

HUMAN

LIVER

The liver is located in the upper right-hand portion of the abdominal cavity, beneath the diaphragm, and on top of the stomach, right kidney, and intestines.

Shaped like a cone, the liver is a dark reddish-brown organ that weighs about 3 pounds.

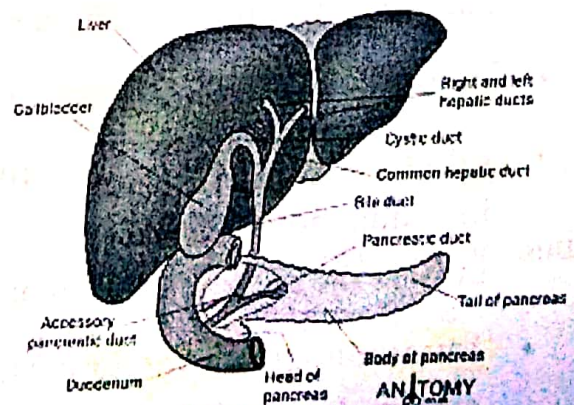
There are 2 distinct sources that supply blood to the liver, including the following:

- Oxygenated blood flows in from the hepatic artery
- Nutrient-rich blood flows in from the hepatic portal vein

The liver holds about one pint (13%) of the body's blood supply at any given moment. The liver consists of 2 main lobes. Both are made up of 8 segments that consist of 1,000 lobules (small lobes). These lobules are connected to small ducts (tubes) that connect with larger ducts to form the common hepatic duct. The common hepatic duct transports the bile made by the liver cells to the gallbladder and duodenum (the first part of the small intestine) via the common bile duct

Functions of the liver

The liver regulates most chemical levels in the blood and excretes a product called bile. This helps carry away waste products from the liver. All the blood leaving the stomach and intestines passes through the liver. The liver processes this blood and breaks down, balances, and creates the nutrients and also metabolizes drugs into forms that are easier to use for



the rest of the body or that are nontoxic. More than 500 vital functions have been identified with the liver. Some of the more well-known functions include the following:

- **Bile production:** Bile helps the small intestine break down and absorb fats, cholesterol, and some vitamins. Bile consists of bile salts, cholesterol, bilirubin, electrolytes, and water.
- **Absorbing and metabolizing bilirubin:** Bilirubin is formed by the breakdown of hemoglobin. The iron released from hemoglobin is stored in the liver or bone marrow and used to make the next generation of blood cells.
- **Supporting blood clots:** Vitamin K is necessary for the creation of certain coagulants that help clot the blood. **Bile is essential for vitamin K absorption** and is created in the liver. If the liver does not produce enough bile, clotting factors cannot be produced.
- **Fat metabolism:** Bile breaks down fats and makes them easier to digest.
- **Metabolizing carbohydrates:** Carbohydrates are stored in the liver, where they are broken down into glucose and siphoned into the bloodstream to maintain normal glucose levels. They are **stored as glycogen** and released whenever a quick burst of energy is needed.
- **Vitamin and mineral storage:** The liver stores vitamins **A, D, E, K, and B12**. It keeps significant amounts of these vitamins stored. In some cases, several years' worth of vitamins is held as a backup. The liver stores iron from hemoglobin in the form of ferritin, ready to make new red blood cells. The liver also stores and releases **copper**.
- **Helps metabolize proteins:** Bile helps break down proteins for digestion.
- **Filters the blood:** The liver filters and removes compounds from the body, including hormones, such as estrogen and aldosterone, and compounds from outside the body, including alcohol and other drugs.
- **Immunological function:** The liver is part of the mononuclear phagocyte system. It contains high numbers of **Kupffer cells** that are involved in immune

activity. These cells destroy any disease-causing agents that might enter the liver through the gut.

- **Production of albumin:** Albumin is the most common protein in blood serum. It transports fatty acids and steroid hormones to help maintain the correct pressure and prevent the leaking of blood vessels.
- **Synthesis of angiotensinogen:** This hormone raises blood pressure by narrowing the blood vessels when alerted by production of an enzyme called **renin** in the kidneys.

Regeneration

Because of the importance of the liver and its functions, evolution has ensured that it can regrow rapidly as long as it is kept healthy. This ability is seen in all vertebrates from fish to humans.

The liver is the only visceral organ that can regenerate.

It can regenerate completely, as long as a minimum of 25 percent of the tissue remains. One of the most impressive aspects of this feat is that the liver can regrow to its previous size and ability without any loss of function during the growth process.

In mice, if two-thirds of the liver is removed, the remaining liver tissue can regrow to its original size within 5 to 7 days. In humans, the process takes slightly longer, but regeneration can still occur in 8 to 15 days – an incredible achievement, given the size and complexity of the organ.

Over the following few weeks, the new liver tissue becomes indistinguishable from the original tissue.

This regeneration is helped by a number of compounds, including growth factors and cytokines. Some of the most important compounds in the process appear to be:

- hepatocyte growth factor
- insulin
- transforming growth factor-alpha
- epidermal growth factor
- interleukin-6
- norepinephrin

MUSCULOSKELETAL SYSTEM

Musculoskeletal system

The **musculoskeletal system** provides form, stability, and movement to the body. It consists of the body's bones (which make up the skeleton), muscles, tendons, ligaments, joints, cartilage, and other connective tissue.

The human skeleton

The human skeleton performs several major functions. It protects the internal organs, supports and gives shape to the body and allows for movement. It also the site of blood cell production, which occurs in the marrow of some bones.

The skeleton

The human