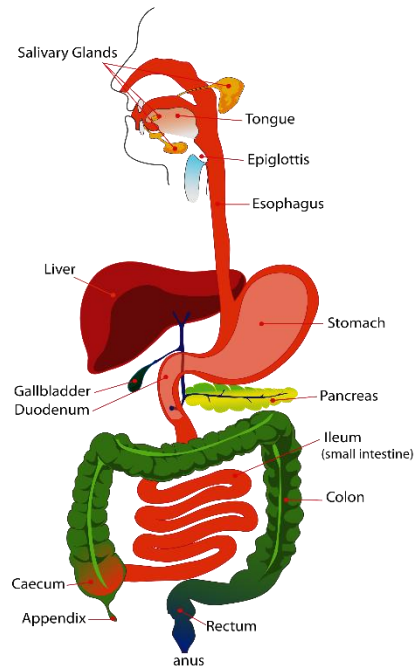




5. Biliary & intestinal secretion.



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liver & bile

The liver is the largest gland in the body (1.5 kg).

* Function of the liver :

1) Metabolic function:

-CHO metabolism :

Glucostat function: the liver maintain the blood glucose within 70-110 mg % via:

- Glycogenesis & gluconeogenesis.

- Conversion of galactose to glucose

-**Protein metabolism:** synthesis of nonessential amino acids, proteins, urea, uric acid

-**Fat metabolism:** Synthesis of lipoprotein, cholesterol & phospholipid.

-FFA oxidation and ketone bodies formation.

2) Storage function:

The liver stores glycogen, vitamins A,D,E,K&B12 and metals as iron & copper.

3) **blood clotting factors** : the liver needs vit. K to synthesis factors II, VII, IX, X.

4) Vascular function :

-Storage of blood.

-By Kupffer cells removal of bacteria & blood clots

5)**Drug and hormonal inactivation:** e.g. steroid H., penicillin & others.

6) **Immune response** : the liver is a part of the reticuloendothelial system

7) Bile formation :

- Formation and secretion of about 0.2gm of bile salts/day.

- Formation and excretion of bile pigments

Gall bladder

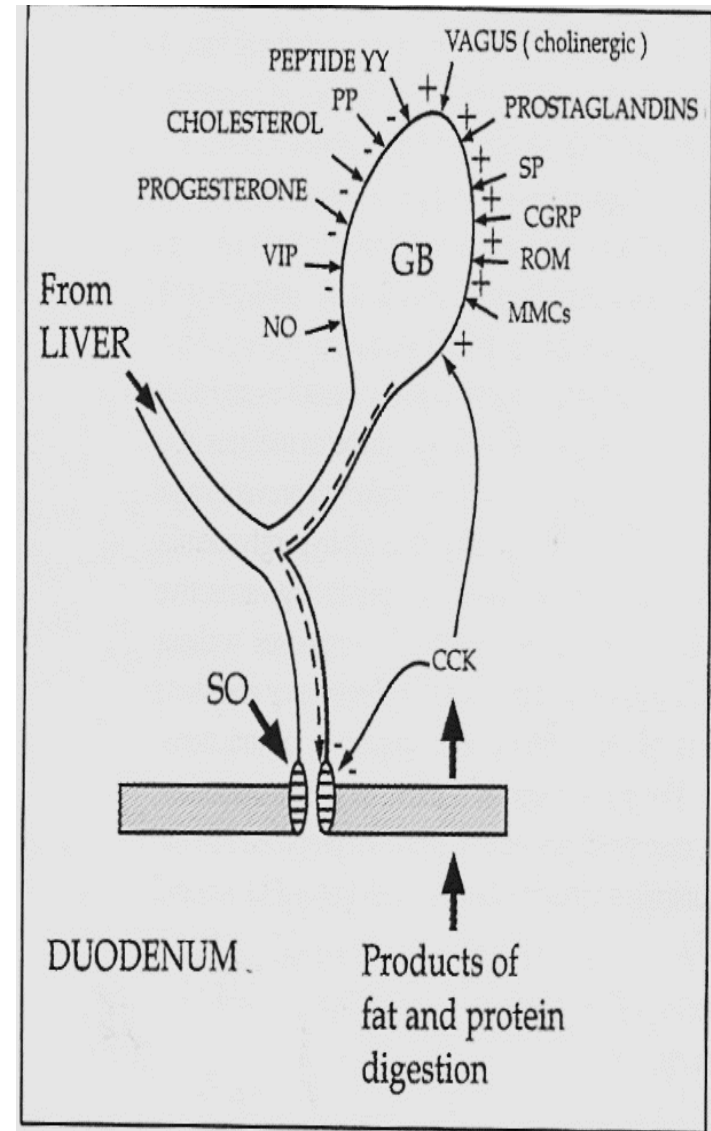
•Motility of the gall bladder

- At meal time the gall bladder contract and sphincter of Oddi relaxes → evacuation of bile.

- **Cholagogues:** factors increase evacuation of the bile as vagal stimulation, cholecystikin hormone and magnesium sulphate.

•Functions of gall bladder :

- 1) Storage of bile in between meals as the sphincter is closed and the liver continue to secrete bile.
- 2) Concentration of bile : by absorption of water, Na^+ and Cl^- to accommodate large volume of stored hepatic bile.
- 3) Help continuous flow of hepatic bile in between meals by storage and concentration.
- 4) Acidification of bile by absorption of Na^+ bicarbonate to prevent precipitation of Ca^{++} bile stones (pH changed from 7.8 to 7).
- 5) Evacuation of bile in the duodenum.
- 6) Secretion of white bile as mucus to protect the bladder wall from the concentrated bile.



Bile

* Volume : 1 – 1.5 L/day.

* PH : in liver bile : alkaline - in gall bladder bile : acidic.

• Constituents :

Liver bile	Gall bladder bile
• H ₂ O : 97.5 gm%.	• 92 gm %.
• Inorganic : Na ⁺ , Hco ₃ , CL ⁻ .	• Less concentrated ions
• Organic : less - bile salts : 1.1 gm % -others: cholesterol, fat lecithin, F.A, bile pigments	- 6 gm %. - More concentration.
• PH : 7.8 – 8.5.	• 7.0 – 7.4.

• **Regulation of bile :**

• **a. Choloretics:** factors stimulate bile secretion and flow as:

- 1- Vagal stimulation to liver and gall bladder.
- 2- Bile salts (via enterohepatic circulation)
- 3- Secretin hormone is hydrochloretic, as it increases the bile flow via increasing bicarbonate and water secretion.

• **b. Cholagogue :** factors evacuate the bile from gall bladder as : 1- Vagal. 2- Mg⁺⁺ sulphate. 3- CCK – PZ. H.

* **Mechanism of bile secretion :**

a) Between meals:

The sphincter of Oddi is closed and the hepatic bile is stored in the bladder to be concentrated and acidificated.

b) During food intake:

- Swallowing causes reflex vagal relaxation of sphincter and evacuation of bile.

- The CCK enzyme from duodenum → evacuation of bile into the intestine.

c) After meal: 90 % to 95 % of bile salts are actively reabsorbed from the terminal ileum back to the liver via the portal vein and re-excreted in the bile stimulating more bile secretion (enterohepatic circulation), the normal rate of bile salts secretion is 0.3 gm/day and recycles 6 – 8 times/day → total amount of 3.5 gm/day of bile salts.

Small Intestine Secretions

- **Mucus**
 - Protects against digestive enzymes and stomach acids
- **Digestive enzymes**
 - Disaccharidases: Break down disaccharides to monosaccharides
 - Peptidases: Hydrolyze peptide bonds
 - Nucleases: Break down nucleic acids
- **Duodenal glands**
 - Stimulated by vagus nerve, secretin, chemical or tactile irritation of duodenal mucosa

Intestinal secretion (succus entericus)

(1)The small intestine has 3 types of **secretory cells**:

- Crypts of lieberkuhn.
- Brunner's gland and Goblet cells.
- Enterochromaffin cells which secrete serotonin.

(2)The intestinal secretion is **made up of**:

- Mucus:

- Secreted by Brunner's glands & goblet cells.
- Important for protection and lubrication.
- Stimulated by vagus, local distension or acidic chyme & secretin.
- Inhibited by sympathetic stimulation so, irritable persons have high incidence of duodenal ulcers.

-Alkaline fluid: (Na HCo₃):

- Dissolves the chyme.
- Stimulated by secretin, CCK, VIP and PGS.
- Inhibited by sympathetic.

-Sloughed Mucosa (enzymes):

- The intestinal secretion is about 1 liter/day of pH 7.5 and have no enzymes secreted from Crypts of lieberkuhn.
- The sloughed cells contain disaccharides (sucrase, maltase& lactase) di-peptidases (Amino-peptidase, enterokinase) and phosphatases.

Control of intestinal secretion:

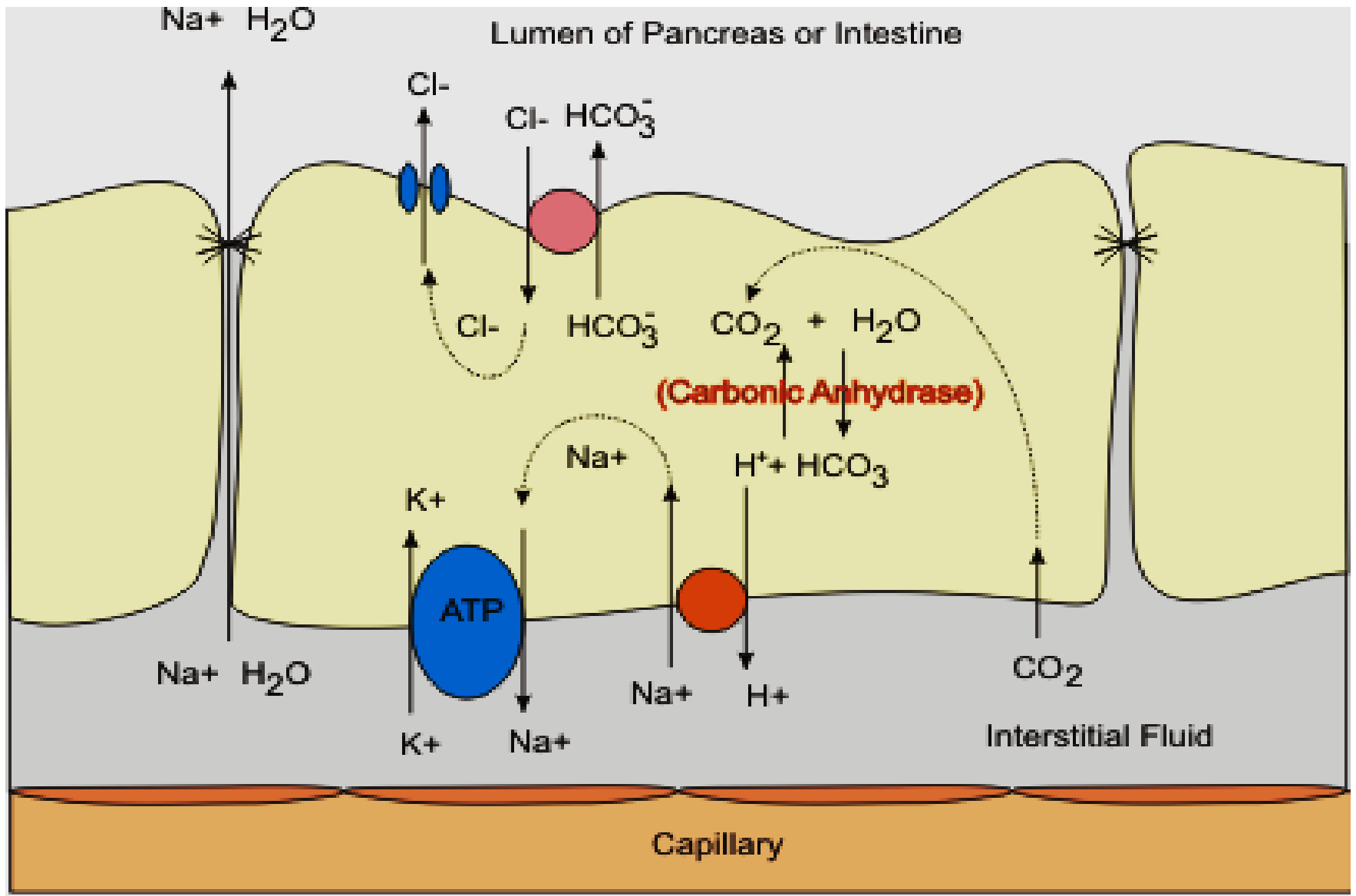
Nervous: - local enteric reflexes → ↑ secretion .
- Vagal → ↑ mucus secretion only.

Hormonal: VIP, secretin, CCK → ↑ secretion.

Vaso active Intestinal Peptide (VIP)

It is released from the GIT and act as a hormone or co-transmitter and has the following effects:

- 1-stimulate intestinal motility and secretion.
- 2-Causes vasodilatation.
- 3-Inhibition of gastric acid secretion.
- 4-Relaxation of L.O.S.



Bicarbonate Secretion in Pancreas or Intestine

Secretions of the Large Intestine

- Mucus protects the intestinal lining
- The bacterial flora of the large intestine consist of:
 - Bacteria surviving the small intestine that enter the cecum
 - Those entering via the anus
- These bacteria:
 - Colonize the colon
 - Ferment indigestible carbohydrates
 - Release irritating acids and gases (flatus)
 - Synthesize B complex vitamins and vitamin K
 - Constitute about 30% of the dry weight of the feces