Al-Mustaqbal University

College of Technology and Health Sciences

Medical physics Department

Medical Physics

First Semester

3rd stage

Lesson -10

Liver

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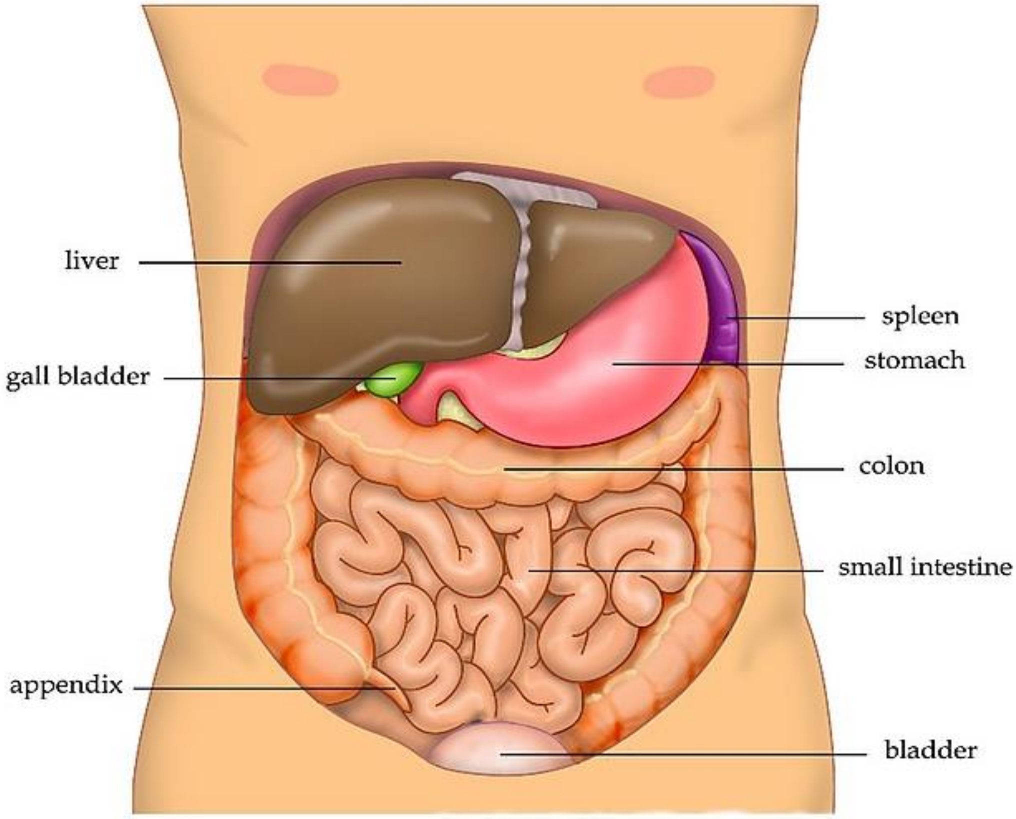
Liver

The liver is a major metabolic organ exclusively found in vertebrate animals, which performs many essential biological functions such as detoxification of the organism, and the synthesis of proteins and various other biochemicals necessary for digestion and growth. In humans, it is located in the right upper quadrant of the abdomen, below the diaphragm and mostly shielded by the lower right rib cage. Its other metabolic roles include carbohydrate metabolism, the production of hormones, conversion and storage of nutrients such as glucose and glycogen, and the decomposition of red blood cells.

The liver is also an accessory digestive organ that produces bile, an alkaline fluid containing cholesterol and bile acids, which emulsifies and aids the breakdown of dietary fat. The gallbladder, a small hollow pouch that sits just under the right lobe of liver, stores and concentrates the bile produced by the liver, which is later excreted to the duodenum to help with digestion. The liver's highly specialized tissue, consisting mostly of hepatocytes, regulates a wide variety of high-volume biochemical reactions, including the synthesis and breakdown of small and complex organic molecules, many of which are necessary for normal vital functions. Estimates regarding the organ's total number of functions vary, but is generally cited as being around 500. For this reason, the liver has sometimes been described as the body's chemical factory.

It is not known how to compensate for the absence of liver function in the long term, although liver dialysis techniques can be used in the short term. Artificial livers have not been developed to promote long-term replacement in the absence of the liver. As of 2018 liver transplantation is the only option for complete liver failure.



Structure

The liver is a dark reddish brown, wedge-shaped organ with two lobes of unequal size and shape. A human liver normally weighs approximately 1.5 kilograms (3.3 pounds) and has a width of about 15 centimetres (6 inches). There is considerable size variation between individuals, with the standard reference range for men being 970–1,860 grams (2.14–4.10 lb) and for women 600–1,770 g (1.32–3.90 lb).[14] It is both the heaviest internal organ and the largest gland in the human body. It is located in the right upper quadrant of the abdominal cavity, resting just below the diaphragm, to the right of the stomach, and overlying the gallbladder.

The liver is connected to two large blood vessels: the hepatic artery and the portal vein. The hepatic artery carries oxygen-rich blood from the aorta via the celiac trunk, whereas the portal vein carries blood rich in digested nutrients from the entire gastrointestinal tract and also from the spleen and pancreas.These blood vessels subdivide into small capillaries known as liver sinusoids, which then lead to hepatic lobules.

Hepatic lobules are the functional units of the liver. Each lobule is made up of millions of hepatic cells (hepatocytes), which are the basic metabolic cells. The lobules are held together by a fine, dense, irregular, fibroelastic connective tissue layer extending from the fibrous capsule covering the entire liver known as Glisson's capsule after British doctor Francis Glisson. This tissue extends into the structure of the liver by accompanying the blood vessels, ducts, and nerves at the hepatic hilum. The whole surface of the liver, except for the bare area, is covered in a serous coat derived from the peritoneum, and this firmly adheres to the inner Glisson's capsule.

Gross anatomy

Terminology related to the liver often starts in hepat- from ἡπατο-, from the Greek word for liver.

Lobes

he liver is grossly divided into two parts when viewed from above – a right and a left lobe – and four parts when viewed from below (left, right, caudate, and quadrate lobes).

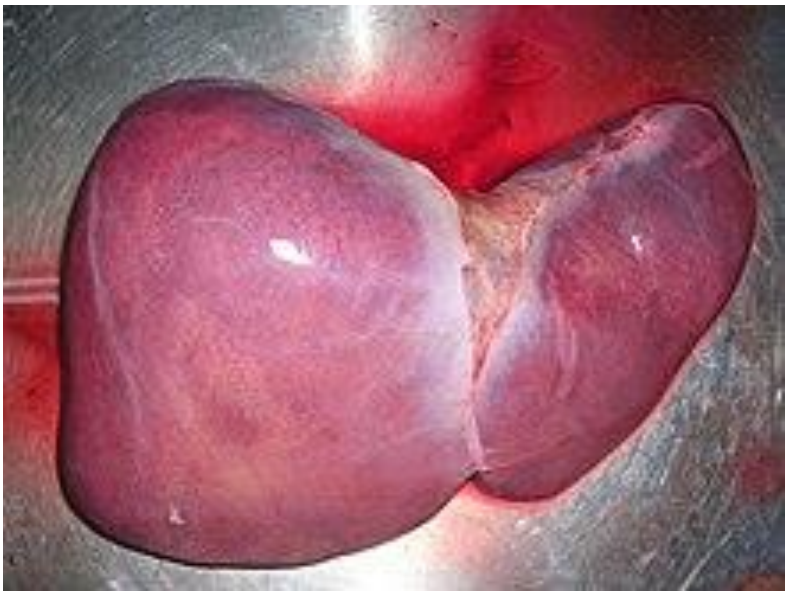
The falciform ligament makes a superficial division of the liver into a left and right lobe. From below, the two additional lobes are located between the right and left lobes, one in front of the other. A line can be imagined running from the left of the vena cava and all the way forward to divide the liver and gallbladder into two halves. This line is called Cantlie's line.

Other anatomical landmarks include the ligamentum venosum and the round ligament of the liver, which further divide the left side of the liver in two sections. An important anatomical landmark, the porta hepatis, divides this left portion into four segments, which can be numbered starting at the caudate lobe as I in an anticlockwise manner. From this parietal view, seven segments can be seen, because the eighth segment is only visible in the visceral view.

Surfaces

Normal human liver at autopsy

On the diaphragmatic surface, apart from a triangular bare area where it connects to the diaphragm, the liver is covered by a thin, double-layered membrane, the peritoneum, that helps to reduce friction against other organs. This surface covers the convex shape of the two lobes where it accommodates the shape of the diaphragm. The peritoneum folds back on itself to form the falciform ligament and the right and left triangular ligaments.



These peritoneal ligaments are not related to the anatomic ligaments in joints, and the right and left triangular ligaments have no known functional importance, though they serve as surface landmarks.The falciform ligament functions to attach the liver to the posterior portion of the anterior body wall.

The visceral surface or inferior surface is uneven and concave. It is covered in peritoneum apart from where it attaches the gallbladder and the porta hepatis. The fossa of gallbladder lies to the right of the quadrate lobe, occupied by the gallbladder with its cystic duct close to the right end of porta hepatis.

Functional anatomy

The central area or hepatic hilum, includes the opening known as the porta hepatis which carries the common bile duct and common hepatic artery, and the opening for the portal vein. The duct, vein, and artery divide into left and right branches, and the areas of the liver supplied by these branches constitute the functional left and right lobes. The functional lobes are separated by the imaginary plane, Cantlie's line, joining the gallbladder fossa to the inferior vena cava. The plane separates the liver into the true right and left lobes. The middle hepatic vein also demarcates the true right and left lobes. The right lobe is further divided into an anterior and posterior segment by the right hepatic vein. The left lobe is divided into the medial and lateral segments by the left hepatic vein.

Fetal blood supply

In the growing fetus, a major source of blood to the liver is the umbilical vein, which supplies nutrients to the growing fetus. The umbilical vein enters the abdomen at the umbilicus and passes upward along the free margin of the falciform ligament of the liver to the inferior surface of the liver. There, it joins with the left branch of the portal vein. The ductus venosus carries blood from the left portal vein to the left hepatic vein and then to the inferior vena cava, allowing placental blood to bypass the liver. In the fetus, the liver does not perform the normal digestive processes and filtration of the infant liver because nutrients are received directly from the mother via the placenta. The fetal liver releases some blood stem cells that migrate to the fetal thymus, creating the T cells (or

T lymphocytes). After birth, the formation of blood stem cells shifts to the red bone marrow. After 2–5 days, the umbilical vein and ductus venosus are obliterated; the former becomes the round ligament of liver and the latter becomes the ligamentum venosum. In the disorders of cirrhosis and portal hypertension, the umbilical vein can open up again.

Unlike eutherian mammals, in marsupials the liver remains haematopoietic well after birth.