

Anatomy of the pancreas and the spleen

Harold Ellis

Abstract

The pancreas comprises a head, uncinate process, neck, body and tail. It lies retroperitoneally, roughly at the transpyloric plane, separated from the stomach in front by the lesser sac. Its tail abuts onto the spleen. It has a rich blood supply, from the superior and inferior pancreatico-duodenal arteries and, particularly, from the tortuous splenic artery, which lies along its superior border. Its corresponding veins drain into the portal system. It has both exocrine (digestive enzymes), and endocrine secretory functions, the latter, most importantly, being the secretion of insulin from the islet cells. It also secretes glucagon, somatostatin and gastrin.

The spleen fits comfortably into the palm of the hand. It is just palpable when it is enlarged to three times normal size. It lies against the left diaphragm, which separates it from the base of the left lung and the ninth, 10th and 11th ribs. It is supplied at its hilum by the splenic artery and vein. It has a thin, closely adherent capsule which provides trabeculae which divide the contained vascular splenic pulp.

Aberrant splenic tissue may occur, especially at the splenic hilum.

Keywords Body; main and accessory pancreatic ducts; neck; *Pancreas*: head; pulp; splenic artery; splenic artery and vein; *Spleen*: capsule; superior and inferior pancreatico-duodenal arteries; tail; uncinate process

The pancreas

The pancreas is the largest of the digestive glands and performs a range of vital exocrine and endocrine functions.

The gland lies retroperitoneally, roughly in the transpyloric plane, at the level of the first lumbar vertebra. For descriptive purposes, it is divided into a head, neck, body and tail (Figure 1).

Relations

The pancreatic head lies in the C-curve of the duodenum. Inferomedially, it sends out its *uncinate process*, that hooks around the superior mesenteric vessels, as these descend from behind the pancreas into the mesenteric root. Anteriorly, the lesser sac separates it from the posterior aspect of the stomach. A collection of fluid into the lesser sac following an episode of acute pancreatitis results in a so-called 'pseudocyst of the pancreas'. To the left, the tail of the gland abuts against the spleen. Superiorly, the tortuous splenic artery runs along the upper border of the pancreas (Figure 2) and constitutes its main blood supply, (perhaps it would be better named the 'pancreatico-splenic artery', which would prevent examination candidates forgetting the most important artery supplying the pancreas!). Posteriorly, from right to left, the gland lies on the inferior vena cava, the commencement of the portal vein, the aorta and superior mesenteric vessels, the left crus of the diaphragm, the left kidney, with its vascular pedicle, and the left suprarenal gland. The splenic vein runs behind the length of the body of the gland, receives the inferior mesenteric vein and joins the superior mesenteric vein to form the portal vein behind the neck of the pancreas (Figure 3).

To complete this long list of important posterior relationships, the common bile duct, having descended behind the first part of the duodenum, with the gastro-duodenal artery to its left, then lies in a groove on the posterior surface of the head of the pancreas, or else partially embedded in its substance, as it passes to open, with the main pancreatic duct, into the second part of the duodenum at the duodenal papilla (Figure 1).

Blood supply and lymphatic drainage

The pancreas is supplied by the superior and inferior pancreatico-duodenal arteries, which form an anastomosis between the coeliac and superior mesenteric arteries, and by numerous short branches from the splenic artery. The reason for the tortuosity of the splenic artery remains unexplained; it is straight in the human fetus and in the lower animal species, and has a single kink in the ape. It is the only artery in the trunk

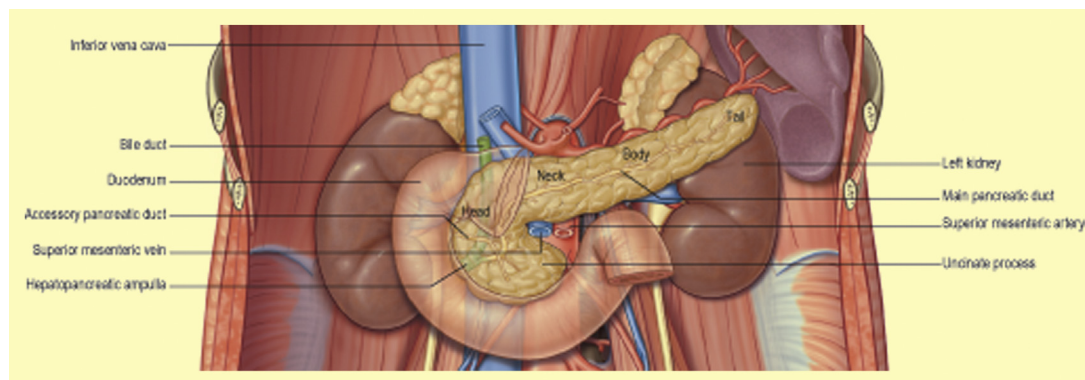
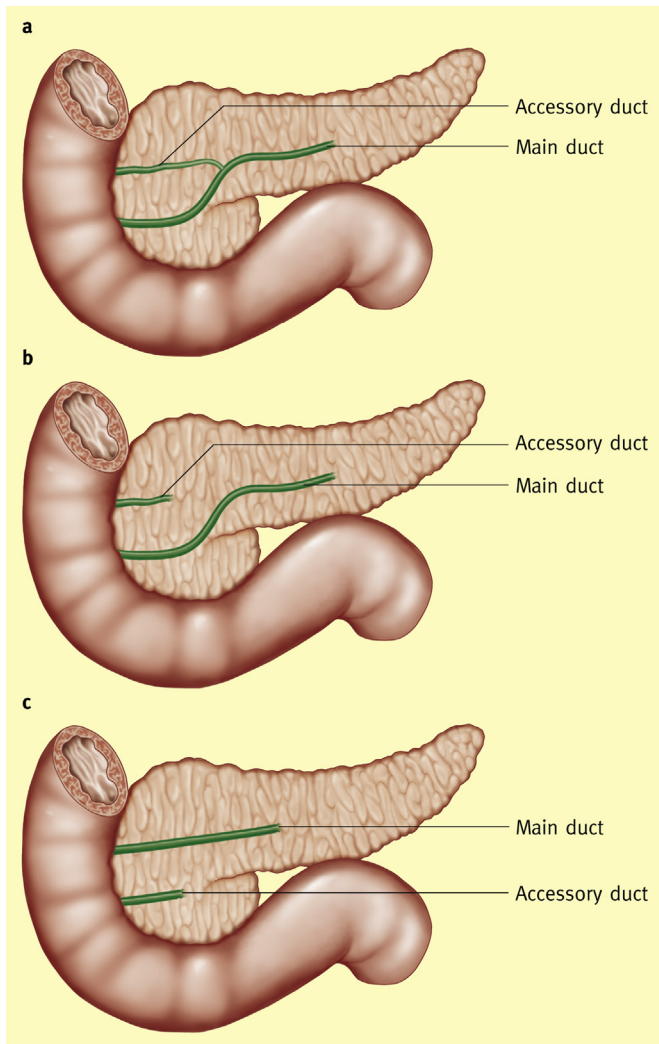


Figure 1 Relations of the pancreas.

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which is tortuous in normal anatomy. At least this makes it immediately recognizable on an aortic angiogram. Venous drainage is by the corresponding veins, which drain into the portal system (Figures 2 and 3). The lymphatic drainage obeys the general rule of accompanying the blood supply of a structure.



It drains to nodes lying along the upper border of the gland and in the groove between the pancreatic head and the duodenum to

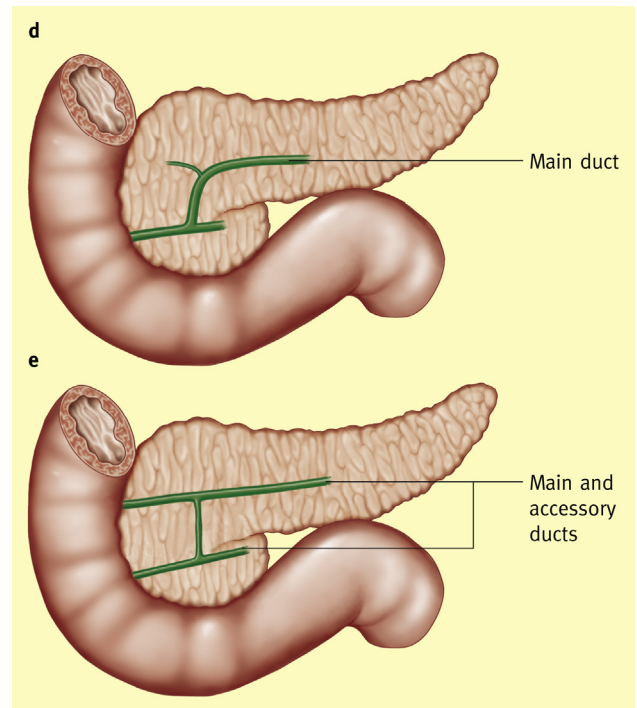


Figure 3 Variations in the ductal anatomy of the pancreas. (a) Normal (50%). (b) Absence of communication between normally sited accessory duct and main ducts (10%). (c) Persistence of complete ventral and dorsal ducts with separate drainage (5%). (b) and (c) are both forms of 'pancreas divisum'. (d) Absence of accessory duct (20%). (e) Conjoined drainage of persistent ventral and dorsal ducts (<5%).

reach nodes at the roots of the coeliac and superior mesenteric arteries.

Structure

The pancreas macroscopically is finely lobulated and is contained within a delicate fibrous capsule. These lobules are made up of alveoli of serous secretory cells, which drain via their ductules into

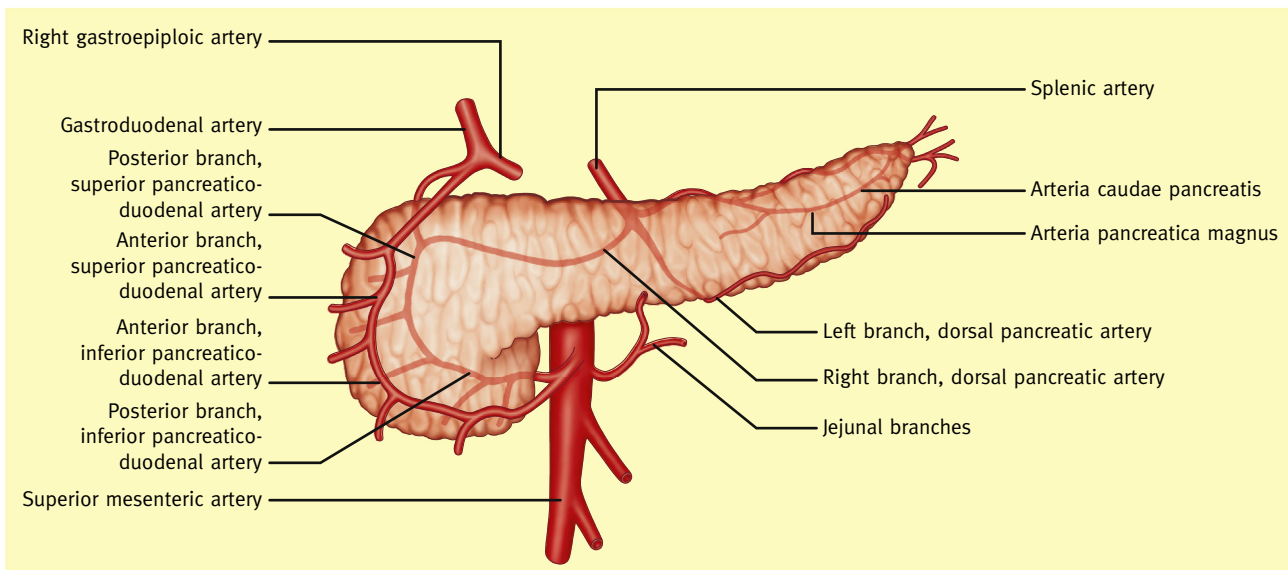


Figure 2 Arterial supply of the pancreas.

Pancreas opened to show the duct system

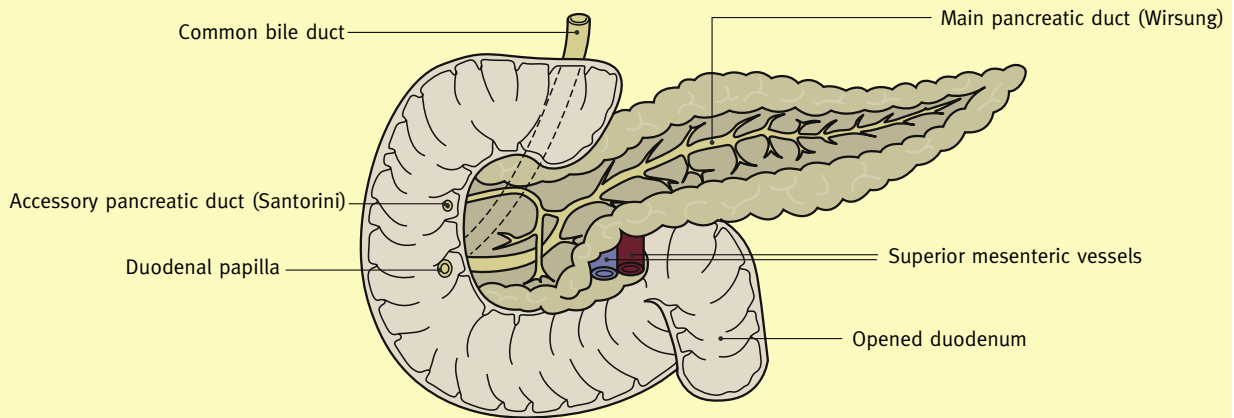


Figure 4

the principal ducts. Between the alveoli lie the *islets of Langerhans*, up to 1 million in number and especially numerous in the pancreatic tail. The alpha cells of the islets secrete glucagon; the beta cells secrete insulin. The third cell type – the delta cell – secretes gastrin and somatostatin.

The main duct of the gland, the *duct of Wirsung*, runs the length of the gland and usually joins with the termination of the common bile duct to form the *ampulla of Vater* that opens into the second part of the duodenum at a prominent *duodenal papilla*. The accessory pancreatic duct, the *duct of Santorini*, passes from the upper part of the head, often communicates with

it, and then opens into the duodenum about 2 cm above the main duct (Figure 4).

Development

The pancreas develops from a large dorsal diverticulum from the duodenum and a smaller ventral out pouching from the side of the common bile duct. The ventral pouch migrates round posteriorly to fuse with the lower aspect of the dorsal diverticulum to trap the superior mesenteric vessels between its two parts. The two ducts then communicate; amazingly, the smaller ventral duct takes over the main pancreatic flow to form the main duct of

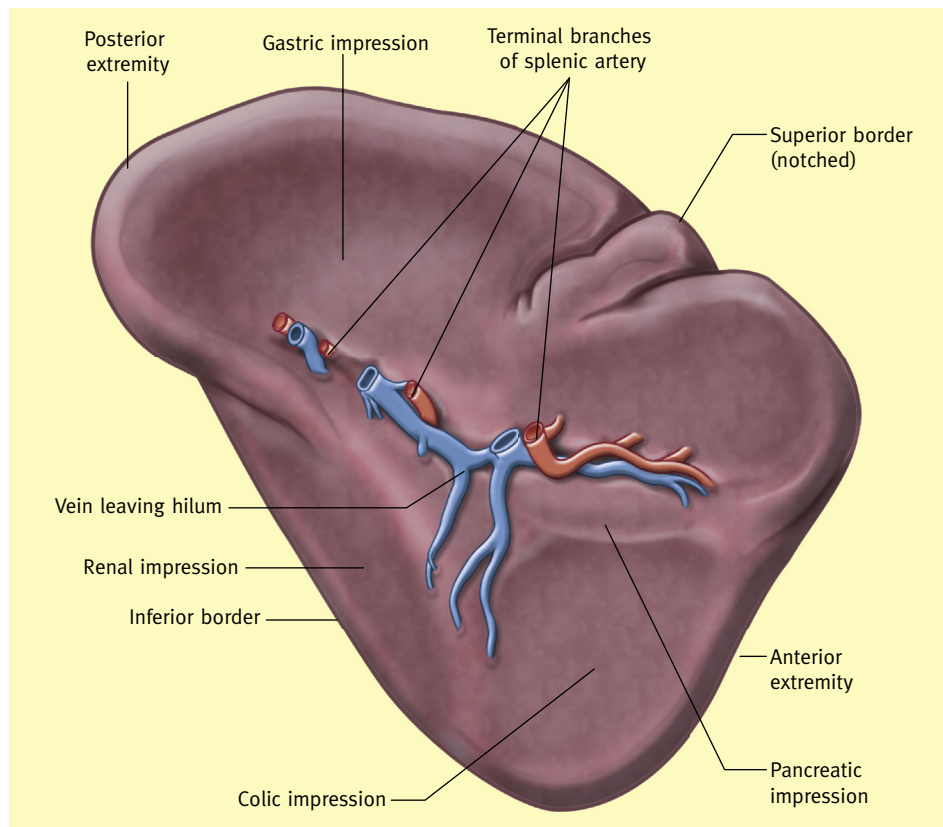


Figure 5 The visceral surface of the spleen.

Wirsung, joined with the termination of the common bile duct, leaving the original duct of what was the larger portion of the gland as the accessory duct of Santorini. As can be imagined from this complicated process, variations in the ductal anatomy of the pancreas are common.

The spleen (Figure 5)

The spleen fits comfortably into the cupped hand, and this gives a good idea of the size of the normal organ. It cannot be felt on abdominal palpation in the normal subject and, indeed, it has to be enlarged three times its normal size before its edge can just be felt below the left costal margin.

The spleen forms the lateral extremity of the lesser sac. Passing from it are the pancreatico-renal ligament to the tail of the pancreas and the posterior abdominal wall in front of the left kidney, and the gastro-splenic ligament, which passes to the greater curvature of the stomach. These so-called ligaments are, in fact, double folds of peritoneum, which carry blood vessels and accompanying lymphatics, the pancreatico-renal conveying the splenic artery, a branch of the coeliac axis, and the splenic vein, which drains into the portal vein, together with the superior mesenteric vein, while the gastro-splenic ligament conveys the short gastric and the left gastroepiploic branches of the splenic vessels to the fundus and greater curvature of the stomach.

Note that the splenic artery and vein are not very well named. Of course, they do indeed provide the blood supply of the spleen, but they also constitute the principal blood supply of the pancreas. Perhaps some time in the future they will be re-named the pancreatico-duodenal vessels.

Posteriorly, the spleen lies against the left diaphragm, which separates the spleen from the pleura, the base of the left lung and the ninth, 10th and 11th ribs. Note that a stab wound in the left lower chest posteriorly may give the patient a pneumothorax, a lacerated lung and a torn spleen. The author has, indeed, dealt with such a case.

To define the surface markings of the spleen, place your closed fist over the left 10th rib posteriorly, its medial edge about 5 cm from the mid-line.

Anterior to the spleen lies the stomach; inferiorly the well-named splenic flexure of the colon and medially the left kidney. The tail of the pancreas abuts against the hilum of the spleen, through which blood vessels, lymphatics and autonomic nerves enter and leave the organ.

Structure

The spleen represents the largest accumulation of reticulo-endothelial tissue in the body. It has a thin fibrous capsule to which the overlying peritoneum closely adheres — the peritoneum is only deficient at the splenic hilum. The fibrous tissue of the capsule extends into the spleen to form a series of trabeculae, between which lies the splenic pulp.

Accessory spleens, one or more, may occur. They are found most commonly at the splenic hilum but also in the tail of the pancreas, the splenic mesenteries, the omentum, small bowel mesentery and even the ovary and testis. They are, of course, of no consequence in splenic trauma, but, if left behind, they may result in persistence of symptoms following splenectomy for conditions such as thrombocytopenic purpura or autoimmune haemolytic anaemia. ◆