

10 The Pancreas

Anatomy

General Facts

The pancreas is 14–18 cm long and weighs 70–80 g. It is a gland with exocrine and endocrine features.

Division

- head of pancreas with the uncinate process
- body of pancreas
- tail of pancreas
- pancreatic duct (Wirsung)
- accessory pancreatic duct (Santorini)

Location

The pancreas is a secondarily retroperitoneal organ. It lies on the median line roughly at the level L1–L2, with the head lower than the tail: the axis of the body is inclined toward the upper left approximately 30° to the horizontal line.

The accessory pancreatic duct, if present, enters the duodenum 2–3 cm above the major duodenal papilla.

Topographic Relationships

- duodenum
- L2–L3 (head of pancreas), covered by the right crus of the diaphragm
- common bile duct
- aorta
- inferior vena cava
- left renal vein

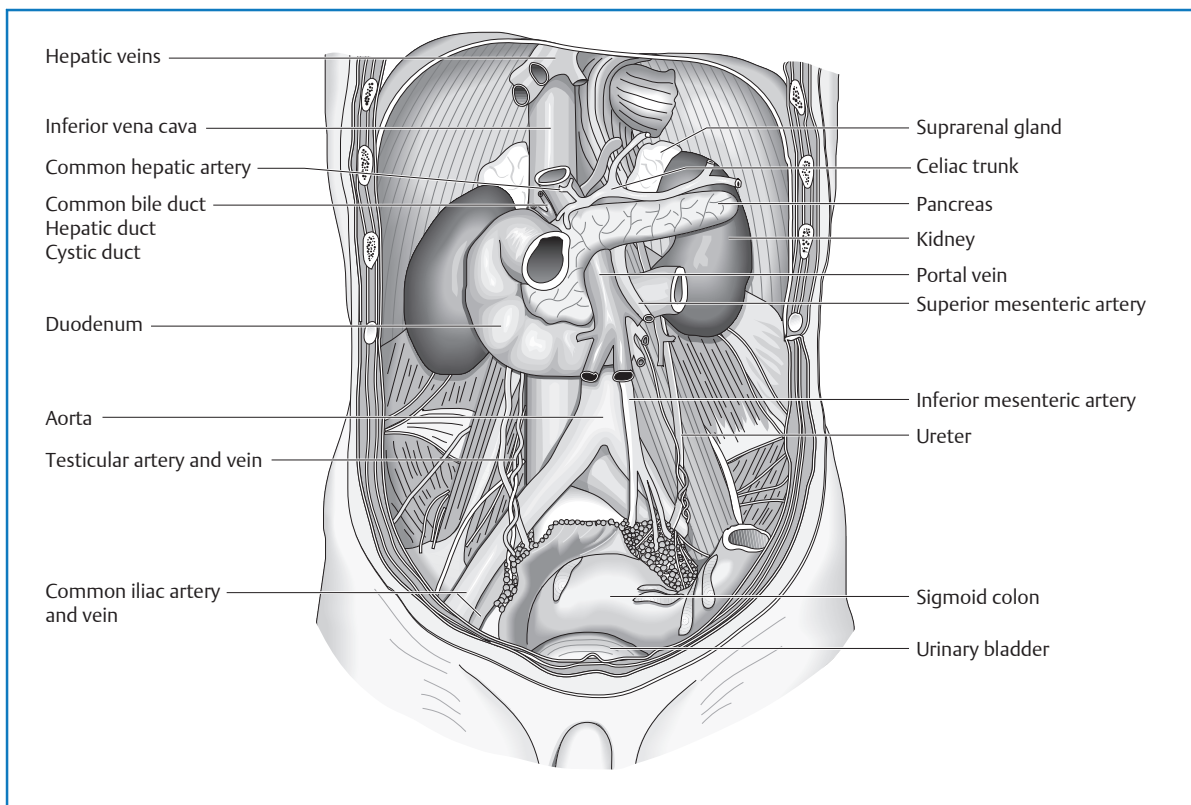


Fig. 10.1 Topographic relationships of the pancreas.

- pylorus
- superior mesenteric artery and vein
- duodenojejunal flexure
- omental bursa
- stomach
- kidneys
- transverse mesocolon (divides the pancreas into a sub- and a supramesocolic part)
- transverse colon
- left colic flexure
- splenic vein
- peritoneum
- spleen
- lesser omentum
- portal vein

Attachments/Suspensions

- organ pressure
- turgor
- attachments of connective tissue in the retroperitoneal space
- pancreaticosplenic ligament
- retropancreatic fascia (Treitz)
- transverse mesocolon
- duodenum

Circulation

Arterial

- superior mesenteric artery
- gastroduodenal artery (from the common hepatic artery)
- splenic artery

Venous

- superior mesenteric vein
- portal vein (from the splenic vein and pancreaticoduodenal veins)

Lymph Drainage

- direct lymphatic connections to nearby organs (duodenum)
- via celiac lymph nodes to the gastric and hepatic lymph nodes on the left side of the body
- mediastinal and cervical lymph nodes
- pancreaticolienal lymph node and pylorus
- mesenteric and periaortal lymph nodes

Innervation

- sympathetic nervous system from T5 to T9 (sometimes also T10 and T11) via the major splanchnic nerve, with switching in the celiac plexus
- vagus nerve

Organ Clock

Maximal time: 9–11 a.m.

Minimal time: 9–11 p.m.

Organ–Tooth Interrelationship

For basic information, see page 34.

- First back tooth in the lower jaw, right side
- First molar in the upper jaw on the right side

Movement Physiology according to Barral

Mobility

Due to the good fascial anchoring in the retroperitoneal space, it is impossible to detect a separate mobility. Nevertheless, the movements of the neighboring organs and the diaphragm cause pushing and pulling on the pancreas.

Motility

With a hand that rests on the projection of the pancreas on the abdomen (fingers pointing to the tail, thenar lies above the head), we can detect a wave from the heel of the hand to the fingertips during exhalation. During inhalation, the wave runs in the opposite direction.

Physiology

The pancreas is a gland with exocrine and endocrine features. The endocrine parts, the islets of Langerhans, are distributed throughout the entire pancreas with accumulations in the body and tail. The cells in the islets of Langerhans produce the hormones that are responsible for regulating blood sugar: insulin, glucagon, and somatostatin.

Insulin

Insulin is synthesized in the β cells of the islets of Langerhans (approximately 2 mg/day) and lowers the blood sugar level by making the cell wall of each body cell permeable to glucose. In addition, insulin assists in the uptake of different amino acids into the cell.

In the liver, it initiates a variety of metabolic processes:

- glycogen synthesis and inhibition of glycogenolysis
- synthesis of lipids and inhibition of lipolysis
- inhibition of protein breakdown

Glucagon

Glucagon is produced in the α cells of the islets. It is the “insulin antagonist”: by promoting glycogenolysis and gluconeogenesis in the liver, it raises the blood sugar level.

Somatostatin

The δ cells synthesize this hormone. It suppresses the release of insulin and glucagons, and decreases digestive activity by reducing intestinal peristalsis and inhibiting the secretion of digestive juices. Its function is to maintain the glucose level as much as possible.

The **exocrine gland part** of the pancreas secretes juice into the pancreatic duct. As a result of its activity, approximately 1–1.5L of “abdominal saliva” thus reaches the duodenum per day.

This secretion consists of:

- bicarbonate to neutralize the acidic chyme from the stomach
- trypsinogen and chymotrypsinogen (enzymes for digesting protein)
- α -amylase (also present in the saliva of the mouth) for cleaving carbohydrates
- lipase (enzyme for cleaving fat)

The enzymes of this “abdominal saliva” are not yet activated in the pancreas. It is only after contact with bile or the enterokinase in the duodenal juice that they are activated and begin working. If this activation takes place in the pancreas, it results in autodigestion and the symptoms of acute pancreatitis.

Pathologies

Symptoms that Require Medical Clarification

- Icterus
- Pain in the depth of the upper abdomen with back pain in the area of the lower thoracic spinal column, radiating beltlike from the back to the front
- “Rubber stomach”

Acute Pancreatitis

Definition. Inflammation of the pancreas with disturbance of exocrine and endocrine functions.

Causes

- biliary tract disorders (40–50%)
- alcohol abuse (30–40%)
- idiopathic (10–30%)

Rare causes include:

- medications (diuretics, β blockers, glucocorticoids, antibiotics, nonsteroidal antirheumatics)
- trauma
- infections (mumps, Coxsackievirus)
- hypercalcemia (e.g., hyperparathyroidism)
- hyperlipoproteinemia
- papillary stenosis

Clinical

- guiding symptom: severe upper abdominal pain, arising approximately 8–12 hours after a large meal or alcohol abuse, with pain radiating into the back and ringlike to the left around the torso
- shock

Chronic Pancreatitis

Definition. Chronic inflammation of the pancreas is characterized by persistent or recurrent pain with usually irreversible morphologic changes in the pancreatic parenchyma and functional disturbances in the pancreas.

Causes

- alcohol (70–90%)
- idiopathic (10–25%)

Rare causes include:

- anomalies in the pancreatic duct system
- hyperparathyroidism
- trauma
- abuse of analgesics