Liver

The liver is the largest exocrine gland in the body and a vital organ. Thanks to the large blood supply, they can serve primarily as a center for processing nutrients from food, a metabolic and detoxification center, a storage warehouse for glycogen, proteins and lipids. With their exocrine function, they ensure the excretion of bile, which helps in the digestion of fats. In the embryonic stage, they are also the seat of hematopoiesis.

Anatomy of the Liver

The liver has the shape of a three-dimensional triangle with a long hypotenuse from the lower right side to the upper left side. In an adult, they weigh on average around 1.5 kg and flow through them 1.5 l of blood/min. They are placed under the right part of the diaphragmatic arch and their end extends over the left medial part of the diaphragm. They press against the abdominal organs with their visceral surface (distinct impressions), their upper part is fused with the diaphragm.

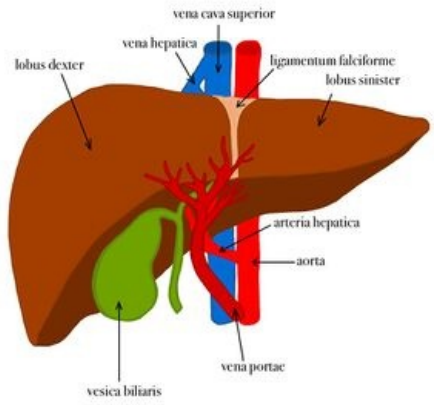
- **facies diaphragmatica** - part of the liver attached to the diaphragm;
- **facies visceralis** - the lower part of the liver facing the abdominal organs.

These surfaces are separated in front by a sharp **margo inferior**, behind the visceral part passes into the diaphragmatic part without a sharp border.

Peritoneum forms a shiny coating on almost the entire surface of the liver - **tunica serosa**. Only on the diaphragmatic surface, where the f. diaphragmatica passes into the f. visceralis, is the **area nuda**, which is not covered by the serosa. tela subserosa attached to **tunica fibrosa** (capsula Glissoni), which is a firm and immovable covering of liver tissue. The tunica is related to the ligaments and blood vessels inside the liver.

The liver is divided, like the lungs, into **lobes**:

- **lobus dexter** - the largest liver lobe located on the right;
- **lobus sinister** – smaller and flat left lobe;
- **lobus quadratus** – quadrangular lobe in front between the right and left lobes, visible especially on the facies visceralis;
- **lobus caudatus** - caudate lobe at the back between the right and left lobes.



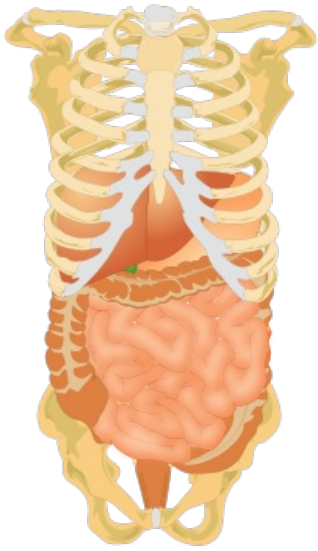
Liver and gallbladder syntopy

Facies visceralis

Especially on this side, the sagittal hepatic **grooves** - left and right and between them the transverse groove are visible. They separate the lobes and can be thought of as the letter H. The transverse depression is called the **porta hepatis**, which contains:

- entering **a. hepatica propria** (front left) and **v. portae** (back);
- emerging **ductus hepaticus dexter et sinister** (right and left bile ducts), it joins in the ductus hepaticus communis (front right).

Other important formations on this side include the **fossa vesicae biliaris** (storage of the gallbladder) at the right side of the lobus quadratus, where bile is stored and processed. The last prominent structure is the **sulcus venae cavae** laterally from the lobus caudatus, where the**vena cava inferior** runs. The inferior vena cava has either a transverse strip of lig. venae cavae, or is completely surrounded by liver tissue.


Storage of organs in the abdominal cavity

Position and projection of the liver

The liver is located in the diaphragmatic vault, touching:

- on the right lobe with adrenal gland, kidney, duodenum and with flexura coli dextra;
- on the left lobe with esophagus and stomach.

The organs leave their respective **imprints** on the f. visceralis.

the latter continues to the pars abdominis oesophagi and curvature minor of the stomach. It ends at the beginning of the duodenum in **lig. hepatoduodenal**.

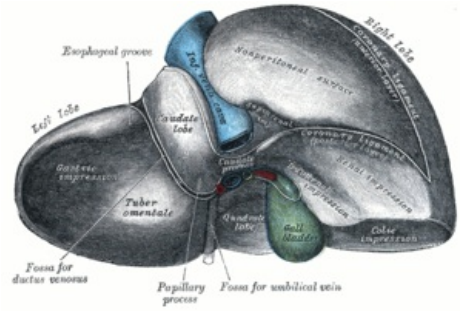
The liver is projected in the regio hypochondriaca dextra (cartilages of the lower ribs on the right). Margo inferior begins at the edge of the right costal arch and continues to the medioclavicular line (the edge behind the 8th rib). From there, it proceeds obliquely to the left upwards (midway between the xiphoid process and the umbilicus) and

ends behind the edge of the left costal arch, approximately midway between the edge of the sternum and the left medioclavicular line.

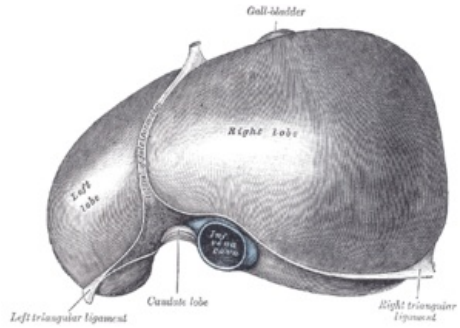
Liver fixation

Several mechanisms are involved in liver fixation. They are:

- **League. teres hepatis** - the rest after the umbilical vein, comes from the lig. falciform; fixes the liver to the anterior abdominal wall.
- **Vena cava inferior** - suspension of the liver to the VCI by means of the ligamentum venae cavae is an important "fixator" of the liver.
- **Connection with diaphragm** in the scope of area nuda - a part of the liver is connected to the diaphragm, which is referred to in Latin as pars *affixa hepatis*.
- **Intestinal position** - the organs located under the liver are also involved in the fixation of the liver, the liver "rests" on these organs.
- **Intra-abdominal pressure**
- The **atmospheric pressure** that stores the liver in the diaphragmatic vault also has a certain meaning. It can be broken by opening the abdominal cavity.



Facies visceralis



Facies diaphragmatica (view from above)

Histology of the liver

Hepatocyte

Polyhedral cell with dimensions of approx. 20–30 µm. Commonly contains **one** or **two** nuclei, which may be polyploid. It is a versatile cell with high metabolic activity. On the side facing the capillary (to Disse's space) it contains microvilli for a larger surface area for nutrient absorption.

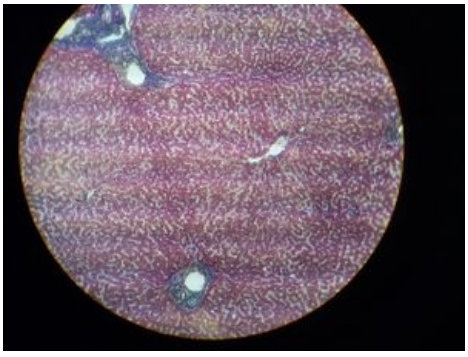
The cell contains eosinophilic cytoplasm, mainly due to numerous **mitochondria** and **smooth endoplasmic reticulum**. This has several functions – notably methylation, oxidation and conjugation to modify xenobiotics before they are eliminated from the body.

Also present is **rough endoplasmic reticulum** for proteosynthetic activity. It forms clusters in the so-called *basophilic bodies*. Both proteins needed by the cell and **blood serum proteins** (ie albumins, prothrombins, fibrinogens, lipoproteins) are synthesized here. These are not stored, but escape directly into the bloodstream.

In coarse, electrodense granules, the cell stores **liver glycogen**, which is produced or degraded for the needs of the organism.

Other very important components of the hepatocyte include a high number of mitochondria (around 2,000), lysosomes, peroxisomes or Golgi complexes. The secretion of **bilei** is also essential.

Structure of liver parenchyma


Histological slide

The morphological unit of the parenchyma is made up of liver cells, which create **beams**. Between these beams are the fenestrated **sinusoids**, where nutrients come from v. portae and oxygenated blood from a. hepatica propria. These beams, together with the vessels, form a radially arranged **lobulus venae centralis** with a central vein in the middle. It runs along the axis of the lobule and collects blood from the sinusoids, which it carries away from the liver.

The contact of the blood in the fenestrated capillary with the microvilli of the hepatocytes ensures the **Disse's space** (perisinusoidal) where the blood flows. On the lumina of the sinusoid there are also **Kupffer cells** (phagocytes) and infrequent Ito cells, which store lipid droplets, microfilaments, vitamin A in their cytoplasm and other important components. They also have a supporting function in liver regeneration.[1]

Bile ducts and triads

🔎 *For more information see Biliary tract.*

At the junction of two hepatocytes there is also a **bile duct**, the walls of which consist only of liver cell walls. It gradually passes into the **ductus biliferi interlobulares**. These leave in the **portobiliary spaces**, which contain three formations:

- *arteria interlobularis* from a. hepatica propria, which enters the lobule;
- *vena interlobularis* from v. portae, which also enters the lobule;
- *ductus bilifer interlobularis*, which emerges from the lobule.

This formation is collectively called **trias hepatica** (Glisson's trias)[2]. The vessels came here from the porta hepatis, when v. portae mostly accompanies a. hepatica propria. The ductus biliferi converge into a larger one and leave the port as the ductus hepaticus dexter et sinister.

Blood Flow

The **functional** flow of the liver is provided by the *v. portae*, which brings absorbed nutrients from the intestines. The **nourishing** component for the liver itself consists of the *a. hepatica propria*, which is one of the main branches of the truncus coeliacus. **Nevertheless, it contributes little to the nutrition of hepatocytes with oxygen.**

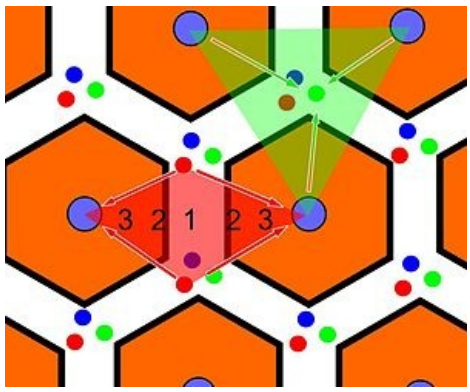
After entering through the porta hepatis, both vessels branch and form **aa. et vv. interlobulares** - part of the trias hepatica. In the portobiliary space, they also send out **aa. et vv. circumlobulares'** (distribution vessels) that surround the liver lobules.

In the trias hepatica, the vein joins the artery in the **hepatic sinusoid** between the hepatic trabeculae and continues to the center of the lobule in the **v. centralis**. They connect in the **vena hepatis**, which flows into the inferior vena cava in the sulcus venae cavae.

Primary hepatic acinus and portal lobule

The **primary liver acinus** is a functional liver unit, made up of two imaginary triangles that touch at their bases and have v. centralis at their apex. It is supplied by one circumlobular vein and artery. These send vessels to the sinusoids of two adjacent lobes. Primary hepatic acinus is histologically further divided into three zones:[3]

- **zone I** - the center of the liver acinus, it is closest to the circumlobular vein and artery, therefore there is the **highest** oxygen and nutrient supply;
- **zone II** - is further from the center of the liver acinus, **smaller** oxygen and nutrient supply;
- **zone III** - closest to the central vein, oxygen and nutrients arrive here as the **last**.



Primary hepatic acinus (left) and portal lobule

This division has a functional significance mainly for the examination of pathological conditions.

The **portal lobule** has peaks in three central veins centered in the portal triad. It thus occupies the functional parts of the three liver lobes.

Liver regeneration

Although the liver has a slow cell renewal, regenerative activity is high. Loss of liver tissue, whether from surgery or toxic agents, will prompt significant proliferation of cells. This results in almost complete replacement of the original tissue loss. It is probably caused by the so called **chalons**[4] that inhibit cell proliferation. If there are few cells, they also secrete few chalons and this leads to mitotic activity. In the case of many cells, enough chalons are secreted to suppress proliferation.

With repeated damage to the liver, there is a proliferation of **ligament**, which leads to irreversible changes.

Links

Related Articles

- Liver function
- Biochemical examinations of the liver • Diagnostic imaging methods in the examination of the pancreas, liver and spleen
- Hepatomegaly • Hepatosplenomegaly • Sarcoidosis of liver • Hepatic cysts and abscesses • Hepatic failure • Hepatic cirrhosis • Hepatitis • Liver Tumors • Liver Injury • Portal Hypertension
- Development of liver and gallbladder
- Liver (image) • Liver - HE • Liver (SFLT) • Liver - PAS • Chronic liver abscess (slide) • Focused large droplet steatosis of the liver (slide)
- Biliary tract • Gallbladder • Spleen • Kidneys

Sources

- PASTOR, Jan. *Langenbeck's medical web page* [online]. [cit. 2009]. <http://langenbeck.webs.com>.

Bibliography

- ŠIHÁK, Radomír – GRIM, Miloš. *Anatomy 2.* Second edition. Prague : Grada, 2002. 488 pp. pp. 127-138. ISBN 80-247-0143-X.

- JUNQUIERA, L. Carlos – CARNEIRO, José – KELLEY, Robert O, et al. *Základy histologie.* 1. edition. Jinočany : H & H, 1997. 502 pp. pp. 303-317. ISBN 80-85787-37-7.

References

1. CHIHÁK, Radomír – GRIM, Miloš. *Anatomy 2.* Second edition. Prague : Grada, 2002. 488 pp. pp. 134. ISBN 80-247-0143-X.
2. CHIHÁK, Radomír – GRIM, Miloš. *Anatomy 2.* Second edition. Prague : Grada, 2002. 488 pp. pp. 135. ISBN 80-247-0143-X.
3. JUNQUIERA, L. Carlos – CARNEIRO, José – KELLEY, Robert O, et al. *Základy histologie.* 1. edition. Jinočany : H & H, 1997. 502 pp. pp. 315. ISBN 80-85787-37-7.
4. JUNQUIERA, L. Carlos – CARNEIRO, José – KELLEY, Robert O, et al. *Základy histologie.* 1. edition. Jinočany : H & H, 1997. 502 pp. pp. 315. ISBN 80-85787-37-7.