Original Research Paper

Volume - 12 | Issue - 06 | June - 2022 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Anatomy

PANCREAS: ANATOMY, EMBRYOLOGY & HISTOLOGY – A REVIEW ARTICLE

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ABSTRACT The pancreas is an elongated, tapered organ located across the back of the belly, behind the stomach. The right side of the organ called the head. It is the widest part of the organ and lies in the curve of the duodenum, the first division of the small intestine. The tapered left side extends slightly upward called the body of the pancreas and ends near the spleen. It is called the tail. The enzymes secreted by the exocrine gland in the pancreas help break down carbohydrates, fats, proteins, and acids in the duodenum. These enzymes travel down the pancreatic duct into the bile duct in an inactive form. When they enter the duodenum, they are activated. The exocrine tissue also secretes a bicarbonate to neutralize stomach acid in the duodenum. This is the first section of the small intestine. The main hormones secreted by the endocrine gland in the pancreas are insulin and glucagon, which regulate the level of glucose in the blood and somatostatin, which prevents the release of insulin and glucagon. It is part of the digestive system and produces insulin and other important enzymes and hormones that help break down foods. The pancreas has an endocrine function because it releases juices directly into the bloodstream, and it has an exocrine function because it releases juices into ducts. The article was done for the period of one year i.e., March 2019- February 2020 in the Department of Anatomy, Govt Medical College and Hospital, Ongole.

KEYWORDS : Pancreas, Insulin, Glucagon

Introduction:

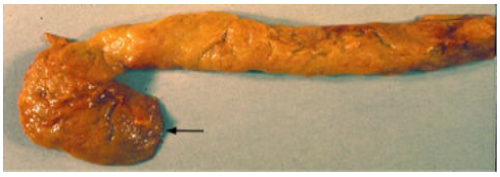
The mandate for this chapter is to review the anatomy and histology of the pancreas. The pancreas (meaning all flesh) lies in the upper abdomen behind the stomach. The pancreas is part of the gastrointestinal system that makes and secretes digestive enzymes into the intestine, and also an endocrine organ that makes and secretes hormones into the blood to control energy metabolism and storage throughout the body. Exocrine pancreas, the portion of the pancreas that makes and secretes digestive enzymes into the duodenum. This includes acinar and duct cells with associated connective tissue, vessels, and nerves. The exocrine components comprise more than 95% of the pancreatic mass. Endocrine pancreas, the portions of the pancreas (the islets) that make and secrete insulin, glucagon, somatostatin and pancreatic polypeptide into the blood. Islets comprise 1-2% of pancreatic mass.

Gross Anatomy (Fig:1)

Depict the gross anatomy of the pancreas and its relationship to surrounding organs in adults. It is customary to refer to various portions of the pancreas as head, body, and tail. The head lies near the duodenum and the tail extends to the hilum of the spleen. When the terms anterior, posterior, front and back are used, they pertain to relationships in the human, standing erect. Superior and inferior are used in the same context so that they mean toward the head and toward the feet, respectively. These usages obviously do not pertain in quadraped animals where dorsal, ventral, cephalad, and caudad are more useful terms. Use of the terms left and right can be problematic.

For example, the spleen is located in the upper portion of the abdomen on the left side of the body. When the abdomen is pictured from the front, this places the spleen on the viewer's right-hand side. We will adopt the convention that right and left (unqualified) will be used in the first sense in the legends for gross anatomy (indicating the subject's right and left side).

Figure 1. The gross anatomy of the human pancreas



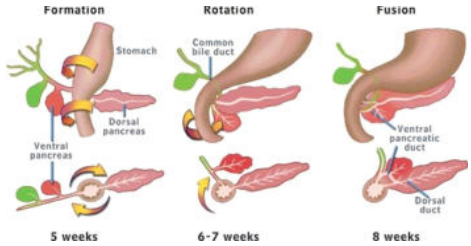
Embryology (Fig 2)

The pancreatobiliary anlagen appear at gestation week 5 in the human; fusion of the dorsal and ventral anlagen occurs during week 7. Full development of acinar tissue extends into the postnatal period. In mice, pancreatic development begins at embryonic day 8.5 and is largely complete by day 14. The pancreas develops from two outgrowths of the foregut distal to the stomach. The ventral diverticulum gives rise to the common bile duct, gallbladder, liver and the ventral pancreatic anlagen that becomes a portion of the head of the pancreas with its duct system including the uncinate portion of the pancreas.

The dorsal pancreatic anlage gives rise to a portion of the head, the body, and tail of the pancreas including a major duct that is continuous through the three regions. The caudal portion of the head of the pancreas (uncinate) and the major papilla (ampulla of Vater) are derived from the ventral anlage. The minor papilla that drains the duct of Santorini is derived from the dorsal anlage. The anatomic variations depicted provide additional examples of individual differences in pancreatic anatomy seen in adults. These will be most easily understood by comparing. It becomes apparent that the duct of Santorini is derived from the dorsal anlage, whereas the duct of Wirsung (the main duct of the pancreas) is derived from the fusion of duct systems of both dorsal and ventral anlagen and drains into the duodenum at the ampulla of Vater.

The common channel has received much attention because stones in the biliary tract (gallstones) may lodge in the common channel causing obstruction of both pancreatic and biliary duct systems. Such an obstruction is frequently the cause of acute pancreatitis.

Fig:2 Development of Pancreas



Histology

Depict the histology of the exocrine pancreas at the light and electron microscopic levels. Most histologic images are from human tissue. Exceptions are usually noted in the legend. In Hematoxylin and Eosin (H&E) stained sections, nucleic acids (DNA and RNA) stain blue; most proteins and carbohydrates stain pink to red; fat is extracted by organic solvents used in tissue processing leaving unstained spaces. Sections for light microscopy are most often made from formalin-fixed paraffin- embedded tissue and the sections are usually 4 or 5 micrometers (μm) thick. Thinner (1 μm) sections of plastic embedded tissues (prepared for electron microscopy) may also be used for light microscopy and a few such sections are also illustrated.

Duct System(fig:3&4)

The components of the duct system are the main pancreatic duct (duct

of Wirsung), interlobular ducts that drain into the main duct throughout the pancreas and intralobular ducts (sometimes called intercalated ductules) that link acinar tubules to the interlobular ducts.

The intralobular ducts and ductules are ordinarily seen only at the level of light and electron microscopy. Enzymes from acinar cells released into a bicarbonate-rich solution that is secreted by the centroacinar and ductal cells and flows from the acini and acinar tubules to the intralobular ducts, then into the interlobular ducts and main duct, and finally into the duodenum at the major or minor papillae.

The integrity of the duct system is of key importance in preventing entry of the exocrine enzymes into the interstitial space where they may be activated and cause tissue damage manifest as pancreatitis. The main and interlobular ducts have thick dense collagenous walls. The connective tissue component of the duct wall becomes progressively thinner as the ducts branch and become narrower. Intercellular tight junctions, also called zonula occludens, between duct cells, centroacinar cells and acinar cells play a major role in preventing leakage of the duct system.

Fig 3: Pancreatic Ductal System

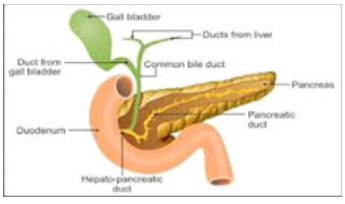
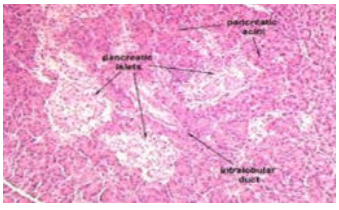


Fig 4: Histology of Duct System



Endocrine Pancreas (Fig 5)

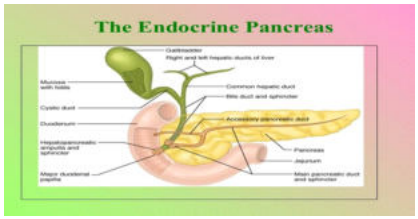
Most islets (islets of Langerhans) that collectively comprise the endocrine pancreas are too small to be seen by gross examination. Islets vary greatly in size; ~70% are in the size range of 50-250 µm in diameter in humans with an average in the range of 100-150 µm. Smaller islets are dispersed throughout the acinar lobules and most larger islets lie along the main and interlobular ducts of the pancreas. Most islets are spherical or ellipsoid, but they can be irregular in shape- - sometimes reflecting the pressure of an adjacent structure, often a duct, or limitation by a tissue plane.

Several reports provide support for the presence of a higher population density of islets in the tail of the pancreas than in the head and body although others find no difference. In adult humans the number of islets is calculated to be 500,000-1 million whereas there are far fewer in smaller animals. Islets comprise 1-2% of the pancreas in adults of most mammalian species. In addition to the islets, isolated islet cells may be found dispersed in the acinar lobules or in association with ducts.

Several of these have been immunostained using antibodies to specific islet peptide hormones to demonstrate various islet cell types including β-cells (insulin), α-cells (glucagon), and δ-cells (somatostatin). The other major islet cell type secretes pancreatic polypeptide (PP) and PP-cells are commonly regarded as the fourth most prevalent endocrine cell type in the islets. Most PP-cells are in the portion of the pancreas derived from the ventral pancreatic anlage, i.e. the uncinate process that is reported to comprise about 10% of the pancreas.

In the portion of the pancreas derived from the dorsal pancreatic anlage, the majority of islet cells are β-cells (75-80%), followed by α-cells (about 15%), δ-cells (about 5%) and very few PP-cells. In the uncinate process there are few α-cells and many more PP-cells. Stefan et al. present data from study of non-diabetic human pancreases showing that the PP-cells comprise 54-94% of the volume of islets in the uncinate region, displacing most α-cells and some β-cells. These investigators provide data indicating that PP-cells are the second most prevalent endocrine cell type overall in the pancreas among their 13 nondiabetic subjects.

Fig:5 Endocrine Pancreas



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