Lecture 4 in Anatomy of GIT

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The Liver

The liver is the largest organ in the body. It is soft and pliable and occupies the upper part of the abdominal cavity just beneath the diaphragm. The greater part of the liver is situated under cover of the right costal margin, and the right hemidiaphragm separates it from the pleura, lungs, pericardium, and heart. The liver extends to the left to reach the left hemidiaphragm. The convex upper surface of the liver is molded to the undersurface of the domes of the diaphragm. The posteroinferior, or visceral, surface is molded to adjacent viscera and is, therefore, irregular in shape; it lies in contact with the abdominal part of the esophagus, the stomach, the duodenum, the right colic flexure, the right kidney and suprarenal gland, and the gallbladder.



The liver may be divided into a large **right lobe** and a small **left lobe** by the attachment of the peritoneum of the falciform ligament. The right lobe is further divided into a **quadrate lobe** and a **caudate lobe** by the presence of the gallbladder, the fissure for the ligamentum teres, the inferior vena cava, and the fissure for the ligamentum venosum. Experiments have shown that, in fact, the quadrate and caudate lobes are a functional part of the left lobe of the liver. Thus, the right and left branches of the hepatic artery and portal vein, and the right and left hepatic ducts, are distributed to the right lobe and the left lobe (plus quadrate plus caudate lobes), respectively. Apparently, the two sides overlap very little.



The **porta hepatis**, or **hilum** of the liver, is found on the posteroinferior surface and lies between the caudate and quadrate lobes. The upper part of the free edge of the lesser omentum is attached to its margins. In it lie the right and left hepatic ducts, the right and left branches of the hepatic artery, the portal vein, and sympathetic and parasympathetic nerve fibers. A few hepatic lymph nodes lie here; they drain the liver and gallbladder and send their efferent vessels to the celiac lymph nodes.



The liver is completely surrounded by a fibrous capsule but only partially covered by peritoneum. The liver is made up of **liver lobules**. The **central vein** of each lobule is a tributary of the hepatic veins. In the spaces between the lobules are the **portal canals**, which contain branches of the hepatic artery, portal vein, and a tributary of a bile duct (portal triad). The arterial and venous blood passes between the liver cells by means of **sinusoids** and drains into the central vein.

Important Relations of the Liver

Anteriorly: Diaphragm, right and left costal margins, right and left pleura and lower margins of both lungs, xiphoid process, and anterior abdominal wall in the subcostal angle. **Posteriorly:** Diaphragm, right kidney, hepatic flexure of the colon, duodenum, gallbladder, inferior vena cava, and esophagus and fundus of the stomach.

Peritoneal Ligaments of the Liver

The **falciform ligament**, which is a two-layered fold of the peritoneum, ascends from the umbilicus to the liver. It has a sickle-shaped free margin that contains the ligamentum teres, the remains of the umbilical vein. The falciform ligament passes on to the anterior and then the superior surfaces of the liver and then splits into two layers. The right layer forms the upper layer of the **coronary ligament**; the left layer forms the upper layer of the **left triangular ligament**. The right extremity of the coronary ligament is known as the **right triangular ligament** of the liver. It should be noted that the peritoneal layers forming the coronary ligament are widely separated, leaving an area of liver devoid of peritoneum. Such an area is referred to as a **bare area of the liver**.



The **ligamentum teres** passes into a fissure on the visceral surface of the liver and joins the left branch of the portal vein in the porta hepatis. The **ligamentum venosum**, a fibrous band that is the remains of the ductus venosus, is attached to the left branch of the portal vein and ascends in a fissure on the visceral surface of the liver to be

attached above to the inferior vena cava. In the fetus, oxygenated blood is brought to the liver in the umbilical vein (ligamentum teres). The greater proportion of the blood bypasses the liver in the ductus venosus (ligamentum venosum) and joins the inferior vena cava. At birth, the umbilical vein and ductus venosus close and become fibrous cords.

The **lesser omentum** arises from the edges of the porta hepatis and the fissure for the ligamentum venosum and passes down to the lesser curvature of the stomach.

Blood Supply:

Arteries: The hepatic artery, a branch of the celiac artery, divides into right and left terminal branches that enter the porta hepatis.

<u>Veins</u>: The portal vein divides into right and left terminal branches that enter the porta hepatis behind the arteries. The hepatic veins (three or more) emerge from the posterior surface of the liver and drain into the inferior vena cava.

Blood Circulation through the Liver

The blood vessels conveying blood to the liver are the hepatic artery (30%) and portal vein (70%). The hepatic artery brings oxygenated blood to the liver, and the portal vein brings venous blood rich in the products of digestion, which have been absorbed from the gastrointestinal tract. The arterial and venous blood is conducted to the central vein of each liver lobule by the liver sinusoids. The central veins drain into the right and left hepatic veins, and these leave the posterior surface of the liver and open directly into the inferior vena cava.

Lymph Drainage

The liver produces a large amount of lymph —about one third to one half of all body lymph. The lymph vessels leave the liver and enter several lymph nodes in the porta hepatis. The efferent vessels pass to the celiac nodes. A few vessels pass from the bare area of the liver through the diaphragm to the posterior mediastinal lymph nodes.

Nerve Supply

Sympathetic and parasympathetic nerves form the celiac plexus. The anterior vagal trunk gives rise to a large hepatic branch, which passes directly to the liver.

The Portal vein

The portal vein enters the liver and breaks up into sinusoids, from which blood passes into the hepatic veins that join the inferior vena cava. The portal vein is about 2 in. (5 cm) long and is formed behind the neck of the pancreas by the union of the superior mesenteric and splenic veins. It ascends to the right, behind the first part of the duodenum, and enters the lesser omentum. It then runs upward in front of the opening into the lesser sac to the portal hepatis, where it divides into right and left terminal branches.

The portal vein drains blood from the abdominal part of the gastrointestinal tract from the lower third of the esophagus to halfway down the anal canal; it also drains blood from the spleen, pancreas, and gallbladder.

The portal circulation begins as a capillary plexus in the organs it drains and ends by emptying its blood into sinusoids within the liver.





Bile Ducts of the Liver

Bile is secreted by the liver cells at a constant rate of about 40 mL per hour. When digestion is not taking place, the bile is stored and concentrated in the gallbladder; later, it is delivered to the duodenum. The bile ducts of the liver consist of the **right** and **left hepatic ducts**, the **common hepatic duct**, the **bile duct**, the **gallbladder**, and the **cystic duct**.

The smallest interlobular tributaries of the bile ducts are situated in the portal canals of the liver; they receive the bile canaliculi. The interlobular ducts join one another to form progressively larger ducts and, eventually, at the porta hepatis, form the right and left hepatic ducts. The right hepatic duct drains the right lobe of the liver and the left duct drains the left lobe, caudate lobe, and quadrate lobe.

Hepatic Ducts

The right and left hepatic ducts emerge from the right and left lobes of the liver in the porta hepatis. After a short course, the hepatic ducts unite to form the common hepatic duct.

The **common hepatic duct** is about 1.5 in. (4 cm) long and descends within the free margin of the lesser omentum. It is joined on the right side by the cystic duct from the gallbladder to form the bile duct.



Bile Duct

The bile duct (common bile duct) is about 3 in. (8 cm) long. <u>In the first part</u> of its course, it lies in the right free margin of the lesser omentum in front of the opening into the lesser sac. Here, it lies in front of the right margin of the portal vein and on the right of the hepatic artery. <u>In the second part</u> of its course, it is situated behind the first part of the duodenum to the right of the gastroduodenal artery.

<u>In the third part</u> of its course, it lies in a groove on the posterior surface of the head of the pancreas. Here, the bile duct comes into contact with the main pancreatic duct.

The bile duct ends below by piercing the medial wall of the second part of the duodenum about halfway down its length. It is usually joined by the main pancreatic duct, and together, they open into a small ampulla in the duodenal wall, called the **hepatopancreatic ampulla (ampulla of Vater)**. The ampulla opens into the lumen of the duodenum by means of a small papilla, the **major duodenal papilla**. The terminal parts of both ducts and the ampulla are surrounded by a circular muscle, known as the **sphincter of the hepatopancreatic ampulla (sphincter of Oddi)**. Occasionally, the bile and pancreatic ducts open separately into the duodenum.



The Gallbladder

Location and Description

The gallbladder is a pear-shaped sac lying on the undersurface of the liver. It has a capacity of 30 to 50 mL and stores bile, which it concentrates by absorbing water. For descriptive purposes, the gallbladder is divided into the fundus, body, and neck. The **fundus** is rounded and usually projects below the inferior margin of the liver, where it comes in contact with the anterior abdominal wall at the level of the tip of the ninth right costal cartilage. The **body** lies in contact with the visceral surface of the liver and is directed upward, backward, and to the left. The **neck** becomes continuous with the cystic duct, which turns into the lesser omentum to join the right side of the common hepatic duct, to form the bile duct.

The peritoneum completely surrounds the fundus of the gallbladder and binds the body and neck to the visceral surface of the liver.

Relations

Anteriorly: The anterior abdominal wall and the inferior surface of the liver. **Posteriorly:** The transverse colon and the first and second parts of the duodenum.

Blood Supply:

The **cystic artery**, a branch of the right hepatic artery, supplies the gallbladder. The **cystic vein** drains directly into the portal vein. Several very small arteries and veins also run between the liver and gallbladder.

Lymph Drainage

The lymph drains into a **cystic lymph node** situated near the neck of the gallbladder. From here, the lymph vessels pass to the hepatic nodes along the course of the hepatic artery and then to the celiac nodes.

Nerve Supply

Sympathetic and parasympathetic vagal fibers form the celiac plexus. The gallbladder contracts in response to the hormone cholecystokinin, which is produced by the mucous membrane of the duodenum on the arrival of fatty food from the stomach.

Cystic Duct

The **cystic duct** is about 1.5 in. (3.8 cm) long and connects the neck of the gallbladder to the common hepatic duct to form the bile duct. It usually is somewhat S shaped and descends for a variable distance in the right free margin of the lesser omentum.

The mucous membrane of the cystic duct is raised to form a spiral fold that is continuous with a similar fold in the neck of the gallbladder. The fold is commonly known as the "spiral valve." The function of the spiral valve is to keep the lumen constantly open.

The pancreas

Location and Description

The pancreas is an elongated structure that lies in the epigastrium and the left upper quadrant. It is soft and lobulated and situated on the posterior abdominal wall behind the peritoneum. It crosses the transpyloric plane. The pancreas is divided into a head, neck, body, and tail.



The **head** of the pancreas is disc shaped and lies within the concavity of the duodenum. A part of the head extends to the left behind the superior mesenteric vessels and is called **the uncinate process**.

The **neck** is the constricted portion of the pancreas and connects the head to the body. It lies in front of the beginning of the portal vein and the origin of the superior mesenteric artery from the aorta.

The **body** runs upward and to the left across the mid-line. It is somewhat triangular in cross section.

The **tail** passes forward in the splenico-renal ligament and comes in contact with the hilum of the spleen.

Relations

Anteriorly: From right to left, the transverse colon and the attachment of the transverse mesocolon, the lesser sac, and the stomach.

Posteriorly: From right to left, the bile duct, the portal and splenic veins, the inferior vena cava, the aorta, the origin of the superior mesenteric artery, the left psoas muscle, the left suprarenal gland, the left kidney, and the hilum of the spleen.



Pancreatic Ducts

The **main duct of the pancreas** begins in the tail and runs the length of the gland, receiving numerous tributaries on the way. It opens into the second part of the duodenum at about its middle with the bile duct on the **major duodenal papilla**. Sometimes the main duct drains separately into the duodenum.

The accessory duct of the pancreas, when present, drains the upper part of the head and then opens into the duodenum a short distance above the main duct on the **minor** duodenal papilla. The accessory duct frequently communicates with the main duct.

Blood Supply:

<u>Arteries:</u> The splenic and the superior and inferior pancreaticoduodenal arteries supply the pancreas.

Veins: The corresponding veins drain into the portal system.

Lymph Drainage

Lymph nodes situated along the arteries that supply the gland. The efferent vessels of these nodes ultimately drain into the celiac and superior mesenteric lymph nodes.

Nerve Supply

Sympathetic and parasympathetic (vagal) nerve fibers supply the area.

The spleen

Location and Description

The spleen is reddish and is the largest single mass of lymphoid tissue in the body. It is oval shaped and has a notched anterior border. It lies just beneath the left half of the diaphragm close to the ninth, tenth, and eleventh ribs. The long axis lies along the shaft of the tenth rib, and its lower pole extends forward only as far as the midaxillary line and cannot be palpated on clinical examination.

The spleen is surrounded by peritoneum, which passes from it at the hilum as the gastrosplenic omentum (ligament) to the greater curvature of the stomach (carrying the short gastric and left gastroepiploic vessels). The peritoneum also passes to the left kidney as the splenic orenal ligament (carrying the splenic vessels and the tail of the pancreas).

Relations

Anteriorly: The stomach, tail of the pancreas, and left colic flexure. The left kidney lies along its medial border.

Posteriorly: The diaphragm; left pleura (left costodiaphragmatic recess); left lung; and ninth, tenth, and eleventh ribs.



Blood Supply:

Arteries: The large splenic artery is the largest branch of the celiac artery. It has a tortuous course as it runs along the upper border of the pancreas. The splenic artery then divides into about six branches, which enter the spleen at the hilum.

Veins: The splenic vein leaves the hilum and runs behind the tail and the body of the pancreas. Behind the neck of the pancreas, the splenic vein joins the superior mesenteric vein to form the portal vein.

Lymph Drainage

The lymph vessels emerge from the hilum and pass through a few lymph nodes along the course of the splenic artery and then drain into the celiac nodes.

Nerve Supply

The nerves accompany the splenic artery and are derived from the celiac plexus.