Pancreatic development

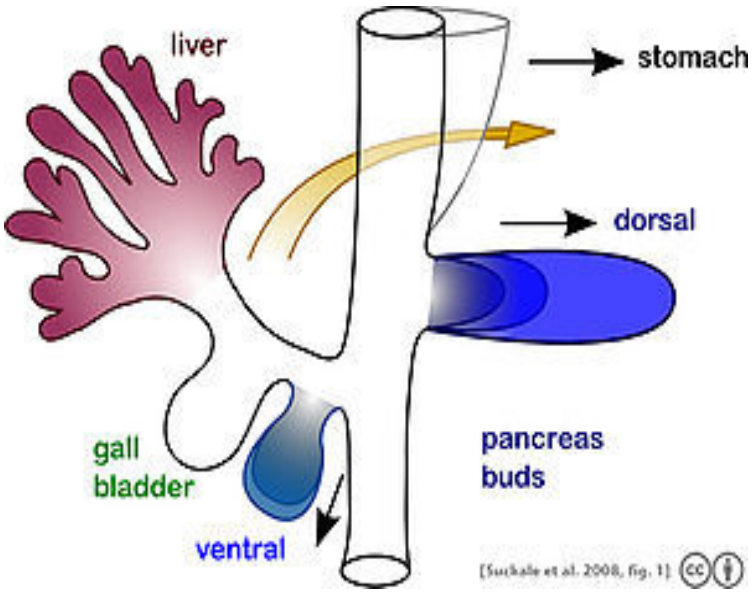
Because the pancreas is a storage depot for digestive enzymes, injury to the pancreas is potentially very dangerous. A puncture of the pancreas generally requires prompt and experienced medical intervention.

Pancreatic cancer, particularly cancers of the Exocrine Pancreas remains one of the most deadly cancers, and the mortality rate is very high.

History

The pancreas was first identified for western civilization by Herophilus (335–280 BC), a Greek anatomist and surgeon. Only a few hundred years later, Ruphos, another Greek anatomist, gave the pancreas its name. The term "pancreas" is derived from the Greek πᾶν ("all", "whole"), and κρέας ("flesh"). – presumably because of its fleshy consistency.

Embryological development



Schematic illustrating the development of the pancreas from a dorsal and a ventral bud. During maturation the ventral bud flips to the other side of the gut tube (arrow) where it typically fuses with the dorsal lobe. An additional ventral lobe which usually regresses during development is omitted.

The pancreas forms from the embryonic foregut and is therefore of endodermal origin. Pancreatic development begins the formation of a ventral and dorsal anlage (or buds). Each structure communicates with the foregut through a duct. The ventral pancreatic bud becomes the head and uncinate process, and comes from the hepatic diverticulum.

Differential rotation and fusion of the ventral and dorsal pancreatic buds results in the formation of the definitive pancreas. As the duodenum rotates to the right, it carries with it the ventral pancreatic bud and common bile duct. Upon reaching its final destination, the ventral pancreatic bud fuses with the much larger dorsal pancreatic bud. At this point of fusion, the main ducts of the ventral and dorsal pancreatic buds fuse, forming the duct of Wirsung, the main pancreatic duct.

Differentiation of cells of the pancreas proceeds through two different pathways, corresponding to the dual endocrine and exocrine functions of the pancreas. In progenitor cells of the exocrine pancreas, important molecules that induce differentiation include follistatin, fibroblast growth factors, and activation of the Notch receptor system. Development of the exocrine acini progresses through three successive stages. These include the pre-differentiated, proto-differentiated, and differentiated stages, which correspond to undetectable, low, and high levels of digestive enzyme activity, respectively.

Progenitor cells of the endocrine pancreas arise from cells of the proto-differentiated stage of the exocrine pancreas. Under the influence of neurogenin-3 and Isl-1, but in the absence of Notch receptor signaling, these cells differentiate to form two lines of

committed endocrine precursor cells. The first line, under the direction of Pax-0, forms α- and γ- cells, which produce the peptides glucagon and pancreatic polypeptide, respectively. The second line, influenced by Pax-6, produces β- and δ-cells, which secrete insulin and somatostatin, respectively.

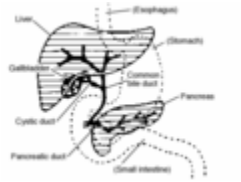
Insulin and glucagon can be detected in the fetal circulation by the fourth or fifth month of fetal development.

In non-human animals

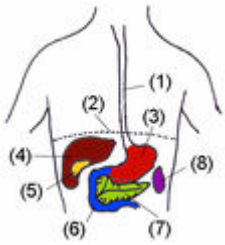
Pancreatic tissue is present in all vertebrate species, but its precise form and arrangement varies widely. There may be up to three separate pancreases, two of which arise from ventral buds, and the other dorsally. In most species (including humans), these fuse in the adult, but there are several exceptions. Even when a single pancreas is present, two or three pancreatic ducts may persist, each draining separately into the duodenum (or equivalent part of the hindgut). Birds, for example, typically have three such ducts.

In teleosts, and a few other species (such as rabbits), there is no discrete pancreas at all, with pancreatic tissue being distributed diffusely across the mesentery and even within other nearby organs, such as the liver or spleen. In a few teleost species, the endocrine tissue has fused to form a distinct gland within the abdominal cavity, but otherwise it is distributed amongst the exocrine components. The most primitive arrangement, however, appears to be that of lampreys and lungfish, in which pancreatic tissue is found as a number of discrete nodules within the wall of the gut itself, with the exocrine portions being little different from other glandular structures of the intestine.

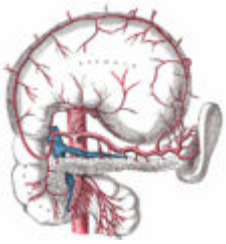
Additional images



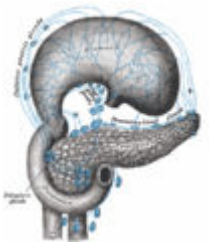
Accessory digestive system.



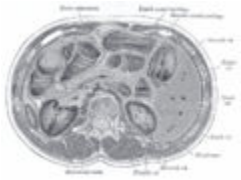
Digestive organs.



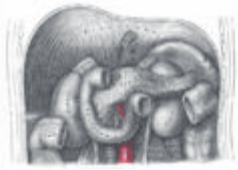
The celiac artery and its branches; the stomach has been raised and the peritoneum removed.



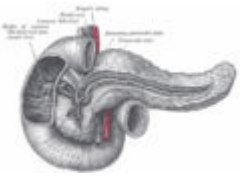
Lymphatics of stomach, etc. The stomach has been turned upward.



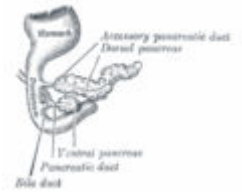
Transverse section through the middle of the first lumbar vertebra, showing the relations of the pancreas.



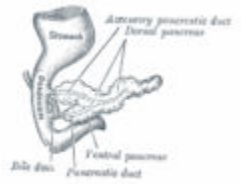
The duodenum and pancreas.



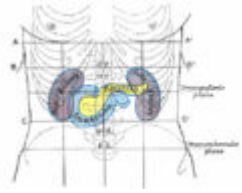
The pancreatic duct.



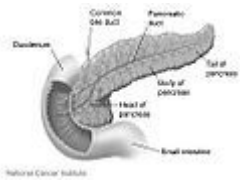
Pancreas of a human embryo of five weeks.

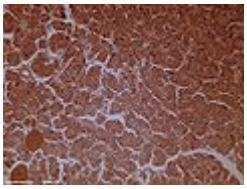


Pancreas of a human embryo at end of sixth week.



Front of abdomen, showing surface markings for duodenum, pancreas, and kidneys.





Dog Pancreas magnified 100 times.