*Pancreas is secondary retroperitoneal, with the exception of the tail, the foregut.

**Anatomy of Pancreas**

- **Location**: Within the curve of the duodenum, located in the epigastric and left hypochondriac regions
- **Surface Projection**: Surface projection of is different depending on the part of it, and will be entailed later.
- **Topography**: touches the doudenum, the spleen, the left kidney, the lower border of the stomach.
- **Function**: releases secretions in an exocrine fashion, namely pancreatic juice, which it then secretes into the duodenum through the major duodenal papilla, or papilla of Vater. This major pancreatic duct is also called the **duct of Wirsung**. Endocrine secretions include glucagon and insulin into the blood.
Parts:

- **Head** – located between L1-2 in curve of the duodenum, to the descending and horizontal parts of it. develops mainly from the ventral pancreatic bud, except the upper part, which is from the dorsal pancreatic bud. Is located right to the sup mesenteric a/v. \( \text{SP} = \text{head of pancreas is anterior loc to IVC, right renal a/v, left renal v} \) **Uncinate process**- at lower head behind sup mesenteric a/v

- **Neck** - short, 1-2cm, sup mesenteric a/v go behind the neck, @ notch below neck, called pancreatic notch. Ant surface of neck covered with peritoneum, and moves along with movements of pylorus of stomach. **Sup mesenteric v and splenic v combine behind the neck of pancreas, to form portal v.**

- **Body** – loc @ L1-2, in front of vert column, posterior to lesser sac Has 3 surfaces:
  - Ant – covered by peritoneum, and indirectly contacts post stomach, lies in floor of lesser sac, helps form gastric bed >
  - Post - contact with aorta, sup mesenteric a/v, L kidney & renal vessels, and L suprarenal gland, Splenic a runs in tortous path superior to it, and has groove for splenic v.
  - Inf - touches 3rd and 4th part of duod Omental tuberosity – in sup surface of body below celiac trunk, contact with visceral surface of liver. (T12-L1 midline)

- **Tail** – loc. at left costal arch, 2-3 fingers lat to T12, runs to hilum of spleen.
  - Can be retroperitoneal or intraperitoneal.
  - If shorter, than usually retroperitoneal, like the rest of pancreas. Then a small peritoneal ligament = pancreaticolineal lig extends from tip of tail – hilum of spleem. Splenic a/v enter spleen through this ligament.
  - If longer, intraperitoneal, and splenic a/v can go directly to spleen.

- **Ducts:**
  - **Main pancreatic duct** = **Duct of Wirsung**, duct of ventral pancreatic bud, begins in tail and runs along entire pancreas, till head, where it turns inf and runs with common bile duct. Opens at major duodenal duct – Ampulla of Vater, which is guarded by sphincter of Oddi, after joining bile duct.
  - **Accessory pancreatic duct** = Santorini’s duct can open into main or minor duodenal papilla, sometimes both. minor duodenal papilla located 2cm above major one, Begins in lower portion of the head, and drains small portion of head and body.
  - **Clinical NOTE** - Bile ducts is embedded into a groove on the post/sup side of the head. If tumors are located within the head, this can block bile flow into the duodenum, resulting in jaundice.

- **Blood Supply:** B/c develops from FOREGUT – supplied by branches of **celiac trunk**.
  - Splenic a – supplies \( \text{derivatives of dorsal pancreatic bud} \) \( \rightarrow \) neck, body, tail of pancreas located on shallow groove on sup/post side of pancreas. 10 branches, that can form arterial arcades (networks) with branches from gastroduodenal a and sup mesenteric a
  - Sup pancreaticoduodenal a (gastroduodenal a) & Inf pancreaticoduodenal a (sup mesenteric a) splits into ant/post branches to supply the head of the pancreas
  - Most veins empty into splenic v, which is embedded into the back of the pancreas itself
o Lymph Drainage

- lymph vessels follow the arteries and drain into **pancreatosplenic nodes** that lie along splenic arteries. The ones by the head go to **pyloric lymph nodes**, as well.
- These two sets of nodes drain into **celiac, hepatic, and sup mesenteric lymph nodes**

o Innervation

- **PNS (Para Sympathetic Nervous System)** – (+) digestion, secretion, vasodilation.
  - From **CN X**, carries pre ggl fibers to submucosal and myenteric plexus within walls of organs, with short post ggl PNS fibers.
  - Go to parenchyme (acinar cells and islets of Langerhans)
  - Inc Insulin secretion, Inc glucagon secretion

- **SNS (Sympathetic Nervous System)** – (-) digestion, secretion, vasoconstriction
  - SNS → (T5-T9) from thoracic splanchnic n → aortic hiatus → celiac ggl plexus around the celiac trunk → post ggl fibers run with branches of celiac trunk.
  - Go to pancreatic trunk and parenchyme (pancreatic acinar cells and islets of Langerhans)
  - dec insulin secretion, inc glucagon secretion

Peritoneal ligaments:

Peritoneal ligaments: none, except for the tail sometimes, which can be located within the pancreaticocolienal ligament.

**Histology Pancreas slide**

Structures to Identify:

- Intercalated duct
- Intralobular duct
- a/v/capillaries
- Islets of Langerhans
- Secretory acinus
- A,B,D, cells
- CT septa lobules

General Information

- Digestive gland with head, neck, body, tail regions
- Mixed gland with endocrine and exocrine functions
Exocrine:

- Tubuloacinar glands mainly composed of serous secretory units
- Secretions proteolytic enzymes
- Proteolytic Endo-peptidases: trypsinogen, chemotrypsinogen
- Exopeptidases: procarboxypeptidases, proaminopeptidases, alpha amylases, lipases nucleolytic enzymes
- Has hormonal/ neural control regulation: Secretin – inc. fluid secretion, CCK – pro enzyme secretion Chyme of stomach and duodenum stimulate enteroendocrine cells to secrete CCK and Secretin → causes pancreas to secrete
- Forms most of pancreas, has tightly packed serous acini – circular gland, small circular lumen, darkly stained. zymogen cells arranged in lobule fashion
- Lobules seperated by thin intralobular, and interlobular CT septa – have blood vessels, interlobular ducts, pacinian corpuscles
- Pacinian corpuscle - concentric circles, lighter than surrounding acini, is a sensory receptor

Endocrine:

- Islets of Langerhans (Pancreatic Islets) – highly vascularized epitheloid tissue
- alpha, beta, delta, cells in periphery, beta cells also in center.
- light staining, globular, with thin CT capsule surrounding it.
- Pyramid shaped cells facing central lumen,
- Secretions go to large vacular network of capillaries just outside the islets,
- Excretes into intercalated duct, lined by low cuboidal epithelium
Alpha cells – glucagon – inc amount of glucose in blood

Beta cells – insulin – dec amount of glucose in blood

Delta cells -Somatostatin – inhibits the other two

Duct flow:

Within the islets, flow into pale staining centro acinar cells within lumen → intercalated (same as intralobular) ducts → interlobular ducts (simple cuboidal epith) in interlobular CT septa →
larger ducts (also interlobular, but with stratified columnar epith)

Embryology – Development of Pancreas

- Endodermal lining of forgut forms two outgrowths, ventral pancreatic bud and dorsal pancreatic bud
- Within both buds, endodermal tubules surr. by mesoderm --> branch to from acinar cells and ducts (exocrine part).
- Clumps of cells within exocrine part form, and become the future islets (endocrine part)
- Remember how the duodenum rotates 90 degrees clockwise? Because of this, the ventral bud (ant) rotates also – dorsally (post) and fuses with the dorsal bud already there to form adult pancreas
- **Ventral bud** = uncinate process and lower part of head of pancreas
- **Dorsal bud** = rest of pancreas
- **Main pancreatic duct (of Wirsung)** = formed by distal dorsal bud and all of ventral bud
- **Acc pancreatic duct (of Santorini)** = prox part of dorsal bud
- **Endoderm origin** = acinar cells, islet cells, simple columnar and cuboidal lined parts of duct system
- **Visceral mesoderm** = CT surrounding them, and a/v/capillaries