

HCSP TRAINING MANUAL

SECTION II: THE LIVER

Alan Franciscus, Editor-in-Chief



The information in this guide is designed to help you understand and manage HCV and is not intended as medical advice. All persons with HCV should consult a medical practitioner for diagnosis and treatment of HCV.

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THE LIVER

Objectives:

- *Be able to describe the physical features of the liver*
- *Be able to describe several functions of the liver and how they are affected by liver damage*

Key Points

- *The liver, located on the upper right side of the abdomen, is the largest internal organ.*
- *The liver is responsible for over 500 bodily functions.*
- *The liver plays an important role in digestion, sugar and fat metabolism, and nutrient storage.*
- *The liver synthesizes many proteins including blood clotting factors and certain hormones.*
- *The liver detoxifies drugs and toxins.*
- *A variety of steps can be taken to keep the liver healthy.*

The Liver

Liver Anatomy

The liver is the largest internal organ. It is reddish-brown, weighs approximately three pounds (in the adult male) and is about the size of a football. It is located behind the ribcage on the upper right side of the abdomen. The liver has the unique ability to regenerate its own tissue; as much as three-quarters of the liver can be lost, and the organ can grow or expand back within several weeks. Not only can the liver expand it can also shrink to the size of the patient such as a child who receives a portion of a donated liver. The use of a partial liver from a living donor allows for life saving transplants.

The liver is divided into four lobes; these are in turn composed of multiple lobules, which contain the hepatocytes, or working liver cells. The liver has an extensive blood supply. It receives oxygen-rich blood from the hepatic artery. The portal vein delivers oxygen-poor blood that contains nutrients, toxins, and other substances absorbed from the intestines. The liver filters this blood, then

sends it on to the heart via the hepatic vein.

Functions of the Liver

The liver is responsible for over 500 bodily functions. It plays a role in digestion, sugar and fat metabolism, and immune defense. It processes almost everything a person eats, breathes, or absorbs through the skin. About 90% of the body's nutrients pass through the liver from the small and large intestines. The liver converts food into energy, stores nutrients, and produces blood proteins. The liver also acts as a filter to remove pathogens and toxins from the blood. In the developing fetus, blood cells are produced in the liver.

Digestion – The liver plays an important role in the digestion and processing of food. Liver cells produce bile, a greenish-yellow fluid that aids in the digestion of fats and in the absorption of fat-soluble nutrients. Bile is delivered to the small intestine through the bile duct; when there is no food to digest, extra bile is stored in a small organ called the gallbladder located beneath the liver. By-products from drugs and toxic substances processed by the liver are carried in the bile and excreted from the body. A person with a damaged liver may experience impaired bile production and flow. When this happens, the body may not be able to absorb nutrients. Liver cells also convert heme (a component of hemoglobin that is released when red blood cells are broken down) into bilirubin. When the liver is damaged, bilirubin may build up in the blood, causing jaundice (yellowing of the skin and whites of the eyes).

Metabolism – The liver carries out many metabolic functions, providing the body with the energy it needs. It regulates the production, storage, and release of sugar, fats, and cholesterol. When food is eaten, the liver converts glucose (blood sugar) into glycogen, which is stored for later use. When energy is needed, the liver converts glycogen back into glucose in a process called gluconeogenesis. The liver regulates the storage of fats by converting amino acids from digested food into fatty acids such as triglycerides; when the body does not have enough sugar, the liver in turn converts fatty acids into ketones, which the muscles use for fuel. The liver also controls the production, metabolism, and excretion of cholesterol, which is an important component of cell membranes and certain hormones.

Storage – The liver stores several nutrients, including vitamins A, D, B9 (folate), and B12. The liver also stores minerals such as copper and iron, which play

a role in converting iron into heme, a component of hemoglobin, the oxygen-carrying molecule in red blood cells.

Protein synthesis – The liver synthesizes (builds) several important proteins, including enzymes, hormones, clotting factors, and immune factors. Liver enzymes called *aminotransferases* or *transaminases* (ALT and AST) break down amino acids from digested food and rebuild them into new proteins needed by the body. When the liver is damaged, these enzymes can build up to high levels in the blood; it is these enzymes that are measured in liver function tests. Several of the proteins synthesized by the liver are needed for proper blood functioning. These include various binding proteins (which bind and transport substances such as vitamins, minerals, hormones, and fats) and albumin (a protein that helps maintain proper blood volume). Clotting factors produced by the liver include fibrinogen, prothrombin (Factor II), and Factor VII. These enable the blood to clot following an injury; low levels can lead to prolonged bleeding and easy bruising. Other proteins synthesized by the liver include alkaline phosphatase, gamma-glutamyl transferase (GGT), and insulin growth factor.

Detoxification – Finally, the liver plays a crucial role in detoxifying substances that are harmful to the body, including alcohol, drugs, solvents, pesticides, and heavy metals. When a person is exposed to high levels of these chemicals, the liver can become overwhelmed. Toxins are delivered to the liver by the portal vein. The liver processes these chemicals and excretes them in the bile. The liver also processes and excretes toxic byproducts of normal metabolism (such as ammonia) and excess hormones (in particular, sex hormones such as estrogen). Many drugs – including common over-the-counter drugs like acetaminophen (Tylenol) and certain herbal remedies – can cause liver damage if taken in high doses or for prolonged periods of time. *People should be especially cautious about combining more than one drug especially with alcohol.* If the liver is damaged, it may not be able to break down and excrete drugs efficiently, potentially leading to dangerously high blood levels and intensified side effects.

Liver Damage

Chronic hepatitis C, heavy alcohol use, and other factors can lead to serious liver damage. Given how many vital functions the liver performs, it is no surprise that liver injury can have an affect on almost all body systems, including

the digestive, endocrine, cardiovascular, and immune systems. As the liver sustains damage, normal liver tissue becomes fibrous (*fibrosis*), fatty (*steatosis*), and scarred (*cirrhosis*). If the liver becomes too heavily damaged, it is no longer able to carry out its normal functions.

In *compensated cirrhosis*, the liver is scarred but can still function relatively normally. In *decompensated cirrhosis*, the liver has sustained so much damage that it is unable to function properly. Scar tissue may block the normal flow of blood through the liver, causing the blood to back up. This can lead to *portal hypertension* (high blood pressure), the development of varices (stretched and weakened blood vessels) in the esophagus and stomach, and internal bleeding. People with severe liver damage may also develop *ascites* (fluid accumulation in the abdomen), *edema* (swelling, especially in the legs and ankles), and kidney damage. If the liver is unable to filter out toxins and metabolic byproducts such as ammonia, these chemicals may build up in the blood, leading to impaired mental functioning, personality changes, and in severe cases, coma. People with long-term liver damage may also develop liver cancer. For more on the consequences of liver damage, see **Section VI: HCV Symptoms and Progression**.

Liver Health

There are several steps people can take – whether or not they have an existing liver disease such as HCV – to keep the liver healthy. These include eating a healthy diet, limiting consumption of alcohol and drugs, and avoiding chemicals that can be harmful to the liver. It is recommended that people with an existing liver disease avoid all raw shellfish such as oysters, which may contain viruses and bacteria. As much as possible, avoid exposure to toxic liquids and fumes including solvents, paint thinners, and pesticides. If it is necessary to use such chemicals, work in a well-ventilated area, cover the skin, and wear gloves and a protective face mask. *Be cautious when using drugs, including prescription and over-the-counter medications, recreational drugs, and herbal remedies*. Do not exceed recommended dosages and be careful about mixing drugs. People should tell all their healthcare providers about all drugs or herbal preparations they are using. Finally, there are vaccines to prevent hepatitis A and hepatitis B (there is currently no hepatitis C vaccine). These vaccines are recommended for anyone who is at risk for exposure to these viruses; today, children in the U.S. receive the hepatitis B vaccine as infants or teenagers.

Liver Tips for Healthy People:

- Eat a healthy, well-balanced diet; visit www.choosemyplate.gov.
- Do not consume more than two alcoholic drinks per day for men; one alcoholic drink a day for women (see chart at the end of the section).
- Never mix alcohol and acetaminophen
- Avoid or limit use of recreational drugs.
- Take no more than the recommended doses of medications.
- Use caution and avoid mixing drugs or mixing drugs and alcohol.
- Avoid toxic substances and fumes.
- Get vaccinated against hepatitis A and hepatitis B if not already immune.

Standard drink equivalents		
	Beer or cooler 12 oz., ~5% alcohol	12 oz. = 1 16 oz. = 1.3 22 oz. = 2 40 oz. = 3.3
	Malt liquor 8-9 oz., ~7% alcohol	12 oz. = 1.5 16 oz. = 2 22 oz. = 2.5 40 oz. = 4.5
	Table wine 5 oz., ~12% alcohol	a 750 mL (25 oz.) bottle = 5
	80-proof spirits (hard liquor), 1.5 oz., ~40% alcohol	a mixed drink = 1 or more* a pint (16 oz.) = 11 a fifth (25 oz.) = 17 1.75 L (59 oz.) = 39

* Depending on factors such as the type of spirits and the recipe, one mixed drink can contain from one to three or more standard drinks.
Source: NIAAA

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