PANCREAS

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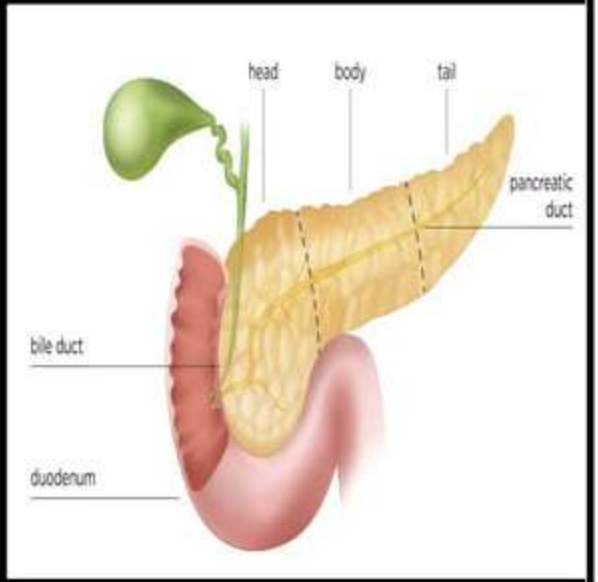
OBJECTIVES.

- **Pancreas**
  - Functional anatomy
  - Pancreatic juice
  - Applied aspects

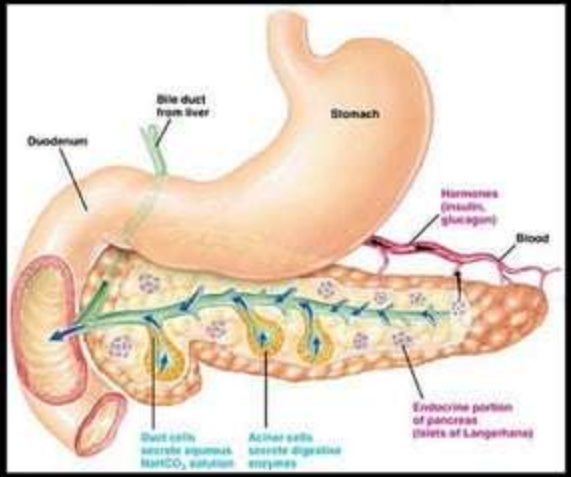
PANCREAS

- **Functional anatomy**
  - Elongated, accessory gland
  - Retroperitoneal
  - Anatomically 4 parts – Head, Neck , Body & Tail.
  - **Physiologically – 2 parts**
  - **Exocrine – pancreatic juice**
  - **Endocrine – 4 hormones**



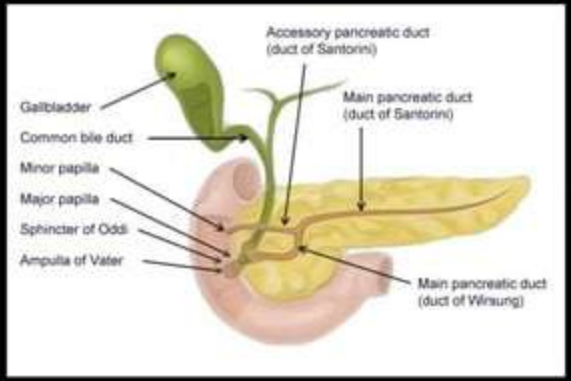
STRUCTURAL CHARACTERISTIC OF EXOCRINE PART OF PANCREAS

- **Acinar cells** – lining the alveoli
  - Numerous granules in cytoplasm
  - Produce secretions containing enzymes.
- **Centroacinar cells**
  - **Lo**cated in center of acinus.



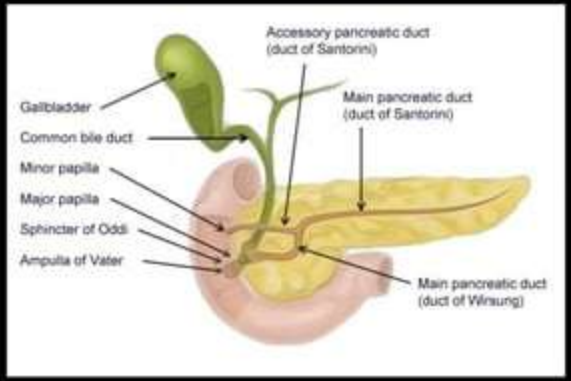
PANCREATIC DUCTS

- The intercalated ducts – receive secretions from acini & pass to interlobular duct.
- Accessory pancreatic duct (Duct of Santorini) runs from head to minor papilla above main duct.



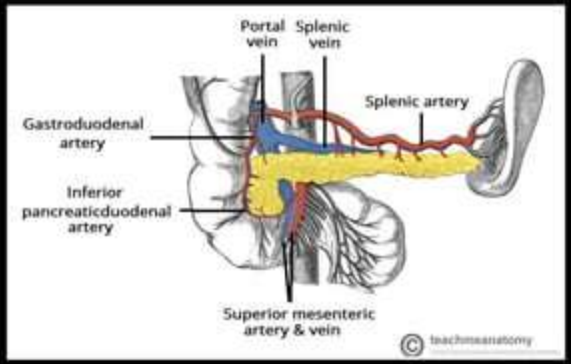
PANCREATIC DUCTS

- Main pancreatic duct – (**Duct of Wirsung**) runs from tail to head, join common bile duct to form ampulla of Vater which is guarded by sphincter of oddi.



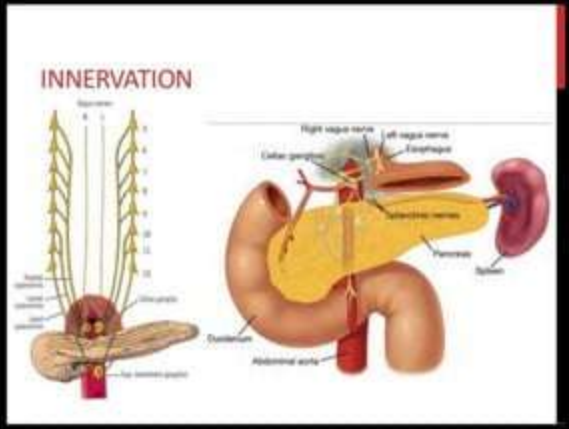
VESSELS & NERVES OF PANCREAS

- Arterial supply – splenic, superior & inferior pancreaticoduodenal arteries.
- Venous drainage – portal system.



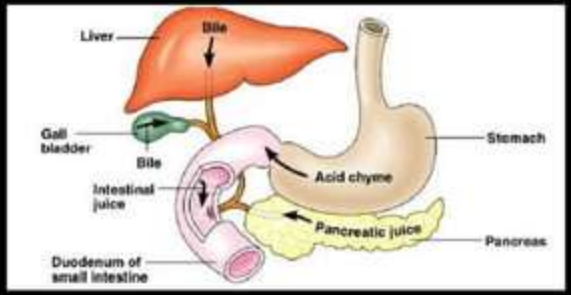
VESSELS & NERVES OF PANCREAS

- **Lymphatic** – Coeliac & superior mesenteric lymph nodes.
- **Nerve supply** – both sympathetic & parasympathetic (Vagi) nerves
  - Stimulation increases pancreatic juice secretion.



PANCREATIC JUICE

- **Properties**
  - Transparent , isotonic
  - 1200-1500 ml/day.
  - Sp gravity – 1.010 to 1.018
  - Mainly alkaline.



PANCREATIC JUICE

- **Composition** – 99.5% water, 0.05% solids
- **Organic** – mainly enzymes, amylase, lipase, Protease & Trypsin inhibitor
- **Inorganic** – Na^+, K^+, Ca^+, Mg^+, Zn^+ & $HCO3^-$, Cl^-

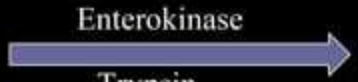
PANCREATIC ENZYMES

- **Pancreatic α amylase** – active form, action on carbohydrate same as salivary amylase
  - Hydrolyses Glycogen, starch.
- **Lipolytic enzymes** – it includes Pancreatic lipases, cholesterol ester hydrolase, & phospholipase A2
- **Pancreatic lipases** – Hydrolyses neutral fats to Glycerol esters & FA

PANCREATIC ENZYMES

- **Cholesterol ester hydrolase** – convert cholesterol ester to cholesterol .
- **Phospholipase A2**
- **Pancreatic proteases** – includes 3 endopeptidase
  - Trypsin
  - Chymotrypsin.
  - Elastase
- 2 exdopeptidases
  - Carboxypeptidase A & B.
- Trypsin inhibitor.

TRYPSIN

- Trypsinogen 

Trypsin
- Trypsinogen 

Trypsin

Hydrolyses proteins to proteoses & Polypeptides.

CHYMOTRYPSIN.

- Chymotrypsinogen

Trypsin.

Chymotrypsin

ELASTASE

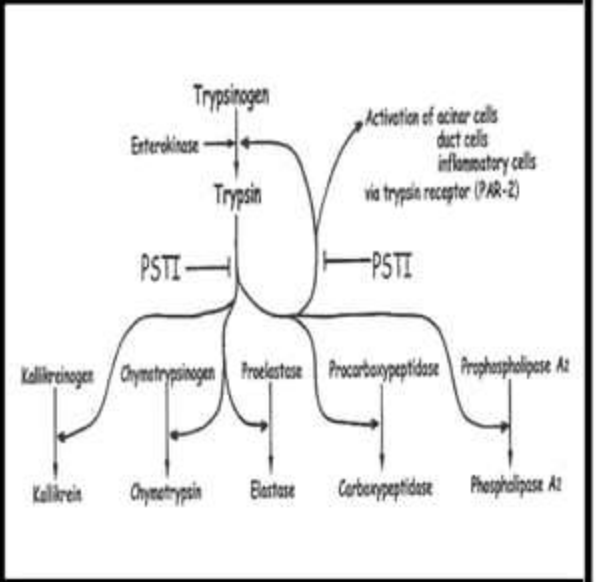
- Proelastase  Elastase

Trypsin

Digest Elastin

TRYPSIN INHIBITOR.

- Protect pancreas from auto digestion by trypsin.



FUNCTIONS OF PANCREATIC JUICE

- **Digestive functions** – digest protein, fats, carbohydrate & nucleic acid.
- **Neutralizing functions** – highly alkaline neutralizes HCl in chyme that enters duodenum.

MECHANISM OF PANCREATIC SECRETION

- Secretion of pancreatic enzymes – from acinar cells
- Formation of aqueous component of pancreatic secretion – by columnar epithelial cells.

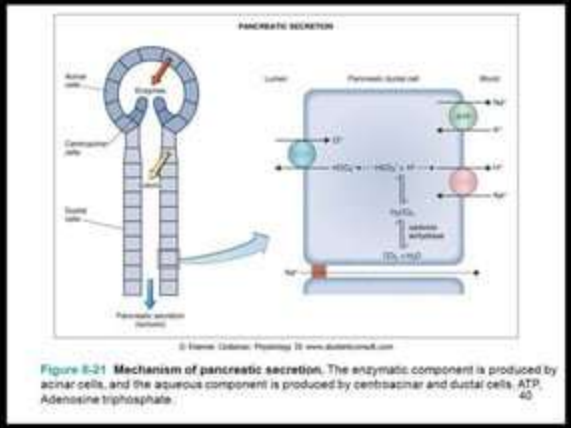


Figure 8-21 **Mechanism of pancreatic secretion.** The enzymatic component is produced by acinar cells, and the aqueous component is produced by centroacinar and ductal cells. ATP, Adenosine triphosphate.

CHARACTERISTICS OF SECRETION

- **Secretion by acinar cells** – isotonic & resembles plasma.
- **Secretion by intralobular ductal cells** – has high conc of K^+ & $HCO3^-$
- **Secretion by extralobular ductal cells** – stimulated by secretin, rich in $HCO3^-$
- **Modification in main collecting duct** – as secretion moves in main duct water moves into duct & makes secretion isotonic & $HCO3^-$ Moves out of duct for Cl^-

EFFECT OF FLOW RATE ON COMPOSITION OF AQUEOUS COMPONENT OF PANCREATIC JUICE

- **HCO_3^- ions** – directly proportional, as rate increases conc increases from 80-120meq/L.
- **Cl- ions** – Inversely proportional
- **Na+ & K+ ions** – do not vary with rate of secretion.

REGULATION OF PANCREATIC SECRETION

- **NEURAL**
- Through Vagus supplying exocrine part of pancreas.

- **HORMONAL**
- Predominant role
- Through Secretin, CCK, Gastrin & Somatostatin.

REGULATION OF PANCREATIC SECRETION

PHASE	STIMULUS	MEDIATOR	PANCREATIC RESPONSE.
CEPHALIC	Conditioned reflex by -Taste, Smell, Thought of food. Unconditioned reflex by – taste of food in mouth.	VAGUS	Little secretion of pancreatic enzyme & $HCO3^-$
GASTRIC	Distension of stomach by food Amino acids & peptides Low pH chyme in duodenum.	VAGUS Gastic secretion.	Little secretion of pancreatic enzyme & $HCO3^-$ Low volume hiogh enz secretion, large secretion with high $HCO3^-$

REGULATION OF PANCREATIC SECRETION- INTESTINAL PHASE.

- **ROLE OF SECRETIN**

Low pH of chyme

↓

Secretion of secretin

↓

Secretion of alkaline pancreatic juice in duodenum

↓

Netralizes HCL & increases pH.

- **ROLE OF CHOLECYSTOKININ**

Products of digestion containing amino acids & polypeptides

↓

Stimulate CCK

↓

Increases bile & pancreatic juice secretion.

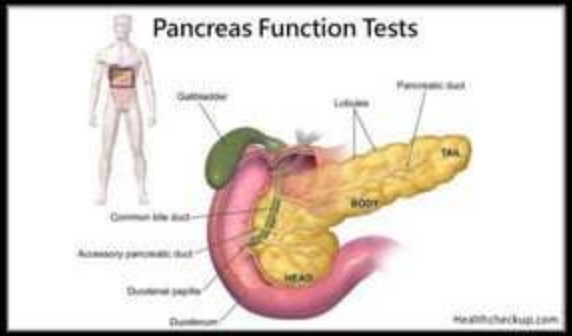
APPLIED ASPECTS

Disorders of pancreas.

- Acute pancreatitis- acute inflammatory disease from autodigestion of pancreatic tissue by proteolytic enzymes.
- Chronic pancreatitis – chronic inflammation
- Cystic fibrosis- decrease pancreatic enz leads to steatorrhoea.
- Pancreatectomy- Removal of pancreas.

PANCREATIC FUNCTION TESTS

- Analysis of pancreatic juice
- Analysis of product of digestion.
- Estimation of serum amylase levels



ANALYSIS OF PANCREATIC JUICE

- Collection of pancreatic juice – Double lumen radiopaque tube (D Veiling tube) inserted upto ampulla of vater
- Recently Fiberoptic catheter used for aspiration.

ANALYSIS OF PANCREATIC JUICE

- Analysis of pancreatic juice collected after direct stimulation of pancreas - Secretin test – after overnight fasting duodenal & gastric content aspirated then intravenous infusion of secretin given & duodenal aspirate measured.

ANALYSIS OF PANCREATIC JUICE

- Combined secretin & CCK test – after above test CCK is given intravenously & whole process repeated.

ANALYSIS OF PRODUCT OF DIGESTION.

- Faecal fat excretion test – subject on 100 gm of fats /day & stool tasted for fats for 3-5 days.
- Tripeptide hydrolysis test – subject given synthetic peptide B2-T4- PABA & PABA excretion measured.

ESTIMATION OF SERUM AMYLASE LEVELS

- To rule out acute pancreatitis in acute pain in abdomen.
- In acute pancreatitis serum amylase level raised more than normal level of 50-120 units/L.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