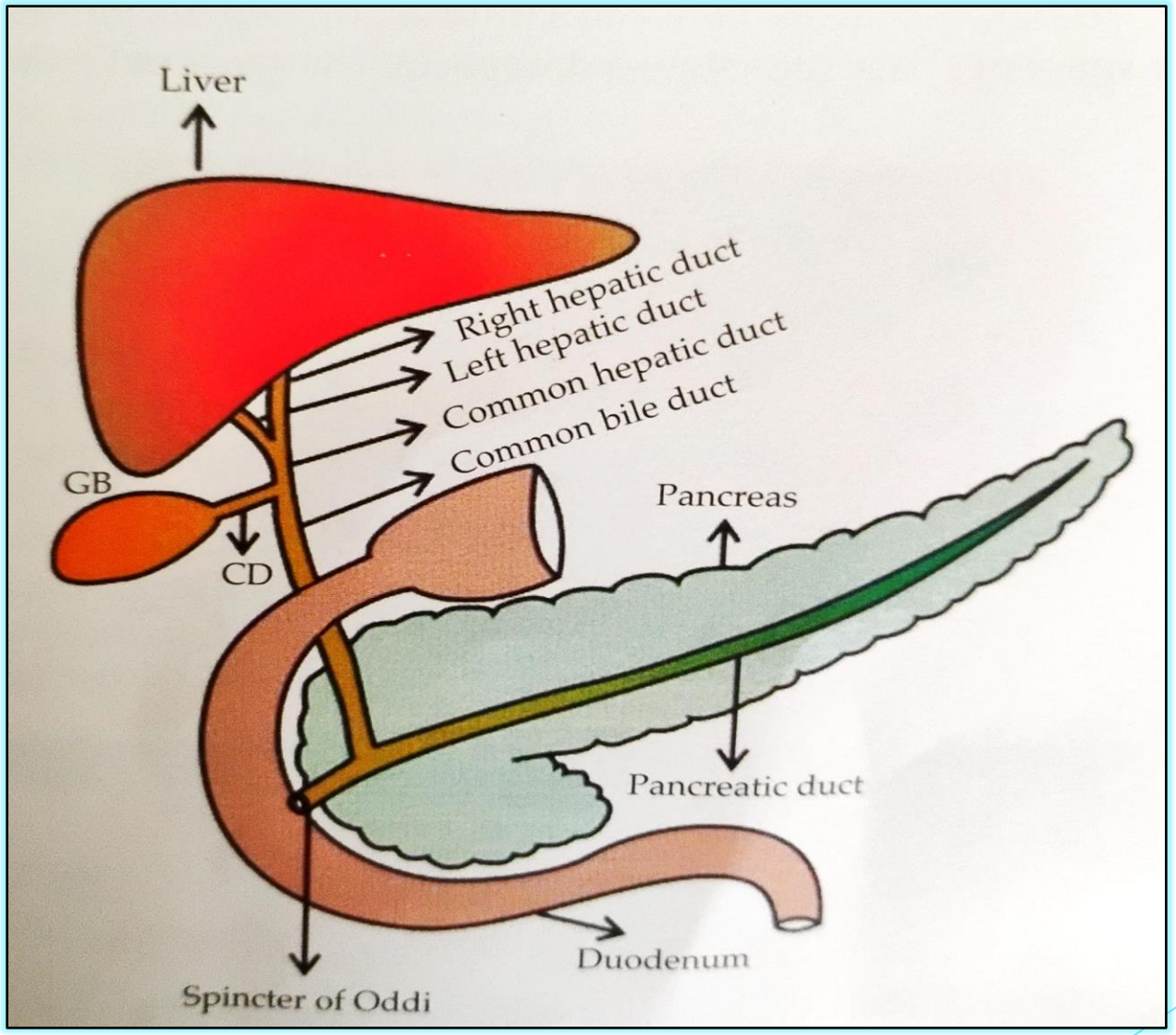
PANCREAS

Structure of Pancreas



PANCREAS

- Head, neck, body, tail.
- Exocrine & Endocrine organ.
- **Exocrine portion-**
  - Numerous acini-Small ductules -Main duct(duct of Wirsung)
  - Acini lined by pyramid shaped cells.
  - Apical portion of cell contain zymogen granules with digestive enzymes.
  - Ducts lined by epithelium. Some epithelial cells invaginate to Acinus CENTRO ACINAR CELLS

PANCREATIC JUICE

- Alkaline with high Bicarbonate content
- 1500 ml/day.
- Bile & Intestinal juice-also neutral or alkaline.

These 3 secretions (Pancreatic Juice, Bile & Intestinal Juice) neutralise Gastric acid.

COMPOSITION OF HUMAN PANCREATIC JUICE

- **Cations-** Na^{+}, K^{+}, Ca^{++}, Mg^{++}
- **Anions** -HCO_3,Cl^{-},SO_4^{2-},HPO_4^{2-}

DIGESTIVE ENZYMES

A) PROTEASES-

Trypsinogen, Chymotrypsinogen, Proelastase, Procarboxypeptidase-A, Procarboxy peptidase B.

B) STARCH SPLITTING-

α Amylase. Activator-Cl^-

C) LIPOLYTIC-

- **PANCREATIC LIPASE**

  Triglycerides to Monoglycerides & Fatty acids.

- **PROCOLIPASE-**

  Activator-Trypsin.

  Substrate-Fat droplets

  Facilitate exposure of active site of pancreatic lipase.

DIGESTIVE ENZYMES

- **CHOLESTERYL ESTER HYDROLASE**

  Substrate-Cholesteryl esters→Cholesterol.

- **PROPHOSPHOLIPASE-A2**

  Activator -Trypsin

  Phospholipids-Fatty acids + Lysophospholipids

  D.NUCLEASES

  DNAase, RNAase.

  DNA & RNA-Nucleotides

PANCREATIC JUICE

BICARBONATES.

- Ductular & Centro acinar cells.
- Stimulus-secretin.
- Role of carbonic anhydrase.

PANCREATIC JUICE

Bicarbonate make pancreatic juice alkaline.

- Neutralise acidic chyme-

  Then only Pancreatic enzymes can act.
- In alkaline PH pepsin is inactive. Otherwise pepsin will digest all pancreatic enzymes.

  Finally Bicarbonate is reabsorbed
- In diarrhoea -Loss of bicarbonate-Acidosis.

PANCREATIC JUICE-ENZYMES

PROTEASES

- Pepsin not essential for protein digestion.
- Pancreatic proteases essential.

1) ENDOPEPTIDASES-Break peptide bond in the interior of peptide chain. Ex-Pepsin,Trypsin, chymotrypsin,Elastase.
2) -Break terminal peptide bond.Ex-carboxy peptidaEXOPEPTIDASEse

- Proteases inactive in pancreatic duct.
- Active only after entering duodenum. Otherwise pancrease will be digested

PANCREATIC JUICE-ENZYMES

TRYPSIN

- Most important proteolytic enzyme.
- Trypsinogen under the influence of ENTEROKINASE from duodenal epithelium converted to TRYPSIN.
- TRYPSIN acts on, other trypsinogen molecules

  Chymotrypsinogen, Proelastase, Procarboxy peptidase, procolipase, prophospholipase & convert them to active form.
  - Digest food proteins. End product of protein digestion-Peptides.
  - Digest other enzymes& finally are absorbed.
  - TRYPSIN INHIBITOR present in pancrease.

PANCREATIC JUICE-ENZYMES

- **CHYMOTRYPSINOGEN**
  - Action similar.

  Difference-

  Trypsin can clot blood. Chymotrypsin can't clot.
- **PROCARBOXYPEPTIDASE-A&B**
  - Split off amino acid from polypeptides.
  - End product-Amino acid.
- **ELASTASE**- Breakdown Elastin.
  - End products from pancreatic digestion.-
  - Oligopeptide, Dipeptide, Amino acid.

PANCREATIC JUICE-ENZYMES

AMYLOLYTIC ENZYME

- **ALPHA AMYLASE**
  - Act on cooked & uncooked starch.
  - Split 1,4 linkage of starch.

Products- Maltose, Maltriose, Alpha limit Dextrin.

- Glucose not formed.
- In A/C pancreatitis- Serum alpha Amylaase increases

LIPOLYTIC ENZYMES,NUCLEASES

REGULATION OF SECRETION

SECRETIN

- S cells from Duodenal mucosa.
- Stimulus for secretion-Acid Gastric chyme.
- Secretin stimulate centro acinar cells & ductal cells.
- EFFECT-Increase Bicarbonate secretion, Increase volume of pancreatic juice
- Via cyclic AMP.

REGULATION OF SECRETION

- CCK-PZ& VAGAL STIMULATION
- Stimulate Acinar cells.
- Release enzymes.

PHASES OF SECRETION

- No food- small volume of basal secretion from pancreas.
- Intake of food- Increase secretion.

1) **CEPHALIC PHASE**
   - Food in oral cavity, smell, sight
   - Vagal refle
   - Secretion rich in enzymes. Poor in Bicarbonate.

2) **GASTRIC PHASE**
   - Distension of stomach- By reflex mechanism VAGAL STIMULATION- (Vago-vagal reflex) -Enzyme rich juice.

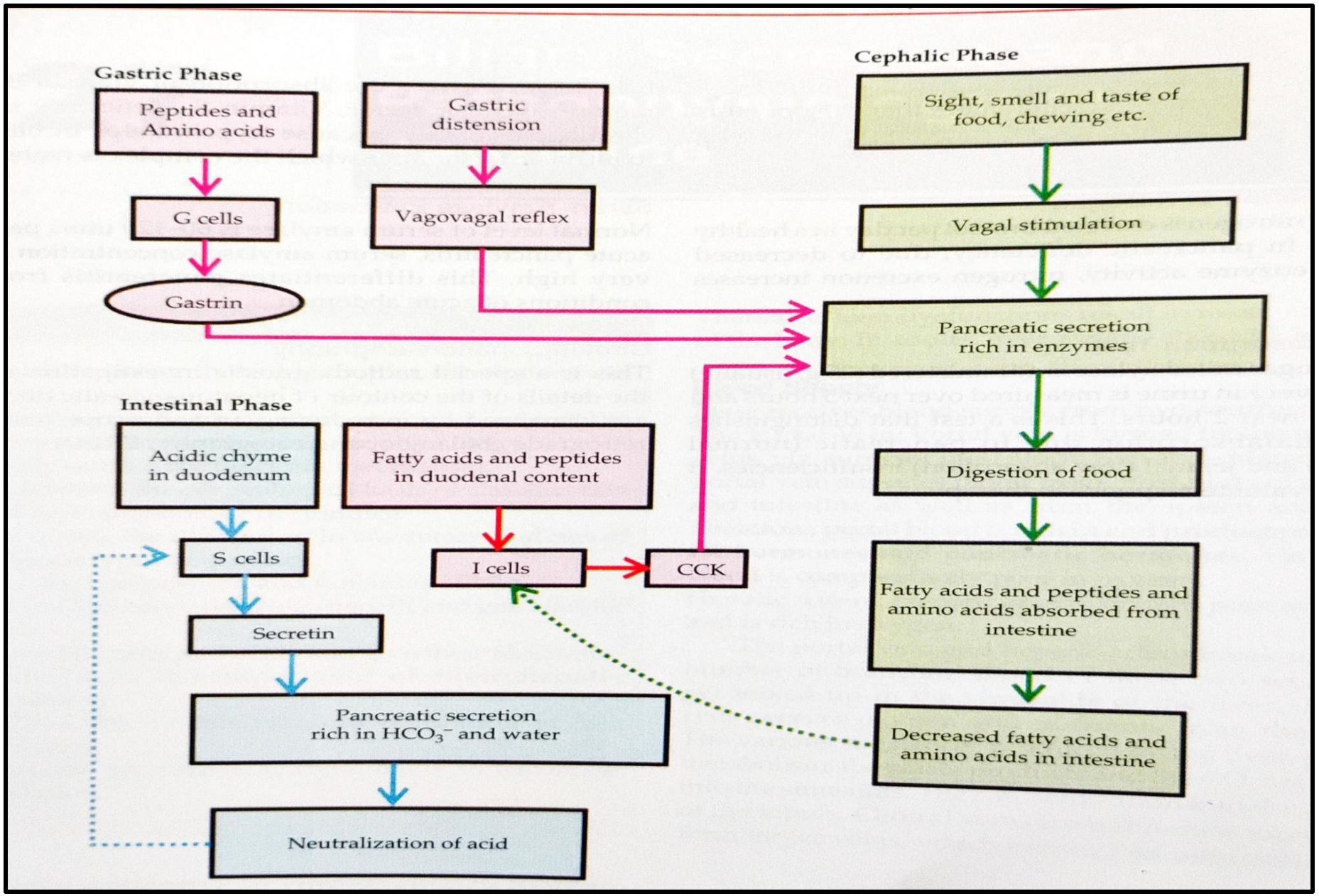
.

PHASES OF SECRETION

3) INTESTINAL PHASE

- Acid Gastric chyme- Secretin from duodenum- Bicarbonate rich juice.
- Partially digested protein & Fat in Duodenum- Increase CCK secretion- Enzyme rich secretion.
- Acid gastric chyme(products of protein digestion) come in contact with duodenal mucosa- Vagovagal reflex- Enzyme rich secretion.

Mechanism of Regulation of Pancreatic Secretion in Gastric,cephalic and intestinal phases



APPLIED PHYSIOLOGY

ACUTE PANCREATITIS

- Normally pancreatic enzymes inactive.
- Active only at duodenum
- In pancreatitis active in Pancreases itself- Widespread digestion of pancreases.

Causes- Idiopathic, alcoholism, gall bladder stones

Investigations-S. Amylase, s. Lipase, USG, CT

APPLIED PHYSIOLOGY

CHRONIC PANCREATITIS

- In chronic alcoholism, Gall bladder stones.
- Degeneration of Acini, Pancreatic deficiency.