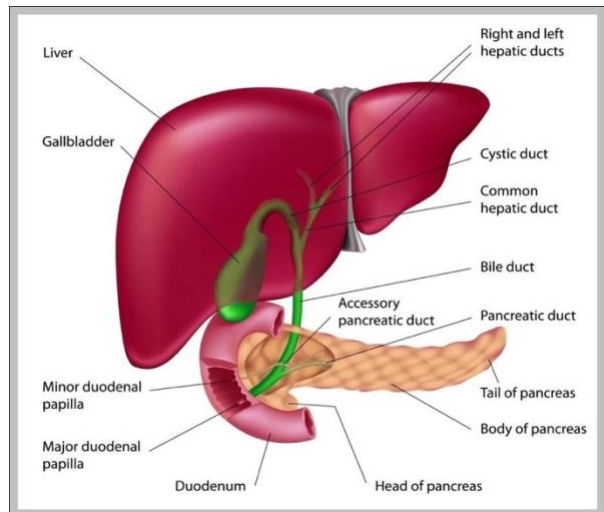


Gallbladder

The gallbladder, also known as the cholecyst, is a small hollow organ where bile is stored and concentrated before it is released into the small intestine.

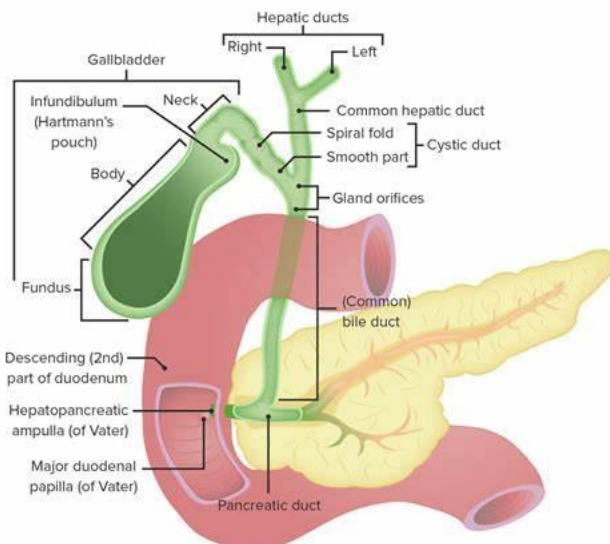
1. Functions

The main function of the gallbladder is to store bile, also called gall, needed for the digestion of fats in food. Produced by the liver, bile flows through small vessels into the larger hepatic ducts and ultimately through the cystic duct (parts of the biliary tree) into the gallbladder, where it is stored. At any one time, 30 to 60 milliliters (1.0 to 2.0 US fl oz) of bile is stored within the gallbladder.



When food containing fat enters the digestive tract, it stimulates the secretion of cholecystikinin (CCK) from “I” cells of the duodenum and jejunum. In response to cholecystikinin, the gallbladder rhythmically contracts and releases bile into the common bile duct, eventually draining into the duodenum. The bile emulsifies fats in partly digested food the same way detergent breaks up the grease/fats/oils on dishes in the kitchen sink. Detergent breaks up these fats so they can be easily washed away.

Bile breaks up the fats in your food in the same way, so they can be more easily absorbed by your digestive system. Bile consists primarily of water and bile salts, and also acts as a means of eliminating bilirubin, a product of hemoglobin metabolism, from the body.



The bile that is secreted by the liver and stored in the gallbladder is not the same as the bile that is secreted by the gallbladder. During gallbladder storage of bile, it is concentrated 3-10-fold by removal of some water and electrolytes. This is through the active transport of sodium and

chloride ions across the epithelium of the gallbladder, which creates an osmotic pressure that also causes water and other electrolytes to be reabsorbed.

Other functions of the gallbladder include:

- Helping eliminate bilirubin from the body.
- Triggering the conversion of the inactive thyroid hormone, T4, into the active form, T3.
- Assisting with the absorption of vitamins A, D, E and/or K.

These functions are addressed in more detail below.

2. Problems Caused by Removal

Over 700,000 people in the US have their gallbladders removed every year—only a small number due to the Whipple Procedure. 40% of all removals have complications...complications caused by the lack of bile, or un-concentrated bile.

Without a gallbladder (like after Whipple surgery), bile that drains from your liver now drains directly into the small intestine...but the bile trickles 24/7 and is not concentrated. In rare cases, this constant trickle may deliver too much bile.

Potential complications of having your gall bladder removed:

- **Difficulty Digesting Fat**—Without the ability to store, concentrate, and deliver bile when the digestive system needs it, your body cannot effectively digest fats from your food. This can cause symptoms of bloating, indigestion, gas, burping, constipation, diarrhea and/or stomach pain. Another function of bile is to lubricate the colon. Without bile, you may have constipation. With too much bile, you may have diarrhea.
- **Yellow Skin/Eyes**—Another function of bile is to take the byproduct of red blood cells, bilirubin, and eliminate it from the body. If there is some form of blockage in or from the liver causing a backup of the bilirubin, it can show up in the skin and/or eyes as jaundice. Since pancreatic cancer often causes blockages in the bile duct, this is a common symptom of the disease that initially sends a patient to the doctor. And, since bile duct blockages are a not uncommon complication after the Whipple surgery, jaundice can occur after this surgery as well.
- **Hypothyroid Symptoms**—Bile enzymes trigger the conversion of the inactive thyroid hormone, T4, into the active form, T3. Without enough bile, this can create symptoms of hypothyroidism.
- **Dry Skin or Vision Problems**—A bile deficiency may also result in deficiencies in vitamins A, D, E and/or K, since bile helps break down and absorb these fat-soluble vitamins. After removal of the gallbladder, some patients experience vision problems, such as blurriness, glaucoma, or cataracts. You need vitamin A to prevent these vision issues.

3. Strategies for Mitigating Problems

For nearly all of the complications listed above, caused by losing the gallbladder...and its ability to store, concentrate, and deliver bile when the digestive system needs it, simply taking digestive enzymes that contain or include lipase with food should alleviate these problems (such as CREON, Pancreaze, Zenpep, Ultresa, Voikace, Pertye, & others). Work with your endocrinologist to adjust the dosage to adapt to your individual needs.

Vitamin supplements may also be taken to address deficiencies in A, D, E and/or K. It may take several sets of trial-and-error to get the dosage right for your specific needs.

For patients with a total pancreaticoduodenectomy, vitamin A may be the most difficult to get to a normal level, since all of the tissues that absorb vitamin A are removed by the surgery. One partial solution is to take a high dose of beta carotene (75,000 IU/day). The body may convert enough of the beta carotene into vitamin A to meet your basic needs.