Anatomy & Function of the Liver in Dogs

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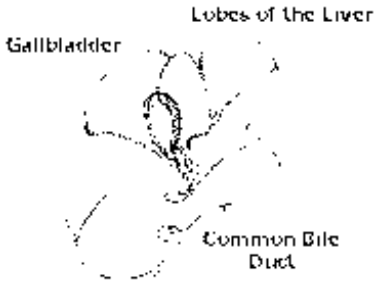

The liver is an extremely important organ in the body. It is responsible for protein, fat, and carbohydrate metabolism; vitamin and mineral storage; digestion of food and detoxification of wastes.

Whether portrayed in a medical text or seen in surgery, the liver appears as nothing more than a large reddish-brown mass. With the exception of the attached gallbladder, it has few distinguishing external or internal features. It is divided into several hepatic lobes or sections, but even these are joined together in such a way that they are sometimes difficult to distinguish one from another.

However, for all of its simplicity of appearance, the liver is a very complicated and hard-working organ. It is known to perform well over 1,000 different tasks, most of which are necessary to life and could not be done elsewhere in the body. The production of the essential protein 'albumin,' the storage of fat soluble vitamins such as A, D, E, and K, the manufacture of some digestive enzymes, the detoxification of wastes and poisons, the production of blood clotting factors, and the storage of energy are just some of these hepatic functions. Yet, unless there is a total (or near complete) failure to function, it is usually very difficult for numerous liver function tests to show that it is diseased, damaged, or even affected. This is because every major section or lobe of the liver performs exactly the same tasks. Additionally, the liver has tremendous reserve capacities and can greatly increase its output and efficiency. It can shift into overdrive on a moment's notice. Therefore, if one to four lobes are loaded with cancer, contain a bacterial or viral infection, or are severely traumatized, the remaining sections just work overtime to fulfill the body's needs. In canine medicine, we believe that many liver conditions go on for a long time before any clinical signs are observed by the animal's owner or veterinarian. In fact, it frequently happens that by the time we are able to make a diagnosis through lab tests, biopsy, or clinical signs, the condition has already passed and the animal is actually improving.

The liver is truly unique in another very important way. Worms, lizards, and salamanders have the ability to grow back (or regenerate) body parts that have been lost or damaged. This is rarely possible in mammals like dogs, except in the case of the liver. We are very familiar with cases in which over three-fourths of the liver is surgically removed because of injury or disease, and then within a year, the organ has grown back to its original size. In these individuals, no functions or abilities of the organ were lost. But even in cases where large portions of tissue were severely damaged rather than lost, the liver constantly amazes clinicians with its ability to recover. Sections that have lost their ability to function, when given supportive medications and a little time, will frequently recover completely.

The medium through which the liver carries out its functions is the blood. The liver is an organ through which thousands of miles of blood vessels course, carrying blood in such a way that it comes into contact with each and every liver cell. It is so filled with blood and vessels that a freshly cut section appears just like a saturated sponge. In fact, when compressed, it expels large quantities of blood just as a sponge would. Twenty percent of the blood pumped by each and every beat of the heart goes through the liver. Additionally, the first tissue to get a chance at the nutrients absorbed by the intestines and stomach is the liver. Every blood vessel leaving the gastrointestinal tract goes directly into the liver.

The liver takes from, adds to, and changes in some way, all of the blood that passes through its mass. Its cells perform their 1,000 plus tasks 24 hours of every day responding to every need of the body through a complicated array of chemical communications. If a section of an animal's body needs a compound that is manufactured by the liver, molecular messages tell it to produce and release more. If other products such as glucose get too low in the blood, the liver converts a storage compound (called glycogen) into glucose and then releases it into the veins leaving the liver. Other materials will be collected from the blood and stored for future needs. All at the same time, different molecules will be constantly manufactured by the cells, while other potentially harmful ones will be filtered out and destroyed. As previously stated, each lobe or section of the liver is able to perform every one of these tasks.

To list all of the functions of the liver would take an entire book, but we will list some of the more important ones.

Production of proteins

Proteins are the building blocks of the dog's body. They are the main component of muscle, skin, cell walls, tendons, connective tissue, blood vessels, etc. The components that make up proteins are called amino acids and they are metabolized in the liver. To name a few of the essential proteins formed in the liver, we will mention the major blood proteins like albumin and many of the globulins. These two groups maintain the pressure gradient within blood vessels, transport all sorts of other compounds, and perform many different immune responses, which protect the body. Proteins cause the blood to clot when a vessel is cut or damaged. Other protein molecules called enzymes are important for many of the chemical reactions that constantly occur within the body.

Additionally, many of these and other proteins are stored within the liver for future use. As part of this entire system, the liver must determine which proteins are in short supply and increase the level of production before a crisis occurs. All of this is regulated closely as it would be inefficient for the body to produce too much of anything when it might be wasted. Many of the protein molecules break down automatically within predetermined periods of time. Therefore, not only does the liver produce, metabolize, and store these substances, but it also constantly monitors the supply and demand of any proteins it

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affects.

Metabolism of carbohydrates and lipids

Carbohydrates and lipids are the energy stores that run an animal's body. The storage and release of many of these is done chiefly by and within the liver. Remember, everything that is absorbed through the gastrointestinal tract arrives at the liver first and very little goes out without being affected in some way. Glucose, the internal sugar and most important source of quick energy, is extracted immediately from the blood and converted into glycogen, which is stored until needed. Fatty acids, triglycerides, and other fats are also stored, metabolized, and/or changed within the liver. As with the proteins, if an animal's liver could not capture and save fats for future use, the animal might starve without a completely balanced diet being provided each and every day.

Vitamin production and storage

Vitamins, except Vitamin C, are all either made, or stored, or are in some way regulated by the liver. Animals in liver failure must have their diet supplemented with huge quantities of these necessary compounds, If not, they will die. This includes both fat soluble and water soluble vitamins. Many older publications stated that only the fat soluble vitamins were affected, but today we know that both groups are equally managed by the liver.

Storage of nutrients

We have mentioned general storage before, but to be complete, we must again state that the liver fulfills this function in a way that no other site in the body can. We have mentioned vitamins, fats, triglycerides, and glycogen, but there are many more. Pre-determined quantities of several metals like iron, copper, and zinc are kept within the liver for future use in the rest of the body. These substances can be irritating to other types of tissue, so it is up to the liver to make sure they are always available. Even in the liver, however, these stored quantities are carefully monitored because excessive amounts can damage the cells. Another important storage factor of the liver is often overlooked. It is simply blood. It is estimated up to 15% of all blood within the body is within the liver at any one time. If the animal suddenly loses large quantities of blood due to injury or disease, the liver can immediately shunt a much larger quantity of whole blood with all of its constituents into general circulation within a matter of seconds.

Digestion

The liver plays a major role in the digestive process that occurs within the intestines. Many of the compounds that are produced or excreted by the liver form the bile, which goes from the gallbladder through the bile duct into the small intestine to aid in the breakdown of food. It is true that most of the bile is an accumulation of waste products destined for excretion from the body, but some of its constituents aid in digestion. Again, this function may not be appreciated by most people, but it is very important.

Detoxification

The liver breaks down and excretes numerous compounds. Just as the kidneys remove potentially harmful materials from the blood, so does the liver. Examples of this are by-products or wastes from normal cellular activity such as urea from protein metabolism, worn out hemoglobin molecules from red blood cells, cholesterol, naturally produced steroids and hormones, and many more. The liver is also the organ that breaks down some of the sedative and anesthetic agents, antibiotics, and other medications that we administer to our pets. This destruction of unwanted or potentially harmful substances is a life or death matter for the individual. If the liver fails to eliminate these compounds, the animal dies.

While a physiologist or medical internist could extend this list of important liver functions for many pages, we hope this gives you some idea of the importance of the liver. Most of its tasks are performed nowhere else in the body. We most appreciate its uniqueness. Every single part of it is capable of every task necessary, and it is the only organ in the body with this capability. The liver has an amazing ability to snap back from injury and it can regenerate lost tissue to heal injured portions. The liver is truly an incredible organ.

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