20 The Viscera Associated with the Alimentary Tract: The Liver, the Pancreas, and the Spleen
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
dline. 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 peri-
toneal 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 ac-
companied by a loss of liver dullness caused by the accu-
mulation 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 ex-
pel a gallstone. Afferent nerve fibers ascend through the
celiac plexus and the greater splanchnic nerves to the tho-
racic 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 im-
paction 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 biliary 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 pan-
creatic 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 peri-
toneum, which is supplied in part by the phrenic nerve (C3,
4, and 5). This may give rise to referred pain over the shoul-
deer, because the skin in this area is supplied by the supra-
clavicular 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.
Some common variations of blood supply to the gallbladder.

atresia of bile duct
atresia of hepatic duct
atresia of entire extrahepatic apparatus
atresia of hepatic ducts

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
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.

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.

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

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 splenorenal 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.

1. The following statements would explain this patient’s symptoms except which?
   A. 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.
   B. 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.
   C. Referred pain is felt in the right upper quadrant or the epigastrium.
   D. T7 through T9 dermatomes are involved.
   E. 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.

2. The signs displayed by this patient can be explained by the following statements except which?
   A. The spleen has a notched anterior border caused by incomplete fusion of its parts during development.
   B. The spleen has a notched anterior border caused by incomplete fusion of its parts during development.
   C. The spleen is situated at the beginning of the splenic vein, and in cases of portal hypertension it often enlarges from venous congestion.
   D. T7 through T9 dermatomes are involved.
   E. The violent contractions of the gallbladder wall are attempts to expel the gallstones.
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 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?

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.