Patients with this condition usually have undergone upper and lower endoscopy at least once without identification of a bleeding source. Therefore, the bleeding must be from a source that is difficult to identify or one that emanates from the small intestine. The small intestine is a difficult area to examine because of its length and configuration. In general, the small intestine is initially evaluated radiographically. The patient may ingest barium, which is followed through the length of the small intestine. To distend the small bowel and provide greater mucosal detail, an enteroclysis tube may be placed with its distal tip near the ligament of Treitz, allowing more forceful administration of barium and air. However, computed tomography and magnetic resonance enterography are rapidly replacing fluoroscopic imaging. All these imaging techniques have limited diagnostic utility. Flat mucosal lesions such as vascular ectasias, a common cause of obscure bleeding, may easily be missed.

If radiographic studies are unrevealing, endoscopic evaluation of the small bowel may be attempted by capsule endoscopy or with push or balloon enteroscopy (see Chapter 34). For the patient with persistent blood loss, no endoscopically identified source of bleeding in the upper GI tract or colon, and negative findings on radiologic studies, the entire small intestine may be examined at laparotomy with endoscopy in the operative suite. In addition, angiographic evaluation of the whole GI tract may reveal the source of chronic blood loss.

C. Malabsorption

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DEFINITION AND EPIDEMIOLOGY

The main purpose of the gastrointestinal (GI) tract is to digest and absorb major nutrients (fat, carbohydrate, and protein), essential micronutrients (vitamins and trace minerals), water, and electrolytes. Impaired absorption of these nutrients is defined as malabsorption. Under normal conditions, the digestion and absorption of nutrients requires both mechanical and enzymatic breakdown of food. Mechanical processes include chewing, gastric churning, and the to-and-fro mixing in the small intestine. Enzymatic hydrolysis is initiated by intraluminal processes requiring salivary, gastric, pancreatic, and biliary secretions and is completed at the intestinal brush border. The final products of digestion are then absorbed through the intestinal epithelial cells and transported into the portal circulation. The coordinated regulation of gastric emptying, normal intestinal progression, and the presence of adequate intestinal surface area are all important factors. The human gut microbiome, which comprises the communities of microorganisms that inhabit the GI tract, has been recognized to play an important role in nutrient utilization as well. From birth, interactions between the microbiotia and the intestinal mucosa contribute to maturation of the host immune system. Disruptions to the homeostasis between the microbiota and the host immune system can lead to increased inflammation and decreased absorption.

Most dietary components can be absorbed anywhere along the length of the small intestine, but there are important exceptions in which absorption is limited to specific areas (e.g., vitamin B_{12} and cholesterol are absorbed only in the terminal ileum). Diseases associated with diffuse mucosal involvement, such as celiac disease, can lead to impaired absorption of many nutrients, whereas diseases affecting only the terminal ileum can lead to decreased vitamin B_{12} absorption. Bile acids are necessary for fat absorption; they undergo an enterohepatic circulation with release into bile and reabsorption from the terminal small intestine. Diseases interfering with this mechanism deplete the bile acid pool and can lead to fat malabsorption. Water and electrolytes are absorbed primarily by the colon. In addition, there is caloric salvage of much of the carbohydrate from indigestible fiber through bacterial enzymatic activity in the colon. The following sections discuss normal assimilation of the major nutrients and the approach to evaluation of patients with suspected malabsorption.

DIGESTION AND ABSORPTION OF FAT

Dietary fat is composed predominantly of triglycerides (~95%) with long-chain fatty acids (16- and 18-carbon molecules). In animal fat, the constituent fatty acids are mostly saturated (e.g., palmitic acid, stearic acid), whereas those of vegetable origin are rich in unsaturated fatty acids (i.e., having one or more double bonds in the carbon chain, such as oleic and linoleic acids). Fats are insoluble in water (hydrophobic), and digestion begins with a process of emulsification, wherein larger fat droplets are dispersed in the aqueous medium of the lumen. In the proximal small intestine, bile salts from liver and pancreatic enzymes are released into the intestinal lumen; there, they mix with and bind to the surface of these globules, where colipase activity results in the release of fatty acids and a monoglyceride. These are taken up as mixed micelles with bile salts, and these hydrophobic particles cross the unstirred water layer that overlies the epithelial brush border.

Within the cell, fatty acids are resynthesized into triglycerides, and, together with cholesterol and phospholipids, they are packaged into chylomicrons and very-low-density lipoproteins to be exported via lymphatic channels. Bile salts remain in the intestinal lumen, are recycled into new micelles, and are finally reabsorbed in the terminal ileum with 95% efficiency. Most dietary lipids are absorbed in the jejunum, together with the fat-soluble vitamins A, D, E, and K. It is recommended that dietary fat account for no more than 35% of calories because higher levels are associated with increased risk of cardiac disease, obesity, and some cancers.

DIGESTION AND ABSORPTION OF CARBOHYDRATES

Most dietary carbohydrates consist of starch (a glucose polymer) and the disaccharides sucrose and lactose, but only monosaccharides are absorbed. Salivary and pancreatic amylases release