KREP 2025

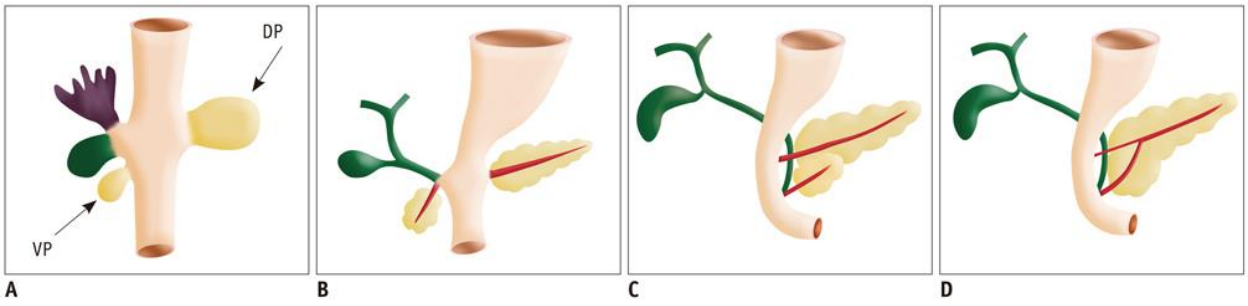
KARNATAKA RADIOLOGY EDUCATION PROGRAM

Anatomy and Applied Radiology – Pancreas-1

The pancreas is an abdominal glandular organ with both digestive (exocrine) and hormonal (endocrine) functions.

Embryologic Development of the Pancreas

The pancreas develops from dorsal and ventral buds that first appear in the fifth gestational week as outgrowths of the primitive foregut (Fig. 1). By the seventh gestational week, expansion of the duodenum causes the ventral bud to rotate and pass behind the duodenum from right to left and fuse with the dorsal bud. The ventral bud forms the posterior head and uncinate process, whereas the dorsal bud forms the anterior head, body, and tail (3). Following this fusion, the ductal systems anastomose, a complicated process with a wide spectrum of possible outcomes. The portion of the ventral duct between the dorsal-ventral fusion and major papilla is termed the duct of Wirsung. The portion of the dorsal duct upstream to the dorsalventral fusion point is called the main pancreatic duct. The segment of the dorsal duct downstream to the dorsal-ventral fusion point is termed the duct of Santorini, or accessory pancreatic duct, which drains at the papilla mino



Drawings show normal embrologic development of pancreas.
Ventral pancreatic bud (VP) arises from hepatic diverticulum, and dorsal pancreatic bud (DP) arises from dorsal mesogastrium (A). During 7th gestational week, expansion of duodenum causes ventral pancreatic bud to rotate and pass behind duodenum from right to left and fuse with dorsal pancreatic bud (B-D). Ventral bud forms posterior head and uncinate process, whereas dorsal bud forms anterior head, body, and tail. Finally, ventral and dorsal pancreatic ducts fuse, and pancreas predominantly is drained through ventral duct, which joins common bile duct at level of major papilla and dorsal duct drains at level of minor papilla.

Anatomical Position

The pancreas is an oblong-shaped organ positioned at the level of the transpyloric plane (L1). With the exception of the tail of the pancreas, it is a retroperitoneal organ, located deep within the upper abdomen in the epigastrium and left hypochondrium regions.

Within the abdomen, the pancreas has direct anatomical relations to several structures

Organs:

Stomach – Separated from the pancreas by the lesser sac, the stomach and pylorus lie anterior and to the pancreas.

Duodenum – The "C" shaped duodenum curves around and outlines the head of the pancreas. The first part of the duodenum lies anteriorly whereas the second part of the duodenum including the ampulla of Vater lies laterally to the right of the pancreatic head

Transverse mesocolon – Attaches to the anterior surface of the pancreas

Common bile duct – Descends behind the head of the pancreas before opening into the second part of the duodenum alongside the major pancreatic duct through the major duodenal papilla

Spleen – located posteriorly and laterally. The lienorenal ligament is formed from peritoneum and connects the spleen to the tail of the pancreas.

Vessels

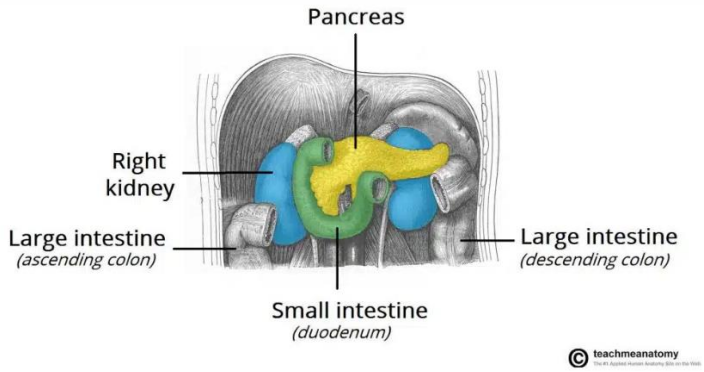
The pancreas lies near several major vessels and significant landmarks in vascular anatomy:

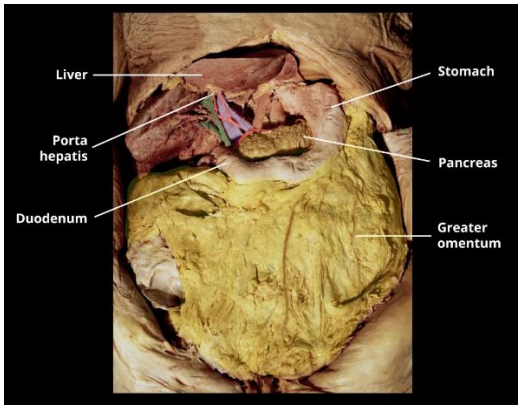
The aorta and inferior vena cava pass posteriorly to the head of the pancreas.

The superior mesenteric artery lies behind the neck of the pancreas and anterior to the uncinate process.

Posterior to the neck of the pancreas, the splenic and superior mesenteric veins unite to form the hepatic portal vein.

As it journeys from its origin at the celiac plexus to the splenic hilum, the splenic artery traverses the superior border of the pancreas





Anterior view of the abdomen. The stomach, transverse colon, and the majority of the small intestine have been removed to expose the underlying pancreas

Dissection

Anatomical Structure

The pancreas is typically divided into five parts:

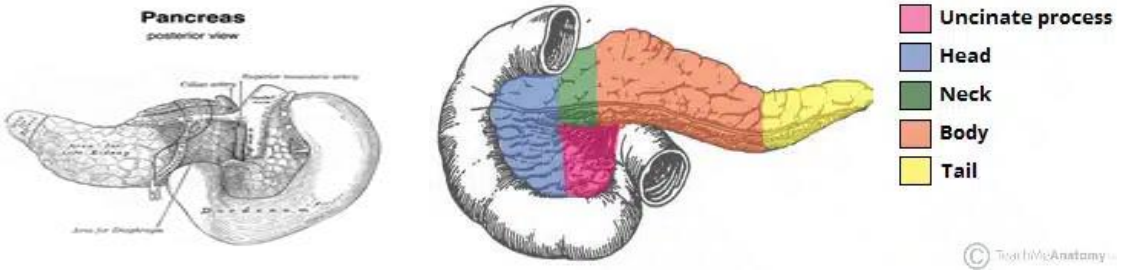
Head – the widest part of the pancreas. It lies within the C-shaped curve created by the duodenum and is connected to it by connective tissue.

Uncinate process – a projection arising from the lower part of the head and extending medially to lie beneath the body of the pancreas. It lies posterior to the superior mesenteric vessels.

Neck – located between the head and the body of the pancreas. It overlies the superior mesenteric vessels which form a groove in its posterior aspect.

Body – centrally located, crossing the midline of the human body to lie behind the stomach and to the left of the superior mesenteric vessels.

Tail – the left end of the pancreas that lies within close proximity to the hilum of the spleen. It is contained within the splenorenal ligament with the splenic vessels. This is the only part of the pancreas that is intraperitoneal.



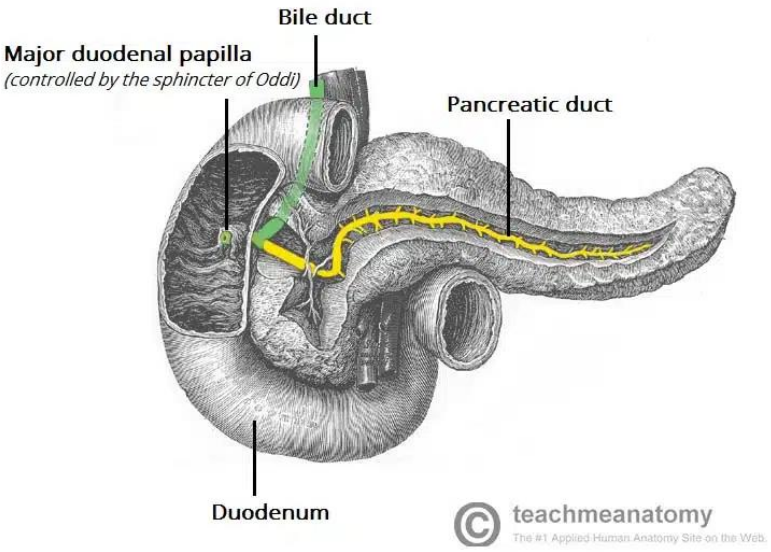
Duct System

The exocrine pancreas is classified as a lobulated, serous gland which produces digestive enzyme precursors. It is composed of approximately one million 'berry-like' clusters of cells called acini, connected by short intercalated ducts.

The intercalated ducts unite with those draining adjacent lobules and drain into a network of intralobular collecting ducts, which in turn drain into the main pancreatic duct.

The pancreatic duct runs the length of the pancreas and unites with the common bile duct, forming the hepatopancreatic ampulla of Vater. This structure then opens into the duodenum via the major duodenal papilla.

Secretions into the duodenum are controlled by a muscular valve – the sphincter of Oddi. It surrounds the ampulla of Vater, acting as a valve.

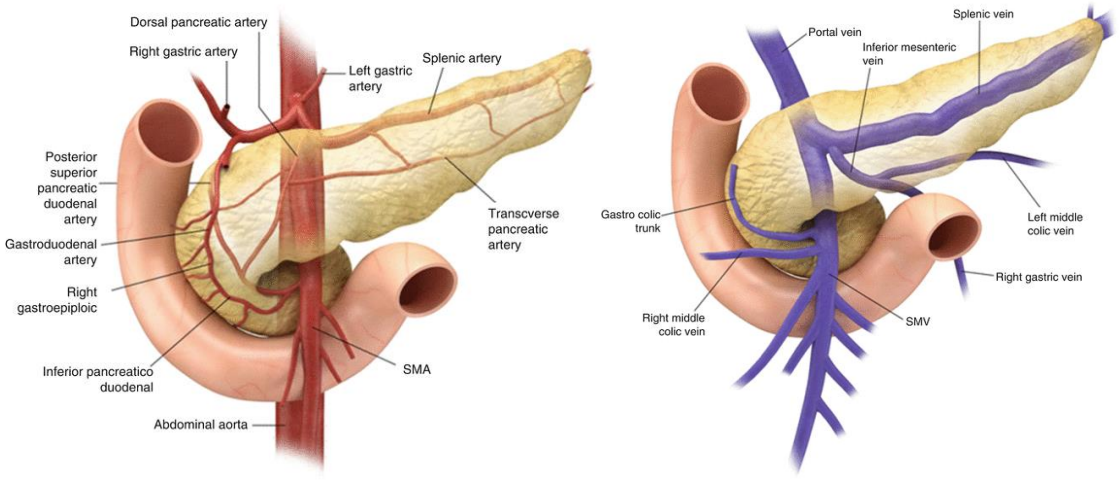


The exocrine pancreas, secreting into the duodenum

Vasculature

The pancreas is supplied by the pancreatic branches of the splenic artery. The head is additionally supplied by the superior and inferior pancreaticoduodenal arteries which are branches of the gastroduodenal (from coeliac trunk) and superior mesenteric arteries, respectively.

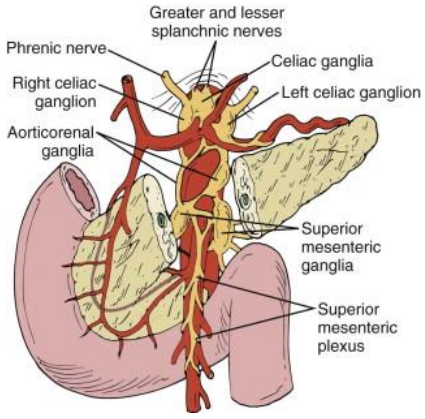
Venous drainage of the head of the pancreas is into the superior mesenteric branches of the hepatic portal vein. The pancreatic veins draining the rest of the pancreas do so via the splenic vein.



The arterial supply and venous drainage of the pancreas

Nerve Supply

It is important to appreciate the nerve supply of the pancreas in planning celiac nerve blocks for control of pain resulting from pancreatic carcinoma or chronic pancreatitis. The pancreas receives sympathetic innervation by way of the splanchnic nerves and parasympathetic innervation from the vagus nerve. The sympathetic nerves carry the pain (visceral afferent) fibers. They pierce the diaphragmatic crura to enter the celiac plexus and celiac ganglion that surround the celiac artery. The superior mesenteric ganglia and plexus surround the superior mesenteric artery. Chemical extirpation of the celiac ganglion interrupts afferent pain fibers from both the sympathetic and the parasympathetic systems and can be accomplished by injection of the chemical agent between the celiac artery and the superior mesenteric artery either antecrurally or retrocrurally.



Nerve supply of the pancreas.

(From Tersingni R, Toledo-Pereyra LH: Surgical anatomy of the pancreas. In Toledo-Pereyra LH: The Pancreas: Principles of Medical and Surgical Practice. Churchill Livingstone, New York, 1985, pp 31–50.)

Lymphatics

The pancreas is drained by lymphatic vessels that follow the arterial supply. They empty into the pancreaticosplenal nodes and the pyloric nodes, which in turn drain into the superior mesenteric and coeliac lymph nodes.

Physiology:

Exocrine Function:

The pancreas produces pancreatic juice, which contains enzymes (amylase, lipase, trypsin, and chymotrypsin) that aid in the digestion of carbohydrates, fats, and proteins.
These enzymes are secreted into the duodenum through the pancreatic ducts.

Endocrine Function:

The islets of Langerhans secrete hormones directly into the bloodstream.
Insulin: Produced by beta cells, lowers blood glucose levels by promoting glucose uptake and storage.
Glucagon: Produced by alpha cells, raises blood glucose levels by stimulating the release of glucose from stored glycogen.
Somatostatin: Produced by delta cells, regulates the release of other pancreatic hormones.
Pancreatic polypeptide (PP): Produced by PP cells, involved in regulating gastric emptying and pancreatic secretion.

Bicarbonate Secretion:The pancreas also secretes bicarbonate ions to neutralize the acidic chyme from the stomach in the duodenum.

Laboratory tests

Pancreas lab tests, like blood tests measuring amylase and lipase, are used to diagnose and monitor conditions affecting the pancreas, such as pancreatitis and pancreatic cancer.
Normal amylase levels typically range from 23 to 85 units per liter (U/L), and
Normal lipase levels are generally between 0 to 160 U/L.

Other tests:

CA 19-9: A blood test used to monitor pancreatic cancer, with normal levels typically between 0 and 37 U/mL.
CRP (C-reactive protein): Generally below 10 mg/L, elevated levels can indicate inflammation, which might be related to pancreatitis.
Secretin Stimulation Test: Measures the pancreas's response to the hormone secretin, helping identify chronic conditions.

VARIANTS

Variations in the pancreatic ductal branching pattern are common (Figure 1). One common variant is the presence of an accessory pancreatic duct, known as the duct of Santorini, which empties into the duodenum separately from the main pancreatic duct via the minor papilla, which is superior to the ampulla. Another variant is the so-called dorsal dominant drainage, where the duct of Wirsung empties into the minor papilla and the duct of Santorini empties into the major papilla. This is similar to pancreas divisum, which is present in about 10% of normal individuals. However, in the pancreas divisum, there is complete separation of the dorsal and ventral pancreatic ducts.

Annular pancreas can result during rotation of the ventral pancreatic bud as it fuses with the dorsal bud, resulting in a ring of pancreatic tissue encircling the duodenum, causing gastric outlet obstruction in infants and pancreatitis in adults

Compiled by: Dr Pravin G U Principal, Prof.RadioDiagnosis . Sri Chamundeshwari Medical college Hospital & Research Institute,Channapatna,Karnataka.President IRIA Karnataka

https://teachmeanatomy.info , https://radiologykey.com/anatomy-of-the-pancreas/ https://www.kjronline.org/