FUNCTION OF THE LARGE INTESTINE

FUNCTIONAL ANATOMY The large intestine (colon) is a wide (6 cm, or 2.5 in) and short (120 cm, or 4 ft) tube extending between the small intestine and the rectum. The large intestine processes the remaining undigested chyme into feces (stools), a relatively solid and bulky material that can be excreted at intervals. In doing so, the colon absorbs water and conducts specific movements, some of which enable fecal excretion in appropriate intervals. The colon wall contains many exocrine glands that secrete a viscous mucus to help mold the feces and protect the colon wall from mechanical damage that could result from the flow of the solid contents.

The unidirectional ileocecal valve, which connects the ileum of the small intestine with the cecum of the large intestine, performs two functions: (1) it permits discontinuous delivery of chyme to the large intestine, allowing time for the colon to perform its functions, and (2) it prevents bacteria from penetrating the normally clean small intestine. The cecum and its vestigial extension, the appendix, contain a high concentration of bacteria. A gastroileal reflex controls the ileocecal valve. Increase in gut motility occurring after meals relaxes the valve; colon distension inhibits it. Occasional peristaltic waves are responsible for the valve's periodic opening. After the cecum, the colon consists of the ascending, transverse, descending, and sigmoid segments. The ascending and transverse colons are the sites of absorption and secretory activities. Absorption of water dehydrates the colon content, facilitating the formation of solid fecal matter. The descending and sigmoid colons are the sites of storage of fecal matter.

The sigmoid colon joins with the rectum, a muscular cavity functioning in short-term storage of feces and in stimulation of defecation (fecal excretion, bowel movement). The anus is the end organ of the digestive tract. It is a sphincter system, consisting of an internal smooth muscle sphincter and an external striated muscle sphincter, designed for both involuntary and voluntary control of defecation.

ABSORPTION OF SODIUM, WATER, AND VITAMINS; SECRETION OF POTASSIUM. To form solid feces, the remaining chyme entering the colon must be dehydrated. This is achieved by absorption of water across the colonic surface epithelium. The absorption of this water is important in the body's water economy because about 2 L of water are absorbed daily in the colon. Water absorption occurs in an obligatory manner by osmosis following the active absorption of sodium. Potassium, however, is secreted in the large intestine, creating a major problem of potassium depletion during severe diarrhea (see plate 77). Nutrients such as glucose and amino acids are not absorbed in the colon, but certain vitamins and drugs can be efficiently absorbed (hence drug administration by rectal suppositories). The slow rate of feces movement in the colon permits the bacteria inhabiting the large intestine to digest the unused cellulose and other fibers, grow, and proliferate. Therefore, as the colon content moves toward the rectum, the mass of the solids of dietary origin gradually diminishes, while the bacterial debris gradually increases. As a result, nearly one-third of the stool's solid mass is of bacterial origin. Bacterial contribution is also one reason why diets rich in pectin and cellulose fibers (e.g., fruits and raw vegetables) result in higher stool mass. The metabolism and death of the colon bacteria provide a useful source for several vitamins, such as the B family and K. This source becomes very important during dietary vitamin deficiency.

LARGE INTESTINE MOTILITY. Three types of movements characterize large intestine motility: segmentation, peristalsis, and mass movement. The segmentation movements entrap the colon contents within a small segment; the contraction of muscle layers then turns and churns the content, exposing it to the epithelial cells for sodium and water absorption. The peristalsis movements occur in regular intervals, passing along as waves of contractions down the colon. Thus, the gradually dehydrating feces move toward the descending colon for storage. The descending colon exhibits another type of movement called mass movement. Here, and in the sigmoid colon, a strong peristaltic wave forces large "masses" of feces into the rectum at once. Such contractions occur a few times daily, usually after meals.

NEURAL CONTROL OF COLON MOVEMENTS AND DEFECATION. Hormones do not play any role in colon movements. Instead, both the intrinsic nerve plexi and the extrinsic parasympathetic nerves (vagus in the upper colon and sacral nerves in the lower colon, rectum, and anus) regulate colon motility and the defecation reflex. The nervous control of segmentation and slow peristalsis is basically similar to that of the small intestine (i.e., under enteric plexi control but influenced in intensity by parasympathetic nerves). Although the mass movements can be generated intrinsically by the plexi, the brain and extrinsic nerves play major roles in regulating them. Thus, anxiety (exams) and the presence of coffee and food in the mouth can activate the colon and the urge for a bowel movement.

DEFECATION REFLEX. Mass movements force fecal matter into the rectum, distending this organ. Rectal distension triggers the defecation reflex, which involves contraction of the sigmoid colon and rectum to force the feces out and relaxation of the normally closed anal sphincters to permit outflow. This occurs in infants, in whom voluntary control of defecation has not developed. In adults, rectal distension also signals the brain, creating the urge for bowel movement. The external anal sphincter, a striated muscle that develops voluntary control by the end of infancy, is voluntarily relaxed, permitting fecal outflow. Other voluntary mechanisms such
as pressure from the abdominal and respiratory muscles (diaphragm) also aid in defecation. In adults, the defecation reflex may be inhibited voluntarily, postponing the bowel movement.