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ANATOMICAL AND PHYSIOLOGICAL FEATURES OF THE BILIARY SYSTEM

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Abstract:
This article discusses the anatomical and physiological features of the bile duct system in the human body.

Keywords: gall bladder, absorption, sphincter of Oddi, pathology

The biliary system is designed to excrete into the intestine the secret of hepatocytes - bile, which performs a number of special functions: participation in the digestion and absorption of lipids in the intestine, the transfer of physiologically active substances to the intestine for subsequent absorption and use in general metabolism, as well as some end products of metabolism intended for release into the external environment.

The anatomy of the biliary system has been well studied by now. Intrahepatic ducts from the left quadrate and caudate lobes of the liver, merging, form the left hepatic duct (ductus hepaticus sinister). The intrahepatic ducts of the right lobe of the liver form the right hepatic duct ductus hepaticus dexter). The right and left hepatic ducts join to form the common hepatic duct (ductus hepaticus communis), the cystic duct flows into it (ductus cysticus), connecting the bile duct system with the gallbladder (vesica felleae), which is a reservoir for the accumulation of bile. After joining the common hepatic and cystic ducts, the common bile duct (ductus) is formed. The common bile duct flows into the duodenum, into the center of a special papillary bulge (papilla duodeni major , major duodenal papilla - BDS). Before this, in most cases (about 75%), the final part of the common bile duct is connected to the main pancreatic duct, at the place of their confluence, an ampulla-like expansion of the Vater nipple is formed, in which bile and pancreatic juice are mixed. In the wall of the duodenal papilla there are annular smooth muscle fibers that form the sphincter of Oddi performing the following functions:

a) regulates the flow of bile and pancreatic juice into the duodenum (duodenum), ensures the economical supply of these valuable digestive secrets, mainly in the digestion phase;

b) prevents the return of duodenal contents into the main pancreatic and common bile ducts.

The muscle bundles of the sphincter of Oddi partially annularly cover the final part of the common bile duct, partially the final part of the pancreatic excretory duct, and the main part of them surrounds these ducts after their confluence. In addition, there is also a thin circular layer of smooth muscle fibers in the submucosal layer of the apex of the BDS. There are several sphincters or sphincter- like formations along the bile ducts : the Mirizi sphincter - at the confluence of the right and left hepatic ducts, the spiral sphincter of Lutkens - a circular bundle of smooth muscle fibers in the neck of the gallbladder (GB) - at the point of transition of the neck into the cystic duct, the sphincter of the distal part of the common bile duct and sphincter of Oddi.

The function of sphincters and sphincter-like formations is to prevent the reverse (retrograde) flow of bile in normal conditions and under pathological conditions (with vomiting, duodenal dyskinesia, etc.) of duodenal contents and pancreatic juice entering the common bile duct.

The mucous membrane of the bile ducts has both absorption and secretion capacity. The length of the common hepatic duct is 2-6 cm, the diameter is from 3 to 9 mm. Sometimes it is absent, then both the right and left hepatic ducts merge directly with the cystic duct, forming the common bile duct. The length of the cystic duct is 3-7 cm, the width is about 6 mm. The common bile duct is usually about 2-9 cm long and 5-9 mm in diameter.

The innervation of the biliary tract is carried out by the branches of the hepatic nerve plexus, the blood supply is carried out by the small branches of the proper hepatic artery, the venous outflow goes to the portal vein, the lymphatic outflow goes to the hepatic lymph nodes of the gate of the liver.

The gallbladder is a part of the biliary system, a small hollow organ that serves to accumulate bile during the interdigestive period, concentrate it and release concentrated bile during meals and digestion. It is a thin-walled pear-shaped sac (its dimensions are very variable - length 5-14 cm, maximum diameter 3.5-4 cm), containing about 30-70 ml of bile. Since the wall of the gallbladder (without pronounced sclerotic changes due to chronic cholecystitis and adhesions with surrounding organs) is easily extensible, its capacity in some individuals can be much larger, reaching 150-200 ml or more.

The gallbladder is adjacent to the lower surface of the liver, located in the fossa of the gallbladder. In the gallbladder, the bottom, body and neck (passing into the cystic duct) are distinguished. The wall of the gallbladder consists of three membranes: mucous, muscular and connective tissue; its lower wall is covered with peritoneum.

The mucous membrane of the gallbladder has multiple folds (which, to a certain extent, allows the gallbladder to significantly stretch when overflowing with bile and contract). Numerous protrusions of the mucous membrane of the gallbladder between the muscle bundles of the wall are called crypts or sinuses of Rokitansky-Ashoff . The surface of the mucous membrane of the gallbladder is covered with high prismatic epithelial cells, on the apical surface of which there is a mass of microvilli, which explains their significant ability to absorb. It has been proven that these cells also have a secretory ability. In the region of the neck of the gallbladder, there are alveolar-tubular glands that produce mucus.

The innervation of the gallbladder comes from the hepatic nerve plexus, formed by nerve branches from the celiac and gastric plexuses, from the anterior vagus trunk and phrenic nerves. The blood supply to the gallbladder is carried out from the gallbladder artery, which in 85% of cases departs from the proper hepatic artery, in rare cases from the common hepatic artery. Veins of the gallbladder (usually 3-4) flow into the intrahepatic branches of the portal vein. The outflow of lymph is carried out to the hepatic lymph nodes located in the neck of the gallbladder and in the gates of the liver.

Functions of the biliary system

The movement of bile through the bile capillaries, intra- and extrahepatic ducts is carried out, first of all, under the influence of the total pressure formed by the secretion of bile by hepatocytes , which can reach approximately 300 mm of water. with m. The further promotion of bile through the larger bile ducts, especially extrahepatic ones, is determined by their tone and peristalsis, the state of the tone of the sphincter of the hepatic-pancreatic ampulla (sphincter of Oddi). The filling of the gallbladder with bile depends on the level of bile pressure in the common bile duct and the tone of the Lütkens sphincter .

It has been established that there are 3 types of contractions of the gallbladder:

1) small rhythmic with a frequency of 3-6 times per 1 minute. in the non-digestive period;
2) peristaltic of varying strength and duration, combined with rhythmic ;
3) strong tonic contractions during digestion, causing the flow of a significant portion of concentrated bile into the common bile duct and then into the duodenum.

The time from the start of a meal to the contractile reaction of the GI (latent period) depends on the nature of the food and ranges from 0.5-2 minutes. up to 8-9 min. The flow of bile into the duodenum coincides with the time of passage of the peristaltic wave through the pylorus. The time of tonic contraction of the gallbladder depends on the volume and qualitative composition of the food taken. With plentiful food, especially fatty, the contraction of the gallbladder lasts until the stomach is completely empty. When taking a small amount of food, especially with a low fat content, the reduction of the gallbladder is short-term. Of the nutrients taken in approximately equivalent weight quantities, the strongest reduction in gallbladder is caused by egg yolks, contributing to the release of up to 80% of the bile contained in it from the bladder (in healthy individuals).

In the daytime, when a person eats and at intermediate intervals, there is an alternation of periods of emptying and accumulation of bile ducts; at night, a significant amount of bile accumulates and concentrates in it.

The regulation of the functions of the gallbladder and ducts is carried out by the neurohumoral way.

The gastrointestinal hormone cholecystokinin (pancreozymin) stimulates the contraction of the gallbladder and relaxation of the sphincter of Oddi , the release of bile by hepatocytes (as well as pancreatic enzymes and bicarbonates). Cholecystokinin is secreted by special cells (J -cells) of the mucous membrane of the duodenum and jejunum when the products of the breakdown of proteins and fats enter and act on the mucous membrane. Some hormones of the endocrine glands (adrenocorticotropic (ACTH), corticosteroids, adrenaline, sex hormones) affect the function of the gallbladder and biliary tract. Cholinomimetics increase the contraction of the gallbladder, anticholinergic and adrenomimetic substances - inhibit. Nitroglycerin relaxes the sphincter of Oddi and reduces the tone of the bile ducts, morphine increases the tone of the sphincter of Oddi .

Bile acid metabolism

Bile acids (BAs) were discovered by A. Strecker in 1848 , who found that there are two organic acids in the bile of cattle: one of them does not contain sulfur and has the formula C 26 H 43 NO 6, and the other, on the contrary, contains sulfur and has the formula C 26 H 45 NSO 7. Both of these acids, splitting, give the same new acid - $C_{24}H_{40}O_5$, called cholic , due to its presence in bile. When splitting, the first acid, in addition to cholic , forms glycerol, the second - taurine, so they were named respectively glycocholic and taurocholic acids. A. Strecker's discovery contributed to the enhanced study of this class of compounds.

BAs are solid powdery substances with a high melting point (from 134 ° C to 223 ° C), which have a bitter taste, are poorly soluble in water, better in alcohol and alkaline solutions. According to the chemical structure, they belong to the group of steroids and are derivatives of cholanic acid ($C_{24}H_{40}O_2$). All fatty acids are formed only in hepatocytes from cholesterol.

Among human LC Bergstrom S. _ distinguished between primary (cholic and chenodeoxycholic, synthesized in the liver) and secondary (deoxycholic and lithocholic , formed in the small intestine from primary acids under the influence of intestinal bacterial microflora). Human bile also contains allocholic and ursodeoxycholic acids (UDCA), stereoisomers of cholic and chenodeoxycholic acids, respectively.

Under physiological conditions, free fatty acids practically do not occur in bile, since they are all bound in paired compounds with glycine or taurine. The liver is the only organ capable of converting cholesterol into hydroxyl-substituted cholanic acids, since the enzymes involved in hydroxylation and conjugation of fatty acids are found in microsomes and mitochondria of hepatocytes .

BAs synthesized in hepatocytes are excreted into the bile conjugated with glycine or taurine and enter the biliary tract through the biliary tract, where they accumulate. In the walls of the gallbladder, an insignificant amount of fatty acids is absorbed - about 1.3%. On an empty stomach, the main pool of fatty acids is located in the stomach, and after stimulation of the stomach with food, the stomach is reflexively reduced and fatty acids enter the duodenum.

BAs accelerate lipolysis and absorption of fatty acids and monoglycerides . In the intestine, fatty acids are deconjugated and reabsorbed under the influence of anaerobes , mainly in the distal small intestine, where secondary fatty acids are formed by bacterial dehydroxylation from primary. From the intestines, BAs with the portal blood flow again enter the liver, which absorbs almost all BAs (approximately 99%) from the portal blood; a very small amount (about 1%) enters the peripheral blood. That is why, if there is a pathology of the liver, its ability to absorb bile acids from the portal blood and excrete them into the common bile duct may be reduced, therefore, the level of fatty acids in the peripheral blood will increase. It has been established that active absorption of fatty acids occurs in the ileum of the small intestine, while passive absorption occurs due to the concentration of fatty acids in the intestine, since it is always higher than in portal blood. With active absorption, the bulk of the fatty acids are absorbed, and the absorption of a small amount falls to the share of passive absorption. BAs absorbed from the intestine bind to albumin and are transported back to the liver through the portal vein. In hepatocytes, toxic free fatty acids, which make up approximately 15% of the total amount of fatty acids that enter the blood, are converted into conjugated ones. From the liver, fatty acids are again excreted into bile in the form of conjugates . Such enterohepatic circulation in the body of a healthy person occurs 2-6 times a day, depending on the diet. Up to 10-15% of all FAs that enter the intestine after deconjugation undergo deeper degradation in the lower parts of the small intestine. As a result of the processes of oxidation and reduction caused by the enzymes of the microflora of the large intestine, the ring structure of the BA breaks, which leads to the formation of a number of substances excreted with feces into the external environment.

In a healthy person, about 90% of fecal BAs are secondary, i.e. lithocholic and deoxycholic acids. BAs in the human body perform various functions, the main ones being participation in the absorption of fats from the intestines, regulation of cholesterol synthesis, and regulation of bile formation and bile secretion. The rate of cholesterol synthesis in the small intestine depends on the concentration of fatty acids in the intestinal lumen. The main part of cholesterol in the human body is formed by synthesis, and a small part comes from food. Thus, the effect of fatty acids on cholesterol metabolism is to maintain its balance in the body. ZhK minimize the increase or lack of cholesterol in the body.

The destruction and release of part of the fatty acids represent the most important pathway for the excretion of end products of cholesterol. Cholic acids serve as a regulator of the metabolism of not only cholesterol, but also other steroids, in particular hormones. The physiological function of the fatty acid is to participate in the regulation of the excretory function of the liver. The choleretic property of fatty acids, confirmed by many authors, is used to introduce them into the composition of choleretic agents (decholine , allochol , etc.). Bile salts act as physiological laxatives, increasing intestinal peristalsis. This action of cholates explains the sudden diarrhea when large amounts of concentrated bile enter the intestine, for example, with hypomotor biliary dyskinesia. When bile is thrown into the stomach, gastritis can develop.

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