereditary diffuse gastric cancer
- Hereditary non-polyposis colorectal cancer (Lynch syndrome)
- Hirschsprung disease (aganglionic megacolon)

Autosomal recessive:

- Glucose galactose malabsorption
- Glycogen storage disease (von Gierke disease)
- Pompe disease
- Zellweger syndrome

Inheritance pattern includes autosomal dominant and autosomal recessive:

- Familial adenomatous polyposis

X-linked:

- Fabry disease

Inheritance pattern is not distinct; however, there is a genetic predisposition for the disease:

- Crohn's disease
- Type 1 diabetes
- Celiac disease
- Pancreatic cancer

Other genetic disorders that will impact the digestive and gastrointestinal system:

- Cleft lip and/or palate
- Cystic fibrosis

Nursing Assessments

Refer to [Chapter 4, Chart 4-2: Genetics in Nursing Practice: Genetic Aspects of Health Assessment](#)

Family History Assessment Related to Digestive and Gastrointestinal Disorders

- Careful family history assessment for other family members with a similar condition (e.g., cleft lip/palate, pyloric stenosis).
- Assess for other family members in several generations with early-onset colorectal cancer.
- Inquire about other family members with inflammatory bowel disease.

- Assess family history for other cancers (e.g., endometrial, ovarian, kidney).

Patient Assessment Specific to Digestive and Gastrointestinal Disorders

- Ask about bowel pattern and color of stool.
- Assess if patient experiences episodes of abdominal cramping, diarrhea, or dehydration.
- Assess for unexplained weight loss.
- Identify intolerance to specific foods (e.g., gluten, high-fat foods, lactose).
- Assess for prior history of liver disorders.

Assess for presence of other clinical conditions:

- With clefting—congenital heart defect, other birth defects suggestive of a genetic syndrome.
- With familial adenomatous polyposis—congenital hypertrophy of retinal pigment epithelium.

Genetics Resources

Cancer.Net, www.cancer.net

Celiac Disease Foundation, www.celiac.org

Crohn's & Colitis Foundation, www.ccfa.org

See [Chapter 6](#), [Chart 6-7](#) for components of genetic counseling.

Imaging Studies

Numerous minimally invasive and noninvasive imaging studies, including x-ray and contrast studies, computed tomography (CT) scan, magnetic resonance imaging (MRI) scan, positron emission tomography (PET) scan, scintigraphy (radionuclide imaging), and virtual colonoscopy are available today.

Upper Gastrointestinal Tract Study

An upper GI fluoroscopy delineates the entire GI tract after the introduction of a contrast agent. A radiopaque liquid (e.g., barium sulfate) is commonly used; however, thin barium, diatrizoate sodium (Hypaque), and at times water are used due to their low associated risks. The GI series enables the examiner to detect or exclude anatomic or functional disorders of the upper GI organs or sphincters. It also aids in the diagnosis of ulcers, varices, tumors, regional enteritis, and malabsorption syndromes. The procedure may be extended to examine the duodenum and small bowel (small-bowel follow-through). As the barium descends into the stomach, the position, patency, and caliber of the esophagus are visualized, enabling the examiner to detect or exclude any anatomic or functional derangement of that organ. Fluoroscopic examination

next extends to the stomach as its lumen fills with barium, allowing observation of stomach motility, thickness of the gastric wall, the mucosal pattern, patency of the pyloric valve, and the anatomy of the duodenum. Multiple x-ray images are obtained during the procedure, and additional images may be taken at intervals for up to 24 hours to evaluate the rate of gastric emptying. Small-bowel x-rays taken while the barium is passing through that area allow for observation of the motility of the small bowel. Obstructions, ileitis, and diverticula can also be detected.

Variations of the upper GI study include double-contrast studies and enteroclysis. The double-contrast method of examining the upper GI tract involves administration of a thick barium suspension to outline the stomach and esophageal wall, after which tablets that release carbon dioxide in the presence of water are given. This technique has the advantage of showing the esophagus and stomach in finer detail, permitting signs of early superficial neoplasms to be noted.

Enteroclysis is a very detailed, double-contrast study of the entire small intestine that involves the continuous infusion (through a duodenal tube) of 500 to 1000 mL of a thin barium sulfate suspension; after this, methylcellulose is infused through the tube. The barium and methylcellulose fill the intestinal loops and are observed continuously by fluoroscopy and viewed at frequent intervals as they progress through the jejunum and the ileum. Air may also be used, but methylcellulose is preferred as it is associated with enhanced visibility (Lampignano & Kendrick, 2018). This process (even with normal motility) can take up to 6 hours and can be quite uncomfortable for the patient. The procedure aids in the diagnosis of partial small-bowel obstructions or diverticula. After completion of the fluoroscopic component of the study, the patient may have a CT scan to assess for lesions or adhesions, and in this case an iodinated contrast media may be used (Lampignano & Kendrick, 2018).

Nursing Interventions

Instruction regarding dietary changes prior to the study may include a low residue or clear liquid diet, and nothing by mouth (*nil per os*; NPO) after midnight the night before the study. In addition, the patient is advised to not smoke or chew gum during the NPO period because these can increase gastric secretions and salivation (Lampignano & Kendrick, 2018). Polyethylene glycol (PEG)-based solutions are considered the most effective bowel cleansing preparatory agent; other agents include sodium phosphate, magnesium citrate, and preparations containing sodium picosulfate, citric acid, and magnesium oxide (Harrison & Hielkrem, 2016; Tan, Lin, Ma, et al., 2018). Typically, oral medications are withheld on the morning of the study and resumed that evening, but each patient's medication regimen should be evaluated on an individual basis. When a patient with insulin-dependent

diabetes is NPO, their insulin requirements will need to be adjusted accordingly (see [Chapter 46](#)).

Follow-up care is provided after the upper GI procedure to ensure that the patient has eliminated most of the ingested barium. Fluids may be increased to facilitate evacuation of stool and barium.

Lower Gastrointestinal Tract Study

Visualization of the lower GI tract is obtained after rectal installation of barium. The barium enema can be used to detect the presence of polyps, tumors, or other lesions of the large intestine and demonstrate any anatomic abnormalities or malfunctioning of the bowel. After proper preparation and evacuation of the entire colon, each portion of the colon may be readily observed. The procedure usually takes about 15 to 30 minutes, during which time x-ray images are obtained.

Other means for visualizing the colon include double-contrast studies and a water-soluble contrast study. These tests are still occasionally used because they are relatively inexpensive and simple. A double-contrast or air-contrast barium enema involves the instillation of a thicker barium solution, followed by the instillation of air. The patient may feel some cramping or discomfort during this process. This test provides a contrast between the air-filled lumen and the barium-coated mucosa, allowing easier detection of smaller lesions. CT colonography has replaced double-contrast barium enema for nearly all indicated GI disorders (Rex et al., 2017) (see later discussion).

If active inflammatory disease, fistulas, or perforation of the colon is suspected, a water-soluble iodinated contrast agent (e.g., diatrizoic acid [Gastrografin]) can be used. The procedure is the same as for a barium enema, but the patient must first be assessed for allergy to iodine or contrast agent. The contrast agent is eliminated readily after the procedure, so there is no need for postprocedure laxatives. Diarrhea may occur in some patients until the contrast agent has been totally eliminated.

Nursing Interventions

Preparation of the patient includes emptying and cleansing the lower bowel. This often necessitates a low residue diet 1 to 2 days before the test, a clear liquid diet and a laxative the evening before, NPO after midnight, and cleansing enemas until returns are clear the following morning. The nurse makes sure that barium enemas are scheduled before any upper GI studies. If the patient has active inflammatory disease of the colon, enemas are contraindicated. Barium enemas also are contraindicated in patients with signs of perforation or obstruction; instead, a water-soluble contrast study may be performed. Active GI bleeding may prohibit the use of laxatives and enemas.

Postprocedural patient education includes information about increasing fluid intake, evaluating bowel movements for evacuation of barium, and noting

increased number of bowel movements, because barium, due to its high osmolality, may draw fluid into the bowel, thus increasing the intraluminal contents and resulting in greater output.

Computed Tomography

A CT scan provides cross-sectional images of abdominal organs and structures. Multiple x-ray images are taken from numerous angles, digitized in a computer, reconstructed, and then viewed on a computer monitor. As the sensitivity and specificity of CT scans have increased in recent years, so has their use. Volume CT scanners (i.e., helical or spiral scanning) provide more accurate reconstruction of patient data into alternate planes, require shorter scan times, and have less artifact when compared to single slice scanning (Lampignano & Kendrick, 2018). CT is a valuable tool for detecting and localizing many inflammatory conditions in the colon, such as appendicitis, diverticulitis, regional enteritis, and ulcerative colitis, as well as evaluating the abdomen for diseases of the liver, spleen, kidney, pancreas, and pelvic organs, and structural abnormalities of the abdominal wall. The CT procedure is completely painless, but radiation doses are considerable. A CT scan may be performed with or without oral or intravenous (IV) contrast, but the enhancement of the study is greater with the use of a contrast agent. In patients at risk for complications from use of contrast, the radiologist and provider must be in agreement that the scan is medically necessary and that the benefits outweigh the risks (Yale School of Medicine, 2019).

Nursing Interventions

Common risks from IV contrast agents include allergic reactions and contrast-induced nephropathy (CIN); therefore, patients must be screened for these risks (Hossain, Costanzo, Cosentino, et al., 2018). Any allergies to contrast agents, iodine, or shellfish, the patient's current serum creatinine level, and pregnancy status in females must be determined before administration of a contrast agent. Patients allergic to the contrast agent may be premedicated with a corticosteroid and antihistamine.

The most effective ways to prevent CIN include careful selection of patients, maintaining hydration status, using newer contrast agents, and avoiding nephrotoxic agents pre- and postprocedure (Hossain et al., 2018).

Magnetic Resonance Imaging

MRI is used in gastroenterology to supplement ultrasonography and CT. This noninvasive technique uses magnetic fields and radio waves to produce images of the area being studied. The use of oral contrast agents to enhance the image has increased the application of this technique for the diagnosis of GI diseases.

It is useful in evaluating abdominal soft tissues as well as blood vessels, abscesses, fistulas, neoplasms, and other sources of bleeding.

The physiologic artifacts of heartbeat, respiration, and peristalsis may create a less-than-clear image; however, newer, fast-imaging MRI techniques help eliminate these physiologic motion artifacts. MRI is not totally safe for all people; having the patient complete a preprocedure MRI tool that screens for contraindications to MRI is required (Lampignano & Kendrick, 2018). Any ferromagnetic objects (metals that contain iron) can be attracted to the magnet and cause injury. Items that can be problematic or dangerous include jewelry, dental implants, paper clips, pens, keys, IV poles, clips on patient gowns, and oxygen tanks.



Quality and Safety Nursing Alert

MRI is contraindicated in patients with any device containing metal because the magnetic field could cause malfunction. MRI is also contraindicated for patients with internal metal devices (e.g., aneurysm clips), intraocular metallic fragments, or cochlear implants. Foil-backed skin patches (e.g., nicotine, nitroglycerin, scopolamine, clonidine) should be removed before an MRI because of the risk of burns; however, the patient's primary provider should be consulted before the patch is removed to determine whether an alternate form of the medication should be provided.

Nursing Interventions

Preprocedure patient education includes NPO status 6 to 8 hours before the study and removal of all jewelry and other metals. The patient and family are informed that the study may take 60 to 90 minutes; during this time, the technician will instruct the patient to take deep breaths at specific intervals. The close-fitting scanners used in many MRI facilities may induce feelings of claustrophobia, and the machine will make a knocking sound during the procedure. Patients may choose to wear a headset and listen to music or wear a blindfold during the procedure. Open MRIs that are less close fitting eliminate the claustrophobia that many patients experience; however, they produce lower-resolution images.

Positron Emission Tomography

PET scans produce images of the body by detecting the radiation emitted from radioactive substances. The radioactive substances are injected into the body IV and are usually tagged with radioactive isotopes of oxygen, nitrogen, carbon, or fluorine (Lampignano & Kendrick, 2018). These isotopes decay quickly, do not harm the body, have lower radiation levels than a typical x-ray

or CT scan, and are eliminated in the urine or feces. The scanner essentially “captures” where the radioactive substances are in the body, transmits information to a scanner, and produces a scan with “hot spots” for evaluation by the radiologist or oncologist.

Scintigraphy

Scintigraphy (radionuclide testing) relies on the use of radioactive isotopes (i.e., technetium, iodine, indium) to reveal displaced anatomic structures, changes in organ size, and the presence of neoplasms or other focal lesions such as cysts or abscesses. Scintigraphic scanning is also used to measure the uptake of tagged red blood cells and leukocytes. Tagging of red blood cells and leukocytes by injection of a radionuclide is performed to define areas of inflammation, abscess, blood loss, or neoplasm. A sample of blood is removed, mixed with a radioactive substance, and reinjected into the patient. Abnormal concentrations of blood cells are then detected at 24- and 48-hour intervals. Tagged red cell studies are useful in determining the source of internal bleeding when all other studies have returned a negative result.

Gastrointestinal Motility Studies

Radionuclide testing also is used to assess gastric emptying and colonic transit time. During gastric emptying studies, the liquid and solid components of a meal (typically scrambled eggs) are tagged with radionuclide markers. After ingestion of the meal, the patient is positioned under a scintiscanner, which measures the rate of passage of the radioactive substance from the stomach (Parkman, 2018). This is useful in diagnosing disorders of gastric motility, diabetic gastroparesis, and dumping syndrome.

Colonic transit studies are used to evaluate colonic motility and obstructive defecation syndromes. The patient is given a capsule containing 20 radionuclide markers and instructed to follow a regular diet and usual daily activities. Abdominal x-rays are taken every 24 hours until all markers are passed. This process usually takes 4 to 5 days; in the presence of severe constipation it may take as long as 10 days. Patients with chronic diarrhea may be evaluated at 8-hour intervals. The amount of time that it takes for the radioactive material to move through the colon indicates colonic motility.

Endoscopic Procedures

Endoscopic procedures used in GI tract assessment include fibroscopy/esophagogastroduodenoscopy (EGD), colonoscopy, anoscopy, proctoscopy, sigmoidoscopy, small-bowel enteroscopy, and endoscopy through an ostomy.

Upper Gastrointestinal Fibroscopy/Esophagogastroduodenoscopy

Fibroscopy of the upper GI tract allows direct visualization of the esophageal, gastric, and duodenal mucosa through a lighted endoscope (gastroscope) (Fig. 38-5). EGD is valuable when esophageal, gastric, or duodenal disorders or inflammatory, neoplastic, or infectious processes are suspected. This procedure also can be used to evaluate esophageal and gastric motility and to collect secretions and tissue specimens for further analysis.



Figure 38-5 • Patient undergoing gastroscopy.

In EGD, the gastroenterologist views the GI tract through a viewing lens and can obtain images through the scope to document findings. Electronic video endoscopes also are available that attach directly to a video processor, converting the electronic signals into pictures that are projected on a screen. This allows larger and continuous viewing capabilities, as well as the simultaneous recording of the procedure.

PillCam ESO, or capsule endoscopy, requires that the patient swallows a capsule that travels by peristalsis through the small intestines. The capsule contains an oxide metal silicon chip video camera, which transmits digital images of the GI mucosa to a data recorder that is worn on the patient's waist. This technology is a diagnostic option for patients with esophageal diseases who cannot tolerate an EGD (Park, Cho, & Kim, 2018). Capsule colonoscopy is FDA approved for patients with previous incomplete colonoscopies, and for those who are not candidates for colonoscopies or sedation (Rex et al., 2017).

Endoscopic retrograde cholangiopancreatography (ERCP) uses the endoscope in combination with x-rays to view the bile ducts, pancreatic ducts,

and gallbladder (MedlinePlus, 2019). The side-viewing flexible scopes are used to visualize the common bile duct and the pancreatic and hepatic ducts through the ampulla of Vater in the duodenum. ERCP is helpful in evaluating jaundice, pancreatitis, pancreatic tumors, common bile duct stones, and biliary tract disease. Current trends show an increase in ERCP use for therapeutic indications (sphincterotomy, stone removal, and biliary stenting), with a decline in its use for conventional diagnostic testing (Ahmed, Kanotra, Savani, et al., 2017). ERCP is described further in [Chapter 44](#).

Upper GI fibroscopy also can be a therapeutic procedure when combined with other procedures. Therapeutic endoscopy can be used to remove common bile duct stones, dilate strictures, and treat gastric bleeding and esophageal varices. Laser-compatible scopes can be used to provide laser therapy for upper GI neoplasms. Sclerosing solutions can be injected through the scope in an attempt to control upper GI bleeding.

After the patient is sedated, the endoscope is lubricated with a water-soluble lubricant and passed smoothly and slowly along the back of the mouth and down into the esophagus. The gastroenterologist views the gastric wall and the sphincters and then advances the endoscope into the duodenum for further examination. Biopsy forceps to obtain tissue specimens or cytology brushes to obtain cells for microscopic study can be passed through the scope. The procedure usually takes about 30 minutes.

The patient may experience nausea, gagging, or choking. The use of topical anesthetic agents and moderate sedation makes it important to monitor and maintain the patient's oral airway during and after the procedure. Finger or ear oximeters are used to monitor oxygen saturation, and supplemental oxygen may be given if needed. Precautions must be taken to protect the scope, because the fiberoptic bundles can be broken if the scope is bent at an acute angle. The patient wears a mouth guard to keep from biting the scope.

Nursing Interventions

The patient should be NPO for 8 hours prior to the examination. Before the introduction of the endoscope, the patient is given a local anesthetic gargle or spray. Midazolam, a sedative that provides moderate sedation with loss of the gag reflex and relieves anxiety during the procedure, is given. Atropine may be given to reduce secretions, and glucagon may be given to relax smooth muscle. The patient is positioned in the left lateral position to facilitate clearance of pulmonary secretions and provide smooth entry of the scope.

After gastroscopy, assessment includes level of consciousness, vital signs, oxygen saturation, pain level, and monitoring for signs of perforation (i.e., pain, bleeding, unusual difficulty swallowing, rapidly elevated temperature). Temporary loss of the gag reflex is expected; after the patient's gag reflex has returned, lozenges, saline gargle, and oral analgesic agents may be offered to relieve minor throat discomfort. Patients who were sedated for the procedure

must remain in bed until fully alert. After moderate sedation, the patient must be transported home with a family member or friend if the procedure was performed on an outpatient basis. Someone should stay with the patient until the morning after the procedure. Because of sedation, many patients will not remember postprocedure instructions. For this reason, discharge and follow-up verbal and written instructions are provided to the person accompanying the patient home, as well as to the patient. In addition, many endoscopy suites have a program in which a nurse telephones the patient the morning after the procedure to find out if the patient has any concerns or questions related to the procedure.

Fiberoptic Colonoscopy

Historically, direct visualization of the bowel was the only means to evaluate the colon, but virtual colonoscopy (also known as CT colonography) is now available. Advantages include less risk for perforation when compared to colonoscopy; however, the need for bowel preparation is considered a disadvantage (Rex et al., 2017).

Direct visual inspection of the large intestine (anus, rectum, sigmoid, transcending and ascending colon) is possible by means of a flexible fiberoptic colonoscope (Fig. 38-6). These scopes have the same capabilities as those used for EGD but are larger in diameter and longer. Still and video recordings can be used to document the procedure and findings.

This procedure is used commonly as a diagnostic aid and screening device. It is most frequently used for cancer screening and for surveillance in patients with previous colon cancer or polyps. (See [Chapter 12](#), [Table 12-3](#) for details on the ACS's screening guidelines.) In addition, tissue biopsies can be obtained as needed, and polyps can be removed and evaluated. Other uses of colonoscopy include the evaluation of patients with diarrhea of unknown cause, occult bleeding, or anemia; further study of abnormalities detected on barium enema; and diagnosis, clarification, and determination of the extent of inflammatory or other bowel disease.

The procedure can be used to remove all visible polyps with a special snare and cautery through the colonoscope. Many colon cancers begin with adenomatous polyps of the colon; therefore, one goal of colonoscopic polypectomy is early detection and prevention of colorectal cancer. This procedure also can be used to treat areas of bleeding or stricture. The use of bipolar and unipolar coagulators and heater probes, as well as injections of sclerosing agents or vasoconstrictors, is possible during this procedure. Laser-compatible scopes provide laser therapy for bleeding lesions or colonic neoplasms. Bowel decompression (removal of intestinal contents to prevent gas and fluid from distending the coils of the intestine) can also be completed during the procedure.

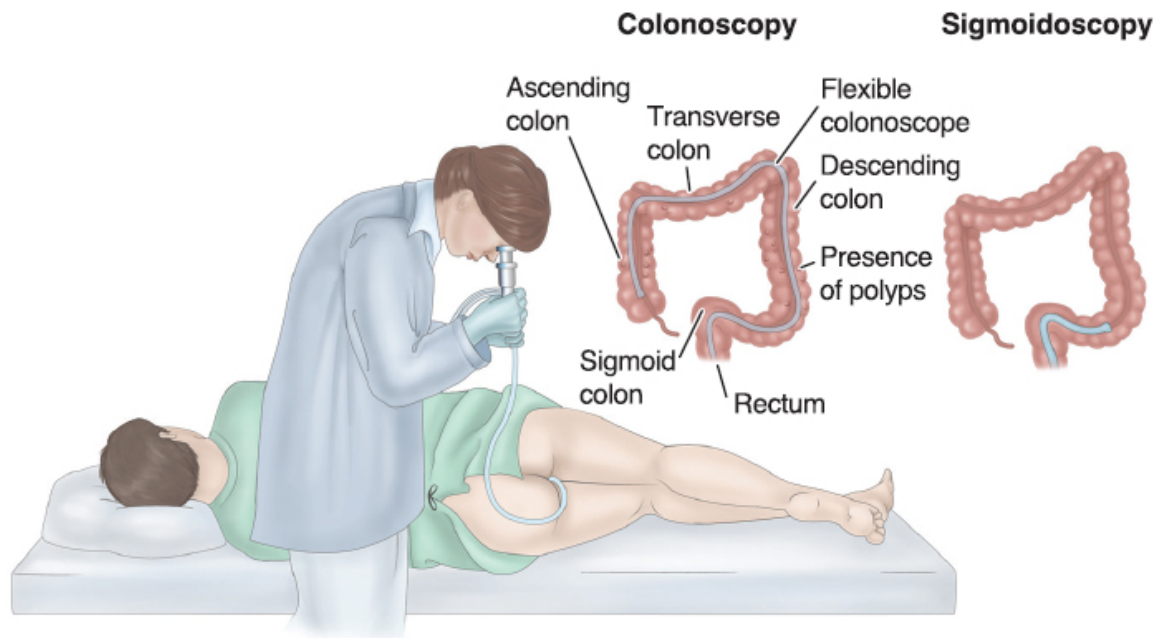


Figure 38-6 • Colonoscopy and flexible fiberoptic sigmoidoscopy. For the colonoscopy, the flexible scope is passed through the rectum and sigmoid colon into the descending, transverse, and ascending colon. For the flexible fiberoptic sigmoidoscopy, the flexible scope is advanced past the proximal sigmoid and then into the descending colon.

Colonoscopy is performed while the patient is lying on the left side with the legs drawn up toward the chest. The patient's position may be changed during the test to facilitate advancement of the scope. Biopsy forceps or a cytology brush may be passed through the scope to obtain specimens for histology and cytology examinations. Complications during and after the procedure can include cardiac arrhythmias and respiratory depression resulting from the medications given, vasovagal reactions, and circulatory overload or hypotension resulting from overhydration or underhydration during bowel preparation. The patient's cardiac and respiratory function and oxygen saturation are monitored continuously, with supplemental oxygen used as necessary. Typically, the procedure takes about 1 hour, and postprocedure discomfort results from instillation of air to expand the colon and insertion and movement of the scope during the procedure.

Capsule colonoscopy is another option for patients who cannot tolerate colonoscopy or for patients with incomplete colonoscopies. This minimally invasive test consists of an ingestible capsule with a two-sided camera (similar to the PillCam ESO). This test requires that the patient completes a more extensive bowel preparation than required for a colonoscopy; patients with a positive test then require a follow-up colonoscopy on a separate day (Rex et al., 2017).

Nursing Interventions

The success of colonoscopy depends on how well the colon is prepared (Tariq, Kamal, Sapkota, et al., 2019). Adequate colon cleansing provides optimal visualization and decreases the time needed for the procedure. Cleansing of the colon can be accomplished in various ways. The primary provider may prescribe a laxative for two nights before the examination and a Fleet or saline enema until the return is clear the morning of the test. However, more commonly, PEG electrolyte lavage solutions (GoLYTELY, CoLyte, and NuLYTELY) are used for effective cleansing of the bowel. Current preparations include either the nonsplit dose regimen, in which the entire solution is ingested the night before the procedure, or the split-dose regimen, in which half of the dose is ingested the night before and half is ingested the morning of the procedure, 3 hours prior to the scheduled test. Tariq et al. (2019) report improved bowel preparation and cleansing with the split prep.

Patient health history and comorbidities such as diabetes, chronic constipation, or history of opioid use, or problematic colonoscopies influence patient preparation. Preprocedure diet instructions include a clear liquid or a low residue diet starting the day before the procedure; diet type has not been shown to affect bowel preparation in patients ingesting the split preparations (Tariq et al., 2019). If necessary, the nurse can give the solution through a feeding tube if the patient cannot swallow. Patients with a colostomy can receive this same bowel preparation. The use of lavage solutions is contraindicated in patients with intestinal obstruction or inflammatory bowel disease.

A sodium phosphate tablet (OsmoPrep, Visicol) can be used for colon cleansing prior to colonoscopy. Dosing consists of 32 tablets: 20 tablets (4 tablets every 15 minutes) with 8 oz of any clear liquid (water, any clear carbonated beverage, or juice) on the evening prior to the examination, and 12 tablets (taken in the same manner) on the morning of the examination.

With the use of lavage solutions, bowel cleansing is fast (rectal effluent is clear in about 4 hours) and is tolerated fairly well by most patients. Side effects of the electrolyte solutions include nausea, bloating, cramps or abdominal fullness, fluid and electrolyte imbalance, and hypothermia (patients are often told to drink the preparation as cold as possible to make it more palatable). The side effects are especially problematic for older adults, and sometimes they have difficulty ingesting the required volume of solution. Monitoring older patients after a bowel preparation is especially important because their physiologic ability to compensate for fluid loss is diminished. Many older adults take multiple medications each day; therefore, the nurse's knowledge of their daily medication regimen can prompt assessment for and prevention of potential problems and early detection of physiologic changes.

Additionally, the nurse advises the patient with diabetes to consult with their primary provider about medication adjustment to prevent hyperglycemia

or hypoglycemia resulting from the dietary modifications required in preparing for the test. The nurse also instructs all patients, especially older adults, to maintain adequate fluid, electrolyte, and caloric intake while undergoing bowel cleansing.

Special precautions must be taken for some patients. Implantable defibrillators and pacemakers are at high risk for malfunction if electrosurgical procedures (i.e., polypectomy) are performed in conjunction with colonoscopy. A cardiologist should be consulted before the test is performed for device management. These patients require careful cardiac monitoring during the procedure (American Society of Anesthesiology Taskforce, 2020; Neubauer, Wellman, Herzog-Niescery, et al., 2018).

Colonoscopy cannot be performed if there is a suspected or documented colon perforation, acute severe diverticulitis, or acute colitis. Patients with prosthetic heart valves or a history of endocarditis require prophylactic antibiotics before the procedure.

Informed consent is obtained by the practitioner before the patient is sedated. Before the examination, an opioid analgesic agent or sedative (e.g., midazolam) is given to provide moderate sedation and relieve anxiety during the procedure. Glucagon may be given, if needed, to relax the colonic musculature and to reduce spasm during the test. Patients who are older or debilitated may require a reduced dosage of the analgesic agent or sedative to decrease the risks of oversedation and cardiopulmonary complications.

During the procedure, the patient is monitored for changes in oxygen saturation, vital signs, color and temperature of the skin, level of consciousness, abdominal distention, vagal response, and pain intensity. After the procedure, patients are maintained on bed rest until fully alert. Some patients have abdominal cramps caused by increased peristalsis stimulated by the air insufflated into the bowel during the procedure.

Immediately after the test, the patient is monitored for signs and symptoms of bowel perforation (e.g., rectal bleeding, abdominal pain or distention, fever, focal peritoneal signs). Because of the amnesic effects of midazolam, the patient may be unable to recall verbal information and should receive written instructions. If the procedure is performed on an outpatient basis, someone must transport the patient home. After a therapeutic procedure, the nurse instructs the patient to report any bleeding to the primary provider.

Anoscopy, Proctoscopy, and Sigmoidoscopy

Endoscopic examination of the anus, rectum, and sigmoid and descending colon is used to evaluate chronic diarrhea, fecal incontinence, ischemic colitis, and lower GI hemorrhage and to observe for ulceration, fissures, abscesses, tumors, polyps, or other pathologic processes.

The flexible fiberoptic sigmoidoscope (see [Fig. 38-6](#)) permits the colon to be examined up to 40 to 50 cm (16 to 20 inches) from the anus, much more

than the 25 cm (10 inches) that can be visualized with the rigid sigmoidoscope. It has many of the same capabilities as the scopes used for the upper GI study, including the use of still or video images to document findings.

For flexible scope procedures, the patient assumes a comfortable position on the left side with the right leg bent and placed anteriorly. It is important to keep the patient informed throughout the examination and to explain the sensations associated with it. Biopsies and polypectomies can be performed during this procedure. Biopsy is performed with small biting forceps introduced through the endoscope; one or more small pieces of tissue may be removed. If polyps are present, they may be removed with a wire snare, which is used to grasp the pedicle, or stalk. An electrocoagulating current is then used to sever the polyp and prevent bleeding. It is extremely important that all excised tissue be placed immediately in moist gauze or in an appropriate receptacle, labeled correctly, and delivered without delay to the pathology laboratory for examination.

Nursing Interventions

These examinations require only limited bowel preparation, including a warm tap water or Fleet enema until returns are clear. Dietary restrictions usually are not necessary, and sedation usually is not required. During the procedure, the nurse monitors vital signs, skin color and temperature, pain tolerance, and vagal response. After the procedure, the nurse monitors the patient for rectal bleeding and signs of intestinal perforation (i.e., fever, rectal drainage, abdominal distention, pain). On completion of the examination, the patient can resume regular activities and diet.

Small Bowel Studies

Several methods are available for visualization of the small intestine, including capsule endoscopy and double-balloon enteroscopy. Capsule endoscopy allows the noninvasive visualization of the mucosa throughout the entire small intestine. It is particularly useful in the evaluation of obscure GI bleeding. The technique consists of the patient swallowing a capsule embedded with a wireless miniature camera, a light source, and an image transmission system. The capsule is the size of a large vitamin pill. It is propelled through the intestine by peristalsis. Images are transmitted from the end of the capsule to a recording device worn by the patient. The capsule allows for inspection of the small intestine without patient discomfort (Yamamoto & Aabakken, 2019).

Double-balloon enteroscopy has made it possible to visualize the mucosa of the entire small bowel as well as carry out diagnostic and therapeutic interventions (Yamamoto & Aabakken, 2019). This endoscope is comprised of two balloons, one attached to the distal end of the scope and the other attached to the transparent overtube that slides over the endoscope. The endoscope is advanced alternately inflating and deflating the balloons; this causes

telescoping of the small intestine onto the overtube. As a result of this telescoping, the endoscope can visualize much more of the small intestine than the length of the scope itself. The procedure takes between 1 and 3 hours and requires moderate sedation. Nursing interventions are similar to those for other endoscopic procedures.

Endoscopy through an Ostomy

Endoscopy through an ostomy stoma is useful for visualizing a segment of the small or large intestine and may be indicated to evaluate the anastomosis for recurrent disease, or to visualize and treat bleeding in a segment of the bowel. Nursing interventions are similar to those for other endoscopic procedures.

Manometry and Electrophysiologic Studies

Manometry and electrophysiologic studies are methods for evaluating patients with GI motility disorders. The manometry test measures changes in intraluminal pressures and the coordination of muscle activity in the GI tract with the pressures transmitted to a computer analyzer.

Esophageal manometry is used to detect motility disorders of the esophagus and the upper and lower esophageal sphincter. Also known as esophageal motility studies, these studies are very helpful in the diagnosis of achalasia (i.e., absence of peristalsis), diffuse esophageal spasm, scleroderma, and other esophageal motor disorders. The patient must refrain from eating or drinking for 8 to 12 hours before the test. Medications that could have a direct effect on motility (e.g., calcium channel blockers, anticholinergic agents, sedatives) are withheld for 24 to 48 hours. A pressure-sensitive catheter is inserted through the nose and is connected to a transducer and a video recorder. The patient then swallows small amounts of water while the resultant pressure changes are recorded. Evaluation of a patient for GERD typically includes esophageal manometry.

Gastroduodenal, small intestine, and colonic manometry procedures are used to evaluate delayed gastric emptying and gastric and intestinal motility disorders such as irritable bowel syndrome or atonic colon. This is often an ambulatory outpatient procedure lasting 24 to 72 hours. Anorectal manometry measures the resting tone of the internal anal sphincter and the contractibility of the external anal sphincter. It is helpful in evaluating patients with chronic constipation or fecal incontinence and is useful in biofeedback for the treatment of fecal incontinence. It can be performed in conjunction with rectal sensory functioning tests. Dibasic sodium (Phospho-soda) or a saline cleansing enema is given 1 hour before the test, and positioning for the test is either the prone or the lateral position.

Rectal sensory function studies are used to evaluate rectal sensory function and neuropathy. A catheter and balloon are passed into the rectum, with

increasing balloon inflation until the patient feels distention. Then the tone and pressure of the rectum and anal sphincter are measured. The results are especially helpful in the evaluation of patients with chronic constipation, diarrhea, or incontinence.

Electrogastrography, an electrophysiologic study, also may be performed to assess gastric motility disturbances and can be useful in detecting motor or nerve dysfunction in the stomach. Electrodes are placed over the abdomen, and gastric electrical activity is recorded for up to 24 hours. Patients may exhibit rapid, slow, or irregular waveform activity.

Defecography measures anorectal function and is performed with very thick barium paste instilled into the rectum. Fluoroscopy is used to assess the function of the rectum and anal sphincter while the patient attempts to expel the barium. The test requires no preparation. The nurse educates the patient about what to expect during these procedures.

Gastric Analysis, Gastric Acid Stimulation Test, and pH Monitoring

Analysis of the gastric juice yields information about the secretory activity of the gastric mucosa and the presence or degree of gastric retention in patients thought to have pyloric or duodenal obstruction. It is also useful for diagnosing Zollinger-Ellison syndrome or atrophic gastritis.

The patient is NPO for 8 to 12 hours before the procedure. Any medications that affect gastric secretions are withheld for 24 to 48 hours before the test. Smoking is not allowed on the morning of the test because it increases gastric secretions. A small nasogastric tube with a catheter tip marked at various points is inserted through the nose. When the tube is at a point slightly less than 50 cm (21 inches), it should be within the stomach, lying along the greater curvature. Once in place, the tube is secured to the patient's cheek and the patient is placed in a semireclining position. The entire stomach contents are aspirated by gentle suction into a syringe, and gastric samples are collected every 15 minutes for the next hour.

Important diagnostic information to be gained from gastric analysis includes the ability of the mucosa to secrete HCl. This ability is altered in various disease states, including:

- *Pernicious anemia*: Patients with this disease secrete no acid under basal conditions or after stimulation.
- *Severe chronic atrophic gastritis or gastric cancer*: Patients with these diseases secrete little or no acid.
- *Gastric ulcer*: Patients with this disease secrete some acid.
- *Duodenal ulcers*: Patients with this disease usually secrete an excess amount of acid.

The gastric acid stimulation test usually is performed in conjunction with gastric analysis. Histamine or pentagastrin is given subcutaneously to stimulate gastric secretions. It is important to inform the patient that this injection may produce a flushed feeling. The nurse monitors the patient's blood pressure and pulse frequently to detect hypotension. Gastric specimens are collected after the injection every 15 minutes for 1 hour and are labeled to indicate the time of specimen collection after histamine injection. The volume and pH of the specimen are measured; in certain instances, cytologic study by the Papanicolaou technique may be used to determine the presence or absence of malignant cells.

Esophageal reflux of gastric acid may be diagnosed and evaluated by ambulatory pH monitoring (Triadafilopoulos, Zikos, Regalia, et al., 2018). The patient is NPO for 6 hours before the test. A sensor that measures pH is inserted and positioned via endoscopy. The sensor is then connected to an external recording device and is worn for 24 hours while the patient continues usual daily activities. The result is a computer analysis and graphic display of the results.

The Bravo pH monitoring system offers the advantage of pH monitoring of the esophagus without the transnasal catheter. The clinician, by means of endoscopy, attaches a capsule (approximately the size of a gel cap) to the patient's esophageal wall. Data related to pH are transmitted from the capsule to a pager-sized receiver that the patient wears. Data are collected for up to 96 hours and then downloaded and analyzed. The capsule spontaneously detaches from the esophagus in 7 to 10 days and then is passed through the patient's digestive system. The accuracy of this method of pH testing is greater than methods in which a catheter is used because the patient can eat normally and continue typical activities during the testing. The patient is evaluated for both acid reflux and nonacid reflux events (Medtronic, 2019).

Laparoscopy (Peritoneoscopy)

With the tremendous advances in minimally invasive surgery, diagnostic laparoscopy is efficient, cost-effective, and useful in the diagnosis of GI disease. After a pneumoperitoneum (injecting carbon dioxide into the peritoneal cavity to separate the intestines from the pelvic organs) is created, a small incision is made lateral to the umbilicus, allowing for the insertion of the fiberoptic laparoscope. This permits direct visualization of the organs and structures within the abdomen, permitting visualization and identification of any growths, anomalies, and inflammatory processes. In addition, biopsy samples can be taken from the structures and organs as necessary. This procedure can be used to evaluate peritoneal disease, chronic abdominal pain, abdominal masses, and gallbladder and liver disease. However, laparoscopy has not become an important diagnostic modality in patients with acute

abdominal pain, because less invasive tools (e.g., CT and MRI scans) are readily available. Laparoscopy usually requires general anesthesia and sometimes requires that the stomach and bowel be decompressed. Gas (usually carbon dioxide) is insufflated into the peritoneal cavity to create a working space for visualization. One of the benefits of this procedure is that after visualization of a problem, excision (e.g., removal of the gallbladder) can then be performed at the same time, if appropriate.

CRITICAL THINKING EXERCISES

1  You are caring for a 45-year-old woman recently admitted to the emergency department (ED) with new onset of right upper quadrant pain with radiation to the mid-upper back, accompanied by nausea and bloating. The symptoms began several hours after the patient ate lunch, which included several fatty foods. The patient's past medical history is unremarkable. Identify questions that you should ask when taking the patient's history. What are your priority assessments? What diagnostic tests would you expect? While in the ED, the patient reports that the pain has increased in intensity, and abdominal guarding and temperature elevation are noted. Given these new developments, what questions will you now ask and what are your priority assessments?

2  A 50-year-old man presents to the ED with midsternal chest discomfort, nausea, and diaphoresis. He has a history of elevated cholesterol, which is managed with an oral medication. You recognize the symptoms of a potential cardiac or gastrointestinal condition. Given the urgency of the evolving situation, which members of the health care team do you anticipate will participate in the care of this patient? How can you best coordinate care to assure positive patient outcomes?

REFERENCES

*Asterisk indicates nursing research

Books

- Antunes, C., & Curtis, S. A. (2019). Gastroesophageal reflux disease. *NCBI Bookshelf StatPearls*. Treasure Island, FL: StatPearls Publishing. Retrieved on 11/4/2019 at: www.ncbi.nlm.nih.gov/books/NBK441938
- Eliopoulos, C. (2018). *Gerontological nursing* (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.