The Gallbladder: A Change in Physiology

The gallbladder is a hollow, muscular organ that stores and releases bile into the duodenum of the small intestine. Under normal conditions the liver produces bile, which is a yellowish-green liquid composed mainly of cholesterol, bile acids, lecithin, and water that emulsifies dietary fat in the small intestine, and releases it into the duodenum when fat is present. When bile is produced but not yet needed in the intestine, it is stored and concentrated in the gallbladder. Normal functioning of the biliary system (liver, gallbladder, and associated ducts) ensures optimal release of bile into the GI tract. However, a disruption in the physiology of this system can lead to poor bile release, severe pain, inflammation, and infection. The most common condition associated with a change in the physiology of the gallbladder is cholelithiasis, or gallstones.

Cholelithiasis is the presence or formation of gallstones in the gallbladder. In general, gallstones are hard, calcified stones made of cholesterol, bilirubin, and calcium that form when the ratio of bile components is offset, leading to hardening of the bile into small stones. There are two major types of gallstones: cholesterol and pigment stones. The most common type is the cholesterol stone, which forms when the liver secretes an abnormally high amount of cholesterol into bile which overwhelms the other bile components and leads to stone formation. This hypersecretion of cholesterol into bile is due to genetic, dietary, or environmental factors. It is not entirely known by which mechanism gallstones are formed, but many scientists agree that nucleating agents are required to allow precipitation of excessive cholesterol in the bile to crystallize and form stones. Nucleating agents are generally proteins, such as IgG and aminopeptidase N, which are secreted by the liver or gallbladder. Excessive secretion of mucin glycoproteins, which are normally secreted from the gallbladder mucosal layer, can also facilitate the nucleation and formation of cholesterol stones. It is hypothesized that the mucin glycoproteins form a gel on the interior lining of the gallbladder that traps cholesterol crystals. The crystals aggregate with the help of the glycoproteins to begin gallstone formation. In general, the gallbladder is an ideal place for gallstone formation if excessive cholesterol is present, because of the long duration of time that bile is typically stored between meals.
Eighty percent of individuals with gallstones do not experience symptoms. However, when a stone becomes impacted in the cystic duct, bile cannot properly empty into the duodenum when needed, which leads to increased pressure as the gallbladder contracts to release its contents. Normally, the gallbladder fills and empties several times throughout the day. Individuals with gallstones have been shown to have incomplete emptying of the gallbladder and high gallbladder volume after meals, which increases the length of bile storage and further promotes stone formation. In addition to the increased volume due to a gallstone blockage, the blood supply to the dilated gallbladder is also altered. Poor blood circulation alters the normal bile concentration mechanisms in the gallbladder and leads to poor absorption of water and electrolytes from the bile. These gallbladder contractions and increased pressure lead to cholecystitis, a sharp, severe pain and inflammation of the gallbladder in the upper abdominal region. Huang et al (2010) reports that these factors, along with the presence of white blood cells at the inflammation site, can lead to infection and gangrene in some patients.

Gallstone complications are one of the most common gastrointestinal problems that require hospitalization. The pain, inflammation, and possible infection associated with gallstones blocking the normal flow of bile into and out of the gallbladder necessitate the complete removal of the gallbladder through a relatively simple and frequently performed procedure called a cholecystectomy. Several types of gallstone-dissolving medications are also on the market to treat gallstones without surgery. While the gallbladder is not essential for proper digestion and absorption of nutrients, its removal does affect several systems, particularly the physiology of the biliary tract.

References


