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HARRISON'S™ PRINCIPLES OF INTERNAL MEDICINE

EDITORS

Dan L. Longo, MD

Lecturer, Department of Medicine, Harvard Medical School; Senior Physician, Brigham and Women's Hospital; Deputy Editor, New England Journal of Medicine, Boston, Massachusetts; Adjunct Investigator, National Institute on Aging, National Institutes of Health, Baltimore, Maryland

Anthony S. Fauci, MD

Chief, Laboratory of Immunoregulation; Director, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, Maryland

Dennis L. Kasper, MD

William Ellery Channing Professor of Medicine, Professor of Microbiology and Molecular Genetics, Harvard Medical School; Director, Channing Laboratory, Department of Medicine, Brigham and Women's Hospital, Boston, Massachusetts

Stephen L. Hauser, MD

Robert A. Fishman Distinguished Professor and Chairman, Department of Neurology, University of California, San Francisco, San Francisco, California

J. Larry Jameson, MD, PhD

Robert G. Dunlop Professor of Medicine; Dean, University of Pennsylvania School of Medicine; Executive Vice-President of the University of Pennsylvania for the Health System, Philadelphia, Pennsylvania

Joseph Loscalzo, MD, PhD

Hersey Professor of the Theory and Practice of Medicine, Harvard Medical School; Chairman, Department of Medicine; Physician-in-Chief, Brigham and Women's Hospital, Boston, Massachusetts

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Approach to the Patient With Gastrointestinal Disease

William L. Hasler
Chung Owyang

ANATOMIC CONSIDERATIONS

The gastrointestinal (GI) tract extends from the mouth to the anus and is composed of several organs with distinct functions. Specialized independently controlled thickened sphincters that assist in gut compartmentalization separate the organs. The gut wall is organized into well-defined layers that contribute to functional activities in each region. The mucosa is a barrier to luminal contents or as a site for transfer of fluids or nutrients. Gut smooth muscle mediates propulsion from one region to the next. Many GI organs possess a serosal layer that provides a supportive foundation but that also permits external input.

Interactions with other organ systems serve the needs both of the gut and the body. Pancreaticobiliary conduits deliver bile and enzymes into the duodenum. A rich vascular supply is modulated by GI tract activity. Lymphatic channels assist in gut immune activities. Intrinsic gut wall nerves provide the basic controls for propulsion and fluid regulation. Extrinsic neural input provides volitional or involuntary control to degrees that are specific for each gut region.

FUNCTIONS OF THE GASTROINTESTINAL TRACT

The GI tract serves two main functions—assimilating nutrients and eliminating waste. The gut anatomy is organized to serve these functions. In the mouth, food is processed, mixed with salivary amylase, and delivered to the gut lumen. The esophagus propels the bolus into the stomach; the lower esophageal sphincter prevents oral reflux of gastric contents. The esophageal mucosa has a protective squamous histology, which does not permit significant diffusion or absorption. Propulsive esophageal activities are exclusively aboral and coordinate with relaxation of the upper and lower esophageal sphincters on swallowing.

The stomach furthers food preparation by triturating and mixing the bolus with pepsin and acid. Gastric acid also sterilizes the upper gut. The proximal stomach serves a storage function by relaxing to accommodate the meal. The distal stomach exhibits phasic contractions that propel solid food residue against the pylorus, where it is repeatedly propelled proximally for further mixing before it is emptied into the duodenum. Finally, the stomach secretes intrinsic factor for vitamin B_{12} absorption.

The small intestine serves most of the nutrient absorptive function of the gut. The intestinal mucosa exhibits villus architecture to provide maximal surface area for absorption and is endowed with specialized enzymes and transporters. Triturated food from the stomach mixes with pancreatic juice and bile in the duodenum to facilitate digestion. Pancreatic juice contains the main enzymes for carbohydrate, protein, and fat digestion as well as bicarbonate to optimize the pH for activation of these enzymes. Bile secreted by the liver and stored in the gallbladder is essential for intestinal lipid digestion. The proximal intestine is optimized for rapid absorption of nutrient breakdown products and most minerals, while the ileum is better suited for absorption of vitamin B_{12} and bile acids. The small intestine also aids in waste elimination. Bile contains by-products of erythrocyte degradation, toxins, metabolized and unmetabolized medications, and cholesterol. Motor function of the small intestine delivers indigestible food residue and sloughed enterocytes into the colon for further processing. The small intestine terminates in the ileocecal junction, a sphincteric structure that prevents coloileal reflux and maintains small-intestinal sterility.

The colon prepares the waste material for controlled evacuation. The colonic mucosa dehydrates the stool, decreasing daily fecal volumes from 1000–1500 mL delivered from the ileum to 100–200 mL expelled from the rectum. The colonic lumen possesses a dense bacterial colonization that ferments undigested carbohydrates and short-chain fatty acids. Whereas transit times in the esophagus are on the order of seconds and times in the stomach and small intestine range from minutes to a few hours, propagation through the colon takes more than one day in most individuals. Colonic motor patterns exhibit a to-and-fro character that facilitates slow fecal desiccation. The proximal colon serves to mix and absorb fluid, while the distal colon exhibits peristaltic contractions and mass actions that function to expel the stool. The colon terminates in the anus, a structure with volitional and involuntary controls to permit retention of the fecal bolus until it can be released in a socially convenient setting.

EXTRINSIC MODULATION OF GUT FUNCTION

GI function is modified by influences outside of the gut. Unlike other organ systems, the gut is in continuity with the outside environment. Thus, protective mechanisms are vigilant against deleterious effects of foods, medications, toxins, and infectious organisms. Mucosal immune mechanisms include chronic lymphocyte and plasma cell populations in the epithelial layer and lamina propria backed up by lymph node chains to prevent noxious agents from entering the circulation. All substances absorbed into the bloodstream are filtered through the liver via the portal venous circulation. In the liver, many drugs and toxins are detoxified by a variety of mechanisms. Although intrinsic nerves control most basic gut activities, extrinsic neural input modulates many functions. Two activities under voluntary control are swallowing and defecation. Many normal GI reflexes involve extrinsic vagus or splanchnic nerve pathways. The brain gut axis further alters function in regions not under volitional regulation. As an example, stress has potent effects on gut motor, secretory, and sensory functions.

OVERVIEW OF GASTROINTESTINAL DISEASES

GI diseases develop as a result of abnormalities within or outside of the gut and range in severity from those that produce mild symptoms and no long-term morbidity to those with intractable symptoms or adverse outcomes. Diseases may be localized to one organ or exhibit diffuse involvement at many sites.