

Pancreatic secretions

Dr. Arwa Rawashdeh

* absorption: mostly in s.intestine and
small amount in stomach.

* digestion $\left\{ \begin{array}{l} \text{mechanical} \rightarrow \text{Stomach, mouth.} \\ \text{chemical} \rightarrow \text{secretion or hormonal.} \end{array} \right.$
small intestine (duodenum) \leftarrow

Objectives

1. Describe the mechanism of pancreatic secretions from the acinar cells
2. Indicate the composition and role of pancreatic juice in food digestion
3. Describe the activation of the pancreatic enzymes in the lumen of the small intestine
4. Illustrate the regulation of pancreatic secretion (hormonal and neural)

Pancreas

- ▶ Gland with both exocrine and endocrine functions
posterior
- ▶ Location: retro-peritoneum, 2nd lumbar vertebral level
- ▶ 15-25 cm long *why?*
نوع من أنواع الحماض الحبيبي
أي مشكلة فيه ينتج الـ إنسولين
الضرورية.
Pancreatic diseases (like pancreatitis) can spread quickly in the retroperitoneal space
- ▶ 60-100 g
- ▶ Extends in an oblique, transverse position
- ▶ Parts of pancreas: head, neck, body and tail

Basic functions of pancreatic secretions

It plays an important role:

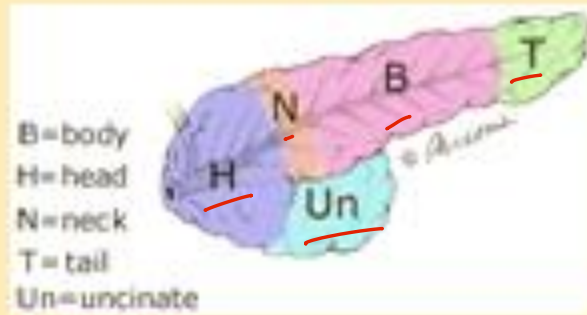
exocrine function (secretion)

- in digestion of lipids proteins and carbohydrates,
- in metabolism since it produces insulin and other hormones.
- in neutralizing the pH to become suitable for the action of the pancreatic digestive enzymes.

Physiological anatomy of Pancreas

LF → LF hepatic part + RT portion → RT lobe of liver

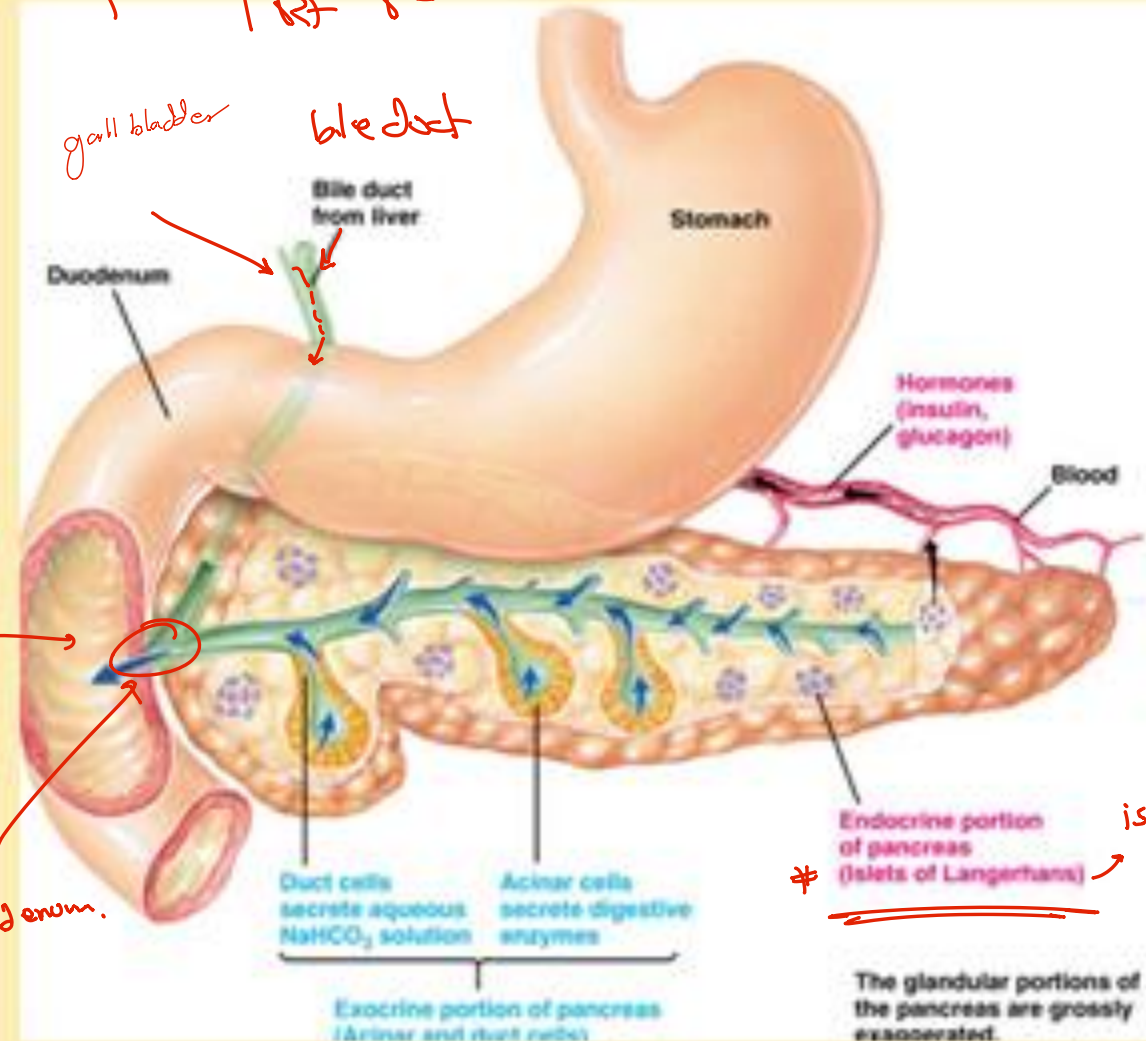
bile
common duct
on whole length of
pancreas



for digestion.
(fat)

bile secretion +
pancreatic secretion

ampulla
of duodenum.



island of langerhans
small part of
pancreas

Exocrine pancreatic secretions

- The pancreas acts as an exocrine gland by producing pancreatic juice which empties into the small intestine at hepato pancreatic ampulla

head + neck

- The pancreas also acts as an endocrine gland to produce insulin.

body + tail

endocrine system

secretion hormone → insulin.
glucagon → blood supply.
somatostatin.

* جگر و embryonic pancreas
اعضاء من

Wirsung or pancreatic duct



Pancreatic acinar cells are responsible for the synthesis, storage, and secretion of enzymes for the digestion of our daily foodstuff

- Drain into duodenum together
- Number of people bile duct drain separately

③ 30% of people have accessory duct (duct of Santorini) less like to get gall stone pancreatitis

stones in gallbladder → pancreatic duct. (block) ↓↓ secretion in s. intestine.

duct → No role in secretion enzymes.

HCO_3^- ✓
↓

enzymes X

. pH 2-3

Pancreatic Duct System:

- The Wirsung duct (main pancreatic duct) and the common bile duct usually drain together into the duodenum.
- In some people, the bile duct drains separately.
- Around 30% of people have an accessory pancreatic duct (called the duct of Santorini).
- These people are less likely to develop gallstone pancreatitis.

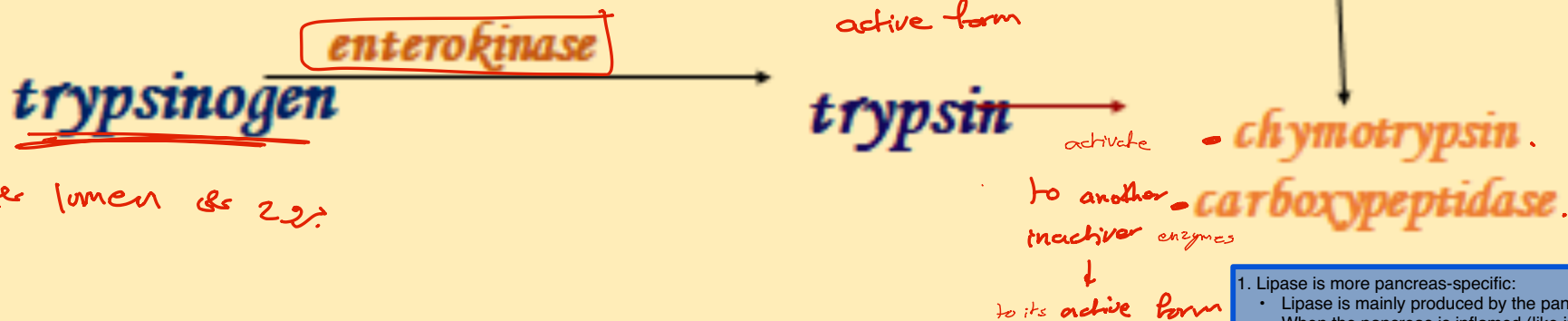
* enzymes in inactive form in pancreas

Mechanism of enzymes activation

cell lysis due to it

Proteolytic enzymes – secreted as inactive precursors

- ✓ Pancreatic Enzymes:
1. Lipase and Colipase
 - Break down triglycerides (TGLs) into free fatty acids (FFA) and glycerides.
 2. Amylase
 - Acts on starch and glycogen, breaking them into maltose in the intestine.



brush border of the lumen is 2.2. s. initiate

* significant for pancreas

only acute injury → ↑↑ level of lipase? pancreas attack but

Lipase and colipase TGLs FFA And glycerides
Amylase starch and glycogen maltose in intestine

Amylase ↑↑ not significant for pancreas, why?

1. Lipase is more pancreas-specific:
 - Lipase is mainly produced by the pancreas.
 - When the pancreas is inflamed (like in acute pancreatitis), lipase leaks into the blood — and stays elevated longer (up to 8–14 days).
 - So, if lipase is high, it's very likely due to a pancreatic issue.
2. Amylase is produced by multiple organs:
 - Amylase is made by the pancreas, salivary glands, and even other tissues.
 - So, amylase can increase in conditions unrelated to the pancreas, like:
 - Salivary gland inflammation (e.g. mumps)
 - Kidney failure
 - Intestinal obstruction or perforation
 - Ectopic pregnancy
 - Macroamylasemia (amylase bound to proteins and trapped in blood)

Pancreatitis

- Enzyme starts to breakdown cells inside the pancreas
- 65% alcohol abuse
- 20% gall stones
- 15% toxins and drug viral infection or trauma

↑ enzymes in liver/pancreas
وظيفته (lipid split) ← like
injury acinar cells (inactive → active) lysis of protein.

Microlithiasis

Viscosity

Prevent Pancreatic secretion

Alcohol abuse

Slow down pancreatic peristalsis

Activate trypsinogen - elastases systemic inflammatory syndrome –
respiratory distress syndrome- DIC

dilatation of B.V. → ↑ area around acinar cells → ↑ secretion

(SIS)

↓ lung → ↑ vascular / breathing → DIC.

Pancreatitis (Inflammation of the Pancreas):

- Happens when pancreatic enzymes start digesting the pancreas itself.
- Causes:
 - 65%: Alcohol abuse
 - 20%: Gallstones
 - 15%: Toxins, drugs, viral infections, or trauma
 - Microlithiasis: Tiny stones that can block ducts.
 - Increased viscosity of secretions can also block ducts.
 - Alcohol can:
 - Prevent normal pancreatic secretion.
 - Slow down pancreatic movement (peristalsis).
 - Lead to activation of trypsinogen inside the pancreas (normally it's inactive there).
 - This can trigger other enzymes like elastase.
 - May cause systemic inflammation, respiratory distress, and disseminated intravascular coagulation (DIC).

(pancreas من pancreas)

هورمون من بطانة من s.intestine

stimulation من pancreas من بطانة
the secretion

cholecystokinin

gall bladder

kinetic
→ movement

• I Cells Upper small intestine

• pancreozymin

• Pancreas Acinar cells

• Enzyme from pancreas trypsinogen

• Decrease gastric motility and secretion and emptying giving the time
for duodenum + and time for digestion

• Presence of fat and peptides

• Contraction of bile

1. Cholecystokinin (CCK):

- Produced by I-cells in the upper small intestine.
- Also known as pancreozymin.
- Acts on acinar cells in the pancreas to release enzymes like trypsinogen.
- Other actions:
- Decreases gastric motility and secretion (slows down stomach activity).
- Promotes bile release (contracts the gallbladder).
- Triggered by the presence of fats and peptides in the duodenum.

Hormon of GIT = enterogastrin

intestine من pancreas

gastrin ← stomach
s.intest

secretin

2. Secretin:

- Produced by S-cells in the upper small intestine.
- Acts on ducts of the pancreas and bile system.
- Stimulates release of water (H_2O) and bicarbonate (HCO_3^-) to the duodenum.
- This helps neutralize stomach acid and raise pH.
- Also decreases GIT motility and secretions.
- Stimulus: When pH drops below 4.5 in the duodenum.

- S cells USI *not active cells*
- Affect ducts of pancreas and bile system
- Increase H_2O and HCO_3^- duodenum neutralize the acidity higher PH
- Decreases GIT motility and secretions

≈ 8

Factors

PH decrease < 4.5

Composition of normal human pancreatic juice

- Cations: Na^+ , K^+ , Ca^{2+} , Mg^{2+}

secretion in plasma

- (pH approximately 8.0)

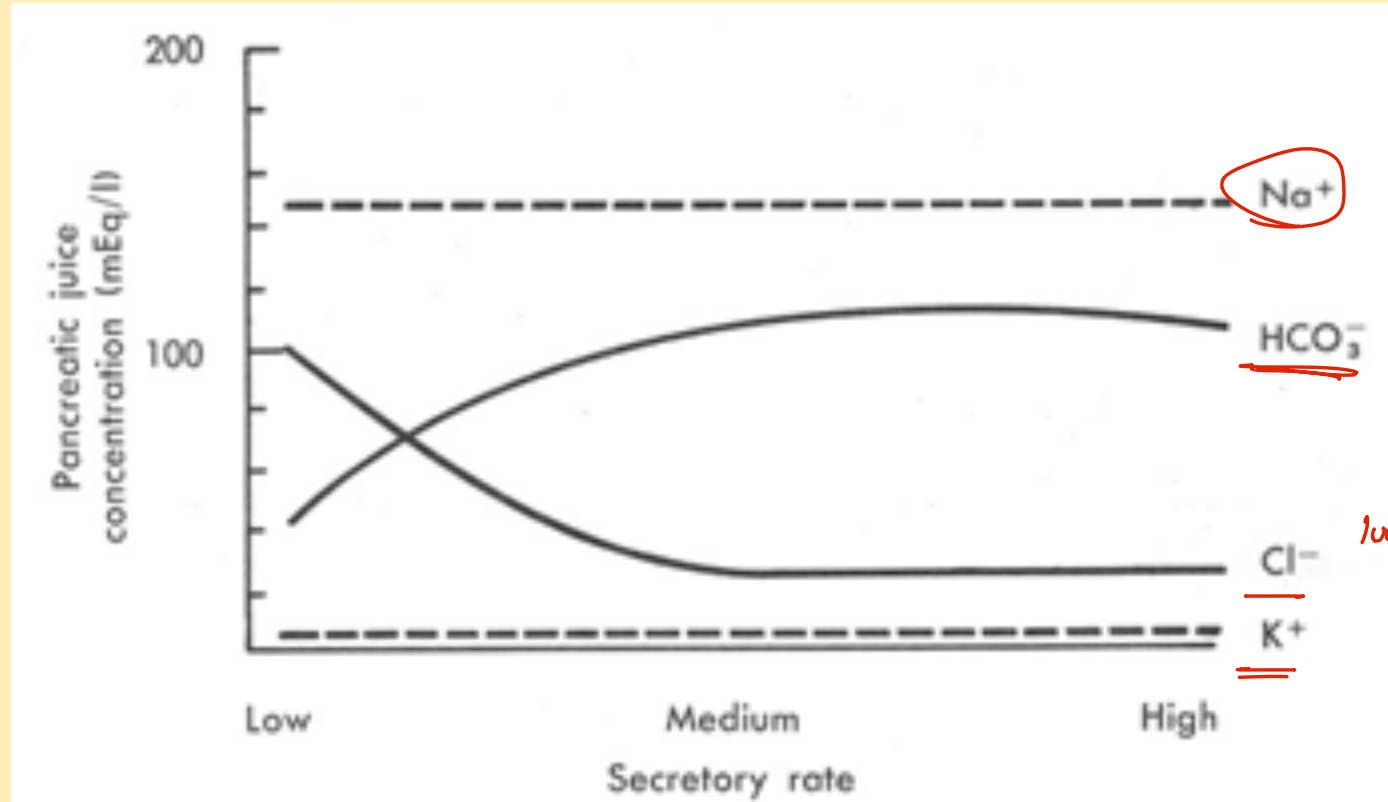
same (=) (Na^+ , K^+)

- ^{*hormones*} Anions: HCO_3^- , Cl^- , SO_4^{2-} , HPO_4^{2-}

- Digestive enzymes (95% of protein in juice) *organic → protein*

- Exocrine cells –produce 1200 to 1500 ml pancreatic juice
/day

Secretion of water and electrolytes



الاعراض في s.intestine 11 من

في ديارها بسبب وجود HCO_3^- في lumen

$\uparrow \text{pH} = 8$

- Na, K - the same as in plasma
- Bicarbonate concentration - up to 5 times higher than in plasma

Vasoactive intestinal peptide

blood vessels.

VIP

- Upper small intestine
- Smooth muscle in blood vessels and gut wall
- ↓ • Relaxation and decrease motility of gastric and secretion
- ↑ • Increase intestinal secretion and electrolytes
- Presence of food in duodenum

Contraction
relaxation

3. Vasoactive Intestinal Peptide (VIP):

- Released in the upper small intestine.
- Acts on smooth muscles in the blood vessels and gut wall.
- Effects:
 - Relaxes muscles
 - Decreases motility and secretion in the stomach
 - Increases intestinal secretions and electrolyte secretion
 - Stimulated by the presence of food in the duodenum.

Glucose dependent insulintropic peptide

- K cells
- Upper small intestine SI
- Insulin secretin

Gastric inhibitory peptide

Factors

Fat and peptide

Decrease PH

Very very little of insulin stimulated from gastrin

4. Glucose-dependent Insulintropic Peptide (GIP):
- Produced by K-cells in the upper small intestine.
 - Promotes insulin secretion.
 - Also called gastric inhibitory peptide.
 - Stimulated by:
 - Presence of fats and peptides
 - Low pH
 - Very small amounts of insulin can also be stimulated by gastrin.

Clinical tie

- Biliary colic

Cholecystitis

CCK

VIPoma

water Diarrhea

Hypokalemia

Achlorhydria decrease HCL

Clinical Conditions and Hormonal Links:

- Biliary colic and cholecystitis are associated with CCK.
- VIPoma: A tumor that secretes VIP → causes:
 - cancer in pancreas (only exocrine)*
 - Watery diarrhea *↑↑ enzymes. (insulin)*
 - Hypokalemia (low potassium) *distal ↓↓*
 - Achlorhydria (low or absent stomach acid, low HCl) *no absorption*

arrhythmia

*distortion parietal cells → HCl x intrinsic factor (VDR) ↓ C D NA in RBCs
↓ hemolytic anemia*

Clinical tie

- Biliary colic

Cholecystitis

CCK

VIPoma

water Diarrhea

Hypokalemia

Achlorhydria decrease HCL