



20

The Viscera Associated
with the Alimentary
Tract: The Liver, the
Pancreas, and the Spleen



Chapter Outline

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THE LIVER

Liver Supports and Surgery

The liver is held in position in the upper part of the abdominal cavity by the attachment of the hepatic veins to the inferior vena cava. The peritoneal ligaments and the tone of the abdominal muscles play a minor role in its support. This fact is important surgically because even if the peritoneal ligaments are cut, the liver can be only slightly rotated.

Liver Trauma

The liver is a soft, friable structure enclosed in a fibrous capsule. Its close relationship to the lower ribs must be emphasized. Fractures of the lower ribs or penetrating wounds of

the thorax or upper abdomen are common causes of liver injury. Blunt traumatic injuries from automobile accidents are also common, and severe hemorrhage accompanies tears of this organ.

Because anatomic research has shown that the bile ducts, hepatic arteries, and portal vein are distributed in a segmental manner, appropriate ligation of these structures allows the surgeon to remove large portions of the liver in patients with severe traumatic lacerations of the liver or with a liver tumor. (Even large, localized carcinomatous metastatic tumors have been successfully removed.)

Liver Biopsy

Liver biopsy is a common diagnostic procedure. With the patient holding his or her breath in full expiration—to reduce the size of the costodiaphragmatic recess and the likelihood of damage to the lung—a needle is inserted through

the right eighth or ninth intercostal space in the midaxillary line. The needle passes through the diaphragm into the liver, and a small specimen of liver tissue is removed for microscopic examination.

Subphrenic Spaces

The important subphrenic spaces and their relationship to the liver are described on text page 713. Under normal conditions these are potential spaces only, and the peritoneal surfaces are in contact. An abnormal accumulation of gas or fluid is necessary for separation of the peritoneal surfaces. The anterior surface of the liver is normally dull on percussion. Perforation of a gastric ulcer is often accompanied by a loss of liver dullness caused by the accumulation of gas over the anterior surface of the liver and in the subphrenic spaces.

Portal-Systemic Anastomoses

See CD Chapter 8.

Portal Hypertension

See CD Chapter 8.

Blood Flow in the Portal Vein and Malignant Disease

See CD Chapter 8.

Gallstones

Gallstones are usually asymptomatic; however, they can give rise to gallstone colic or produce acute cholecystitis.

Biliary Colic

Biliary colic is usually caused by spasm of the smooth muscle of the wall of the gallbladder in an attempt to expel a gallstone. Afferent nerve fibers ascend through the celiac plexus and the greater splanchnic nerves to the thoracic segments of the spinal cord. Referred pain is felt in the right upper quadrant or the epigastrium (T7, 8, and 9 dermatomes).

Obstruction of the biliary ducts with a gallstone or by compression by a tumor of the pancreas results in backup of bile in the ducts and development of jaundice. The impaction of a stone in the ampulla of Vater may result in the passage of infected bile into the pancreatic duct, producing pancreatitis. The anatomic arrangement of the terminal part of the bile duct and the main pancreatic duct is subject to considerable variation. The type of duct system present

determines whether infected bile is likely to enter the pancreatic duct.

Gallstones have been known to ulcerate through the gallbladder wall into the transverse colon or the duodenum. In the former case, they are passed naturally per the rectum, but in the latter case, they may be held up at the ileocecal junction, producing intestinal obstruction.

Acute Cholecystitis

Acute cholecystitis produces discomfort in the right upper quadrant or epigastrium. Inflammation of the gallbladder may cause irritation of the subdiaphragmatic parietal peritoneum, which is supplied in part by the phrenic nerve (C3, 4, and 5). This may give rise to referred pain over the shoulder, because the skin in this area is supplied by the supraclavicular nerves (C3 and 4).

Cholecystectomy and the Arterial Supply to the Gallbladder

Before attempting a cholecystectomy operation, the surgeon must be aware of the many variations in the arterial supply to the gallbladder and the relationship of the vessels to the bile ducts (CD Fig. 20-1). Unfortunately, there have been several reported cases in which the common hepatic duct or the main bile duct has been included in the arterial ligature with disastrous consequences.

Gangrene of the Gallbladder

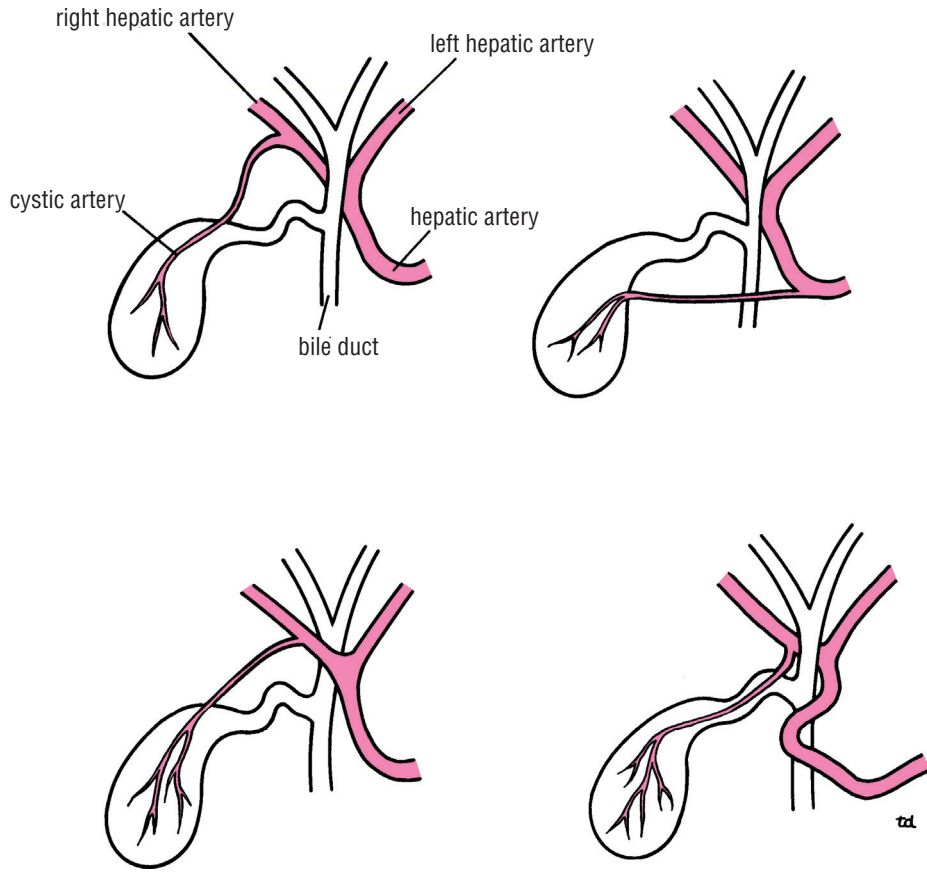
Unlike the appendix, which has a single arterial supply, the gallbladder rarely becomes gangrenous. In addition to the cystic artery, the gallbladder also receives small vessels from the visceral surface of the liver.



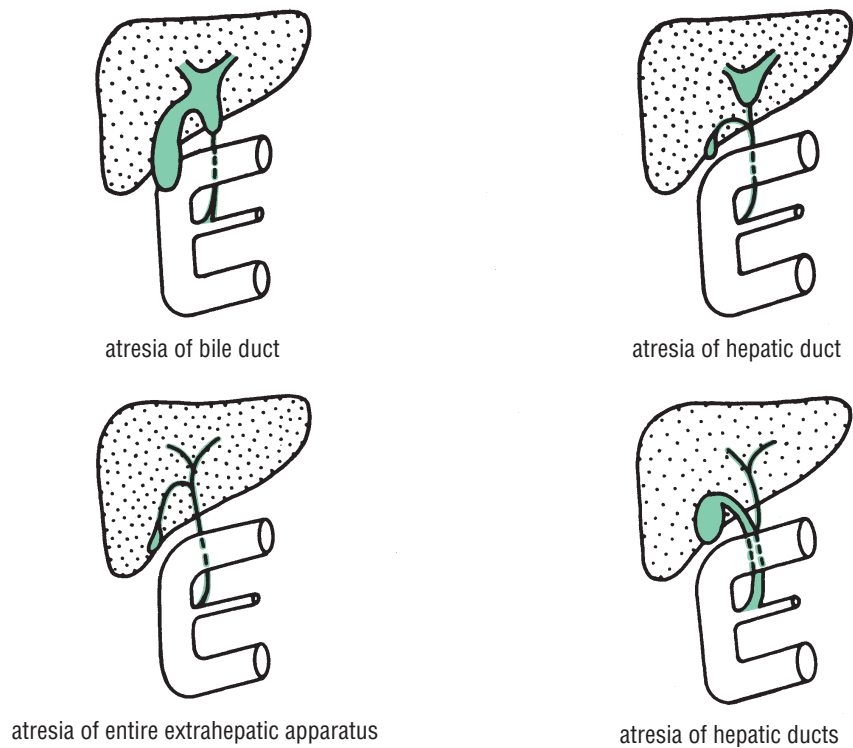
CONGENITAL ANOMALIES OF THE GALLBLADDER

Biliary Atresia

Failure of the bile ducts to canalize during development causes atresia. The various forms of atresia are shown in CD Fig. 20-2. Jaundice appears soon after birth; clay-colored stools and very dark colored urine are also present. Surgical correction of the atresia should be attempted when possible. If the atresia cannot be corrected, the child will die of liver failure.



CD Figure 20-1 Some common variations of blood supply to the gallbladder.



CD Figure 20-2 Some common congenital anomalies of the biliary ducts.

Absence of the Gallbladder

Occasionally, the outgrowth of cells from the hepatic bud fails to develop. In these cases, there is no gallbladder and no cystic duct (CD Fig. 20-3).

Double Gallbladder

Rarely, the outgrowth of cells from the hepatic bud bifurcates so that two gallbladders are formed (see CD Fig. 20-3).

Absence of the Cystic Duct

In absence of the cystic duct, the entire outgrowth of cells from the hepatic bud develops into the gallbladder and fails to leave the narrow stem that would normally form the cystic

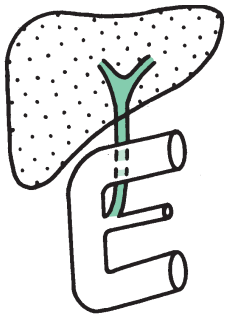
duct. The gallbladder drains directly into the bile duct. The condition may not be recognized when performing a cholecystectomy, and the bile duct may be seriously damaged by the surgeon (see CD Fig. 20-3).

Accessory Bile Duct

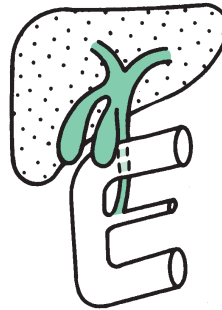
A small accessory bile duct may open directly from the liver into the gallbladder, which may cause leakage of bile into the peritoneal cavity after cholecystectomy if it is not recognized at the time of surgery (see CD Fig. 20-3).

Congenital Choledochal Cyst

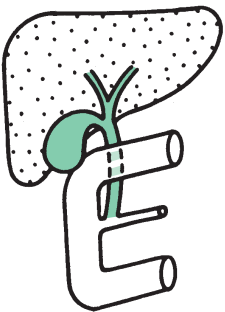
Rarely, a choledochal cyst develops because of an area of weakness in the wall of the bile duct. A cyst can contain 1 to 2 L of bile. The anomaly is important in that it may press



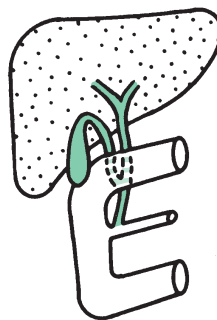
congenital absence of gallbladder



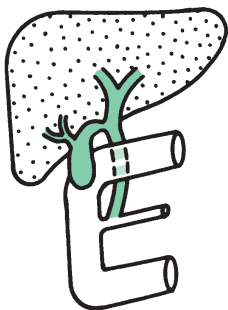
double gallbladder



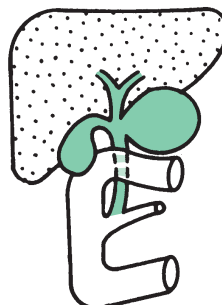
absence of cystic duct



abnormally long cystic duct



accessory bile duct



choledochal cyst

CD Figure 20-3 Some common congenital anomalies of the gallbladder.

on the bile duct and cause obstructive jaundice (see CD Fig. 20-3).



THE PANCREAS

Diagnosis of Pancreatic Disease

The deep location of the pancreas sometimes gives rise to problems of diagnosis for the following reasons:

- Pain from the pancreas is commonly referred to the back.
- Because the pancreas lies behind the stomach and transverse colon, disease of the gland can be confused with that of the stomach or transverse colon.
- Inflammation of the pancreas can spread to the peritoneum, forming the posterior wall of the lesser sac. This in turn can lead to adhesions and the closing off of the lesser sac to form a pseudocyst.

Trauma of the Pancreas

The pancreas is deeply placed within the abdomen and is well protected by the costal margin and the anterior abdominal wall. However, blunt trauma, such as in a sports injury when a sudden blow to the abdomen occurs, can compress and tear the pancreas against the vertebral column. The pancreas is most commonly damaged by gunshot or stab wounds.

Damaged pancreatic tissue releases activated pancreatic enzymes that produce the signs and symptoms of acute peritonitis.

Cancer of the Head of the Pancreas and the Bile Duct

Because of the close relation of the head of the pancreas to the bile duct, cancer of the head of the pancreas often causes obstructive jaundice.

The Pancreatic Tail and Splenectomy

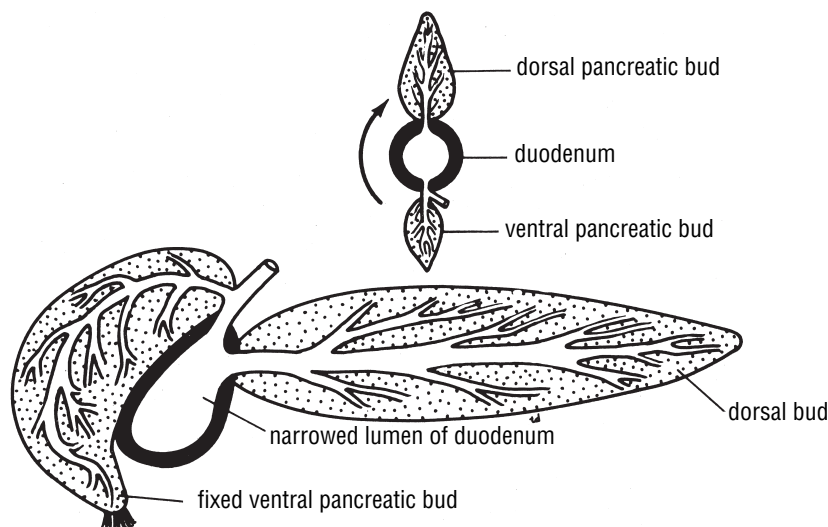
The presence of the tail of the pancreas in the splenicorenal ligament sometimes results in its damage during splenectomy. The damaged pancreas releases enzymes that start to digest surrounding tissues, with serious consequences.



CONGENITAL ANOMALIES OF THE PANCREAS

Anular Pancreas

In anular pancreas, the ventral pancreatic bud becomes fixed so that, when the stomach and duodenum rotate, the ventral bud is pulled around the right side of the duodenum to fuse with the dorsal bud of the pancreas, thus encircling the duodenum (CD Fig. 20-4). This may cause obstruction of the duodenum, and vomiting may start a few hours after birth. Early surgical relief of the obstruction is necessary.



CD Figure 20-4 Formation of the anular pancreas, producing duodenal obstruction. Note the narrowing of the duodenum.

Ectopic Pancreas

Ectopic pancreatic tissue may be found in the submucosa of the stomach, duodenum, small intestine (including Meckel's diverticulum), and gallbladder and in the spleen. It is important in that it may protrude into the lumen of the gut and be responsible for causing intussusception.

Congenital Fibrocystic Disease

Basically, congenital fibrocystic disease in the pancreas is caused by an abnormality in the secretion of mucus. The mucus produced is excessively viscid and obstructs the pancreatic duct, which leads to pancreatitis with subsequent fibrosis. The condition also involves the lungs, kidneys, and liver.



THE SPLEEN

Splenic Enlargement

A pathologically enlarged spleen extends downward and medially. The left colic flexure and the phrenicocolic ligament prevent a direct downward enlargement of the organ. As the enlarged spleen projects below the left costal margin, its notched anterior border can be recognized by palpation through the anterior abdominal wall.

The spleen is situated at the beginning of the splenic vein, and in cases of portal hypertension it often enlarges from venous congestion.

Trauma to the Spleen

Although anatomically the spleen gives the appearance of being well protected, automobile accidents of the crushing or run-over type commonly produce laceration of the spleen. Penetrating wounds of the lower left thorax can also damage the spleen.



CONGENITAL ANOMALIES OF THE SPLEEN

Supernumerary Spleens

In 10% of people, one or more supernumerary spleens may be present, either in the gastrosplenic omentum or in the splenicorenal ligament. Their clinical importance is that they may hypertrophy after removal of the major spleen and be responsible for a recurrence of symptoms of the disease for which splenectomy was initially performed.

Clinical Problem Solving Questions

Read the following case histories/questions and give the best answer for each.

A 55-year-old woman with a history of flatulent dyspepsia suddenly experienced an excruciating colicky pain across the upper part of the abdomen. On examination in the emergency department, she was found to have some rigidity and tenderness in the right upper quadrant. A diagnosis of biliary colic was made.

- The following statements would explain this patient's symptoms **except** which?
 - The pain of gallstone colic is caused by spasm of the smooth muscle in the wall of the gallbladder and distension of the bile ducts by the stones.
 - The pain fibers from the gallbladder and bile ducts ascend through the superior mesenteric plexus and the greater splanchnic nerves to enter the thoracic segments of the spinal cord.

- Referred pain is felt in the right upper quadrant or the epigastrium.
- T7 through T9 dermatomes are involved.
- The violent contractions of the gallbladder wall are attempts to expel the gallstones.

On examination of the abdomen of a 31-year-old woman, a large swelling was found to extend downward and medially below the left costal margin. On percussion, a continuous band of dullness was noted to extend upward from the left of the umbilicus to the left axillary region. On palpation, a notch was felt along the anterior border of the swelling. A diagnosis of splenic enlargement was made.

- The signs displayed by this patient can be explained by the following statements **except** which?
 - The spleen has a notched anterior border caused by incomplete fusion of its parts during development.

- B. Because of the presence of the left colic flexure and the phrenicocolic ligament, the spleen is unable to expand vertically downward.
 - C. A pathologically enlarged spleen extends downward and forward, toward the umbilicus.
 - D. The spleen is situated in the upper left quadrant of the abdomen beneath the diaphragm.
 - E. The long axis of the spleen lies along the twelfth rib.
3. A 19-year-old football player was accidentally kicked on the left side of his chest. On returning to the locker room he said he felt faint and collapsed to the floor. On examination in the emergency department, he was found to be in hypovolemic shock. He had tenderness and guarding in the left upper quadrant of his abdomen. He also had extreme local tenderness over his left tenth rib in the midaxillary line. A diagnosis of a ruptured spleen and the possibility of a fractured tenth rib was made. Explain the tenderness and guarding in the abdomen in this patient.

A 40-year-old obese woman complaining of indigestion was admitted to the hospital for investigation. She had a past history of gallstones and transient attacks of jaundice. Large gallstones have been known to erode through the posterior wall of the gallbladder and enter the intestinal tract.

- 4. Which part of the intestinal tract is likely to initially contain the stone?
 - A. The sigmoid colon
 - B. The descending colon
 - C. The transverse colon
 - D. The ascending colon
 - E. The jejunum
- 5. A 50-year-old woman with a history of flatulent dyspepsia suddenly experienced an excruciating colicky pain

across the upper part of the abdomen. On examination after the attack, some rigidity and tenderness was noted in the right hypochondrium. Two days later the patient became jaundiced, and it was noticed that the degree of jaundice varied from day to day. The diagnosis of biliary colic was made. Why should a person passing a gallstone experience pain? Why is the pain experienced in the area described above? Why does the jaundice vary in intensity?

- 6. A 65-year-old woman was admitted to the hospital with progressive jaundice of three months' duration and weight loss. She had not experienced any colicky pain. On examination, a soft swelling could be felt in the abdomen in the region of the tip of the right ninth costal cartilage. A diagnosis of cancer of the head of the pancreas was made. What anatomic structure is responsible for the swelling?
- 7. A patient with thrombocytopenic purpura was advised to have a splenectomy to stop the episodes of bleeding from the gums and gastrointestinal tract. The operation was successful. Eighteen months later the clinical features returned. Can you explain in anatomic terms the recurrence of the bleeding after the condition had apparently been cured by splenectomy?
- 8. Following a splenectomy, it was noticed that pancreatic juice was exuding through the patient's abdominal wound. Is the pancreas likely to be damaged during splenectomy? Which part of the pancreas?
- 9. The anatomic arrangement of the terminal part of the bile duct and the main pancreatic duct is subject to considerable variation. Which variations are likely to be associated with a pancreatitis should a gallstone become impacted at the lower end of the bile duct?

Answers and Explanations

- 1. **B** is the correct answer. The pain fibers from the gallbladder and bile ducts ascend through the celiac plexus.
- 2. **E** is the correct answer. The long axis of the spleen lies along the tenth rib (see text Fig. 20-27).
- 3. Initially in this patient, the spleen underwent a subcapsular hemorrhage, and later, in the locker room, the capsule gave way, allowing the blood to escape into the peritoneal cavity. The presence of blood in the peritoneal cavity irritated the parietal peritoneum, causing tenderness in the left upper quadrant and reflex guarding of the muscles in the same area.
- 4. **C** is the correct answer. The transverse colon is in close posterior relation to the gallbladder.
- 5. The pain is due to the spastic contraction of the muscle of the gallbladder attempting to flush the stone down the bile ducts and to the distension of the ducts by the stone. The afferent pain fibers from the gallbladder and bile ducts enter the spinal cord between segments T5 and T9. Pain is referred to the epigastrium via the sev-

- enth to the ninth intercostal nerves. A variable amount of bile gets past the stone.
6. A small carcinoma of the head of the pancreas was found at operation to be compressing the bile duct. Back pressure along the bile ducts produced dilatation of the gallbladder, which could be felt in the region of the tip of the right ninth costal cartilage.
 7. About 10% of persons have accessory spleens. These should always be looked for when performing a splenectomy for such conditions as thrombocytopenic purpura. If an accessory spleen is missed, it will enlarge and take over the functions of the main spleen.
 8. The tail of the pancreas lies within the splenicorenal ligament, and its tip is related to the hilus of the spleen. The surgeon has to take extreme care not to damage the tail of the pancreas during a splenectomy.
 9. Any variation in which the bile duct and the pancreatic duct open by a common orifice into the duodenum is likely to cause this problem (see text Fig. 20-26). Gallstones are usually associated with infected bile. A stone impacted at the orifice into the duodenum will allow reflux of infected bile along the main pancreatic duct, and pancreatitis will occur.

